Hawai‘i Volcanoes National Park
Island of Hawai‘i

Paliuli

EMERGENCY SALVAGE PROJECT

Written by:
Catherine Glidden, M.A.

With Contributions by:
Mike Heilen, Kilian Melloy,
Leslie Morlock, Susan Lebo,
Jerome Ward, and Gail Murakami

Edited by:
Jadelyn J. Moniz Nakamura, Ph.D

Pacific Island Cluster
National Park Service
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Patricia Spears drafted all the field maps for the draft report. Her final maps were both accurate and beautifully produced. As such, her drafting skills were an invaluable resource to the project. In addition, Patricia provided overall guidance in marine shell identification and analysis and contributed to the construction of the midden tables.

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duration of the field project, Keswick also acted as project manager and primary editor. As such, she provided overall guidance for all aspects of the project including the field, lab and write-up portion of the draft report. Keswick was also frequently in the field where she assisted in recording and mapping archeological features. Most importantly, Keswick kept the project firmly on track by clearly delineating objectives and emphasizing the importance of a strong research focus.

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Thanks to Tracy Laqua and Patti Spears who were solely responsible for formatting, scanning photographs and getting the draft report up to snuff. Thanks also to Jennifer Waipa who helped with an edit of the draft report.

Catherine Glidden, 1997

Editors Summary

This final report is the result of the contributions of a number of individuals. The field work and draft report for this project was completed in 1997 under the guidance of Catherine Glidden. Her acknowledgements of the many individuals who contributed to the field surveys, excavations and preparation of the draft report are on the preceding pages.

The draft report prepared by Glidden's team was well written but the final was never completed. As part of an overall effort by the Hawai'i Volcanoes National Park Cultural Resources program to complete unfinished projects, the report was revamped and updated in 2006. Specific changes to the original included reformatting of the text and figures and rescanning of the artifacts for new photos. Since the time the draft was written technology has improved and the previously drafted maps required revisions. All of the maps were scanned and re-drawn using Corel Draw. The final figures in this report is a combined effort by the CRM staff. The ArcMap images were done by myself and Jessica Dougherty. All of the feature maps were re-done by Kalena Blakemore, Jahkotta Burrell and Summer Roper. The artifact photos were retaken by the HAVO Curator, Tracy Laqua. Limited changes were made to the actual text although in a few places the content was updated.

Since the initial survey and draft report were completed, all of the sites identified during this survey have been covered by lava flows from Puu O'o except for sites 20430 – 20433, 20439 and portions of sites 20434 and 20440. The information contained within this report is the only surviving data from this area and will serve forever as a representation of not only the activities in this part of Hawai'i Island, but as a reminder to us all of the tenuous nature of our cultural heritage.

Jadelyn Moniz Nakamura, Ph.D.
Editor, 2006

CHAPTER 1. INTRODUCTION

The 1995 Paliuli Emergency Salvage Project came about after several months of correspondence between then Hawai‘i Volcanoes National Park (HAVO) Cultural Resources Manager Janet Keswick, James Martin the park Superintendent, and officials at the Western Region Office (WRO) over the potential danger of new lava flows to archeological resources within the park. Keswick and Martin conveyed their concerns in a letter written on March 7, 1995 to Don Hibbard Administrator and Deputy State Historic Preservation Officer of Land and Natural Resources (DLNR). This communication stressed the parks concerns over the increased flow output at the mouth of Pu‘u ‘Ō‘ō vent within Kīlauea Volcano. Beginning on October 25, 1994, lava flows began to move westward covering areas within the Lae‘apuki and Pānau Iki *ahupua‘a*. The potential impact of the subsequent surge in flow activity was highlighted in a memo released by Hawaiian Volcanoes Observatory officials on November 22, 1994. In specific the memo states that, “an active channel was seen high on the Pūlama Pali on Saturday evening. On Sunday an ‘*a‘ā* flow was burning forest on the West side of Pūlama Pali. Also flows were active on the western edge of the Lae‘apuki field from Paliuli to the road. Up to 10 streams were falling over Paliuli. A few hundred more feet of the road were covered and asphalt was burning much of the day.”

Between February 3rd and 16th1995, lava flows effectively impacted a large geographic area west of the main flow. Specific letters written by Keswick had suggested that a new arm of the main lava flow could potentially impact a number of archeological sites. In a document dated November 30, 1994 Keswick outlined a plan for emergency salvage archeological investigations within the area and requested emergency funding for this purpose. In a letter written on December 1, 1995 Martin included this document requesting emergency funding for mapping archeological features above Paliuli Pali and confirmed the seriousness of the potential lava flows to archeological resources within the park. As predicted by Keswick, a new arm, later termed the Jason Flow, did break off from the main flow around February 7, flowing between two residential areas, termed Residential Complex 1 and 2 in this report. Prior to the survey documented in this report, a number of features were lost and buried beneath the flow.

In her project statement for the Paliuli 1995 Salvage Project dated March 6, 1995, Keswick outlined research objectives for the impacted archeological sites and other sites near the flow. Of particular concern was the lack of archeological data currently available concerning inland or *mauka* areas within the park. As suggested by Keswick “it is important to gain comparative information above Paliuli as agricultural practices and settlement patterns are noticeably different from coastal areas.” In response to the imminent impact of the lava threat to archeological resources within the park, WRO finally approved funding for an emergency salvage project. The DLNR subsequently approved the project in a letter dated March 14, 1995, waiving the usual review procedures required before the onset of archeological projects within the state of Hawai‘i.

The field portion of the 1995 Paliuli Salvage Project was hastily started on February 27, 1995 and ended on April 21, 1995. At the time the project was begun, the lava flow was still active. Surface flows were not readily apparent,

however, steam, sulfur, and heat generated by buried lava tubes were clearly evident. Survey activity proceeded with extreme caution due to the potential of fires and methane explosions, the latter of which could be heard throughout the day. Due to concern over the possible further inundation of sites, the archeological crew concentrated their attention on survey and excavation of features near the flow. This initial area is referred to as the Phase I Area throughout this report. As the fieldwork progressed attention was redirected to a transect swath to the west of the flow (Transect 1). This transect is referred to as the Phase II Area.

