Archaeological Remains at Angier-Karian, Nan Madol, With Supplemental Studies at Sokehs and Temwen, Pohnpei, Federated States of Micronesia

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Abstract:

This project contributed to the mapping and documentation of early architecture at Nan Madol and the adjacent Temwen Island, Madolenihmw Municipality, Pohnpei State. Support was provided by the US National Park Service through the FSM Historic Preservation Program ("Identification and Mapping of Selected Architectural Complexes at Nan Madol," Grant No. 64-05-204456). The focus was on recording and conserving archaeological places containing stone remains because of their visibility and their importance to the Pohnpeian community as well as to international scientific concerns. In addition to Nan Madol, research was conducted in the Ipwal area, Sokehs, and at selected structures on Temwen Island, adjacent to Nan Madol, in Madolenihmw District. The documentation of these sites is essential for understanding the material remains of the past, and locating them and mapping them is an integral step in the ongoing discussion about how they should be protected and conserved. Ancient chiefly ritual sites, agricultural features, and historic sites were examined and mapped in this project. Artifact, faunal and other archaeological materials were observed and their forms and distributions provide evidence related to dating, site usage, and early Pohnpeian diet. The project contributes to preservation of Pohnpei's archaeological past and historic resources.

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Ayres, Seikel and Levin

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Archaeological Remains at Angier-Karian, Nan Madol, with Supplemental Studies at Sokehs and Temwen, Pohnpei, FSM

W. Ayres, K. Seikel and M. Levin

I. Introduction

Scope of Project and Personnel

Archaeological field survey and mapping of early stone architectural features, representing ruins at Nan Madol and adjacent areas of Temwen Island, Pohnpei, Federated States of Micronesia, as well as survey work at Ipwal, Sokehs, Pohnpei, was conducted in July-August 2008. The work, which is a continuation of earlier field studies of Nan Madol, was undertaken with support of the US National Park Service and in cooperation with the Pohnpei State Historic Preservation Office, the Historic Preservation Office of the Federated States of Micronesia government, and the traditional leadership of Madolenihmw and Sokehs Municipalities.

The specific topic of interest for this project is mortuary architecture and documenting how such structures were built and used on Pohnpei. Through this study, we created maps of critical stone architectural features at Nan Madol, developed documentation of surface remains (artifacts, food remains) and construction features, and photographed selected features. This research builds on prior field studies done by Ayres, Saxe, and Athens at Nan Madol and provides insights into possible status differences and variation reflecting location, architectural style, and surface remains associated with mortuary and other structural features found on Nan Madol's 100 artificial islets.

As one of three volcanic high islands in the central-eastern Carolines, Pohnpei represents a major Micronesian cultural locale, both in terms of population and political significance (Fig. I-1, 2). Nan Madol and related sites on Pohnpei (Ayres 2003) and the site complex of Lelu on Kosrae (Cordy 1983, 1986; Graves 1986) represent major resources in Micronesia for the study of cultural evolution and development of chiefly societies (Alkire 1980, Hughes 1982; Lichtenberk 1986; Petersen 1992; Peoples 1993; Keating 2000; Dietler and Hayden 2001, Clark et al. 2008). They also provide critical evidence for broader comparisons in the Pacific, particularly to Polynesia (Kirch 1984; Earle 1993).

Figure I-1. The Eastern Caroline Islands, Micronesia, showing Pohnpei's location in the Western Pacific. [image w. ayres].

We examined primary burial structures (*lolong* in Pohnpeian) and other evidence related to a relative chronology of mortuary practices for the island. Given the importance of funerary constructions at Nan Madol and on Pohnpei in general (Seikel n.d./2008), and the artifact content of tombs (Ayres and Takayama n.d.) this will be a significant contribution to better understanding Pohnpeian culture in the past.

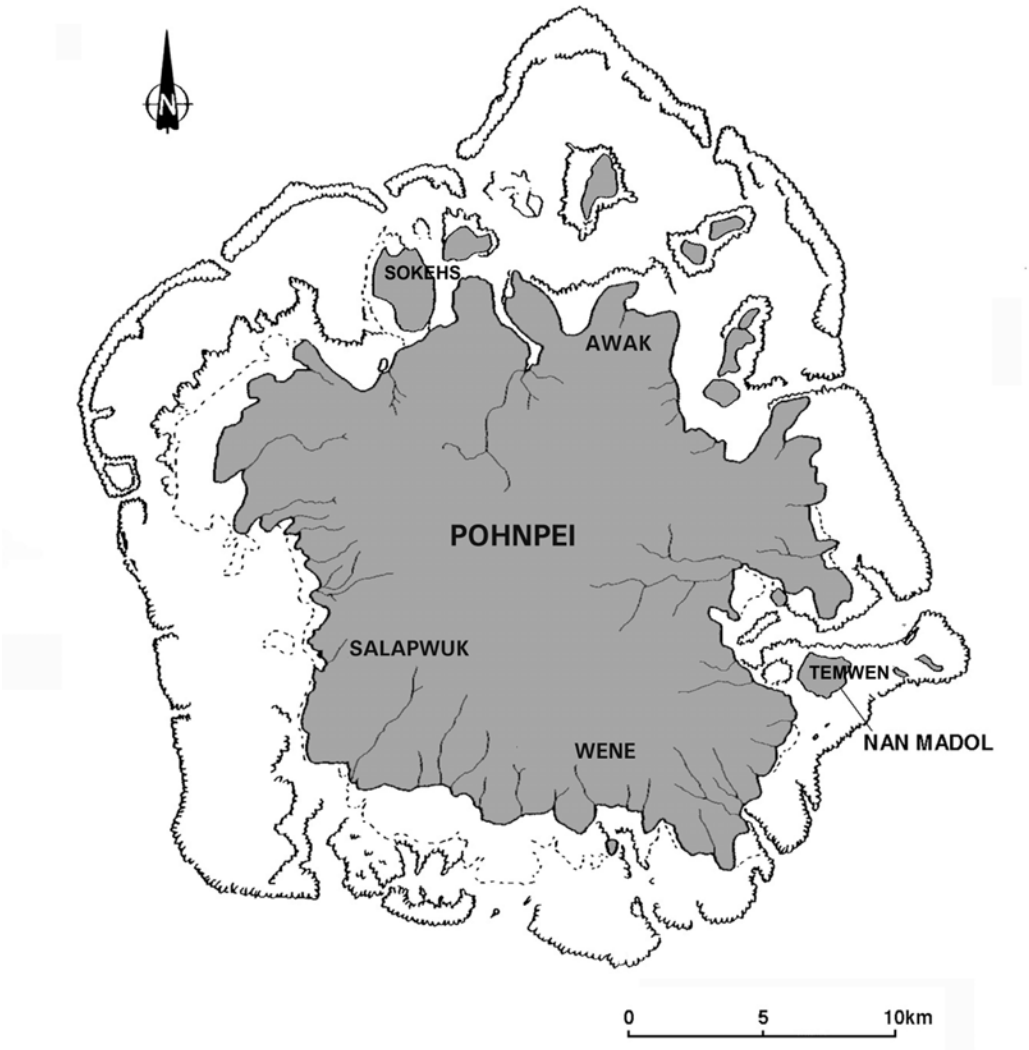


Figure I-2. Map of Pohnpei, Federated States of Micronesia. This volcanic high island in the Caroline Islands was the location of many elaborate chiefly societies in earlier times and is known for its archaeological stone remains. Research locations are indicated; in particular, Nan Madol, Temwen Island, and Sokehs are important in this report. [image w. ayres]

This project provided valuable results for Pohnpei's Historic Preservation program because it contributes to site documentation on the island and specifically to developing detailed maps for Nan Madol. The latter kind of mapping is essential before longer-term planning for site conservation can be accomplished. The project expands the basis for making comparisons among sites and will aid in discussions of site conservation and preservation. This project is part of a larger goal to locate stone structures and other burial sites throughout Nan Madol in order to be better able to conserve these sites, which are typically incorporated into local residents' traditions. Mortuary sites are valuable locations of cultural heritage, and as such should be protected whenever possible. The first step in preservation is site documentation.

An important part of this and other recent projects conducted by the University of Oregon on Pohnpei is a training component that comes about though cooperative field and office study done by the visiting field archaeologists and the Historic Preservation Office staff (Ayres and Eperiam 2001). The work reported here continues that tradition.

II. Research and Documentation Plan

W. Ayres and K. Seikel

Nan Madol Seawall Architecture and Burial Complexes

Archaeological survey and mapping of sites representing places of past activity or occupation is an essential part of documenting early Pohnpeian culture and lifeways, especially prior to the period when written documents become available to complement Pohnpeian oral history (see Fischer et al. 1977; Bernart 1977, Mauricio 1987). To understand Nan Madol and other archaeological sites on Pohnpei, especially ones older than a few hundred years, requires that we use archaeological information. At Nan Madol, detailed mapping and documenting of selected structures was planned for the present project. Approximately forty-five percent of the Nan Madol artificial islets have been individually mapped as a series of plan views at a scale of 1:100 metric by Ayres and co-researchers since 1977 (Ayres 1979, 1983, 1985, 1990; Ayres et al. n.d., 1981; Ayres and Haun 1980, n.d) or smaller maps of 1:200 metric scale by Athens and co-researchers from 1980-1988 (Athens 1980, 1984; Bath 1984a,b). At the scale of 1:100, the plotted map sheets of individual islets range in actual size from 15 by 20 cm to some 150 by 250 cm. Each provides a document showing the remains of past construction and remodeling, dwelling and ritual structures, and a range of activities including feasting, tool making and craft production, and burial. In many cases, more detailed mapping of individual stone features is necessary, and this project addresses those concerns. The three joined islets studied here had not been previously mapped in detail.

We focused on islets and structures that have not been completely documented and those that are prone to damage by visitors and structural deterioration. We documented *lolong,* a type of tomb architecture, and also other

seawall burials to make comparisons among building phases and mortuary practices at these sensitive sites. *Lolong* are especially prone to disturbance by tourists hunting for artifacts and structural deterioration from coral deterioration and other architectural collapse; also, high wave action and vegetation growth have exposed some of the seawall burials in recent years. The survey involved surface recording within individual features such as stone walled enclosures, platforms, and pits to locate and identify artifacts. Identified artifacts were plotted on maps and cataloged so that they can be preserved. Because of the short time frame and a wish to perform a non-invasive study of these sites, no excavations were planned at Nan Madol.

Figure II-1. An aerial view of the main Nan Madol islet complex, located on Pohnpei's East coast, Madolenihmw Municipality. At the right, four sections of the eastern-most seawall architecture are labeled ANG for Angeir, SUWB for Sapwuhtik B, LPK for Lukepenkarian, and KAR for Karian. These are connected by coral fill and retaining walls, but sections of this 380-meter long construction may have been separate islets in the past. The place names are from Pohnpeian oral traditions. [image Google Earth]

Mapping layouts at Nan Madol included work primarily at the islets of Angeir, Sapwuhtik B, Lukepenkarian (connecting these to Karian Islet), with additional observations at Nan Douwas and Pahnwi. We use the place name Angeir for the southwestern-most end of this islet chain; Pohnpeian oral historian M. Hadley has used Pahn Mwasangap for this area as well. In addition, with the permission of Temwen landowner Masao Silbanuz, we developed information about structures possibly related to Nan Madol that exist on his property (Poaroas and inland). The locations of some stone structures had been recorded in an earlier project, but more field description was needed.

Research in Other Areas of Pohnpei

Because complications with logistics and access delayed work at the Nan Madol site at the outset of the project, the first few days of the field effort were devoted to survey and mapping at sites located at Ipwal, Sokehs Municipality. These sites are important for understanding Nan Madol, because some structures in this area are referred to in oral histories as the place where construction of Nan Madol was initiated; it was subsequently shifted around the north coast until the efforts were eventually successful at the present Nan Madol complex at Temwen in Madolenihmw. One particular site, designated PoS4-1 at Ipwal, is also in danger of modification because of the encroaching rock quarry activity located to the east and south of the site. The results of this Ipwal field study and analysis are presented in Section IV of this report.

Temwen Island, because it is adjacent to the main Nan Madol area (Nan Madol Central), is an important land area for examining the archaeological record of early activities during the time Nan Madol was in primary use and later after the Nan Madol site was largely abandoned. One use of Temwen may have been to supply food and water to support residents of Nan Madol. Thus, as a third part of this project, and an aspect of the continuing effort to survey selected land

areas of Temwen, we undertook a preliminary study of agriculturally-related sites on a strip of land extending back from Nan Madol towards the interior of Temwen. One breadfruit pit (*kahlipw*) was examined and a small test unit was excavated to determine some details of its construction and to collect possible evidence of plant foods stored there. The results of this paleoethnobotanical study are reported in Section V. of this report.

Project staff included Katherine Seikel, Maureece Levin, and William Ayres as visiting archaeologists and Mr. Gus Kohler, Head, Jason Lebehn, Douglas Nelber, and Roseder Albert, Research Staff of the Historic Preservation Office, Pohnpei State. Members of the Sokehs and Temwen communities and the Tourism Office participated as part of the field project.

Project Schedule

The project was planned for a period covering approximately one month in July and August 2008. The overall sequence of planned activities was as follows:

Week 1	Consultation with Historic Preservation Office staff and making local arrangements.
Week 2	Beginning reconnaissance and the intensive survey.
Week 3	Doing site definitions, field recording and mapping.
Week 4	Finishing field recording, consolidating field data, submitting field report to HPO office, and storing samples and equipment.

Resulting Report Products

Results of the project include written site descriptions, a photographic record, and site forms based on forms used by the Pohnpei Historic Preservation Office (also see Ayres and Mauricio's report on Salapwuk, 1997). This project

report and copies of field documents have been submitted to the Historic Preservation Office and to the US National Park Service.

III. Survey and Mapping at Nan Madol

K. Seikel and W. Ayres

Nan Madol: Introduction

Nan Madol, located in Madolenihmw Municipality, Pohnpei, Federated States of Micronesia, has been a locale of interest to researchers for over a century. The site complex of more than 100 artificial islands arranged along tidal channels on the coral reef is one of the largest ceremonial sites in the Pacific Islands and represents a building effort spanning many generations from at least 1000 years ago up until approximately AD 1600 when major construction efforts halted. The various islets contain specialized architectural remains, evidence of residential life from a range of time periods, and extensive remodeling and architectural expansion. Formal layout and planning is evident in many aspects of the site's remains.

Even though much information about the site has been provided through field studies and artifact analysis, only approximately forty-five percent of the site's architecturally built up area has been mapped in detail. The primary purpose of this project was to survey and document areas of Nan Madol that have not been thoroughly explored before.

