

Supplement 2:

Background data for the Hane, Ha'atuatua, Ho'oumi, Teavau'ua, Hakaea, Hanai East and Hanai West archaeological sites, Marquesas Islands (East Polynesia)

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Supplementary Information for "Polynesian settlement of the Marquesas Islands:
The chronology of Hanamiai in comparative context"

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1. Introduction

This document provides background data for the Hane, Ha'atuatua, Ho'oumi, Teavau'ua, Hakaea, Hanai East and Hanai West archaeological sites in the Marquesas Islands of East Polynesia. Information provided here explains why these particular sites were selected for the models presented in Supplement 1. For each site, the background data includes environmental context, a brief history of the excavations, a description of the stratigraphic sequence, and information about the artifact assemblages.

2. Hane (Ua Huka)

Hane is a typical amphitheater-shaped valley on the leeward coast of Ua Huka, in the northern Marquesas. Like Hanamiai, it faces a well sheltered bay. The Hane site is a large sand dune reaching elevations of more than 10 m above sea level. When it was discovered by Y. Sinoto and M. Kellum in 1963, the dune was poorly vegetated and aeolian deflation had exposed numerous artifacts. The initial field work in 1964 included areal excavations covering ca. 100 m², with additional test pits (Sinoto 1966). Stone pavements, both exposed on the dune surface and buried, reached across much of the excavation area. Lower levels of the site (those beneath the pavements) were rich in diagnostically early artifacts, while the upper levels (those above the pavements) contained more than 25 human burials but comparatively few artifacts. Faunal assemblages from the lower levels are notable for significant numbers of extinct and extirpated land birds (Steadman 2006). These, together with the diagnostically early artifacts, mark occupations represented by the lower levels as a founder settlement.

Sinoto's (1966) original Hane chronology based on legacy dates estimated the age of the founder settlement occupation at around AD 700-850.

Following a long-standing debate over the timing of the Hane cultural sequence (Kirch 1986; Anderson et al. 1994; Rolett 1998; Anderson and Sinoto 2002; Wilmshurst et al. 2011), the Hane site was reinvestigated in 2009 by a research team directed by E. Conte and G. Molle. They opened an 18 m² areal excavation in the immediate vicinity of the original fieldwork, revealing a ca. 2.5 m deep stratigraphic sequence similar to that described by Sinoto (Conte and Molle 2014).

Contributions of the 2009 investigation differ from but complement Sinoto's earlier work. Sinoto's large-scale areal excavation brought to light an artifact assemblage of exceptional value for understanding change over time in Marquesan material culture (e.g. Sinoto 1966, Sinoto 1979), as well as one of the largest collections of extinct Marquesan avifauna (Steadman 2006). By contrast, the smaller, more precisely controlled excavation by Conte and Molle (2014) yielded fewer artifacts but 17 new radiocarbon dates, including ones for specimens consisting of short-lived botanical remains.

Hane meets our proposed criteria for a founder settlement. Eleven species of extinct and extirpated land birds were identified from faunal assemblages of lower levels of the site (Steadman 2006). The diagnostically early artifact assemblages include untanged adzes and fishhook assemblages dominated by hooks with curved and angular shanks. We included Hane in our model for estimating the timing of the Archaic/Classic transition, with

the lower levels as a marker for the Archaic and the upper levels as a marker for the Classic era.

3. Ha'atuatua (Nuku Hiva)

Ha'atuatua is a deep, well-watered valley facing an exposed bay on the windward side of Nuku Hiva. The Ha'atuatua site itself is situated within the largest dune complex in the Marquesas, a formation measuring 750 m long and extending 250 m inland. Almost devoid of vegetation, the dune surface is characterized by aeolian deflation and blowouts. The site was discovered and investigated in 1956-57 by R. Suggs, who conducted the first archaeological excavations in the Marquesas (Suggs 1961). Suggs' fieldwork focused on Location A, where he opened an area of around 60 m² along a nearly vertical scarp that rises from the beach to ca. 16 m above sea level. His excavations uncovered more than 30 burials, in addition to well-defined pavements and other cultural features. The principal cultural deposit yielded rich artifact assemblages, including diagnostically early specimens and a small number of ceramic sherds. Suggs' (1961) original Ha'atuatua chronology, based on legacy dates, estimated that the site was settled around 150 BC.