Due to the imminent threat of lava inundation, the large number of features, and the limited project funding it was impossible to record all of the features within the Phase I area. At the onset of the emergency project it was believed that the new lava flow would certainly inundate the entire Phase I Area rather quickly. The project managers believed that a transect area chosen to the west of the flow would allow time to more fully analyze the sites without the constant threat of imminent danger. Thus, within the Phase II area the crew was able to document and map 100% of the features. Following the survey and feature documentation the crew began more detailed analysis within this later area. By the conclusion of the field project, the Jason Flow cooled off and became inactive leaving portions of the Phase I area untouched. By the conclusion of this final report, however, the entire area has been covered by subsequent lava flows from Pu‘u ‘Ō‘ō permanently sealing the remaining portions of the residential complexes.

Objectives and Research Design

The 1995 Paliuli Salvage Project was initiated due to the threat of lava inundating archeological sites within Hawai‘i Volcanoes National Park. This natural incursion was thus the primary factor delineating research objectives within the project area. In specific, features observed to be within the closest proximity to the active lava flow were given the highest priority in terms of survey, mapping and excavation of features. Once these areas were documented, the project area was extended to include a 20 m wide and 1,000 m long transect to the west of the flow. The project area thus consisted of two phases. Phase I involved the documentation of the most threatened archeological sites near active lava flows. Phase II entailed a research plan designed to test for morphological feature types and function of archeological features within a *mauka-makai* transect.

The primary purpose of the project (Phase I) was to record the sites threatened by the lava flow. The secondary purpose of the project (Phase II) was to obtain archeological data from the *mauka* areas within Panau Iki and Lae*‘*apuki *ahupua‘a*. Previous surveys conducted in this area dealt primarily with coastal (makai) sections within the park (Ladefoged et al. 1987; Carter-Schuster in prep), leaving a gap in our understanding of subsistence within *mauka* areas during prehistoric and historic times. The archeological investigations for this project were conducted exclusively above Paliuli Pali. The information obtained from this mauka survey is compared and contrasted in this report with data previously collected in coastal regions of the park.

Phase II of the project was added principally to answer questions regarding the degree of variability of archeological features across the landscape with regard to elevation change. The transect is situated along a steady slope heading in a *mauka* direction and passes through a number of vegetation zones). For instance, the lower portion of the transect is located along a *pāhoehoe* flow with mostly exotic vegetation including guava, grasses etc. The upper portion, which ends at the Kalapana Trail (Site 50-10-63-20443), consists mostly of native vegetation including *ʻākia*, *ʻaʻaliʻi, lauaʻe*, etc. The ecological and environmental variability within the transect areas allowed for the introduction of various hypotheses concerning ecological and geological influences on archeological patterning across the landscape.

Research Questions

Some of the topics considered central to determining settlement and subsistence patterns in the project area include how the area was utilized agriculturally and in what ways settlement patterns in *mauka* areas differed from coastal locations. Specific questions guided archeological investigations during the field portion of the project and include the following:

1) Does a comparison between the project area and the more coastal regions indicate different settlement patterns?

2) Did agricultural activities in more *mauka* regions begin later on in historic times?

3) Could population pressures account for the increase in archeological features in more marginal areas of Hawaiʻi?

4) Were people forced to move into drier areas in historic times? What are the demographic patterns of the region in historic times?

5) Is the project area suited to agriculture in general, or is the area only suited to production of certain crops (i.e. sweet potatoes)?

6) Are all the sites within the project area contemporaneous? If not, in what ways did features evolve through time in terms of architecture and function?

7) Land-use generally changed from sweet potato production in pre-contact times to reliance upon free-ranging cattle and goat production in historic times. Is this evident within the project area?

8) Is the Pānau Nui/Laeʻapuki *ahupuaʻa* boundary marked above Paliuli Pali?

9) Is there a demographic pattern to petroglyphs located within the project area? If so, what are some possible functions of the petroglyphs?

To assist in answering the above questions, the following analysis were done:
1) Seed and pollen identification to help identify agricultural cultigens, and vegetation change.

2) Charcoal identification to help reconstruct the wood species used for fires and to determine if the wood was imported or collected locally.

3) Radiocarbon analysis of charcoal from agricultural features, habitation sites and caves to date the period of occupation and abandonment.
4) Identification of faunal remains to help reconstruct diet and subsistence strategies

5) Analysis of historic artifacts to determine the time span that the sites were occupied within the historic period.

Field Methods

The field portion of the Paliuli Salvage Project was conducted over a two-month period beginning on February 27, 1995 and ending on April 21, 1995. Catherine Glidden was the field supervisor. Michael Heilen, Janet Keswick, Penny Moblo, Timothy Scheffler, Patricia Spears, and Jennifer Waipa were all part of the field crew. Patricia Spears was the field supervisor for the excavation portion of the project. The field methods utilized to document the Phase I and Phase II areas differed to some extent and are discussed separately below.

In general, the vegetation coverage was relatively sparse allowing for easy access and identification of archeological features within the project area. However, specific areas were found to be densely vegetated. This includes, in particular, agricultural features defined here as “terraced slopes” and a “mound concentration” in a basin. These heavily vegetated areas were not surveyed with the thoroughness and intensity of other areas, thus the number of features could only be estimated.

Phase I began with the identification, mapping and recording of archeological features within a 25 acre area on both sides of the Jason Flow. This initially involved the identification of features with flagging tape, then clearing the area of vegetation. Next, the size and extent of the habitation sites were approximated. All of the features within these sites were then mapped and recorded in detail using standardized feature forms. Color slide and black and white print photographs were taken of each feature.