Field survey and mapping, in conjunction with oral traditions, provide a basis for analyzing when and how the site was used by early Pohnpeians; it is also is a requirement for all aspects of site conservation. This includes the assessment of multiple processes that are damaging the site's occupational remains and architectural structures as well as its informational content. Data collected on various damaging impacts on the islets and structures provides essential detail for short term stabilization and long term preservation efforts at Nan Madol (Fig. III-1, 2).

Figure III-1. View of exterior of one of the Nan Madol artificial islets, Usendau (UED), showing displacement of columnar header and stretcher construction and exposed coral rubble fill behind this retaining wall. This kind of deterioration and damage weakens the wall itself and results in deflation of the islet fill from tidal action. [photo nm_ued_shoreline_00334; k. seikel]

Earlier Research at the Nan Madol Complex

In order to briefly summarize past research at the site, we review some key research projects. These include Hambruch's pioneering work in 1910 (Hambruch 1932-1936), Japanese studies done in the 1930s, a Smithsonian Institution project done the early 1960s, early reconnaissance (Davidson 1967), and, finally, work since the late 1970s by Athens and Ayres.

While Christian in 1899 and, before him, Rosamel in 1840 produced sketch maps of the overall layout of Nan Madol, Hambruch (1936) created in

Figure III-2. An interior view of a well-constructed tomb chamber built into a *lolong* burial structure in Nan Douwas (NDA), Nan Madol (PoC3-1). This uses the classic columnar stone typical of Pohnpei. The chamber has been disturbed significantly over the last century or two by looters and shows evidence of recent digging in the floor as well. Such disturbance reduces the cultural and scientific value of the archaeological site. [photo P1080541; w. ayres]

1910 the first reasonably complete map of the site that is sufficiently accurate for preliminary archaeological interpretation. This map included a scale representation of the overall layout of all the 100 or so individual islets (although the scale is not totally reliable), placenames for individual islets, and sketches of individual architectural features. Although he was an ethnographer, Hambruch's map documentation is important today for any archaeological study of Nan Madol. It was supplemented by photographs and extensive documentation of oral history that was available at that time from a few knowledgeable Pohnpeians.

The next field study at the site took place nearly 20 years later with observations by various Japanese ethnologists of individual islet features and oral history (Yawata 1932, Chapman 1974). Some excavations were done, but these have not been fully reported; however, some details about the collections of artifacts have been published (Intoh 1998).

Since 1936, when Hambruch's survey results were published, researchers have attempted to pair his map with oral histories (for example, Bernart 1977) and early written accounts (see Hanlon 1988) to more fully understand the site and to guide research projects (for example, Athens 1984). As noted previously, the majority of mapping at Nan Madol was performed in the 1980s and 1990s by Ayres and Athens. Many of the islets that have been mapped have architectural features and place names linked to Pohnpeian oral histories. Although approximately half of Nan Madol's islets have yet to be mapped, reconnaissance surveys of almost all unmapped islets have been done. The results of these preliminary surveys are not fully published in reports, but have provided basic information for developing overviews (Ayres 1990, 2003) and specific survey projects on individual islets.

Research Plan for 2008

Most of the artificial islets that have been mapped and studied have large columnar basalt constructions and often have associated stories from Pohnpeian oral tradition. The goal of this study was to begin survey and mapping of islets not previously studied, including ones that are relatively roughly built of coral rubble rather than extensive work with massive boulders and columns.

Nan Madol, like many other coastal sites, has been impacted by weathering, and encroaching vegetation and silt accumulation in the mangrove tidal swamp. We chose islets along the seawall because they are more exposed to direct tidal wave action than those closer to land, which tend to be more

susceptible to silt infill and gradual tidal deflation of surfaces. The practice of curio hunting has also been noted as a major problem at Nan Madol (for example we observed evidence of digging in structures, including tombs). Lukepenkarian, Sapwuhtik B and Angeir were chosen for this survey because they are located on the seawall adjacent to Karian Islet, which has been mapped (Athens 1984) and are visited by tourists, so there may be on-going disturbance of the site contents.

Field Methods at Nan Madol

Fifteen days were spent surveying and documenting structures on three inter-connected artificial islets (Lukepenkarian, Sapwuhtik B and Angeir) that adjoin Karian islet and form the seawall extending for over 300 m to the southwest. A preliminary map of the set of three joined islets was made at 1:200 scale. Distance and direction measurements from structure to structure were taken to construct this map, and islet widths were measured approximately every ten meters. The islet surfaces were surveyed and major architectural features were recorded. Each feature was cleared of vegetation and photo-documented and through this sub-features representing various kinds of smaller constructions and use areas were distinguished.

Artifacts and a few bone fragments representing human remains were located on the maps and photo documented. Three artifacts were collected from Sapwuhtik and Angeir (2 shell adzes and a basalt flake). Fragmentary human remains were observed in association with a couple of the structures and these fragments were documented and left in situ. The frequency of shellfish food remains was noted, but we did not perform detailed documentation of surface shellfish remains during this survey. On many other islet surfaces hundreds of artifacts and food remains have been recorded on each islet.

Survey Results from Nan Madol

The initial reconnaissance and intensive survey at Nan Madol concentrated on the islet chain extending from Karian at the NE to Angeir at the SW; this forms the most easterly part of the seawall protecting the Nan Madol Central islet cluster.

As noted, Karian was mapped at a scale of 1:200 in a project conducted in the 1980s by Steve Athens and so only a re-examination of the main tomb structure was undertaken here. We investigated the stability of the main entry into the lolong enclosure and found that it has not deteriorated significantly (Fig.III-3, 4). Because the walled over entry (with lintel stones) is very unusual, if

III-3

III-4

Figure III-3. The stone construction of the entryway area of the unusual *lolong* called Karian (KAR), Nan Madol (PoC3-1). The front wall is overgrown, but details of the header and stretcher construction are visible and two tiers of headers are identifiable above the top of the entryway. The entryway width is approximately 2.5 m. [381; photo P1080558; w. ayres]

Figure III-4. View of collapsed columns forming part of the lintel structure of the main Karian tomb entryway. The nearly vertical column has fallen from the roof-over of the entryway and the main inner lintel stone has fallen because of the collapse of the inner side of the enclosing wall visible in the lower center of the image. [photo P1080559; w. ayres]

not unique, at Nan Madol, stabilization should be done in the near future.

The survey of Lukepenkarian, Sapwuhtik B and Angeir identified fifteen structures built of combinations of coral rubble and basalt rock (Appendix C; Fig. III-5). Seven of these are on Lukepenkarian, one is on Sapwuhtik B and seven are on Angeir. A third of those structures originally had a mortuary function, while the majority of the remaining structures could be identified only as "platforms." Other structures include stone pavements and alignments. While the surface artifact

Figure III-5. View of exterior of the ANG-SWUB section of the Nan Madol seawall showing the mid tide level. The broad sandy reef flat east of Nan Madol (PoC3-1) protects the architecture somewhat, but heavy wave action in some areas has reduced the basalt boulder wall construction and deflated the coral fill. Nahkapw Island is in the background. [photo nm00465.jpg; k. seikel]

survey will not be completed until detailed maps are finished, distributions of artifacts and food remains in and around many of the structures suggest ritual and feasting functions. To develop a more detailed plan and artifact distributional data, Feature 2 on Lukepenkarian was mapped at 1:100 scale after clearing (Fig. III-6, 7). Given the project time constraints and the size of the seawall structures, we were able to do detailed mapping only for this structure, which was selected because it is a basalt and coral rubble *lolong* complex with some of the original floor surfaces mostly intact.

Figure III-6. Clearing vegetation from Feature 2, Lukepenkarian Islet, Nan Madol (PoC3-1). This coral and basalt stone construction represents part of a burial complex characteristic of the Nan Madol eastern seawall. The clearing exposes architectural details and surface remains that can be recorded as part of the archaeological documentation. [photo clearing_isletview_00406.jpg ; k. seikel]

Figure 7a. Overall plan, islet construction from Angeir (Likinangeir) to Karian.

Figure 7b. Likinangeir to Sapwuhtik B section, detail:

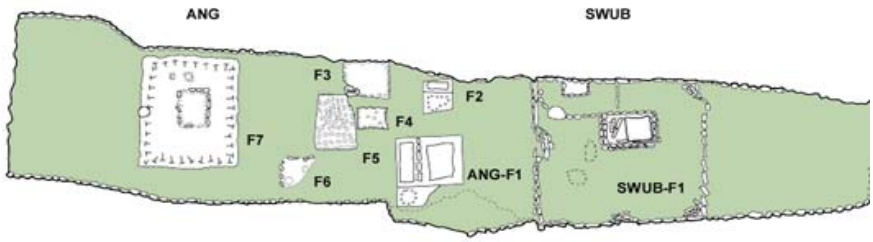


Figure 7c. Lukepenkarian section, detail:

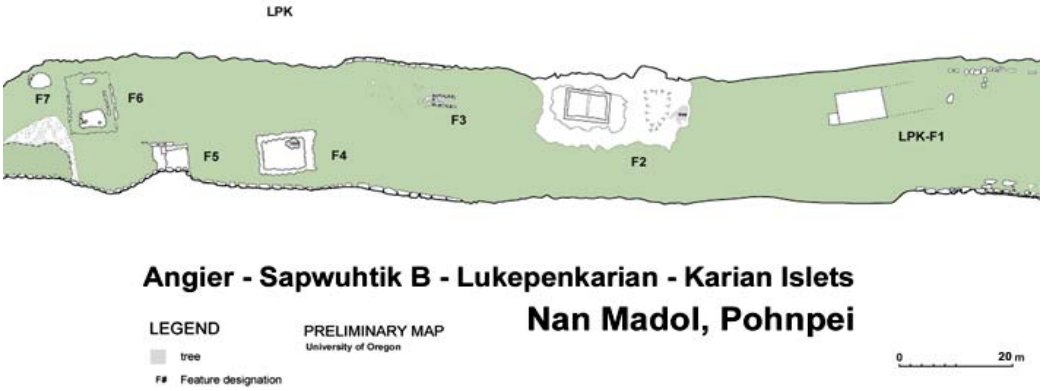


Figure III-7. Plan of the islet set from Angier (ANG) to Karian (KAR) that forms the northern section of the Nan Madol eastern seawall. This preliminary map (a, b, c) was produced during the field project. Additional place names associated with islet sections include Sapwuhtik B (SWUB) and Lukepenkarian (LPK). Numeric feature designations are sequential for each islet designation as per the Nan Madol site referencing protocol. [drafting: w. ayres, j. kennan, d. balmforth, m. levin, k. seikel]

Lukepenkarian (LPK), Nan Madol

The elongated islet called Lukepenkarian is nearly 200 meters long and averages 25 m in width. Its height ranges from 10 cm in deflated areas on the seaward side to approximately 2.5 meters at the highest stone wall constructions. The retaining walls are built up using a combination of basalt boulders and columns and coral boulders. In the most architecturally complex islets, the original retaining wall was constructed of massive basalt boulders with coral rubble forming the islet surface behind the wall.

Feature LPK-1 consists of a series of basalt stone alignments positioned on the coral islet fill. It is located 19 m SW of the entry wall of Karian *lolong*. These alignments form a set of rectangular enclosures (SF 1-3), extending approximately 27 m in length and 5.5 m in width, which may have functioned as a foundation for a perishable structure. There are two *sakau* stones and one larger basalt boulder located just to the northeast of Feature LPK-1; these help establish the ritual function of the structure (as noted for other *lolong* structures elsewhere on the island). The relationship of these stone alignments to the Karian *lolong* is not clear at present.

Feature LPK-2 is a *lolong* complex with two enclosures (see Fig. III-7 to 10). The enclosing walls are primarily built of coral rubble (cobble to boulder size) along with basalt columns providing definition and structural support. There is an alignment of short basalt columns in the southwest enclosing wall (SF 1) that likely functioned as part of the entry (SF 4). Unfortunately, the wall on the south side of the alignment has been dug into so it is nearly level with the coral rubble of the islet surface, thus making it difficult to distinguish an entrance. The tomb platform itself is constructed primarily from columnar basalt. The southwest side of the tomb chamber (SF 2) contains a few fragmentary human remains (adult canine and probable forearm fragments; see Fig. III-8 - 10). In addition, shellfish food remains cover the surface of the tomb chamber. There

are also shellfish remains covering the largely intact surface in the western corner of the tomb enclosure and scattered throughout the eastern enclosure (SF 3). The shellfish paired with the *sakau* stone (SF 5; Fig. 11) located in the eastern enclosure suggests a ritual and feasting aspect of mortuary practices at Nan Madol. Drawings were made of the *sakau* stone.

Figure III-8. View of Feature 2, Lukepenkarian Islet (LPK), Nan Madol. This enclosure walled with coral and basalt columns represents part of a *lolong* kind of structure on the seawall islet. This appears to be badly disturbed. [photo LPK_F2_view00420; k. seikel]

Feature LPK-3 is a small basalt stone paving (SF 1) and alignment (SF 2) southwest of Feature 2. The paving is approximately 2.5 by 4 m and the alignment is 2.5 m by 0.4 m with basalt rocks scattered around and to the southwest of the alignment. There are shellfish remains scattered around Feature 3.

Figure III-9. View of exposed floor area of Feature 2, Lukepenkarian Islet (LPK), Nan Madol. The wall at the left is primarily coral cobbles and boulders and it encloses and area that may represent part of a *lolong* kind of structure on the seawall islet. The compact coral gravel surface has some fragmentary human skeletal remains. [photo LPK_F2_view00422; k. seikel]

Feature LPK-4 is a coral rubble platform 10 m by 8 m and standing approximately 1.35 m high (Fig. III-12). The coral rubble is primarily cobble-sized. Although it has been damaged by the growth of a large tree, it is clear that the platform retaining walls were originally built approximately 15cm higher than the platform surface.

Feature LPK-5 is a coral rubble platform with a foundation outlined by basalt columns forming a rectangle approximately 5 by 5 m. Shellfish remains are scattered on the islet surface to the west of the platform between Features LPK-5 and 6.