B. Rolett and E. Conte initiated new fieldwork at the site in 1992, 1993 and 1994, concentrating on coring and test excavations with the goal of reinvestigating the early deposits identified by Suggs and collecting new material for radiocarbon dating (Rolett and Conte 1995; Rolett et al. 1997; Rolett 1998). This work shows that the same basic

stratigraphic sequence is encountered across large areas of the main dune: 1) an aeolian surface deposit of sterile sand (Layer A) underlain by 2) a rich, charcoal-stained deposit (Layer B) representing intensive occupation over an area of 4000 m² or more, and 3) a light-colored deposit (Layer C) containing scattered charcoal flecking and isolated artifacts that transitions to the pre-Polynesian colonization dune. Shell and bone midden in Layer B is mostly broken into small pieces, as if from trampling. However, Steadman's (2006) analysis of the bird bone assemblages reveals limited evidence of extinct and extirpated landbirds that is consistent with the interpretation of a founder settlement. Rolett and Conte collected and radiocarbon dated five new specimens consisting of unidentified wood charcoal and marine shell. Later work directed by Rolett in 1994 led to the dating of three additional specimens. Background information for these specimens is provided in Supplement 3 (Radiocarbon dates for grid units E391-392 N402-403 of the Ha'atuatua archaeological site, Marquesas Islands (East Polynesia)). One of the age determinations is for bones from the articulated skeleton of a seabird that died in its burrow, likely before Polynesian colonization of the Ha'atuatua Dune or during the first few decades of settlement. Dating of the seabird skeleton helps to constrain age estimates for initial Polynesian settlement of the Ha'atuatua Dune.

Ha'atuatua meets our proposed criteria for a founder settlement. Five species of extinct and extirpated land birds were identified from faunal assemblages of lower levels of the site (Steadman 2006). The diagnostically early artifact assemblages include untanged adzes and fishhook assemblages dominated by hooks with curved and angular shanks (Suggs 1961; Rolett and Conte 1995). We included Hane in our model for estimating the

timing of the Archaic/Classic transition.

4. Ho'oumi (Nuku Hiva)

Ho'oumi is a deep, narrow valley with a permanent stream, located adjacent to Taipivai, one of the largest valleys on Nuku Hiva. It has a well-protected bay. The site was discovered and investigated in 1956-57 by Suggs (1961) during fieldwork that also included excavations at Ha'atuatua. It is located close to the beach on a coastal flat adjacent to the river bank. In an area with large *paepae* (house platforms) on the ground surface, Suggs' opened five pits with a combined area of around 72 m². He identified two cultural deposits separated by a layer of sterile sand in a stratigraphic sequence extending about 75 cm from the surface. In the deepest deposit, excavations revealed pavements made of stone slabs (Suggs' Paved *Paepae*). The artifacts include a single ceramic sherd, moderate numbers of pearl shell one-piece fishhooks and coral files, with smaller counts of cowrie-shell peelers, poi pounders, adzes and ornaments. A large majority of the fishhooks consist of ones with straight shanks (Suggs' "jabbing and "open jabbing" forms).

On the basis of his artifact seriations, but no radiocarbon dates, Suggs' (1961) proposed that the upper Ho'oumi occupation represents his Classic Period and the lower occupation represents late stages of his Developmental Period. A single SLM sample collected by Suggs from his Hearth 1 was analyzed by Allen et al. (2012:97; 2021:84). According to Suggs' field map published by Allen et al. (2012:98), Hearth 1 is directly

associated with one of the largest stone pavements and the ceramic sherd. Suggs linked these to the lower occupation: "One sherd of poorly fired pottery was found in the lower stratum associated with the Paved *Paepae*" (1961:56). The depth for the associated Hearth 1, dated by Allen and colleagues, is given as 38 cm below surface (2021:84). The SLM sample yielded an age estimate of 130 ± 30 .

The Ho'oumi site was reinvestigated in 2011 by a research team directed by M. Allen (Allen et al. 2012, Allen et al. 2021, Allen et al. 2022). While Suggs' investigation yielded significant numbers of artifacts but no radiocarbon dates, the second investigation yielded eighteen radiocarbon dates but almost no artifacts. In addition, the second investigation documents flora and fauna, including extinct and extirpated species of plants and invertebrates, from a waterlogged deposit.