Due to time constraints, and concerns about impending lava flows, the numerous agricultural features located within sites 50-10-63-19469 and 50-10-63-19470 of the Phase I Area were not individually mapped. Instead, a select number of each morphological type was recorded. All of the features within the agricultural areas were then counted. Each type of agricultural feature (i.e. terraces and mounds) was identified, recorded, mapped, and photographed. In areas where vegetation was particularly thick, the number of agricultural features was simply approximated.

Twelve excavations were conducted within the Phase I Area. Excavation units were generally 50 cm x 50 cm test units. All excavations proceeded with respect to natural stratigraphic layers and 10 cm arbitrary levels. Screening was

conducted on site with 1/4" and 1/8" mesh. All cultural material was collected and bagged. In addition, pollen, charcoal and bulk soil samples were collected.

Phase II of the project area involved the documentation of 100% of all the features within the 1,000 m x 20 m transect swath. The transect was initially set using flagging tape and compass. Bearings were taken with respect to Magnetic North. All of the features within the transect were then flagged. Features, other than simple mounds and pits, were identified with striped flagging tape. These features were then mapped, recorded, and photographed. Agricultural features were distinguished with blue flagging, then recorded with the Global Positioning System (GPS) using a Data Dictionary. The GPS was programmed to record specific information regarding the dimension (length, width, and height); geological placement associated artifacts and amount of soil and vegetation in and around each agricultural feature. This data was later transferred to feature forms.

Two slab-lined pits located within enclosures identified as habitation features were excavated in the transect area. These features were excavated in the same manner as the units within the Phase I Area and included the collection of pollen, charcoal and soil samples.

All of the features within the project area were GPS'ed. Maps were subsequently produced using the ArcView software program. The data gathered from this survey was used to develop the maps that are included in this report.

Environmental Context

The project area is located within the southeast section of Hawai'i Volcanoes National Park along the southern flank of Kīlauea Volcano (Figure 1). The park itself is situated on the southeast end of the island of Hawai'i within the districts of Puna and Ka'u. The project area is located within the Puna-Ka'u Historic District, a 129,665-acre region nominated to the National Register of Historic Places in 1974. This district includes numerous significant archeological sites that represent over 600 years of occupation (Figure 2).

The survey area is composed of two parcels of land (Phase I and Phase II) that combine to yield an area less than 12 ha (30 acres) total. It is located above Paliuli Pali between the Lae'apuki and Pānau Iki *ahupua'a* within the Puna District (Figure 2). The Phase I Area of the project is less than 10 ha. (25 acres). The Phase II Area is a 1km (0.6 mile) transect with a width of 0.2km (0.01 mile) and an area of less than 2 ha (5 acres). At the time of the survey the landscape surrounding the Phase I project area had been inundated by flow activity from the Pu'u *'Ō'ō* vent of Kīlauea Volcano. This includes a swath of new lava (Jason Flow) that separates two residential areas within the project area (Residential Complex 1 and 2) (Figure 3).

The geological foundation upon which the sites were constructed includes *pāhoehoe* and *'a'ā* flows; though *pāhoehoe* is noted in greater abundance. The age of the flows falls within the range of 1200 A.D. to 1450 A.D. (Holcomb 1980). These dates determine the maximum ages of the archeological sites built above them.

The amount of soil development in the area is limited and confined to pockets of soil that accumulate in depressed locations, cracks, and areas subject to wind-blown erosional deposits in the pāhoehoe flows. It appears that soil development is much more pronounced in the areas inland from the coast. Above Paliuli Pali, soil depth reaches a maximum of 40 cm to 50 cm while below Paliuli Pali, soil depth is often less than 10 cm. Development of soil on *ʻaʻā* flows is even less impressive and sometimes not even visible to the naked eye. Even so, plants are observed growing directly out of the *ʻaʻā.* Thus, even without soil, both types of lava flows appear to provide as adequate foundation for a relatively diverse plant life.

Rainfall within the project area varies from month to month, from day to night, and depends partly on "a complex interplay between terrain and wind" (Armstrong 1979:57). According to Armstrong (1979), the project area receives anywhere from 50 to 75 inches of rain a year. According to Stone and Pratt (1994:85), however, the average rainfall is much lower, ranging from 20 inches in the west to 60 inches in the eastern lowlands. Stone and Pratt (1994) note that the limiting conditions of the often dry and sparse landmass within lowland regions allow for a rather limited plant community. They recognize, however, that the relative lack of shrubs and trees within the area is "unnatural" and a direct result of historic grazing activities and past burning of the area by Hawaiians.

The project area in general is composed of a mixed complex of indigenous, endemic, Polynesian introduced and alien plant species. The dominant plant community consists of lowland mesic grass and shrublands. Grasses dominate the landscape and plant types found in the area. *Heteropogon contortus* (*pili*) grass is noted in areas that have been recently subjected to fires. Elsewhere, *Rhynchelytrum repens* (natal redtop), *Heteropogon contortus* (twisted beardgrass) and *Melinis minutiflora* (molasses) grass are abundant as well. Molasses grass is mostly observed within the Phase II transect swath and is absent within Phase I Area. Alien shrubs and trees are also abundant in the project areas.