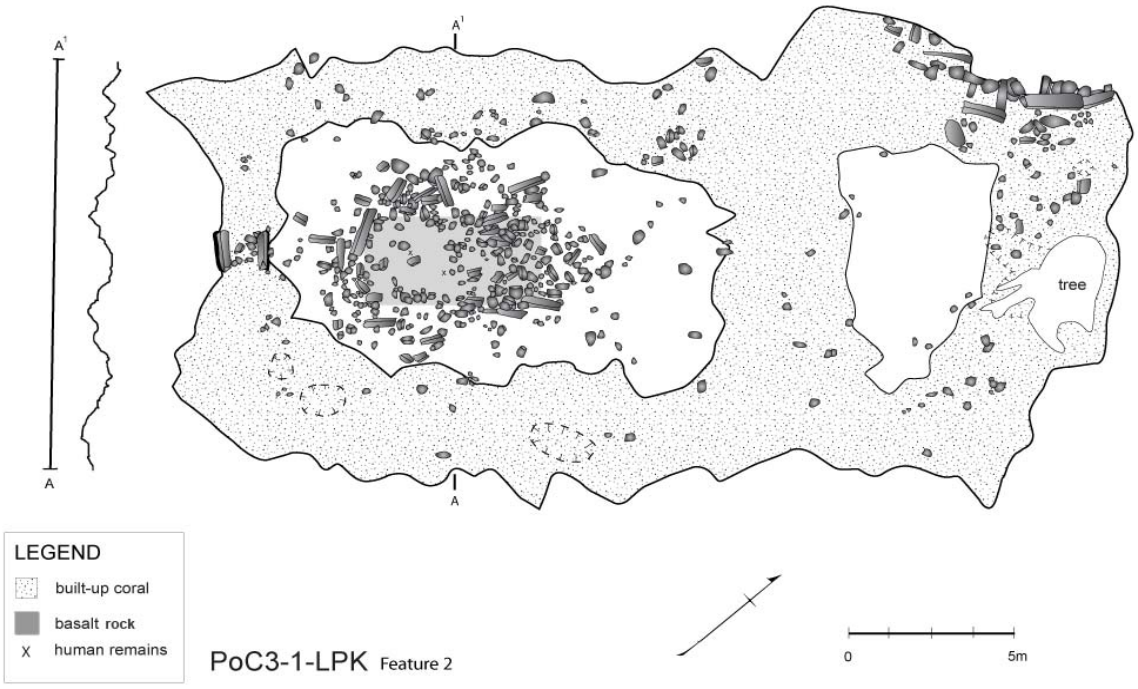


Figure III-10. A plan map of Feature 2 forming a *lolong* complex on Lukepenkarian Islet (LPK), Nan Madol. The construction is coral rubble walls with basalt columns selectively placed for definition. The main tomb chamber is the gray rectangle. [drafting: k. seikel, w. ayres]

Figure III-11. A small *sakau* (kava) stone found in the vicinity of Feature 2, Lukepenkarian Islet, Nan Madol. This subfeature (SF5) is located east of the coral walled enclosure forming part of an ancient *lolong*. [photo sakaustone_0409; k. seikel]

Figure III-12. Stone platform of coral cobbles and boulders on Lukepenkarian Islet, Nan Madol (PoC3-1). This structure, Feature LPK-4, is a roughly square foundation. View from the west. [photo nm00442; k. seikel]

Feature LPK-6 consists of a structure formed by two basalt column and coral rubble platforms. The low coral rubble platform is outlined by basalt columns (SF 1) and is approximately 9.5 by 12 m. The small raised platform constructed of basalt columns (SF 2) is located on the western side of the low platform. Scattered shellfish remains surround the low platform and are suggestive of feasting activity. Both platforms have been damaged by unauthorized digging and this has displaced direct evidence of Feature 6's function.

Feature LPK-7 is a coral rubble platform with a basalt column foundation (Fig. III-13). The platform is located just southwest of LPK-6 and measures approximately 4 by 4 m.

Figure III-13. Feature 7, Lukepenkarian Islet, Nan Madol (PoC3-1), after clearing. This small foundation is made from coral cobbles and boulders. The view is to the west across the open tidal area inland from the seawall constructions. [photo nm00455; k. seikel]

Sapwuhtik B (SWUB), Nan Madol

The portion of the long seawall section called Sapwuhtik B was possibly originally built up as a distinct islet that was subsequently attached to Lukepenkarian to the northeast and perhaps to Angeir to the southwest. The length of the built-up separate islet, Sapwuhtik B, is approximately 65 m. It is dominated by one large architectural complex, a *lolong* (Feature SWUB-1). The *lolong* complex is mainly constructed of columnar basalt with coral rubble fill (Fig. III-14). The complex incorporates a tomb platform, a high square platform built into the northwestern wall, and a series of basalt stone alignments. It measures approximately 24 m by 27.5 m. The enclosure has been damaged by trees and

Figure III-14. East end of the *lolong* forming the main part of Sapwuhtik B Islet, Nan Madol (PoC3-1) is shown here after clearing. This structure, Feature SWUB-1, consists of an enclosing wall made with basalt columns on top of coral rubble fill and a central main tomb feature. [photo nm00456; k. seikel].

vines, and there is also evidence of uncontrolled digging in the surface of the enclosure southwest of the tomb platform.

The tomb platform (SF 2) is located in the center of the enclosure. A few basalt columns have shifted or fallen out of place, but the tomb platform and chamber itself are largely intact. In 1994, Ayres and Mauricio observed human remains in the tomb chamber, but they were no longer present at the time of this survey. The lack of skeletal fragments suggests that the human remains were removed rather than broken down through weathering.

There are a few openings in the northwest and southeast enclosing walls but the primary entrance is located in the southwest wall. Part of the wall next to the entrance has collapsed, but the number and size of columns that are present

as well as the wall height suggest that the entrance may have been originally covered much like Karian.

There is a tall coral rubble platform (SF 3) with basalt column supports at the corners and base of platform. The platform is built into the northwest enclosing wall. The top of the platform is level with the top of the wall. There is an area in the top of the platform where a series of short basalt columns are exposed; it is unclear whether the exposed basalt was part of the original construction or if coral rubble was displaced. Portions of the southern platform walls have collapsed.

A series of basalt column alignments (SF 4) lies along the northwestern side of the enclosure. Two of them extend from the northwest wall toward the tomb platform (SF 4.1-2); only one extends completely to the platform. A third alignment (SF 4.3) extends from the western corner of the tomb platform and extends to the northwest wall near the western corner of the enclosure. This alignment initially extends toward the southwest wall and curves toward the northwest wall just after it passes the southern corner of the coral platform (SF 3). There is one stone in the curved alignment that could be a *sakau* stone.

Only two artifacts were associated with Sapwuhtik. There is a grouping of small basalt cobbles, manuports (SF 6), just south of the tall coral platform (SF 3). A large basalt flake (Cat. SWUB-001) was collected near the eastern-most basalt alignment. This flake may have been unintentionally created, but it is of the form identified by Pohnpeians as a breadfruit “knife.” A small shell adze (Cat SWUB-1001) was found to the northeast of the complex a short distance from the northern edge of the islet. Also, shellfish food remains are scattered on the islet surface around the *lolong* complex.

Angeir, Nan Madol

Angeir Islet as identified here is 75 m long by approximately 28 m wide and has irregular walls of coral and basalt boulders. The islet height varies from 10 cm at deflated edges to approximately 2.0 m.

Feature ANG-1 is a coral rubble and basalt column burial platform (8 m by 10.5 m) with an attached coral rubble platform. The tomb platform contains two tomb chambers; no artifacts were observed in the western chamber (SF 2), while three coral beads were recorded in the larger eastern chamber (SF 1). The eastern tomb chamber walls have collapsed into the chamber. The coral platform (SF 3) is attached to the southeast side of the tomb platform. Its eastern corner has been disturbed, apparently washed out by wave action, and there is a depression in the platform surface, which may have been dug out. There are shellfish remains scattered around Feature 1 and in the washed out area adjacent to the structure.

Feature ANG-2 is a platform, measuring 5 m by 5.5 m, made of basalt columns and coral cobbles. It has two main sub-features; there is one clearly defined tomb chamber located in the northwest side of the platform and the other side of the platform has deflated. The tomb chamber is intact and contains human cranial fragments and shellfish remains. Shellfish remains are also scattered around the platform.

Feature ANG-3 is a coral rubble platform outlined with basalt columns forming a rectangle of approximately 6 m by 7 m. The platform has been disturbed by trees. Shellfish food remains are scattered to the northeast of the platform.

Feature ANG-4 is a coral rubble platform outlined by basalt columns to form an area of 3.5 m by 4.5 m. The platform has a shallow central depression. There are shellfish remains scattered to the northeast of the platform.

Feature ANG-5 is a basalt stone paving, 6.5 m by 9.5 m, extending from the southern corner of Feature 3 to Feature 6 and toward Feature 7.

Feature ANG-6 is a coral rubble platform, approximately 5 m by 6 m, with basalt columns supporting the platform walls. There are depressions in the north and south corners of the platform; however, it is not clear if the depressions were originally part of the platform construction. The proximal end of a broken shell adze was found on the northwest side of the platform near the platform wall. There are shellfish remains scattered to the west of the platform.

Feature ANG-7 is a coral rubble *lolong* of approximately 16 m by 19 m (Fig. III-15). There is an area that has been dug out in the southwest enclosing wall. The tomb platform (SF 2) is located in the center of the enclosure. It is primarily built of coral rubble with basalt columns supporting the exterior platform walls. The tomb chamber has been damaged by a tree and portions of the interior chamber wall have collapsed. Two shallow cists (SF 3-4) are outlined by basalt columns northwest of the tomb platform. There are shellfish food remains in the tomb chamber and scattered around the platform.

Field Survey Conclusions

Archaeological survey produces a wide range of information about a specific area. It is important to understand the collected data in relation to both the specific space from which it was collected and the surrounding area. In the case of Nan Madol it is important to consider survey data on multiple levels to understand how this information maps spatial relationships, defines the purpose of specific architectural features and the individual islets, and clarifies clusters of

Figure III-15. Feature ANG-7, located on the southern end of Angier Islet, Nan Madol (PoC3-1). This view after clearing shows the built-up coral rubble that originally formed a platform and enclosing wall with a tomb depression in the center (visible as basalt columns in the center here). [photo reecie_ANG_better00499; k. seikel]

islets as well as the functions of the Nan Madol site as a whole. Survey is also essential for identifying possible impacts on the site and subsequent changes that have affected the archaeological record we can observe today. This evidence is fundamental to assessing the site's state of preservation.

Lukepenkarian has the widest variability in architectural types. Feature LPK-2 is the only structure that has a known function as a mortuary and ritual structure. Although all the other features on Lukepenkarian have been classified, it is not possible to identify their specific function based on the information available at this time. Four of the seven structures on Lukepenkarian are associated with shellfish food remains (LPK-2, 3, 5 and 6). The shellfish remains are the only commonality between the structures since they all vary in type,

which suggests multiple feature types with potential feasting or associated food consumption purposes.

Sapwuhtik contains only one structural complex, the *lolong*. Though it is definitely a mortuary and ritual feature, the purposes of sub-feature 3 and the cobbles that comprise sub-feature 6 are unclear. Since the top of sub-feature 3 is level with the enclosing wall (SF 1), it is possible that it had a function not shared by other features along the surveyed stretch of seawall, but further exploration is necessary. The shellfish scattered around the *lolong* suggest feasting.

Angeir contains the largest number of mortuary features of all these islets. There are two burial platforms (ANG-1 and 2) and a larger *lolong* (ANG-7), all of which are surrounded by scattered shellfish remains. Two other platforms are also associated with shellfish (ANG-3 and 6), which suggests feasting across most of Angeir.

Hambruch (1936) identifies the outer seawall as the primary burial complex and Bath and Athens (1990: 279) state “the islets comprising the outer wall of Nan Madol contain the majority of tombs and/or mortuary features.” The high proportion of mortuary structures identified during our survey supports this statement, but nearly half of the identified structures are platforms or other foundation features that have no clear mortuary function. However, it is clear that this section of the seawall was not a primary residence or occupation area. If the seawall section from Karian to Angeir is primarily a mortuary locale, the platforms, pavings, and stone alignments should have a connection to mortuary practices and associated ritual at Nan Madol. Shellfish remains were found in or around two thirds of the structures identified during the survey. Shellfish food remains are found widely on the surfaces of Nan Madol’s islets, including in both burial and non-burial contexts, but distributional evidence supports the

hypothesis that there was ritual feasting and *sakau* preparation related to mortuary practices at Nan Madol.

At least one *lolong* and other burial features were identified on each of the three islets surveyed. Lukepenkarian's *lolong* (LPK-2) has an alignment of basalt columns in the southwest wall that could delineate the original entrance to the complex, which is now obscured by damage to the wall itself. The *lolong* (ANG-7) on Angeir does not have anything to distinguish a possible entrance. The only *lolong* with a clear architectural entryway is located on Sapwuhtik B (Feature SWUB-1). Its entrance is partially preserved in the southwest wall. Seikel (n.d., 2008: 20-21) has noted that six of seven *lolong* located on Karian, Pein Kitel, Pahndipap, and Pahnwi have entryways in the southwestern walls, which is consistent with the *lolong* on Lukepenkarian and Sapwuhtik B. The significance of the southwesterly direction has yet to be established, but the number of *lolong* with this entry orientation suggests the need for further study.

Each structure identified in this survey has been disturbed by natural and human impacts. In most cases, vegetation and stone deterioration have the largest impact on Nan Madol's structural remains. Vegetation has grown up over the islet surface and root systems have invaded the stone structures. In spite of the damage vegetation causes, it also has helped to preserve some structures. Feature 2 on Lukepenkarian was included on Hambruch's map (1936) as a burial location, but it had not been examined in more detail since then. After clearing the vegetation, we discovered fragmentary human remains and preserved sections of the original enclosure surface. The mangrove, which is growing up in areas around the seawall, may eventually damage Nan Madol more than other vegetation has thus far. Tidal erosion has caused three major washouts on the southern sides of the surveyed seawall islets, one of which damaged Feature 1 on Angeir. Work to stabilize these structures and the management of vegetation is integral to the preservation of the site.

Damage to Nan Madol is not limited to natural deterioration; there is evidence of unauthorized digging and the removal of artifacts and human remains from the survey area. According to Ayres and Mauricio (personal comm. 2008) in the 1990s human remains were present in the tomb platform in the Sapwuhtik B *lolong*, but these were no longer present during this survey. Currently the tomb chambers in Feature 1 on Angeir do not contain visible human remains, yet the eastern chamber contains three beads which would have been part of burial offerings. Whoever removed bones and artifacts from Nan Madol may have not known of its protected status or not have cared. The education of visitors to the site about Nan Madol's protected status and other guidelines may help prevent the continued removal of items from the site.

This project has shown that the documentation and mapping of previously unrecorded areas of Nan Madol can provide important insight into how the site functioned as a unit. Survey is critical due to the wide range of information being lost because of the many damaging impacts on the site. Projects to continue this type of work in other areas of Nan Madol are essential to provide additional information about the site's occupation and the potential for conservation and preservation of the site.