The 2011 reinvestigation was constrained by restrictions imposed by landowners and complicated by bulldozer disturbance linked with development of a beach park. Fieldwork consisted of four trenches opened using a backhoe, in addition to excavation of a 1 m² test pit, all estimated to lie about 20–50 m seaward of Suggs' excavation area. (Allen et al. 2021). The stratigraphy in the trenches and an accompanying 1 m² test pit is different from the stratigraphic sequence recorded by Suggs. It was not possible to locate the original excavation area.

Sediments from the 2011 backhoe trenches were not screened and those from the 1 m² test pit were mostly screened using 6.3 mm (1/4"), rather than 3.2 mm (1/8"), due to time

constraints (Allen et al. 2021:79). Cultural deposits were marked by a number of hearths and earth ovens clearly visible in the trench profiles. One trench revealed a basal waterlogged deposit rich in well-preserved plant remains (Allen et al. 2022). Although the waterlogged deposit is interpreted as natural, within it was discovered an adzed timber. The adzed timber and eight specimens of unmodified, anaerobically-preserved plant remains were dated.

In general, stratigraphic profiles from the 2011 investigation showed a single cultural deposit extending from the surface to depths of around 50 cmbs. This upper cultural deposit, which contained small numbers of artifacts, is underlain by culturally-sterile sand layers, including one interpreted as a likely tsunami deposit. In addition to the upper cultural deposit, one of the trenches (Trench 4) revealed a pebble–gravel deposit (Layer IIIa/Feature 9) interpreted as a “simple house pavement, similar to those known from elsewhere in Polynesia” (Allen et al. 2021:89). The 2011 investigation did not reveal evidence of pavements made of stone slabs, such as those discovered during Suggs' excavation (Suggs 1961: 55-57). Although no artifacts or faunal remains were recovered from the pebble-gravel deposit, a fire feature was found immediately beneath it. Four SLM samples collected from the fire feature (at 105 cmbs) were analyzed for age determinations.

Allen et al. (2021) also compared the published data for artifact assemblages from Suggs' upper and lower deposits. However, there are discrepancies, due to an unintentional mistake (M. S. Allen, personal communication, June 2021), between their counts and the

numbers reported by Suggs. We note that Suggs (1961:80, Fig. 27) reported 56 one-piece fishhooks and 39 coral files while Allen et al. (2021:89) reported none.

In sum, Suggs identified two cultural deposits, both containing moderate numbers of artifacts. The deeper deposit, notable for large stone pavements, was dated by Allen et al. using an archived SLM sample curated with Suggs' collection. Allen and colleagues investigated a nearby area with stratigraphy that is different from but possibly related to that recorded by Suggs. Their upper deposit may correspond with Suggs' upper deposit, although very few artifacts were found. By contrast, their lower deposit was found in only one of the four trenches and it is markedly deeper and different from the lower deposit reported by Suggs. Differences include the absence of stone pavements, as well as an apparent absence of artifacts. The lower deposit reported by Allen and colleagues is marked by a pebble–gravel deposit underlain by a fire feature. Four SLM dates from the fire feature are significantly earlier than the single date from Suggs' lower deposit. Given that the lower deposit reported by Allen and colleagues did not yield artifacts, comparison of the material culture with that recovered from Suggs' lower deposit is not possible.

Faunal assemblages from Suggs' excavations have not been analyzed. Allen and colleagues (2021) analyzed botanical specimens collected from a waterlogged deposit and other contexts. Very little bone was recovered during the fieldwork in 2011; the authors suggest that some of the faunal remains may have been deposited by a "major marine event" Allen et al. (2021:82). The waterlogged deposit is interpreted as natural, although it yielded an adzed timber in addition to species of plants and insects believed

to have been introduced by Polynesian settlers of the Marquesas.

Different interpretations of the artifact assemblages from Suggs' excavations have been offered. Suggs (1961) suggested that assemblages from the lower deposit represent his late Developmental Period, which is comparatively early in his sequence. Allen and colleagues state that the lower deposit "may date between 1220 and 1330 AD" (Allen et al. 2021: 93). By contrast, we interpret those assemblages to be somewhat later, specifically after AD 1450. Two lines of evidence support this interpretation. First, the one-piece fishhook forms serve well as chronological markers. Comparisons among multiple Marquesan sites show that fishhooks with curved (main text, Figure 6b) and angular shanks (main text, Figure 6c) are predominant in early assemblages, while ones with straight shanks (main text, Figure 6g) are most abundant in late assemblages (Rolett 1998: 159-175). The Hanamiai data illustrate this pattern with a sample of 55 curved and angular-shank hooks and 166 straight-shank hooks (main text, Table 1). By inference, the dominance of straight-shank one-piece fishhooks, and the absence of ones with curved or angular shanks (Suggs 1961: Figure 26) dates Suggs' Ho'oumi occupations to after AD 1450.