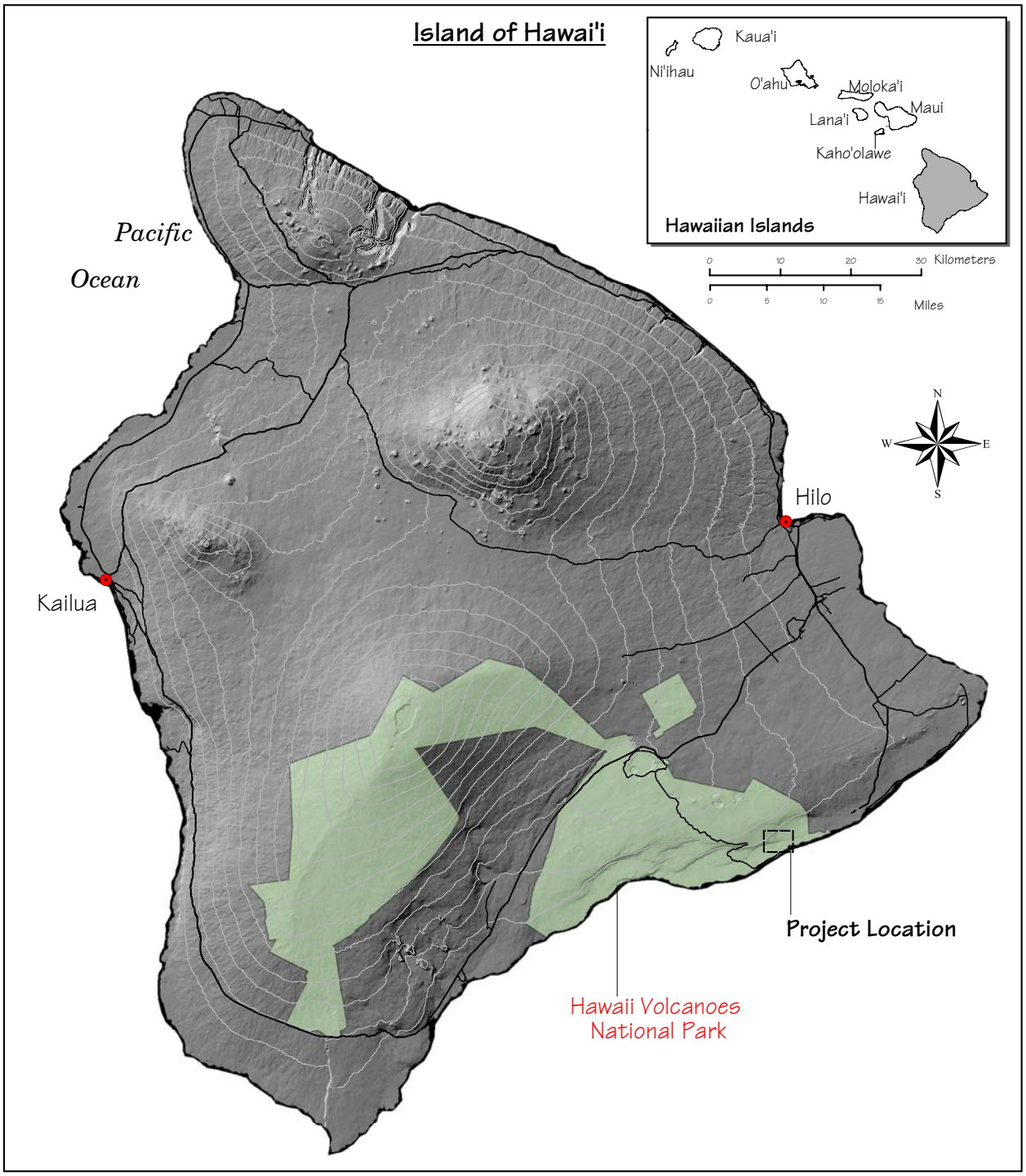

Figure 1. Project Location.

Figure 2. Hawai‘i Volcanoes National Park, district and ahupua‘a boundary lines.