IV. Investigations at Ipwal, Sokehs

W. Ayres, K. Seikel, and M. Levin

Introduction

The initial part of this archaeology and historic preservation project included field survey, mapping and other site documentation at sites in Ipwal, Sokehs. This was done in consultation with the Pohnpei State Historic Preservation Office staff and the FSM Historic Preservation office staff and with the permission of Nahnmwarki of Sokehs and Soulik en Ipwal. The objective was to investigate further the stone platform (a *pehi*, in Pohnpeian) located near the current rock quarrying activities at Ipwal and to determine what impact those were having on the site's integrity. Because the site is important in Pohnpeian oral history as well as with regard to recently recovered archaeological information about the age of settlement of this area, we worked here for several days prior to beginning field work at Nan Madol.

Previous Research at Ipwal

The area near the existing rock quarry at Ipwal has been previously investigated archaeologically three times: 1) by Russell Brulotte in 1993 when he did the original cultural impact study before the rock quarrying started; 2) by J.-P. Galipaud in 2000 when he examined locations for possible early coastal settlement; and 3) by Ayres and Mauricio in 1998 and 2002 during reconnaissance of the area and related survey at Nan Imwinsapw, Sokehs.

Site Designations and Descriptions at Ipwal

For site numbering, the *kousapw* number representing Ipwal--based on earlier research at nearby Nan Imwinsapw--would be PoS4. That is, Sokehs is

now coded “S” (rather than the original system’s use of “E” for Ipwal; see Ayres and Mauricio 1997) and the next number is the *kousapw* designation. There is the intervening *kousapw*, Tamworohi, between Eir (Nan Imwinsapw; code S2) and Ipwal (S4).

The first site numbering concern is the designation for the stone platforms in the mangrove (*naniak*) just north of Ipwal point. Brulotte (n.d./1993) refers to these only as features 1-3 and does not use site numbers; however, these stone structures and other site features deserve to be given site numeric designations for complete recording and consistent documentation. Following established principles of site recording used on Pohnpei since the 1970s, individual architectural features, unless clearly clustered and related to one another, are given separate site numbers for ease in identifying them and recording their locations. Within sites, features are designated with numbers for parts of these architectural structures and related archaeological remains, such as pits, stone alignments, or hearths. This means that Brulotte’s three “features” should be given separate site numbers because although they are close to one another, they are not clearly related in time or purpose. Here, we assign PoS4-1 to his “Feature 1,” PoS4-2 to his “Feature 2,” and PoS4-3 to his “Feature 3,” and so on, as described in Table VI-1.

The other sites Brulotte recorded are somewhat more complex in terms of site numbering, but we think it is important to assign numbers as noted in the following table (Table IV-1). Thus, a total of 9 site designations is proposed here to account for the varied archaeological remains recorded by Brulotte and observed in our field effort. Unfortunately, some of these have already been destroyed in the quarrying activity and so no further information will be available.

There are undoubtedly other sites in this area that need attention so that they can be located, surveyed, mapped, assessed in terms of significance, and conserved. The nine sites in Table VI-1 represent what we know of at present.

Table IV-1. List of Ipwal, Sokehs, Sites

PoS4-

Site 1. Brulotte's original "Feature 1." A stone platform complex. Following Soulik en Ipwal (Douglas Nelber), we refer to this important structure as part of a place called "Nan Mwoluhsei."

Site 2. Brulotte's original "Feature 2." A stone boulder walkway extending across the mangrove swamp between Ipwal and Small Island.

Site 3. Brulotte's original "Feature 3." A small, squarish stone platform in the mangrove. This is of unknown age.

Site 4. A now-covered stone tomb structure (*lolong*) under the existing road at Ipwal Point. None of this is visible today (see Brulotte n.d./1993:Photo 8).

Site 5. A buried deposit, approximately 100 to 150 cm beneath the mangrove tidal flat at Brulotte's test location No. 6. The evidence consists of a red-ware potsherd, a shell ring band, and possible shellfish food remains. This is approximately 15 m from the north side of the current road as shown in Brulotte (n.d./1993:6) but is now totally covered with crushed rock from quarrying operations. Because it has radiocarbon dates going back to 1800 years BP (uncalibrated), this is one of Pohnpei's most important sites. Brulotte did not distinguish this as a site as such, but it should be as it probably represents an early coral shoreline occupation.

Site 6. Brulotte's "Prehistoric Pohnpeian Site C," p. 14-15, on Ipwal Point. One Feature.

Site 7. Brulotte's "Historic Pohnpeian Site B," p. 14, on Ipwal Point.

Site 8. Brulotte's "Historic Pohnpeian Site," p. 17, p. 16 map, in mangrove at shoreline.

Site 9. Brulotte's "Japanese site A," p. 9-11, on Ipwal Point. Features 1 through 8 consist of conceptually inter-related military features dating to pre-1945.

Site Features for PoS4-1: "Nan Mwoluhsei en Ipwal"

Developing a more complete site description for Site S4-1 was the first priority; this location is referred to here with the area name as "Nan Mwoluhsei en Ipwal." We developed site feature designations, improved the mapping, and updated the photographic record. Following standard recording procedures for Pohnpei, the double platform was distinguished as two features within the site designation.

It is interesting that while Brulotte created a detailed plan drawing of the rock construction detail of Feature 1, some problem emerges with the scale. He refers (n.d./1993:18) to the dimensions as 27 by 12 m and the raised platform at 8 by 7 meters. We found the base platform, F1, to be only 11.3 m long and 7 m wide. The raised platform of the structure, here F2, is actually 5 m by 4.5 m. Other than possible mis-measuring from maps that had distorted scales because of reduction, no explanation is available for Brulotte's measurements.

<u>Feature 1, Site PoS4-1</u>

The large stone platform (or raised pavement as it appears today) with an elevated platform on the west end forms the architectural expression of Feature 1, which is to be referred to as *pehi,* a Pohnpeian ritual structure. It is 11 m long by 7 m wide (Fig. IV-1). Based on an excavation pit, Brulotte identifies the base of the larger platform as extending down some 100 cm beneath the present-day swamp mud surface. The underlying stonework and its base he determined from "the occurrence of concentrated cobble" underlying the visible surface cobbles and boulders (Brulotte n.d./1993:19). This was said to rest on a coral gravel and

shell bed, but he does not provide profiles or stratigraphic drawings of the excavation pit to document this. He offers a photograph of subsurface deposits in his test unit at the NE corner of Feature 1, but the photograph does not show the foundation of the platform or the "concentrated cobble(s)." While we did not have time to check this conclusion by opening up another test unit, it would be valuable to expand Brulotte's excavation in the future, because the question about the depth of the platform foundation needs to be resolved.

Subfeature 1a identifies the north wall of the platform. This is 11.3 m long and curves slightly to the south on the eastern half. It consists of a mixture of cobbles and small boulders, with columnar rocks defining the alignment at the corners.

Subfeature 1b refers to the west wall of the lower platform. This is somewhat disturbed today.

Subfeature 1c is the south wall of the platform. Rocks in this curb edge have been moved so that the line is not straight. It has fewer columns and more cobbles and boulders compared to the north alignment.

Subfeature 1d is the east wall of the lower platform. Originally this may have formed a step at the front of the main platform.

Subfeature 1e identifies an L-shaped arrangement of stone columns and boulders located 4.5 meters from the east end (Fea. 1d) of the platform. At least 3 columns end-to-end show the north-south alignment and the alignment of cobbles and small boulders intersects this at an approximate right angle. An alignment of cobbles and boulders at the north edge of the platform may be connected and show what was originally a dividing line across the entire surface width. The function is unknown, although a *sakau* stone was discovered at, or just off, the west end of the feature. This *sakau* stone is referred to as Subfeature 1e1. At present, Subfeature 1e is a somewhat depressed area of the platform, but it is unclear if this is due to architectural deterioration and erosion or the way it was originally constructed. It is likely that it was originally built that way as a defined place for *sakau* preparation.

Figure IV-1. View of the structure forming Site PoS4-1, Ipwal. This platform, considered to be a *pehi* (perhaps a prehistoric *nahs*) consists of two features, the underlying low platform and pavement, Feature 1, and the superimposed rectangular platform, Feature 2. (photo. w.s. ayres)

Feature 2, Site PoS4-1

The higher platform (Feature 2) situated on the west end of Feature 1 is approximately 4.5 m by 5 m. Its elevation is stated by Brulotte to be 1.5 m above the lower one and the latter to be approximately 0.75 m above the surrounding tidal mud. We found the elevation to be much lower relative to the surrounding surfaces. While some sediment build-up in the mangrove area might have occurred since his field study done 15 years ago, it is more likely that this discrepancy represents the same map interpretation problem noted above in

which Brulotte reports a size more than double the actual measured dimensions of Feature 1. The maximum measured height of Feature 2 in the N-S cross-section is 1.0 m above the surrounding tidal mud (compared to the previously stated total of 2.25m).

The construction of the visible architecture is predominantly cobbles and small boulders of 30 to 40 cm by 50 cm size and there are many short columnar rock pieces in the construction. These are in general larger and are strategically placed to highlight edges and corners as is typical with later Pohnpeian status architecture. The observed columns appear to be made of rock from the Ipwal cliff exposure on the adjacent point, that is, they are somewhat irregular in longitudinal facets (a somewhat rippled effect) and are small, mostly 30-40 cm in diameter and less than a meter in length.

Subfeature 2a refers to the north wall of the higher platform at the site. This is presently obscured by a mangrove tree growing right at the wall alignment. However, both ends of the platform north wall are clearly defined.

Subfeature 2b refers to the west wall of the platform.

Subfeature 2c identifies the south wall of the platform. A tree has disturbed part of the southwest corner.

Subfeature 2d is the complex, probably damaged east wall of the upper platform. This might be considered the front of the platform and it is possible that a step was built into this portion. Alternatively, the rock array may represent removal of cobbles for construction elsewhere, for example, site feature S4-2, the stone walkway, which is only 7.5 m to the east of platform S4-1.

Subfeature 2e refers to two arrangements of stone columns on the surface of Feature 2. On the south side, four columns 30 cm wide and 60 to 70 cm long were placed side by side in an east-west alignment (see Fig. IV-2). On the north side and positioned parallel to those lying just 30 to 40 cm to the south, are three or four columns of similar size positioned near the western side of the platform. A rough depression of 15 to 20 cm lies just east of this alignment. To determine the significance of these features would require additional research, probably excavation; this kind of feature may indicate a subsurface burial location.

Dating of Site PoS4-1

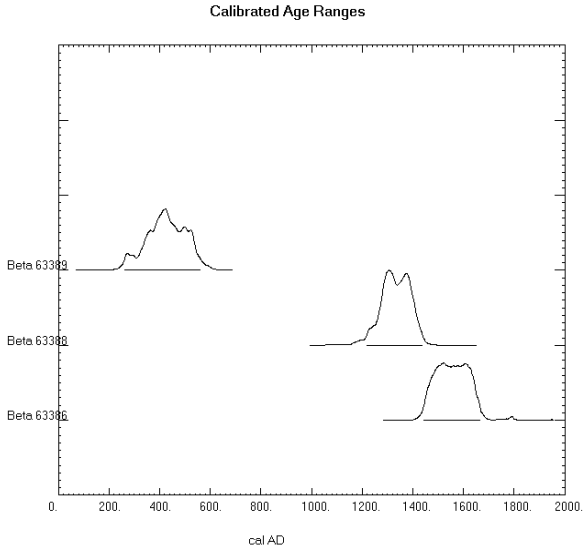
A critical aspect of determining the age and significance of Site PoS4-1 is the depth of the stone foundation and the building materials and their placement used in construction. Brulotte (n.d./1993:19-20) derived some evidence for this from his excavations in the site area and these are important to review here. First of all, Brulotte placed a test unit at the NE corner of the lower platform (his Fea 1; Site PoS4-1, Feature 1, here). This was 50 cm square and penetrated the mangrove swamp deposit and the underlying coral, shell, and sand deposit that predates the mangrove development. The small size of the unit means that clearly establishing the foundation line of Feature 1 might be difficult; however, Brulotte states that the foundation was evident in the form of boulder concentrations and its depth corresponds to a transition in sediments recognized in a large sample of test units in the mangrove area to the east of SiteS4-1. Three radiocarbon dates are pertinent for the issue of the age of Feature 1 (Fig. IV-2):

1) one of these is approximately 500 to 600 years old (550 +/- 70 BP; Beta 63386; uncalibrated) and comes from a depth of 40-60 cm (Brulotte n.d./1993:19). This is somewhat above the level of the structural base, however.

2) A sample from Test unit 6a/b (in Site PoS4-5 as designated here) located approximately 20 m to the SE, also provided a date for the basal coral, shell deposit at a depth of 120-140 cm bs—part of an ancient fringing reef flat—that falls into the range of 1800 BP +/- 60 (Beta 63389, uncalibrated; Brulotte n.d./1993:27, 31).

3) A second date (Beta 63388) from Unit 6 at 100-200 (sic; Brulotte probably meant to indicate 100-120 cm) was 850 +/-80 BP (uncalibrated). A red ware sherd and a tridacna ring band fragment were found at this level as well.

a.



b.

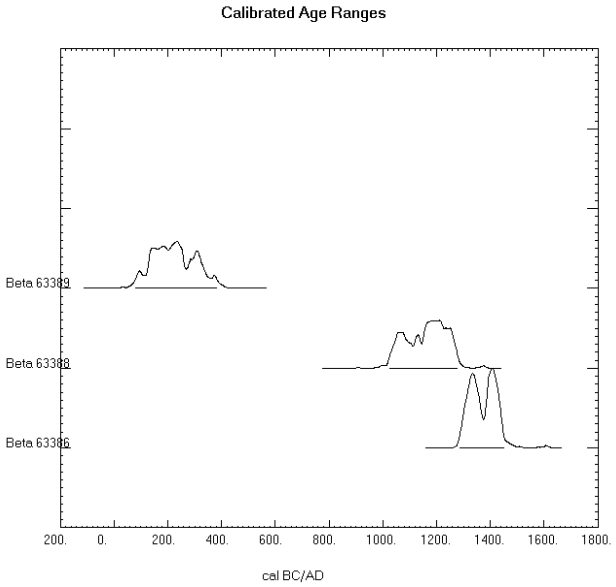


Figure IV-2. (a). Plot of three radiocarbon readings from Ipwal showing distribution of age estimates at two standard deviation (2 sigma). This plot is calibrated based on the Mixed Marine Curve and so the readings are somewhat more recent than those in (b) below, which uses the INTCAL04 standard, non-marine calibration curve. Note that graph time scale axes are different and show that the marine correction (a) provides readings of approximately 200 years later than (b). Radiocarbon data are from Brulotte (n.d./1993: appendix) and calibrations are from the CALIB program (Stuiver, Reimer, et al. 2004).

Considering the depths of materials recovered from Brulotte's Test Unit 6a/b may be informative for resolving issues about dating the overall settlement at Ipwal. A summary of his excavation information about the earliest cultural context is presented in Fig. IV-3, below (note: based on Brulotte n.d./1993:19, 24).