The second line of evidence is based on chronologically diagnostic trolling lure points (main text, Figures 6d, 6h). As explained in the main text, Suggs (1961: 83-84) was the first to suggest that the West Polynesian form (his "proximal extension" point) may have been introduced around the time of initial settlement, while the East Polynesian form (his "incipient proximal extension" point) developed later. Suggs' hypothesis is based largely

on data from his Ha'atuatua and Ho'oumi excavations. His Ho'oumi lower occupation yielded four East Polynesian points and a single West Polynesian point. Occupations of the Ha'atuatua site, which Suggs interpreted to pre-date the Ho'oumi occupations, yielded five West Polynesian points but none of the East Polynesian kind (Suggs 1961, Table 8). Suggs' hypothesis is well supported by the Hanamiai data; all seven of the West Polynesian points from Hanamiai were found in the deepest deposits, while the two East Polynesian points discovered at Hanamiai are from more recent layers (main text, Table 1). Collectively, the evidence for chronologically diagnostic one-piece fishhooks and trolling lure points lends broad support to the interpretation that both of the Ho'oumi occupations documented by Suggs' date to after AD 1450.

At present, Ho'oumi does not meet our proposed criteria for a founder settlement. However, we include the site in our study because chronological data published by Allen and colleagues appear to document early human activities in the Marquesas, with the adzed timber of particular interest. Nevertheless, we did not include Ho'oumi in our model for estimating the timing of the Archaic/Classic transition because of the difficulty in establishing the relationship between stratigraphic deposits recorded by the 1956 and 2011 investigations. This constraint introduces considerable uncertainty in efforts to relate the chronological data to the artifact assemblages.

5. Teavau'ua (Nuku Hiva)

The Teavau'ua site is located in Anaho, a mid-sized amphitheater-shaped valley on the windward side of Nuku Hiva. Anaho faces a wide bay known for the largest fringe reef in the Marquesas. Projects directed by M. Allen in 1997, 2001, 2003, 2006 and 2007 investigated the well-vegetated coastal flat and adjacent lowlands (Allen 2004; Allen 2010).

Investigations at Teavau'ua, on the northern coastal flat, involved two transects of shovel pits at 5 to 10 m intervals and seven 1 m² test excavations. These revealed stratified calcareous deposits, with coralline bedrock encountered at ca. 130 cm below the ground surface. In certain areas of the coastal flat, the subsurface stratigraphy is badly disturbed by crab burrowing (Allen 2004: 150, 154, 157). Test pits in the coastal flat deposits uncovered earth ovens and other cultural features, in addition to small quantities of artifacts. A series of twelve radiocarbon samples were dated (Allen 2004; Petchey et al. 2009).

A lowland area adjacent to the coastal flat was also investigated but the stratigraphic sequences encountered there are unrelated to those recorded for the coastal flat. Allen's (2014) chronology, based on SLM dates, estimates that the Anaho coastal flat and lowlands were settled between AD 1166 and 1258.

The Teavau'ua artifact assemblages have not been reported in detail but Allen suggests the site lacks diagnostically early artifacts (Allen 2004:168,170). Faunal evidence for native species such as flightless birds that later disappeared as a result of anthropogenic influence is also lacking. Thus, at present, the site does not meet our proposed criteria for a founder settlement. However, the discovery of wood charcoal representing the family Sapotaceae, which no longer grows in the Marquesas, suggests that the disappearance of two species of Sapotaceae trees was linked with human activities (Huebert and Allen (2016: 85, Figure 5). We include Teavau'ua in our study because the chronological data are significant for documenting early human activities in the Marquesas. We did not include Teavau'ua in our model for estimating the timing of the Archaic/Classic transition because the artifact assemblages have not been reported in detail.

6. Hakaea (Nuku Hiva)

Hakaea is a small, narrow valley on the windward side of Nuku Hiva. Springs near the beach provide a reliable source of freshwater. Located on a coastal flat in the vicinity of a beach ridge formed by wave action, the Hakaea site was discovered and investigated by M. Allen and A. McAlister during 9 days in 2006 and 2007 (Allen and McAlister 2010). The investigation involved coring, shovel pits and trenches, recording stratigraphic sequences in stream bed profiles, and seven 1 m² square test excavations. The deposits revealed earth ovens and other cultural features, in addition to small quantities of highly fragmented faunal remains and artifacts. Ten radiocarbon samples, including six from the excavations and four from exposed profiles, were dated. Allen and McAlister's (2010)

Hakaea chronology, based mainly on SLM dates, estimates that the site was settled around AD 1188-1286.