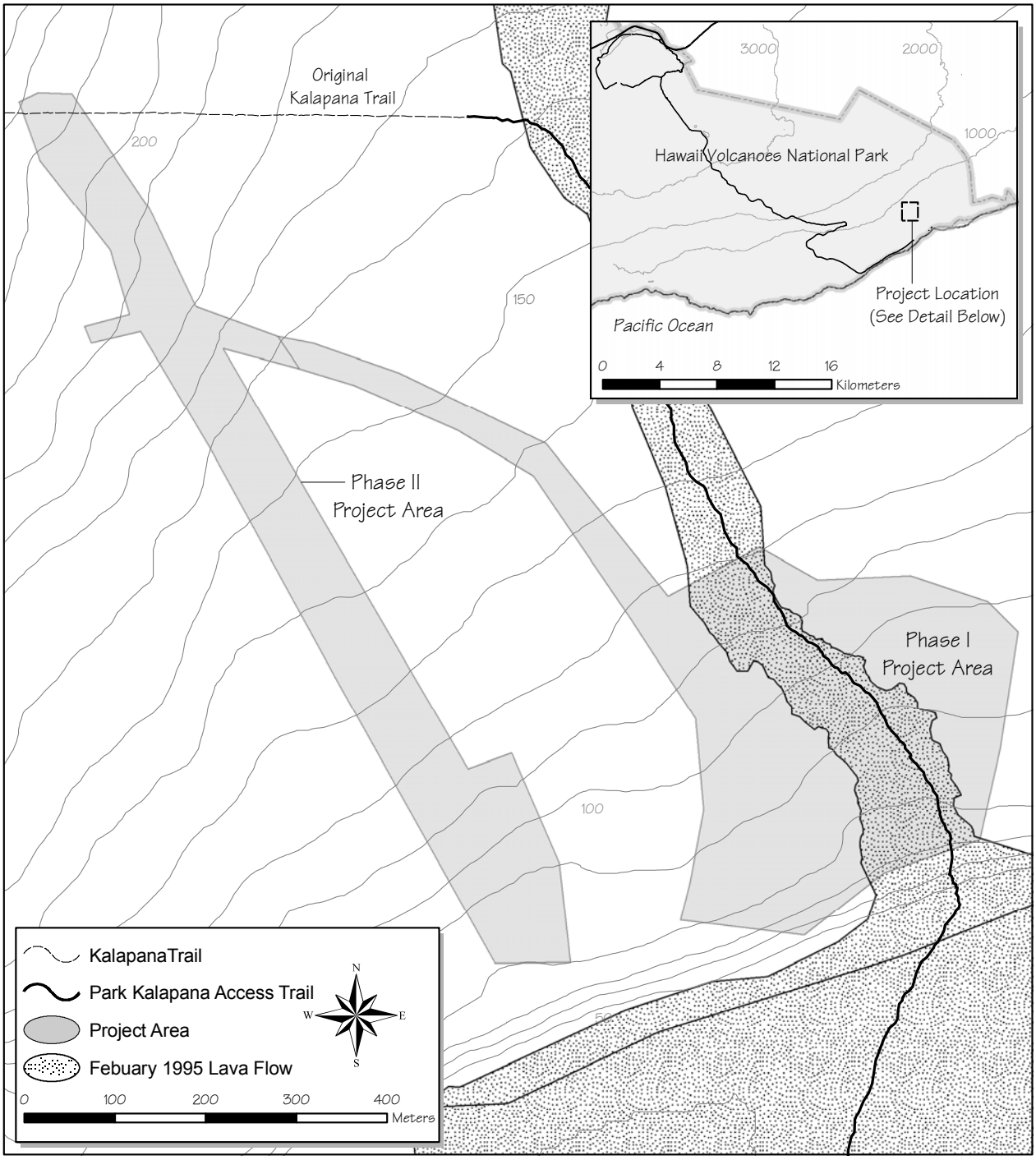

Figure 3. Detail of Project Area.

The most dominant alien shrub is *Lantana camara*. This plant, originally introduced as an ornamental, is ubiquitous within the project area. Other dominant aliens include *Desmodium sandwicense* (Spanish clover), *Psidium guajava* (guava), *Abrus precatorius L* (*pūkiawe*), *Pluchea symphytifolia* (sourbush) and C*hamaecrista nictitans* (partridge pea). *Schinus terebinthifolius* (Christmas berry) is the most common tree within the project area along with *Metrosideros polymorpha* (*ʻōhiʻa lehua*), a native tree. Interspersed amongst these aliens are a number of endemic and indigenous plants that include herbs such as *Waltheria indica* (*ʻuhaloa),* shrubs *Dodonaea viscosa* (*ʻaʻaliʻi*), *Wikstroemia phillyreifolia* (*ʻākia*), and the tree *Canthium odoratum* (*alaheʻe*). The Polynesian introduction *Morinda citrifolia* (*noni*) is also noted dispersed throughout. Finally, the fern *kupukupu* grows everywhere, but is largely limited to *pāhoehoe* crevices and bare *ʻaʻā* flows.

The plant community within the Phase II project area is similar to the one described above. However, the vegetation does increase significantly toward the extreme *mauka* portion of the transect swath. The vegetation also changes from mostly alien plants to a predominantly native plant community. This change is striking and may be due to a change in elevation or may signal the beginning of a culturally unmodified section of the landscape. Of note is the relative lack of archeological features beyond this point. The plants located within this plant community include shrub *Dodonaea viscosa (ʻaʻaliʻi*) and *Wikstromia phillyreifolia* (*ʻākia*), and the tree *Canthium odoratum* (*alaheʻe*). *Waltheria indica* (*ʻuhaloa*), *Osteomeles anthyllidifolia* (*ʻūlei*), *Morinda citrifolia* (*noni*), *Phymatosorus scolopendria* (*lauaʻe*), *kupukupu*, and the alien guava (*Psidium guajava)* are also present.

ʻAʻā lava flows appear to sustain a more diverse biota within the project area. Habitation and agricultural features are also located in greater abundance on this flow type. Steep *ʻaʻā* flows were utilized in particular for terracing and currently reveal a larger number of endemic, Polynesian introduced and alien plants. Three features termed "terraced slopes" in this report are located within the project area. One such slope in the Phase I Area (Site 50-10-63-19470), is particularly interesting as it includes an extremely varied plant community unlike that of the surrounding area. Plants found to be growing directly on the terraces include *Pomoea indica* (*koali ʻawa*), better known as morning glory, *Plectranthus parviflorus* (*ʻalaʻala wainui), Wikstroemia phillyreifolia (ʻākia*), *Osteomeles anthyllidifolia* (*ʻūlei*), *Abrus precatorious* (black-eyed susan), and *Phymatosorus scolopendria* (*lauaʻe).*

The plant community in Residential Complex 2 includes a number of plants that would have been useful for a number of purposes well suited to habitation. This includes at least 15 *Aleurites moluccana* (*kukui*), though several of these are dead or in poor condition, two *Diospyros sandwicensis* (*lama*), and several *Dodonaea viscosa* (*ʻaʻaliʻi*). Other smaller plants and shrubs within this community include *Sifa fallax* (*ʻilima*), *Psilotum nudum* (*moa*)**,** *Nephrolepis multiflora* (*kupukupu*), *Phymatosorus scolopendria* (*lauaʻe*), *Plectranthus parviflorus* (*ʻalaʻala wainui*), and *Melia azebarach* (*ʻīnia*). Two *Cocos nucifera* (*niu*), or palm trees, and several large *Syzygium cumini* (Java plum) provide shade in areas surrounding actual structures. Aliens such as *lantana camara* (lantana), *Schinus terebinthifolius* (Christmas berry), *Psidium guajava* (guava), *Pluchea symphytifolia* (sourbush),

Chamaecrista nictitans (partridge pea), *Desmodium sandwicense* (Spanish clover), *Passiflora foetida* (love-in-a mist), *Crotalaria pallida* (smooth rattlepod), *Senna* sp., and *Indigofera* sp. (indigo), also abound in the area. Many of these latter plants are particularly common in disturbed areas.

The following table (Table 1) is a specific and detailed ethnobotanical summary of plants found within the project area. Included in this list are the known ways in which these plants were used by Hawaiians in pre-contact and historic times. Due to the abundance of these particular plants within the project area, it is highly likely that they were utilized for at least some of the purposes outlined in Table 1 and as such represent part of the cultural landscape.