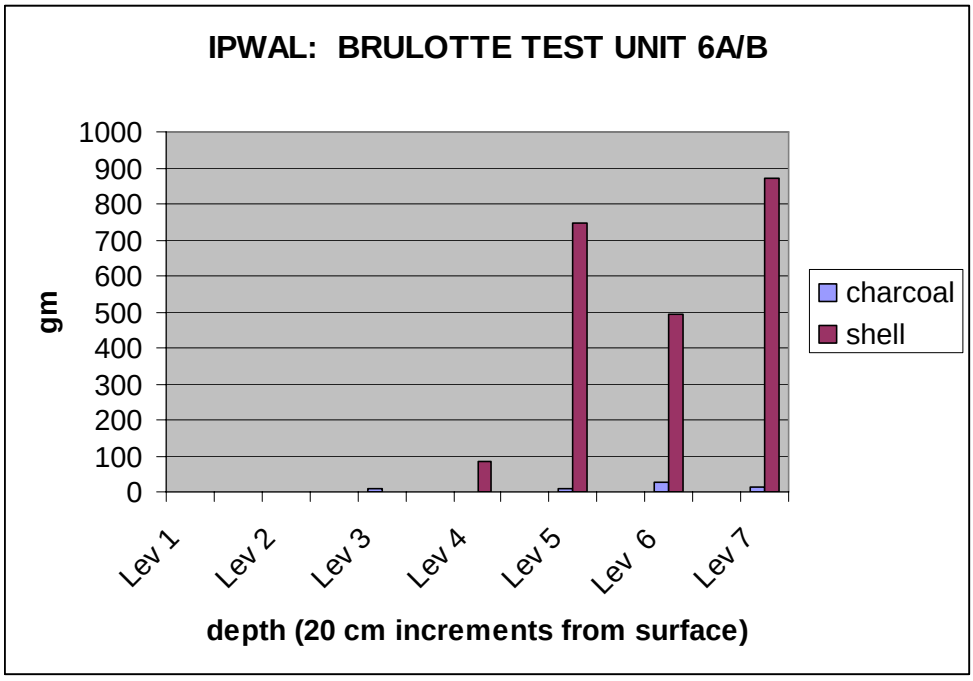


Figure IV-3. Charcoal and marine shell distributions in Brulotte's Test Unit 6a/b, PoS4-5, Ipwal, Sokehs, Pohnpei (based on Brulotte n.d./1993:19, 24).

The concentration of charcoal and marine shellfish (both weights in grams) within the excavation units (20 cm depth each) shows the association of human (and natural) deposits with the pre-mangrove coral lagoon environment. It is unclear how much of the shellfish is part of a natural deposit and how much of it might represent food remains, but the charcoal is clearly a human byproduct from use of the area and the adjacent shoreline. Given the concentrations, a major part of the shellfish is undoubtedly food remains; however, Brulotte did not

distinguish these in his analysis nor did he identify shellfish of the types usually consumed as food in the tropical Pacific. The charcoal was first recorded in level 3 (40-60 cm depth) and it increases towards the lower levels. The same applies to the marine shellfish, especially below 80 to 100 cm depth in this unit. This probably represents an ancient marine surface that later became covered with expanding mangrove sediments (*naniak* soil type) as the coastal environment changed here. Two artifacts, a pot sherd and a shell ring/band were found by Brulotte in this context and suggest a specific coastal occupation.

Galipaud, as represented in a report submitted to the Pohnpei Historic Preservation Office (n.d./2000), found additional pottery and produced several radiocarbon dates from three units excavated inland from Site PoS4-1. These are located approximately 20 to 80 m to the west of Brulotte's test unit 6a/b and showed a pattern similar to that identified earlier by Brulotte, including a range of radiocarbon readings that match those developed by Brulotte: Test Unit 3 at 30 cm: 960 +/- 110 (Beta 135130; at 95 cm: 1150 +/- 40 (Beta 135131); and at 130 cm depth: 1720 +/- 70 (Beta 135132) radiocarbon years.

At this point, then, the actual age of the stone platform of Site PoS4-1 remains unclear. Brulotte's concludes that it dates to before the 550 BP radiocarbon reading recovered from a sample at the 40-60 cm depth and that it was possibly as early as the 1200 BP reading. He indirectly links it (n.d./1993) to the reading of 1800 BP, but this is not clearly supported at present.

Site PoS4-2 (Brulotte's "Feature 2")

A path made of boulders and cobbles extends across the mangrove swamp from the shoreline of the main island (Ipwal) to the shore of Doletik Island. This is located approximately 8 m E of Site PoS4-1. The dimensions of the walkway vary, but it is approximately 1.5 m wide and stands some 15 to 20 cm above the surrounding tidal mud. The paving or step-stones are 25 to 40 cm

in size and the entire structure is quite stable. According to Brulotte's map the walkway is 70 m long and is located 7.5 m E of Site PoS4-1. The path is oriented directly N-S.

Site PoS4-3 (Brulotte's "Feature 3")

A small pile of stones forming a roughly rectangular platform is located out in the mangrove swamp (*naniak*) to the west of Site PoS4-1. This looks like a household feature rather than a ritual structure, but we don't have much other than size to go on. It is a disturbed rectangular—almost square—low paved platform (Pohnpeian: *ketipar*). It is located approximately 50 m away from the SW corner of S4-1 at a bearing of 275 degrees.

The stonework includes some columnar rock in short segments of the type characteristic of the Ipwal cliff exposure. No imported stone was evident. The rock consists of mostly cobbles rather than boulder-size rocks. Site PoS4-1 has more boulders in its construction. No surface artifacts were observed in association with the platform, S4-3.

Site PoS4-4 (Brulotte's "*lolong*.")

We can use this site designation to refer to the *lolong* (tomb) which is now buried beneath the current gravel road. Brulotte (n.d./1993:18) refers to this tomb or "*lolong*," but does not assign it an actual feature number. We think it would be worthwhile to use a number because this is a very important site type. Several local residents, including Soulik en Ipwal, have identified the general location of the structure and it is worth keeping track of that information and the complex of architecture than can represent the overall set of sites (PoS4-1 through 4). Some described it as long, low and tunnel-like, perhaps referring to the original entryway into the main chamber.

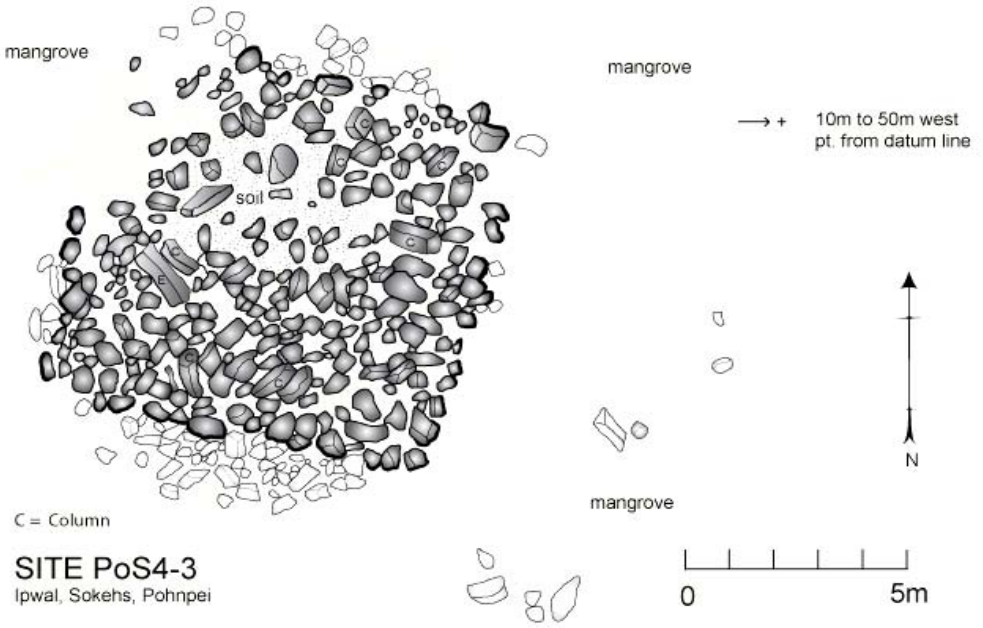


Figure IV-4. Plan of stone foundation, PoS4-3, Ipwal, Sokehs. This low foundation of cobbles and small boulders forms a discrete, isolated architectural unit located in the mangrove-covered tidal flat. (map augmented from Brulotte n.d./1993). [drafting: w. ayres, j. kennan, d. balmforth]

Overall Ipwal Site Interpretations

The site boundaries are still undefined because the testing by both Brulotte and by Galipaud fail to connect the early pottery deposits in the area, which represent the earliest occupational evidence, with the architecture. Presumably the pottery is considerably earlier, but the architecture itself cannot be directly dated based on present evidence. This is an important point, but the only evidence related directly to this question comes from Brulotte's report in which he discusses the test excavation units.

Site PoS4-1, Nan Mwoluhsei en Ipwal, appears to be the foundation for a ritual structure with an original wooden superstructure; based on ethnographic

evidence from Pohnpei, this may have been of *tehnpas* form, an elongated building with multiple sets of supporting house posts on either side. It has the structural features, in general, of the historically-known Pohnpeian *nahs* (Fig. IV-5, and see Fig. V-1).

Soulik en Ipwal reports that a structure showing columnar rock is located out to the NW of the platforms PoS4-1 and 3 in the mangrove; this is at the edge of the recent open lagoon. This structure was also referred to “Nan Mwoluhsei,” and so the larger area might have been identified with this term in the past.

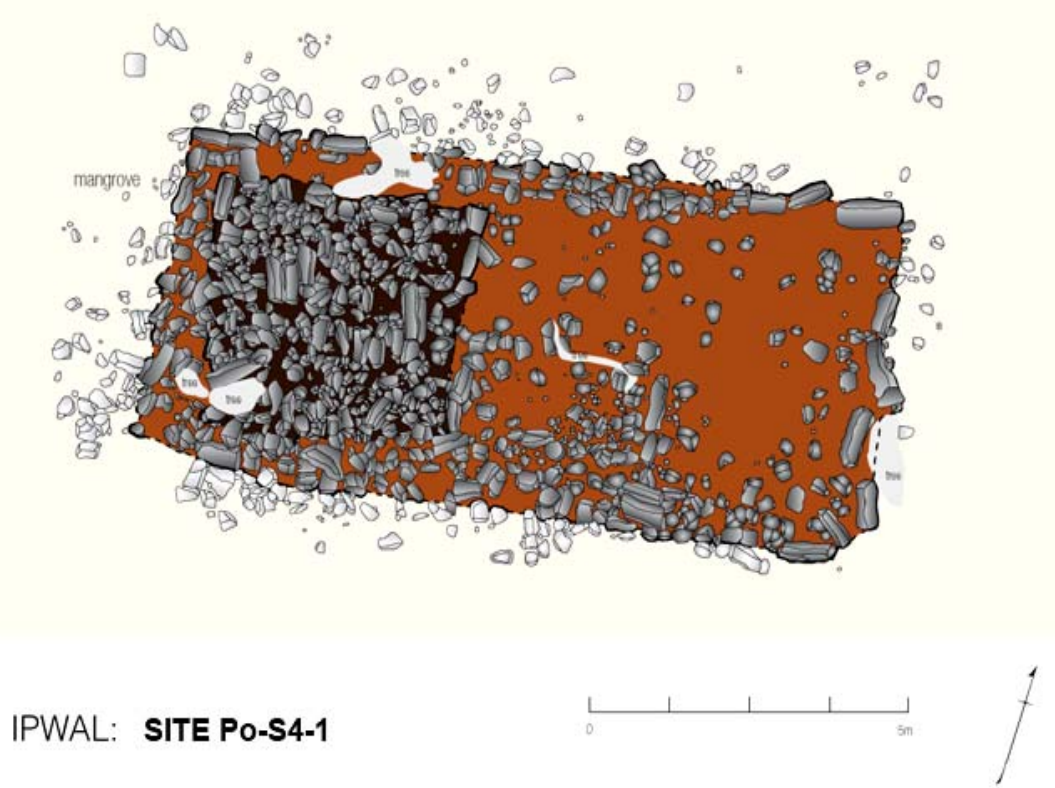


Figure IV-5. Rendered plan of site structure PoS4-1, Ipwal, Sokehs, Pohnpei. The darkened area shows the upper platform of this ritual structure, which is located in the mangrove-covered tidal flat near the Ipwal shoreline (after R. Brulotte n.d./1993 and re-drafted). [drafting: w. ayres, j. keenan, d. balmouth]

Significance of the Ipwal Site Complex

The architectural remains from Ipwal described above form a significant set of archaeological sites representing Pohnpei's cultural heritage. The proposed early age of PoS4-1 and adjacent shoreline occupation (Brulotte n.d./1993), if confirmed, and the architectural details reflecting an early *pehi* or perhaps *nahs* form where *sakau* was used make it of special significance.

An important comparison with the materials buried beneath the present mangrove swamp area of Ipwal can be made with the deeply buried deposits found at Nan Madol, for example, inland and beneath such islets as Dauahdpeidak, where Ayres and colleagues found extensive shellfish food remains, pottery, shell tools and ornaments, and other cultural remains dating to nearly 2000 years ago. Brulotte's data suggest a possible early coastal lagoon cultural deposit of nearly the same time period in the Ipwal area.

Proposed Further Research at Ipwal

Given that we know now that a broad time period of the prehistoric record of Pohnpei's settlement is preserved along the coast near Ipwal point, it would be valuable to finish the mapping and site recording process here and to do additional excavations designed to recover a more complete settlement and material culture record.

V. Early Temwen Food Production Systems

M. Levin and W. Ayres

Nan Madol and Early Food Production on Pohnpei

In agricultural systems relying on root and tree crop staples, evidence of prehistoric food production is often indirect and limited. Root and tree crops are not often preserved through charring in fire in the way that cereal crops sometimes are, and it is rare to find either desiccated or waterlogged remains. Macroscopic remains that are preserved are usually distorted and unquantifiable. Thus, studies of microscopic remains of root and tree crops, notably pollen, phytoliths, and starch, have become more common in recent years. They have proven to be helpful in providing direct evidence of plant use and cultivation in the Pacific and Southeast Asia (e.g., Hather 1992, 1996; Horrocks 2005, Hill and Evans 1989). This portion of the project aims to study cultivated plant use on Pohnpei, particularly from the Temwen and Nan Madol area. Using survey data and information from microremains in collected samples, we aim to better understand both the subsistence and prestige economies at Nan Madol. During the course of the fieldwork, we documented one breadfruit pit and collected surface and subsurface sediment samples. In addition, we documented and took samples for starch analysis from three archaeological *sakau* stones, two at Nan Madol and one at the Ipwal Quarry Site. We also documented and took starch samples from a modern *sakau* stone.