At present, the site does not meet our proposed criteria for a founder settlement because it lacks evidence for vulnerable native species. However, we include Hakaea in our study because the chronological data are significant for documenting early human activities in the Marquesas.

The Hakaea artifact and faunal assemblages have not been reported in detail but Allen and McAlister provide this information: "...the small assemblage of artefacts was dominated by fishing gear and tools related to fishhook manufacture. The fishhooks from layers VII and V are similar in form to those found in other early east Polynesian sites" (2010:58). Allen and McAlister (2021:247) illustrate three fishhooks (all from Layer IV) – all three have curved shanks. Thus, although the assemblage is not fully reported, there is good evidence for curved/angular shank hooks in the Layer IV fishhook assemblage, with nothing to suggest that straight shank hooks may have been present. There are 7 AMS age determinations for Hakaea Layers V to VII (all older than IV) dates. The combination of a diagnostically early fishhook assemblage and a good series of AMS age determinations provides valuable data for estimating the age of the Archaic era material culture. For this reason, we included Hakaea in our model for estimating the timing of the Archaic/Classic transition.

7. Hanauī East and West rockshelters (Hiva Oa)

Hanauī is a small, narrow valley on the sheltered, leeward coast of Hiva Oa. The valley offers scant terrestrial resources but it provides easy access to a plateau lying above, and the bay is a favored locality for inshore fishing. The beach at the mouth of the valley is about 1000 m wide. Wave-cut shelves line the coast of the bay, as is typical of the Marquesas. In 1968, Y. Sinoto discovered and excavated two rockshelters on the opposing east and west coasts of the bay. Although details of the excavations are largely unpublished, some information is provided in Sinoto (1970) and Rolett (1998).

Rolett made basic observations on the artifact assemblage while working on the collection with Sinoto, who provided access to the field notes. The field notes give the stratigraphic provenience for every fishhook. The synopsis given here is based on Sinoto's field notes and Rolett's observations.

The main portion of the East Hanauī rockshelter (MH-21) is 14 m long with an overhang of around 2.5 m. The ca. 21 m² excavation covered most of the area within the interior of the shelter. The stratigraphy is complex with six cultural layers. Two radiocarbon samples were dated, one from the deepest deposit and another from the upper levels (Sinoto 1970; Rolett 1998). Approximately 300 fishhooks (complete and fragmented) were recovered during the excavation. All except nine are straight-shank hooks. Layer II, an upper deposit, is dominated by straight-shank hooks. Eight of the nine hooks with curved or angular shanks are from Layers IV, V and VI. Layer VI, the deepest deposit, is dominated by curved and angular shank hooks. The combination of the large, diagnostically-late Layer II fishhook assemblage, and the much smaller but diagnostically-early Layer VI

fishhook assemblage, with one date for each Layer VI and Layer II, provides valuable data for estimating the timing of the Archaic/Classic transition.

The West Hanau rockshelter (MH-23) is located 8 m from the high tide mark. It has an overhang of around 5 m and the excavation covered ca. 20 m². Five superposed pavements extended over nearly the entire excavated surface, serving as boundaries for the six cultural layers identified by Sinoto. The deepest stratigraphy recorded was about 120 cm below surface. Two radiocarbon samples, both from the mid-level deposits (Layer III or IV), were dated (Sinoto 1970; Rolett 1998).

More than 500 fishhooks (complete and fragmented) were recovered during the excavation. All except four represent jabbing hooks around 2 - 3 cm in height. The four exceptions include one acute recurved point hook, two compound shank hooks and another that is non-diagnostic. The dominance of straight-shank hooks is consistent with artifact assemblages deriving from late stages in the Marquesan sequence.

Hanau East and West do not currently meet our proposed criteria for a founder settlement because neither site has revealed faunal evidence for vulnerable native species. We note, however, that the faunal assemblages have not been analyzed. Hanau West also lacks evidence for diagnostically early artifact assemblages. Nevertheless, we include these sites in our study because the chronological data and artifact assemblages are significant for estimating the timing of the Archaic/Classic transition.

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