Previous Research

Relatively little research has been conducted within or in close proximity to the project area. This is not surprising, as most of the archeological studies within the park have been situated along the coast or in areas with large habitation sites. Though *mauka* areas have generally been ignored, research conducted within thepark prior to this survey provides a wealth of information concerning a number archeological sites from which this research draws (eg. Brigham 1909; Carter 1979; Carter and Somers 1990; Cleghorn 1976a, 1976b; Cox 1974; Cox and Bonk 1959; Cox and Cleghorn 1975; Emory et al. 1959; Emory et al. 1965; Heilen and Camara 1995; Hudson 1932; Kirkendall 1993a, 1993b; Ladd 1962, 1963, 1964, 1967, 1968, 1969, 1972a, 1972b, 1974, 1981, 1986; Ladefoged 1987; Ladefoged et al. 1987; Lee 1993; Lyman 1924; Morlock 1995; Pearthree et al. 1996; Smart 1965; Somers 1986, 1987; Spears 1995; Stasack and Stasack 1997, 1998; Stone 1959; Wilkes 1845). The following discussion is not a complete summary of archeology within the park, but a synopsis of previous archeological investigations concerning the project area itself.

The work of Kenneth Emory et al. (1959) and Colin D. Smart (1965) directly relate to the project area. Both works document archeological sites within the project area. These surveys were conducted under the auspices of Bernice P. Bishop Museum as part of a larger plan to record sites in the area of the planned extension of the Chain of Crater's Road to Kalapana.

The initial field survey conducted by Emory et al. (1959) was a preliminary reconnaissance project. This study covered a wide area of the park and did not result in a complete inventory of sites. Emory et al. (1959:9) write in particular that "much of the Pāʻnau Iki material is in thick lantana and though visibility is clear at eye level, the sites themselves are covered. This area was somewhat too far from our base to allow efficient working time in the field, consequently only a rough reconnaissance resulted."

Emory et al. did discover an unspecified number of sites within the project area. They (1959:92) write that at "the foot of the low bluff back of Lae'apuki and Pānau Iki are several terraces and enclosures, and on the flat area above are scattered house sites and enclosures." They identified this area as "*Mo'olehua*." They list a number of other sites from the region that were eventually assigned Bishop Museum (HV) numbers. However, these sites are explained and described more specifically in the report compiled by Smart in 1965. Thus, this latter report was referred to as the primary documentation of the sites. Smart (1965:36) writes that their "brief examination [of Pānau Iki] during [their] survey revealed no new evidence" of additional sites in the area. They included a hand-drawn map with their report and depicted the location of individual sites. They note, however, that as with the 1959 survey by Emory et al., their primary aim was not to document all the sites within the Kalapana Extension but to "describe in detail only a selected number of these sites to illustrate the range and variety of archeological evidence" (Smart 1965:6).

Smart lists a total of eight sites (HV 187-194) for the Phase I project area. Of these, one was lost in February 1995 due to lava inundation. This site (HV 193) is described as a shelter cave. The remaining sites are all located within the Phase I Area of the current project area. These sites have been reassigned site numbers. In some cases sites have been separated, combined, and redesignated numbers based on increased knowledge developed concerning the project area. Additional sites were discovered in the process of documenting the project area including two caves, petroglyphs and trails not mentioned by Smart or Emory.

Historical Background

A number of sources provide valuable information concerning settlements within close proximity to the project area (eg. Allen 1979; Ellis 1979; Emory et al. 1959; Ladefoged et al. 1987; Lyman 1924; Smart 1965; Spears 1995; Wilkes 1845). This report will draw on these as a means of interpretation.

Settlements and Subsistence Activities

Of particular interest to this project are a number of historic settlements from the region. In general, these upland residences tended to be infrequent and widely dispersed, with villagers dependent on resources from all areas within an *ahupua'a.* As noted by Melinda S. Allen (1979:15), when compared to the more frequent coastal habitations "upland residences were less frequent, more dispersed and usually associated with small agricultural plots." In 1823, William Ellis (1979:190) made a similar observation when he traveled along the Puna coast. He wrote:

> "we have often been surprised to find the desolate coasts more thickly inhabited than some of the fertile tracts of the interior; a circumstance we can only account for, by supposing that the facilities which the former afford for fishing, induce the natives to prefer them as places of abode; for they find that where the coast is low, the adjacent water is generally shallow."

Settlements that sprang up in the interior, *mauka* regions, were not autonomous, but part of an integrated community that relied on various resources within particular *ahupua'a.* Ellis (1979:189) paints a picture of such a community structure in his synopsis of life at Kealakomo, a coastal village within the *ahupua'a* of the same name:

> "The head man of the village was present during the service. He came into our houses after it was over, and told us his provisions were at his farm, which was some distance inland and that tomorrow, he intended to bring us a pig, and some potatoes. We thanked him, but told him probably we should proceed on our way early in the morning. He went away and in a short time returned with a raw salted albacore, and a basket of baked sweet potatoes, which he said was all he could furnish us with to-day."

In referring to their Detailed Study Area (DSA) within Hawaii Volcanoes National Park, Ladefoged et al. (1987) concluded that the primary residences were generally located along the coast, with agricultural features spread over much of the inland areas with the addition of temporary residences in *mauka* regions. Their study covered a varied area within the park, to the east of the project area, and included both coastal *makai* and *mauka* sections up to 152 m above sea level.

Referring to the Pānau Nui *ahupua'a*, Allen (1979:13) relates that there were a total of 13 houses dispersed across the landscape with "two at the coast, six at the edge of the pali, and five in the uplands." Emory et al. (1959:13) discovered more about the area through their informant Samuel Konanui. He stated that "many people lived at Holei." "Holei" is believed to be the name of a village along the Holei Pali. Emory et al. (1959:13) wrote that "Holei is on the top of the bluff on the face of which cling groves of *kukui* trees. The name extended to the bottom of the grove." "Holei" is currently depicted on the 1981 United States Geological topographic map for Kalapana at an elevation of 300 feet. Emory et al. (1959:13) write that in the same general area is a Hale-O-Lono, or house dedicated to the god Lono. They explain that this structure is located along the Holei Bluff. According to Samuel Konanui this temple was "the place where the rain was cooked."