Previous Research on Subsistence at Nan Madol

Only a few previous studies have specifically addressed subsistence activities at Nan Madol, and these studies deal almost exclusively with faunal remains (Kataoka n.d., 1985; Ayres et al. n.d.). However, Haun (1984) and Ayres and Haun (1985, 1990, 1992) have conducted extensive research on

prehistoric subsistence on Pohnpei. Based on intensive survey, pollen cores, radiocarbon dates, oral history, and ethnohistory, they created a timeline for the development of agriculture on Pohnpei. From A.D.1000-1826, approximately the time Nan Madol was occupied, agricultural production was intensified beyond basic necessity. This is due to the development of the prestige economy (Haun 1984:250), which is associated with redistribution and political and religious ceremony. In these political and religious ceremonies, several types of agricultural produce play a large symbolic role. Breadfruit (*Artocarpus altilis*) that has been stored and fermented in pits, and *sakau*/kava (*Piper methysticum*), the two main components of this study, are both important crops in this prestige economy. Most of the data associated with prehistoric food production, however, comes from other parts of the island, notably Awak and Wene. No food storage or production has been found at Nan Madol itself.

Ethnographic studies on Pohnpeian agriculture are somewhat more common. Petersen's early study (1977) addressed the prestige economy, emphasizing the feast as playing an important role traditionally. Yams and kava are especially important crops within this economy. Ragone's (2002) study on Pacific breadfruit storage and preparation focuses on Pohnpei. She also stresses feasting, discussing the importance of *mahr* (fermented breadfruit paste) as a prestige food. The older the *mahr*, the more prestigious it becomes; it is left to ferment in breadfruit pits (*kahlipw*) for years, or even decades. As Nan Madol was the residence of Pohnpei's ruling elite, the prestige economy is especially relevant in this area of the island.

Botanical Information

Breadfruit (*Artocarpus altilis*)

Artocarpus altilis, or breadfruit, is a domesticated tree species native to the western Pacific. It is present throughout much of the Pacific and Southeast Asia, including all of Micronesia. There are approximately 70 varieties used in

Micronesia, distinguished by many qualities such as leaf shape, fruit shape and size, and presence or absence of seeds. It is one of the most important parts of the traditional subsistence economy on Pohnpei. The fruit is used as food, and the latex it produces is used as canoe caulking. Fruits are pear shaped and generally weigh around three pounds when mature. Breadfruit is a dietary staple, and like most staples, is high in starch. There are many methods of preparation, including fermentation in pits, cooking, boiling, or roasting (Sproat 1968).

Kava (*Piper methysticum*)

Kava, known as *sakau* on Pohnpei, is a vegetatively propagated domesticated shrub. It most likely has Southeast Asian origins and it was and is used widely across the Pacific. Kava root is a mild psychoactive drug that has a variety of effects. On Pohnpei, the root is pounded on large basalt stones, mixed with water, and consumed as a drink. Due to the fact that the root is over 60% starch (Lebot et al. 1992:12), it is possible that starch grains have been preserved on stones used for pounding *sakau* on Pohnpei.

Breadfruit Pit

We photo-documented, mapped, and excavated a prehistoric breadfruit pit (PoC3-10) on the land of Masao Silbanuz on Temwen Island. This is the second project on Pohnpei in which breadfruit pits have been studied. The first was in 1979, with excavations by Alan Haun at two pits in Wene (PoD5-11 and PoD11-9). Other field records of food storage were developed in the Awak survey (Ayres et al. 1980, 1981).

The Temwen pit complex is approximately 5.5m x 6m, and consists of three depressions of approximately 60cm to 90cm deep and spaced in a roughly triangular formation within an outcropping of boulders. Rock alignments encircle each depression (Fig. V-1). Other architectural sites are located nearby,

including *lolong* and other stone constructions, but their relationship has yet to be studied.

Figure V-1. View of Temwen site PoC3-10, showing pit features F1-F3 and enclosing cobbles and boulders. The depression was tested with a small trench excavation to recover stratigraphic evidence and possible plant macro- and micro-fossil material. This site lies on the east slope of Temwen Island, approximately 0.2 km inland from Nan Madol, Madolenihmw Municipality, Pohnpei. [photo: k. seikel, m, levin]

Methods

We cleared the feature and took pre- and post-clearing photographs in black and white and in color digital. We then mapped the entire feature at a 1:50 scale and drew two cross-sections. We put a 75cm x 2.5m trench through the largest of the depressions, digging through soil both outside and inside the rock

perimeter alignment. Soil in small samples of approximately 30-45ml (2-3 tablespoons) each, intended for microfossil analysis, was taken every 10cm. Three 1-liter size samples were taken; one at 50-60cm outside the rock alignment, one at 90-100cm outside the rock alignment, and one at 100-134cm inside the rock alignment. Charcoal was also found at 11-20cm and 21-30cm in the area outside the rock alignment and was associated with burnt soil and rock in lower layers. It is unclear whether we can draw an association between the charcoal and use of the breadfruit pit. The subsoil in the pit interior is located at 134cm below the outside soil surface. After reaching the subsoil and completing sample collection, we drew soil profiles of the west and north sides of the pit at a 1:50 scale (see Fig V-3).

Results and Discussion

Further lab analysis will be necessary to develop data on the archaeobotanical remains at the pit. However, some preliminary statements can be made. While there is little stratigraphy at the site and most differences are subtle, the largest stratigraphic difference is between the soil outside the center of the depression, and the soil inside in the center of the depression. The outer soil is a reddish brown (4.25-4.5/6), and the inner soil is a blackish brown (2.5/1), suggesting both a high organic content in the interior as well as significant sediment disturbance. Thus, breadfruit would have been fermented in this inner portion. Masao Silbanuz, the landowner, said that it was a large breadfruit pit and could store a few thousand pieces of fruit.

We will be able to conduct AMS dating on the charcoal fragments in 11-20 and 21-30cm. The charcoal and burnt soil is clearly indicative of some kind of burning in the area, and may be associated with clearing of land to construct the breadfruit pit.

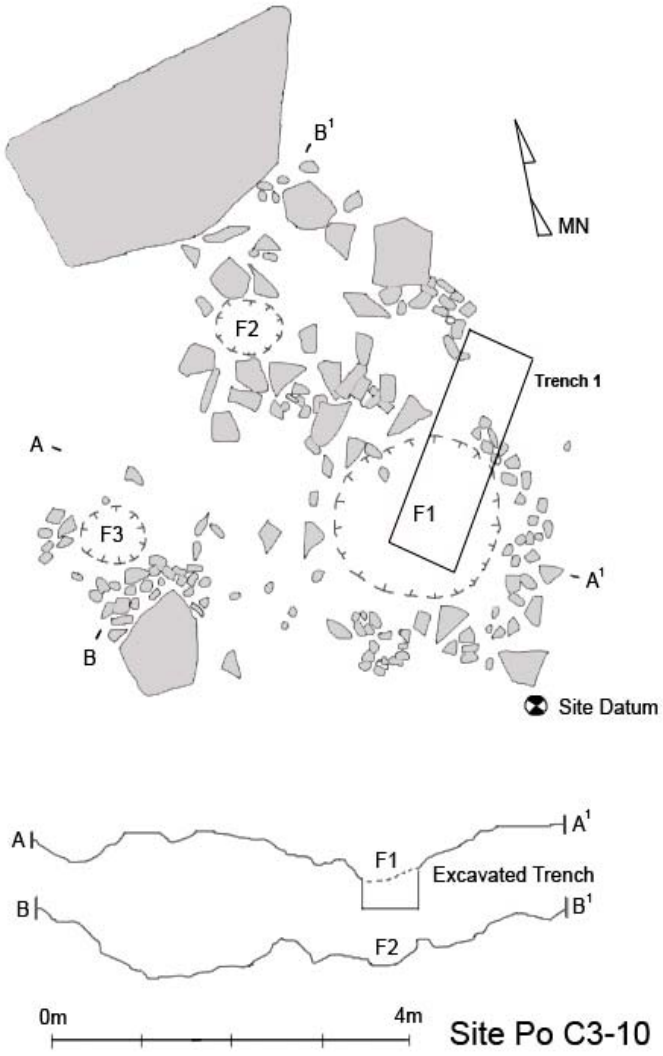


Figure V-2. Plan of Temwen site PoC3-10, showing Features 1-3 and the configuration of cobbles and boulders ringing the area and the individual pits. Trench 1 intersects pit Feature 1 of the storage complex. [drafting: m. levin, w. s. ayres]

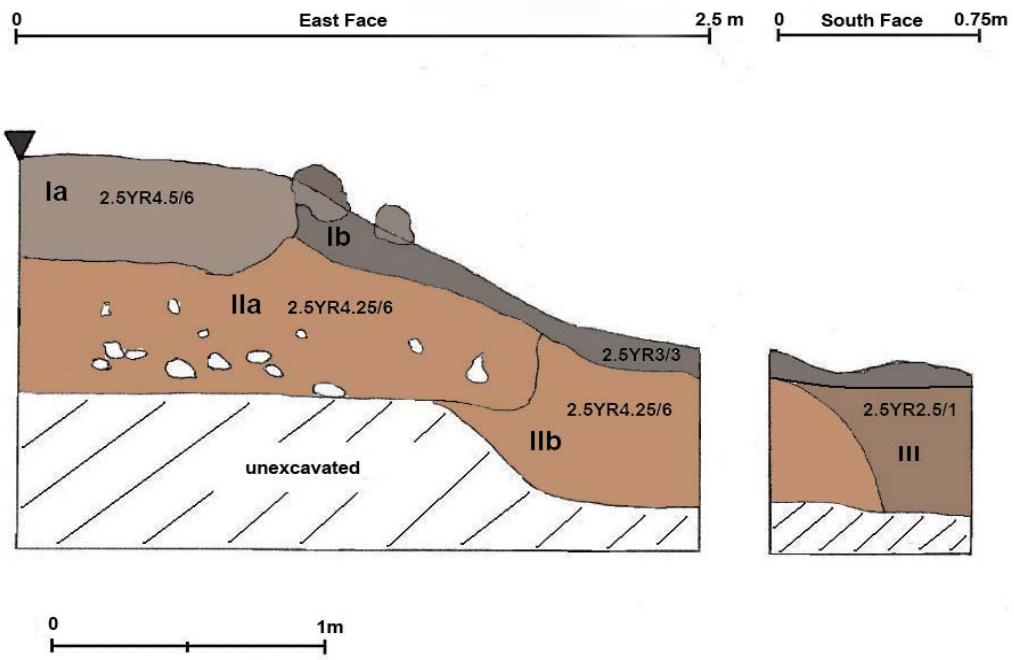


Figure V-3. Profile of Trench 1, Temwen site PoC3-10, showing the main pit feature and the pit spoil for Feature 1. [drafting: m. levin, k seikel, w. ayres]

No plant macrofossils were visible during excavation. This would be expected, as the probability of plant macrofossil survival in a breadfruit pit would be low. However, further laboratory investigation is planned. Samples will be examined for microfossils, primarily phytoliths and starch grains. This should inform us about pit use, both taxa that were stored in the pit and intensity of activity. No other cultural materials, such as artifacts, were discovered as a result of surface survey or the excavation.

There are a few notable differences in construction between these breadfruit pits and those previously excavated. The overall plan and size are different; while the Temwen pit consisted of three depressions very close together, Site PoD11-9 in Wene had only two depressions spaced approximately 6 meters apart, and PoD5-11 had only one large depression. Both Wene pits were considerably larger than the Temwen pit as well. The largest pit at Po11-9

measured 16.4m x 4.4m and Po5-11 measured 17.0m x 6.0m (Haun 1984). Haun states that modern pits are considerably smaller than these pits, averaging around 1.0m x 0.5m. He concludes that this is due to a decline in the need for preservation of surplus as well as a decline of *mahr* use in the prestige economy. If the decline was gradual over time, this would place the Temwen breadfruit pits as being considerably newer than the Wene pits, fitting in with the hypothesis that they were used to support Nan Madol. However, it could also indicate differences in breadfruit pit construction throughout the island. More prehistoric pits would need to be excavated and dated to test this hypothesis.

Sediment layers seem to follow a similar pattern in this pit compared to those in the Haun excavations. Both the Temwen pit and Wene pits show abrupt changes in sediment color near the bottom of each depression. This shows chemical changes that are indicative of human use as well as significant sediment disturbance.

Sakau Stones

The *sakau* stone portion of the project examines the use of *sakau* stones at ceremonial sites on Pohnpei (in Nan Madol and at the Ipwal Quarry Site). We photo-documented, drew, and took surface samples from four *sakau* stones: two on Nan Madol (both on Lukepenkarian Islet), one at the Ipwal Quarry Site, and one recently used modern sakau stone belonging to Masao Silbanuz as a control sample (Fig. V-2). All *sakau* stones are basalt. This was an experimental project, as no previous attempts have been made to recover plant microremains from *sakau* stones. However, starch remains have been recovered from sediments in many other sites in the Asia/Pacific region (e.g. Horrocks 2005; Horrocks et al. 2007). We will also search for other plant microremains, notably phytoliths.

Methods to Investigate *sakau* Stones

We started the process by drawing each *sakau* stone at either a 1:5 or 1:10 scale, depending on the size of the stone, taking note of the major crevices in the rock. Using a medicine dispenser as a pipette, we then took two water-solution samples from each stone. The following is the procedure we used to take samples:

1. Clean medicine dispenser with distilled water
2. Using medicine dispenser, squirt small amount of distilled water on *sakau* stone in crevice or other region where there may be starch residue/phytoliths
3. Retrieve water with medicine dispenser after a second or two
4. Put sample (water and any materials that may have been picked up by the water, including microfossils) into separate sealed plastic container and store in cool location
5. Clean equipment with distilled water again for reuse.

After taking samples, we indicated on each drawing the locations from which we took the samples, labeling bottles and their respective locations on the stone "Sample 1" and "Sample 2" and the site name.

Results and Discussion

Lab analysis will determine if this project was effective in recovering starch grains and phytoliths from the *sakau* stones. However, we can make a few notes about procedure that may affect the results, and we can refine the procedure for future applications. First, micropipettes are generally recommended for removing starch grains from stone tools. As we were unable to obtain micropipettes, we used infant medicine dispensers. This made it more difficult to be precise about placement of water. However, as *sakau* stones are much larger than most stone tools, this may or may not be important. Second, all of the archaeological *sakau* stones appeared to be highly weathered. Given the high rainfall in the area, over time the rain may have removed any remaining microremains on the surface of the rock. A way to counteract this in taking additional samples may be to scrape

the surface of the rock and take samples from locations that are superficially below the surface.

The control sample, which was from a *sakau* stone that had been used the previous day and stored in a dry location, will indicate if this procedure has the potential to be effective.

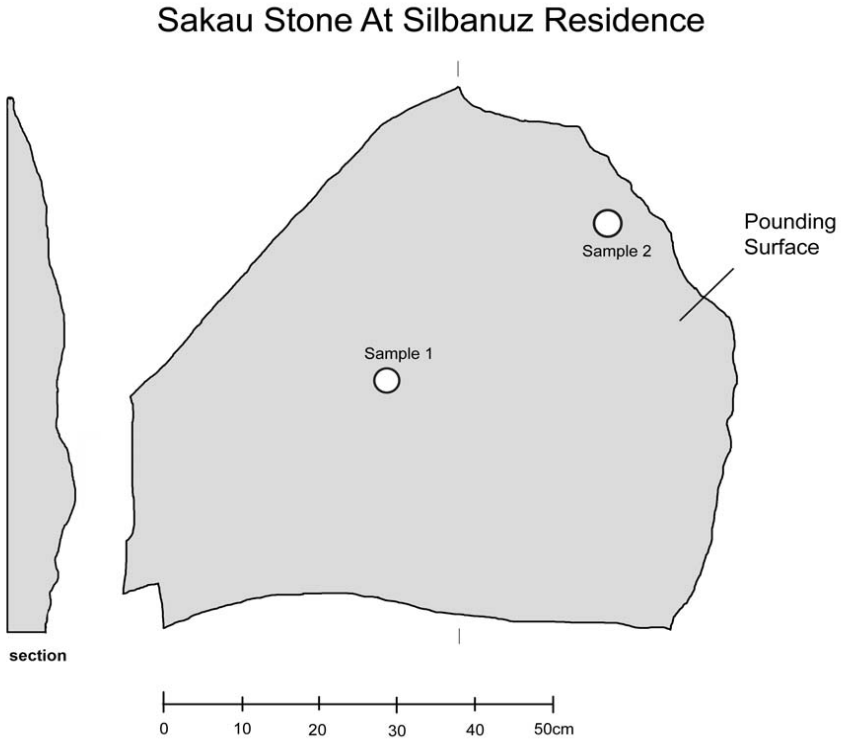


Figure V-4. *Sakau* (kava) stone sampled for phytolith and starch grains, Silbanuz household, Temwen, Madolenihmw, Pohnpei. Sample locations are indicated. [drawing m. levin, w. ayres, d. ;balmforth]

Thus far, we have the following analysis and results to report. One to two drops of liquid from each sample were mounted on separate slides and a 50% glycerol jelly solution was added for mounting. Slides were viewed and photographed under 400x optical magnification. Both of the control samples from the Silbanuz family sakau stone contained clusters of starch grains, in addition to kava root fibers. None of the archaeological sakau stones contained

starch grains similar in appearance; they did contain phytoliths, but given the vegetation in both Nan Madol and at Ipwal, these are overwhelmingly likely modern contaminants. The presence of starch in the control samples, however, is promising for future results. They demonstrate that more precise sampling and refined methodology will likely allow for the retrieval of starches from archaeological sakau stones in future studies. They also provide modern botanical reference material for these future studies.

Conclusions about Food Production

The breadfruit pit and *sakau* stone samples both provide new evidence related to early food production and use in the Pacific, particularly to ceremonial use of agricultural produce. The *sakau* stones are associated directly with the use of Nan Madol and the Ipwal structures and the ritual functions that these served. While we pose as a hypothesis that the pits in Site PoC3-10 was likely used for breadfruit starch storage that contributed to the subsistence and prestige economy on Nan Madol, we first must confirm that breadfruit was actually stored in the pit, and that it was contemporaneous with the use of Nan Madol. While stratigraphy and comparison with the Wene pits point to this conclusion, further analysis will be helpful. There may also be some significance to the three individual depressions in the pit; it is possible that each depression was used to store breadfruit for a different purpose. Examining this hypothesis, however, will require sampling from the other two depressions as well. Further comparison to the sediment samples Haun collected from the breadfruit pits in Wene with these samples may also prove useful for understanding prehistoric breadfruit pit use throughout the island. In the future, photographing, drawing, and excavating a modern breadfruit pit would provide a good control baseline to understand the extent of the data we may be able to gather from breadfruit pit excavation.

Most paleoethnobotanical research focuses on subsistence foods. While breadfruit is a major staple on the island and breadfruit paste (*mahr*) plays a role in both the subsistence and prestige economies, kava is decidedly ceremonial

and thus not a part of the basic subsistence economy. Thus, anything we may be able to learn from analyzing the *sakau* stone samples will give new insights into prehistoric ceremony, as the *sakau* stones at ANG-KAR were both located near tombs (*lolong)*. Both the *sakau* stones and breadfruit pits may provide information about feasting and other rituals on the islets.

Although lab analysis will provide greater detail, more field work needs to be done in order to fully understand the prestige economy of prehistoric Pohnpei. In addition to a control breadfruit pit, more archaeological breadfruit pits should be excavated to add to the available data. Furthermore, more in-depth discussions with people on Pohnpei who know about and use breadfruit pits should be helpful. *Sakau* stone sampling, if it proves to be effective, should be done with more specialized equipment, and more samples should be collected. It would also be helpful to map and sample other features associated with crop cultivation/storage and animal husbandry, particularly on Temwen. Because Temwen Island is adjacent to Nan Madol, we pose as a hypothesis that much of the food production associated with Nan Madol took place on Temwen. The samples and drawings from this field season, however, provide a good basis for further investigation.

VI. Results, Conclusions and Recommendations

W. Ayres, K. Seikel, and M. Levin

Overview

Mapping and documentation of early archaeological sites at Nan Madol and other areas of Pohnpei was accomplished in this project. The focus was on recording and conserving places with stone remains because of their visibility and their importance to the Pohnpeian community as well as to archaeologists and heritage conservation planners. The research conducted in the Ipwal area, Sokehs, and at selected structures on Temwen Island, adjacent to Nan Madol, provides improved perspective for other areas linked through oral history to Nan Madol and to general questions about early food production for the island. The documentation of these sites is essential for understanding the material remains of the past, and locating them and mapping them is an integral step in the ongoing discussion about how they should be protected and conserved. Ancient chiefly ritual sites, agricultural features, and historic sites were examined and mapped in this project. The distributions of observed artifact and faunal remains provide evidence related to dating, site usage, and early Pohnpeian diet. The project contributes to preservation of Pohnpei's archaeological past.

We examined stone structures, including primary burial structures (*lolong* in Pohnpeian) at Nan Madol, and related artifact and feature information and other evidence related to a relative chronology of early mortuary practices. Stone constructions and portable artifacts, such as *sakau (*kava*)* stones and other tools that are associated with *lolong,* provide opportunities to evaluate the full range of burial practices. Mortuary places are valuable sites of cultural heritage, and should be protected. Such funerary constructions in the Pacific have provided valuable evidence for cross-cultural comparison, and this provides a significant contribution to better understanding early Pohnpeian culture.

Locating and mapping archaeological sites, such as *lolong* and other burial structures, throughout Pohnpei enables better conservation, and the first step in this is site documentation.

Site Remains and Field Studies

Nan Madol Central, Madolenihmw

The survey of Lukepenkarian, Sapwuhtik B and Angeir islet sections in the main seawall of the Nan Madol complex (PoC3-1) identified 15 features, most consisting of multiple structures, built of combinations of coral rubble and basalt rock. We documented a range of platforms, alignments, burial structures and other types of architecture. These permit us to make comparisons among building phases and mortuary practices at these sites. The tombs built into the seawall islets at Nan Madol (ranging from Lukepenkarian to Pahnwi) are distinctive compared to the same structures in more inland islets and on the main island because they have extensive coral rubble used in constructing the enclosing walls. Even the foundations of the main tomb chambers are of coral in the seawall islets. Of the *lolong* studied here, the SWUB tomb (Fea. 1) has the most columnar basalt used in construction, in this case primarily in the enclosing wall. In other structures, basalt columns are used in varying, but limited, quantities to form parts of the main tomb chamber, sometimes enclosing-wall corners, and entryways; this is well-represented in the newly-recorded main *lolong* on Lukepenkarian (Fea. 2).

Seven of the structural features are on Lukepenkarian, one is on Sapwuhtik B and seven are on Angeir. A third of these structures originally had a mortuary function, while the majority of the remaining ones could be identified only as “platforms.” We were able to improve the record of artifactual and structural attributes of ritual structures found at Nan Madol and elsewhere on Pohnpei. As well, clarification of the boundaries for the named places and

individual islets forming the seawall resulted from the field study, and the map details represent a substantial contribution to documenting the archaeological remains at Nan Madol.

These sites in the seawall section are especially prone to disturbance by tourists hunting for artifacts and structural deterioration from coral deterioration and other architectural collapse and so complete recording is essential. Substantial disturbance of archaeological features was noted.

Ipwal, Sokehs

The Pohnpei Historic Preservation Office was interested in possible encroachment of the Ipwal rock quarry activities on stone platforms and other sites west of the quarry activities. It was learned that the archaeological values for two sites at Ipwal, designated PoS4-1 and 2, have been affected through loss of landscape setting; also, the early site PoS4-6 has been covered by quarry debris. Early work by R. Brulotte on the Ipwal site cluster provides some detail about individual structures and also evidence of suggested early occupation of a marine shoreline at this location, now a mangrove tidal swamp. Radiocarbon dates in the 1500-2000 calibrated BP range make the occupation of this area of special significance for comparisons with early remains from Nan Madol and for understanding Pohnpei's Peinais Phase (Ayres 1990) and early colonization period. Materials buried beneath the present mangrove swamp area of Ipwal can be compared with the deeply buried deposits found at Nan Madol, for example, inland and beneath such islets as Dauahdpeidak, where Ayres and colleagues found extensive shellfish food remains, pottery, shell tools and ornaments, and other cultural remains dating to nearly 2000 years ago. Brulotte's data suggest a possible early coastal lagoon cultural deposit of nearly the same time period located in the Ipwal area.

Temwen Survey, Madolenihmw

Continuous efforts are being made to survey selected land areas of Temwen Island, adjacent to the Nan Madol Central area, and we undertook a preliminary study of agriculturally-related sites on a strip of land extending back from Nan Madol towards the interior of Temwen. A significant aspect of this research is the conservation of traditional knowledge of botanical and other subsistence resources for Pohnpei (see also, Ragone 2002).

The sample study of a breadfruit pit (*kahlipw;* site PoC3-10) provided details of the structure of breadfruit storage pits, some plant macrofossil remains in the form of charcoal, and likely microremains. No artifacts were found with this site feature, but some materials for dating were recovered and structural details enable comparisons with other food storage facilities in Pohnpei.

Preliminary analysis of samples taken from *sakau* stones provides evidence of starch grains in a modern control sample, but the archaeological stones showed no preserved starch grains. Suggested improvements in sampling methods may allow for their recovery, as the presence of starch in the control samples is promising for future results. Plant macrofossils are relatively rare in site deposits examined thus far on Pohnpei, but microscopic analysis is expected in the long run to provide quite specific identifications. In sum, the breadfruit pit and *sakau* stone samples both provide new evidence related to early food production and use in the Pacific, particularly to ceremonial use of agricultural produce.

Conservation Issues and Recommendations

This field studies for this project concentrated on archaeological remains, but some observations relevant to broader issues of site conservation were made. These need to be continued in a systematic way. For example, observations over time, on an annual basis, are beginning to provide some

documentation of structural change due to tidal inundation of inner Nan Madol islets (see Appendix D for proposals).

Natural Impacts

It is clear that tidal inundation, high wave action and vegetation growth have disturbed the islets and the structures they support since the time they were first being built. Islet rock fill and other structural remains have been increasingly exposed in the past two decades. This may reflect higher sea levels associated with global warming, but no systematic study has yet been completed to establish what impact this higher sea level is having on the Nan Madol site.

Wave action impacts on the ANG-KAR seawall area are represented by significant deflation of seaward coral rubble fill and removal of major basalt boulder constructions made with a range of cobbles and boulders weighing up to approximately ten tons. This erosion is a progressive process that requires active monitoring and active efforts to stabilize remaining wall constructions (see Appendix D).

Vegetation growth represents a complicated problem for conservation of Nan Madol site values from the perspective of archaeological information as well as physical preservation. Current vegetation does not reflect that present on the islets during their construction and use; root systems of plants growing in abandoned areas of Nan Madol have been disrupting wall alignments and pavements to that point that many are now barely recognizable. The impact of the developed mangrove ecosystem (see Fujimoto et al. 1995) is particularly problematic, but a number of other shore species pose similar problems. One major effect of islet clearing over the last several decades is the spread of introduced plant species, such as lantana (*Lantana spp*.), which as weeds limit access to many parts of the site. Cultivated plant species, including coconut, breadfruit, banana, pose additional problems for site use and conservation.

Structural Deterioration

The major cause of structural deterioration in the Nan Madol site, beyond a series of natural erosive factors, is gradual physical breakdown of coral rubble fill supporting basalt construction materials. This seems to be a combination of both the natural decay of the coral mineral composition, through freshwater leaching, thus weakening the structure of the rock, and the physical crushing of the coral material from the weight of construction materials. Rubble core fill walls and retained areas such as islet fills are gradually collapsing and the constructed features they support are gradually breaking down.

Human Impacts

Direct disturbance of the islet surfaces by visitors remains one of the major impacts on the archaeological resources represented by Nan Madol. This includes a range of activities from digging into the architecture, rock removal, breaking rocks, vegetation removal, making fires, and removing sand. Recent construction of walkways linking islets has had an impact on architectural stability of the original islet walls and has disturbed some archaeological data, such as the artifact distributions that appear on the islet surfaces.

Suggestions for long term site conservation and a plan for a pilot architectural preservation project are laid out in Appendix D of this report. Developing a better understanding of the on-going processes that have transformed and are still modifying the Nan Madol site from its original construction state to its present form will require a concerted effort over the next decades to conserve the site's archaeological, historic and cultural values.

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Appendices

Appendix A. The Site Numbering System for Pohnpei, FSM

The system that is used for archaeological and historic site numbering for Pohnpei provides a way to systematically record and add new sites to the Pohnpei State inventory. The numbering system is one applied generally within Micronesia and elsewhere in the Pacific Islands.