Within the *ahupua'a* of Panua Nui is another village documented in the historic literature. In his four volume *Narrative of the United States Exploring Expedition*, Charles Wilkes (1845) recorded his observations concerning his travels including time spent on the island of Hawai'i. Within Volume IV, he writes about the village of Pānau, which he describes as a cleared area in the woods and three to four houses. He noted that the people in the village were skilled in making canoes with "the trees in the vicinity being large and well adapted to this purpose" (Wilkes 1845:181). Just three miles east of Pānau, heading toward the coast they also came across "an extensive taro patch." The residents of Pānau may have maintained this agricultural plot.

Within the *ahupua'a* of Panau Iki was another settlement documented in historic times. Using tax records as her reference, Allen (1979:15) writes about the Pea Residence which was the last of its kind within the *ahupua'a* of Pānau Iki. Archeological evidence of this homestead are located along the Kalapana Trail in

a wooded area several miles *mauka* of the ocean. At the time of her study, one of the wood frame houses was still standing. Allen writes that it is possible that a 'hermit" still resided in the area as late as 1920.

William Ellis described the more coastal regions in Pānau, Lae*'*apuki, and Kamoamoa where the population appeared quite substantial. He wrote that though the water was of poor quality, the area was nevertheless "agreeable" and that "groves of coca-nuts ornamented the projecting points of the land" (Ellis 1979:190). Ellis observed animals such as fowl, dogs, and pigs and saw fish drying areas along the shore. Sweet potato and poi starches provided the remaining staples.

In addition to the above, salt was collected for home use and sold for a small profit. Chester S. Lyman (1924:103) explains that the salt drying areas were frequently evident along the coast. He described the salt production process as follows:

> "Their salt works are on the naked lava near the sea the water of which is evaporated in little cups or vessels of Ki leaf and holding of course by a minute quantity of water. These are laid in parallel rows over several acres and the water poured over them a little at a time from Calabashes. The process is an extremely slow one, tho' the salt is s[ai]d to be excellent for the table. It is sold at an exceedingly low price of 25cts a bag which will contain I she'd judge 1/2 bushel or more."

Though Ellis described the coastal population as dense, the number of inhabitants in the area does appear to have decreased soon after his visit to the area in 1823. Lyman (1924:103) described Kealakomo, a village that was quite populous at the time of Ellis' visit, as "greatly diminished" by the time of his travels in 1846. He wrote that the villagers are "miserably poor and for some time past have been in a state of famine." Lyman documented that the inhabitants of the area "get their living by fishing, making salt and getting fern roots, and a few potatoes in the mountains (Ibid.)."

Though, Ellis describes a number of villages along the coastline of Southwest Puna, there were several that he did not mention. As noted by Ladefoged et al., (1987:21) Ellis failed to mention either the village of Ka'ili'ili, or Poupou Kauka, both formally located near Waha`ula heiau. Ladefoged et al. conclude that this omission indicates that these villages were not present at the time Ellis passed through the area. In fact, according to Ladefoged's reading of Ellis, there were no villages present anywhere along the coast within the *ahupua'a* of either Pānau, Lae'apuki or Kamoamoa.

Historic Industries

In more recent historic times, a number of industries became dominant in the region indicating that the area, though marginal, was still important economically. By the mid to late 1800s, the most substantial resources exploited in the region were fish, sea salt, *pulu*, *'ōhi'a* timber, and open pastures for goat and cattle

grazing (Allen 1979:9). In general, land specifically within the project area was not considered very valuable and was described as "poor pasture" and "waste land (Allen 1979:9)." The government agent for the area referred to Pānau Iki, Lae'apuki, and Kahue as consisting primarily of rocks and lava (Allen 1979:10).

Pulu, a light feathery substance found in the core of native tree ferns (*hapu'u*) was harvested in the area for use as pillow, mattress and upholstery stuffing. Once the *pulu* was harvested it was lugged by mule to Keauhou Landing, where it was first dried and then shipped. The *pulu* industry was begun after 1851 and was in full swing by 1862. Exports at this point involved the transfer of 738,064 lbs. to San Francisco, with some shipped to Portland, Vancouver, Canada and even Australia (Saturday Press: July 7, 1883). The *pulu* was sold for as little as 14 cents and as much as 25 cents per pound, depending on demand.

This cottage industry was evidently dominant within *mauka* regions of the Pānau *ahupua'a* after 1860. At the time, *pulu* dealers Abel and C.C. Harris and Frank Swain leased land in Pānau specifically for this purpose. Soon thereafter individuals named Kaina and Heleluhe leased land in Lae'apuki and Pānau Iki and constructed two camps to house *pulu* pickers. The first camp was built in the vicinity of Makaopuhi Crater and the other near the Keauhou Ranch. According to Allen, the former camp was still in existence at the time of her writing in 1979 and was located somewhere along the Nāpau Crater Trail (Allen 1979:11).

Other entrepreneurs soon followed and continued to harvest *pulu*. Thomas G. Thrum (1929:13) relates that entire families then were employed to collect *pulu* and were required to "provide themselves with rude shelter huts." The *pulu* industry ended in 1884 after a run of only 32 years as cheaper forms of upholstery filling were used instead. Thrum comments that the end of the *pulu* industry "was a blessing in disguise" as people employed as *pulu* pickers were uprooted from their homes along the coast and paid minimal wages (Thrum 1929:13).

Other industries that were dominant at the time were goat and cattle ranching. These activities began in 1862 and were specifically applicable to the Pānau Iki and Lae'apuki *ahupua'a*. Phillip Hafner bought land there specifically for ranching purposes and maintained a number of goats. C. Pea evidently kept a herd of up to 1,000 goats in Pānau Iki (Allen 1979:12).

Table 1. Ethnobotanical Analysis of Plants within Project Area.