For distinct sites ranging from small, isolated stone constructions to large complexes of structures or other archaeological remains, the designation includes the island name (Po for Pohnpei in this case); the district or municipality (*wehi,* C for Madolenihmw for example); the section number (*kousapw,* a subunit of the wehi*)* designation representing the area where the site is located; and finally a sequential number series for sites as these are discovered and described (see Ayres and Mauricio 1997). *Kousapw* are numbered consecutively extending away, or down (*pah),* from Nan Madol within each *wehi* or District/Municipality, and like the *wehi* are traditionally important chiefly land divisions that remain important today. Nan Madol, for example, has been given the site designation PoC3-1, meaning: "Pohnpei, C for Madolenihmw, 3 for the Nan Wei *kousapw*, and site number 1. We tentatively assign site numbers here and these can be confirmed by the Pohnpei Historic Preservation Office.

Appendix B. Time Table and Research Effort

Project Schedule

The project was planned for a period covering approximately one month in July and August 2008. The overall sequence of planned field activities was as follows:

Week 1 Consultation with Historic Preservation Office staff and making local arrangements.

July 10-14:	Arrive, Consult with Historic Preservation Office, and Project logistical Planning.
July 15:	Survey at the Ipwal Site, PoS4-1.
July 16-17:	Meetings with HPO Board, the Nahnmwarki of Madoleniihmw, and Masao Silbanuz.

Week 2 Reconnaissance and beginning intensive survey.

July 18:	Ipwal.
July 19-20:	Arrive on Temwen and Project set up.

Week 3 Doing site definitions, field recording and mapping.

July 21-25:	Work at Nan Madol and on Temwen.
July 26-27:	Check in at HPO and picking up additional supplies.
July 28-Aug. 1:	Work at Nan Madol and on Temwen.
Aug. 2-3:	Work at HPO and double checking records.
Aug. 4-7:	Complete work at Nan Madol.

Week 4 Finishing field recording, consolidating field data, submitting field report to HPO office, and storing samples and equipment.

Aug. 8-10:	Finalize project details with HPO and Packing supplies and samples.

Remaining time, 2008-2009: Lab analysis, drafting, report writing.

Appendix C. Summary of Sites and Features Recorded

Summary Site Features Identified for ANGIER-KARIAN Islets

LUKEPENKARIAN ISLET (PoC3-1-LPK)

Feature 1 - Stone Alignment
- Sub-Feature 1: Partial square stone alignment~19 m W of Karian
- Sub-Feature 2: Square alignment that shares the W portion of SF1
- Sub-Feature 3: Small square alignment that shares the Southern portion of the W boundary of SF2
- Sub-Feature 4: Small paving just N of the NE corner of SF3
- Sub-Feature 5: 2 Sakau stones at NE end of the alignments

Feature 2 - Lolong
- Sub-Feature 1: Wall enclosing the area around the tomb chamber and adjacent area to the E of the tomb
- Sub-Feature 2: Burial platform
- Sub-Feature 3: Small enclosure adjacent to burial enclosure
- Sub-Feature 4: Probable original *lolong* entrance in the far Western wall
- Sub-Feature 5: Sakau stone at the N end of the enclosed area adjacent to the *lolong*

Feature 3 - Paving and Walkway
- Sub-Feature 1: Rectangular basalt paving ~15 m W of Feature 2
- Sub-Feature 2: Basalt walkway extending W of the paving

Feature 4 - Platform
- Coral platform with a slight depression in the center

Feature 5 - Platform
- Coral platform with basalt alignment at the NW corner

Feature 6 - Platform Complex Sub-Feature 1: Low coral platform outlined by basalt columns
- Sub-Feature 2: Raised basalt platform at the N end of SF1

Feature 7 – Platform; Coral

SAPWUHTIK B ISLET (PoC3-1-SWUB)

Feature 1 – Lolong
- Sub-Feature 1: Lolong enclosing wall
- Sub-Feature 2: Burial platform
- Sub-Feature 3: High coral and basalt platform built into the Northern portion of the enclosing wall
- Sub-Feature 4: Stone alignment in the Northern half of the enclosure
- Sub-Feature 5: Sakau stone near western curve in the stone alignment

Sub-Feature 6: Grouping of basalt cobbles near the SW corner of SF3

ANGEIR ISLET (PoC3-1-ANG)

Feature 1 - Burial Platform (multi-chambered)
- Sub-Feature 1: Eastern burial chamber
- Sub-Feature 2: Western burial chamber
- Sub-Feature 3: Coral platform area south of the W burial chamber

Feature 2 - Burial Platform
- Sub-Feature 1: Burial chamber to the North
- Sub-Feature 2: Disturbed area to the south of SF1

Feature 3 - Platform
- Coral platform outlined with basalt

Feature 4 - Platform
- Coral platform outlined with basalt that has a shallow central depression

Feature 5 - Paving Large basalt paving to the west of Angeir feature 4

Feature 6 - Platform
- Coral and basalt platform with 2 small depressions (1 at the NE and 1 at the SW)

Feature 7 - *Lolong*
- Sub-Feature 1: *Lolong* enclosing wall
- Sub-Feature 2: Burial platform
- Sub-Feature 3: Basalt lined cyst just to the N of SF2
- Sub-Feature 4: Basalt lined cyst just to the E of SF3

Summary Site Features Identified for Ipwal Sites (PoS4-1 through 3)

Ipwal (PoS4-1) *Pehi*

Feature 1 - Basal platform
- Sub-Feature 1a: North wall of Platform
- Sub-Feature 1b: West wall of Lower platform
- Sub-Feature 1c: South wall of Lower platform
- Sub-Feature 1d: East wall of Lower platform
- Sub-Feature 1e: *Sakau* stone and pit alignments

Feature 2 - Elevated platform
- Sub-Feature 2a: North wall
- Sub-Feature 2b: West wall
- Sub-Feature 2c: South wall
- Sub-Feature 2d: East wall

Sub-Feature 2e: Stone column alignments on platform

Ipwal PoS4-2

Feature 1 - Stone walkway
Feature 2 - Terrace curb, South end

Ipwal PoS4-3

Feature 1 - Stone platform

Summary Site Features Identified for Temwen Island

Temwen Site PoC3-10

Feature 1 – Breadfruit Storage Pit
Sub-Feature 1: Southeastern Depression – approx. 1.5m – 2m in diameter
Sub-Feature 2: Southwestern Depression – approx. 1m in diameter
Sub-Feature 3: Northern Depression – approx. 1m in diameter

Appendix D.

PROPOSAL FOR STABILIZATION PLANNING AND SITE DEVELOPMENT

NAN MADOL, POHNPEI, FEDERATES STATES OF MICRONESIA

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Revised, June 2009
(original 2001)

Proposal for Stabilization Planning and Site Development, Nan Madol, Pohnpei, Federates States of Micronesia

I. Nan Madol as a Site Complex and a Locale

The Nan Madol archaeological site complex is a massive city-like complex of artificial islands built up on the coral reef on the east coast of Pohnpei Island, Federated States of Micronesia. It represents one of the real architectural and cultural wonders of the Pacific, and its conservation for future generations represents a critical problem for historic preservation efforts in Pohnpei. The Pohnpei Historic Preservation Office and its counterpart in the Federated States of Micronesia government must be the key participants in this conservation effort, the nature and scope of the site demand international support and cooperation in solving the many problems. This proposal outlines the general features of a long term conservation effort. This statement is a revision of a report and proposal initially created by Ayres, Haun, and Mauricio in the 1980s.

The aims of a stabilization program outlined here are initially to provide for immediate conservation needs of the site complex. Evident deterioration should be stopped or at least slowed; this is a simple but very important initial concern. It can be carried out at varying levels of logistical and technological investment. Preparation for selected reconstructions or restorations of architectural features can be accomplished only after the first aim has been achieved and after a great deal of information has been collected about how the archaeological ruins behave after conservation efforts are started. Complementary to both concerns above is improving visitor access and appreciation of the site. Increased knowledge and appreciation of the site by the general public is an important public long term educational process.

II. Methods

Methods of stabilization should be those fostered and defined by international conservation institutions such as UNESCO and the U.S. National Park Service; these must be adapted to meet with local conditions, that is, with the characteristics of the archaeological sites and logistics considerations on Pohnpei. Following international convention, for basic conservation and stabilization it should be stressed that the principle of minimal disturbance of the original archaeological remains should be the aim. Negative impacts at present can be seen in physical deterioration of the architecture resulting from natural processes, human impacts on stones and stone work, and vegetation. As well, there are changes in the local land use patterns that affect the broader conceptual and visual landscape of which Nan Madol is a part. These changes are in some cases subtle and in others very dramatic. Site development in terms of improving public access, long-term aims of selected reconstructions and open-

air park elaborations must be carefully considered in terms of the character of Nan Madol and the local situation on Pohnpei.

Stabilization Techniques and Methods

1. Vegetation Control

The basic technique for maintenance of the existing architectural features is vegetation control and limiting further erosion. The vegetation control will require a continual process of clearing minor vegetation and a very selective removal of larger trees.

Efforts to limit tidal erosion of islet surfaces--currently a major problem--should be initiated. In some areas this may be achieved using sandbags to shore up islet edges and create small, minimally obtrusive coffer dams. This erosion is particular severe in low, inland islets (see Ayres, Haun, and Mauricio 1981).

2. Columnar Basalt Building Materials

A basic concern is with the stabilization of columnar basalt sided walls (header and stretcher) that are collapsing due to decomposition of the supporting coral rubble fill (see Fig. 2). This problem has been discussed in our earlier work at Nan Madol (Ayres, Haun and Mauricio 1981). Stabilization efforts to combat the leveling effect on these walls must concentrate on firming up the loose and poorly supported columnar pieces. Only in extreme cases should total removal and rebuilding be proposed and this should wait until the stabilization plan is well along and experience in working with the walls has been achieved.

The basic technique proposed here for preventing further wall collapse is to initially, at least, experiment with imitation columnar building pieces made of concrete and use these for supporting loose basalt building materials. The reason for making these pieces from cement/concrete rather than just using rock on the Nan Madol islets is that:

1) original building material remains should not be moved for use in stabilization efforts, that is, the archaeological remains should be disturbed as little as possible, especially until an actual reconstruction is possible and approved.
2) the artificial columns can be produced at Nan Madol,
3) they can be made in sizes that are relatively portable and the cement is less dense than the basalt, and
4) that--following international conventions--they can be dyed/tinted to approximate the color of the basalt but still clearly stand out as stabilization columns rather than the original building material.

The cement columns can be produced in wood molds to replicate the basic pentagonal shape of the natural columns. Rebar would be used in the molds to provide a stabilization "rock" capable of withstanding the tremendous weight of the wall structures. If the columnar cement pieces prove to be effective as stabilization material, other shapes of basalt rocks might be prepared as well for use where appropriate. An alternative would be to use natural columnar rock brought in from off-site. However, this may be difficult to acquire from locations that are not in themselves archaeological sites.

One islet should be selected as a test and demonstration case for this method of basic stabilization. The entire islet surface would be gone over to determine which rocks are in need of support and stabilization. An islet like Reitik Islet (RET) which has a good plan map would be a good place to start.

2. Canal Maintenance and Improvement

The present sediment accumulation in Nan Madol canals serves in many cases to protect the original islet architecture and should be carefully viewed in that light prior to canal dredging for improved access or conservation reasons. One negative feature of canal silting is the spread of mangrove and the long term impact of this vegetation type on the architecture is definitely a major problem. Still, a long term aim is improved visitor access and selected canals should be opened up to make boat access easier. The method proposed here is to use a small gasoline engine powered dredge pump (suction dredge with a pump capacity of more than 80 gals/min) to selectively remove sediments from critical canal deposits like those between Pahn Kadira and Idehd and Kelepwel. This pump system could either be floated on truck tire inner tubes or positioned in a boat. The silt and sand discharge would be collected in second boat or raft and removed from the immediate canal area. Experimentation would be required to determine the most effective application, but the discharge should be to pumped through a series of screens to recover whatever artifacts might be included in the silt and sand to be removed. In other words, the sediment removal should be treated as an excavation because of the buried artifacts, including, potentially, preserved perishable artifacts.

As part of the planned improvement in access and tour systems for the site, it is proposed that the channel through the mangrove from Nikawad to the SW edge of Nan Madol, Nanlehnmoak, be maintained and that tours by canoe be set up to depart from the Nikawad area or the Nahnmwarki's residence area. These would follow through the main canal (Dauen Nankieilmwahu) to Nan Douwas, and could vary in length depending on the visitor's interests.

3. Stabilization of Seawall Architecture

The stabilization of major seawall construction at Nan Mwoluhsei, Pahnwi, and Karian requires special consideration due to the massive construction

boulders and the logistics of working in the marine heavy surge environment. Initially, the efforts should be aimed at stabilization to prevent further deterioration of the wall complex; later, some efforts might be directed at reconstruction of the major wall and corner areas.

For Nan Mwoluhsei, a barge with a heavy crane capable of lifting rocks in excess of 50 tons would be required. This perhaps would have to be brought into Nahkap bay. Eventually, reconstruction of a portion of the now-destroyed east side of the Nan Mwoluhsei gate might be planned.

At Pahnwi, the shallow reef tide level poses some major problems for getting adequate machinery into place. A tripod system and a engine powered winch with block and tackle may be useful for some stages of stabilization. The effort needed here to stabilize what is one of Nan Madol's most impressive walls is considerable however, and heavy equipment will definitely be needed. Wall rocks here that must be lifted or at least shifted in position are as large or larger than those at Nan Mwoluhsei. It may be possible to get a barge in and out at very high tides.

Karian poses different problems for stabilization. A barge should be effective for portions of the east end of the structure that is falling into Nahkap Bay. Other areas might be stabilized using a tripod winch system.

III. Scheduling Steps in the Stabilization Process

The overall stabilization and conservation process should follow these steps for the three major tasks that I envision as being most pressing:

1) Preparation of stabilizing materials (columns);
2) Detailed drawings and photos of areas to be modified in the stabilization process;
3) Simple shoring up of loose rocks and wall sections, initially in a trial case study;
4) Canal Dredging; and
5) Seawall Stabilization.

IV. Costs and Stabilization Equipment

The proposed work can be undertaken at varying levels of intensity and thoroughness. It should be recognized from the outset that long-term conservation of Nan Madol will be very expensive and will require funding from international sources to complement Pohnpei State and Federated States of Micronesia support. Particularly costly will be the stabilization of the seawall architecture due to the heavy equipment and manpower needed. However, there really are no alternatives because the rate of Nan Madol's deterioration is

certainly accelerating. Obviously, priorities of conservation must be established due to funding and logistical considerations.

As a demonstration and test case, I propose that Reitik Islet be examined first and the various techniques be applied here. This could be done in one year pilot project. Dredging a sample section of the main canal might be accomplished in the first year as well. The methods and results of this "experiment" must be carefully recorded and monitored over the next five to ten years to ensure that the methods and techniques used are the best ones.

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Aug 2009 (modified from original proposal of 2001)
nmstabil_prp09