Plant Type	Origin	Scientific and common name	Hawaiian Name*	**Ethnobotanical Uses**
Shrub	POL	Cordyline fruticosa Ti	kī	**Flowers**: used to treat asthma, growths in nostrils, overwork and dry fever. **Leaves**: temporary and permanent rain capes, sandals; later in time hula skirts, domicile and temple thatching; plates, cups and wraps for food cooking; whistles, fodder for livestock; dry leaves for a type of fishing (*huki lau*); shark bait, squid lures; sliding for children (*hōlua ki*); signs of divine power; protection from malignant spirit; purify menstruating women. **Root**: famine food, commercially sold as confection; made into a clear brandy called "*'okolehau*." (Nagata 1987; Neal 1965; Krauss 1974; Pukui and Elbert 1986).
Shrub	END	Wikstroemia phillyreifolia	ʻākia	**Entire plant**: laxative, asthma, fish poison. **Bark**:fiber (Wagner et al. 1990).
Tree	IND	Canthium odoratum (Psydrax odorata)	alaheʻe ʻōheʻe walaheʻe	**Wood**: medicinal, digging stick *(ʻōʼō),* adz blades for cutting softer wood. **Leaves**: black dyes for coloring calabashes. (Pukui and Elbert 1986; Wagner et al. 1990).
Tree	POL	Morinda citrifolia Indian mulberry	noni	**Fruit**: famine food; tonic and poultice used for medicinal purposes to treat severe illnesses. Leaves and bark: medicine Roots and bark: dye (Stone and Pratt 1994).

Plant Type	Origin	Scientific and common name	Hawaiian Name*	**Ethnobotanical Uses**
Fern	IND	Nephrolepis exaltata Scaly swordfern	kupukupu	**Fern**: occasionally placed on altar to *Laka* in the interest of acquiring knowledge (Stone and Pratt 1994; Neal 1965; Pukui and Elbert 1986).
Tree	END	Diospyros sandwicensis	lama ēlama	**Wood**: the sick were placed in huts made of *lama*, on hula altars ("*lama*" means "torch, or light" and suggests "enlightenment"); also used for sacred enclosures (*pālama*) for royal women under *kapu* restrictions and for fish pond gates (*mākāhā*) (Pukui and Elbert 1986).
Fern	NAT	Phymatosorus grossus	laua'e, lauwa'e	**Fern**: used to scent *tapa*; also *lei* (Pukui and Elbert 1986; Wagner unpublished).
Grass	IND	Heteropogon contortus Twisted beardgrass Tanglehead	pili, lule	**Entire Plant**: considered a superior thatching grass due to its brown color, rectitude and fragrance; occasionally placed on Laka altar to increase knowledge (Neal 1965; Pukui and Elbert 1986; Rotar 1968; Wagner et al. 1990).
Shrub	IND	Sida fallax	'ilima	**Flowers**: mild laxative for babies, (general debility), afflictions of the womb, asthma, *lei* (*lei pua*) (Abbott 1992; Krauss 1974; Nagata 1987; Neal 1965; Wagner et al. 1990).
Tree	NAT	Melia azederach L. Chinaberry	īnia īlinia	**Leaves**: used medicinally; on Maui made into a tea to soothe skin of lepers (Wagner et al. 1990).
Mint	IND	Plectranthus parviflorus Spurflower	'ala'ala wainui	**Plant**: medicinal; same as *Peperomia spp*. (Pukui and Elbert 1986; Wagner et al. 1990).
Vine	IND	Cocculus trilobus	huehue, hue hue'ie, 'inalua	**Stems**: Used to make funnel-mouthed fish traps and twine to bind part of grass houses. (Pukui and Elbert 1986).

Plant Type	Origin	Scientific and common name	Hawaiian Name*	**Ethnobotanical Uses**
Vine	IND	Ipomoea indica Morning glory	koali ‘awa, koali ‘awahia, koali pehu	**Stems and roots**: pounded into poultice for bruises and broken bones. Stems, roots, leaves and flowers: strong purgative (Neal 1965; Pukui and Elbert 1986; Wagner et al. 1990).
Tree	POL	Cocus nucifera Coconut palm	niu	**Nuts**: source of water. **Wood**: timber. **Leaves**: thatching material (Wagner et al. 1990).
Vine	IND	Caesalpinia bonduc Gray nickers	kākalaioa hihikolo	**Seeds**: powdered for strong purgative, leis, marbles (*kinikini*) (Neal 1965; Pukui and Elbert 1986; Wagner et al. 1990).
Herb or Shrub	NAT	Indigofera suffruticosa Indigo	‘inikō, ‘inikoa, kolū	Entire Plant: Dye (Wagner et al. 1990).
Herb	IND	Peperomia leptostachya	‘ala’ala wainui	**Entire Plant**: medicinal treatment of uterine abnormalities, irregular periods and other female problems (Abbott 1992).
Shrub	IND	Osteomeles anthyllidifolia	‘ūlei, eluehe, u’ulei	**Wood**: digging stick (Ō’ō), fish spears, musical instrument (‘ūkēkē); flexible branches used in making fish net hoops. **Buds and Seeds**: medicinal-general debility. (Nagata 1987; Pukui and Elbert 1986).
Herb	END	Argemone gla uca Hawaiian poppy	pua-kala kala naule pokalaka	**Seeds and sap**: medicinal uses; for ulcers, neuralgia, narcotic for toothaches, treatment of warts (Wagner et al. 1990).

Plant Type	Origin	Scientific and common name	Hawaiian Name*	**Ethnobotanical Uses**
Shrub	IND	Dodonaea viscosa	‘a’ali’i ‘a’ali’ikū-makani ‘a’ali’i-kūmakua	**Fruit cluster**: *lei*. **Wood**: house building. **Leaf**: medicinal for rash and itch (Pukui and Elbert 1986; Wagner et al. 1990; Nagata 1987; Abbott 1992).
Tree	POL	Aleurites moluccana Candlenut	kukui, kuikui	**Oil**: for lamps, canoe paint, bird lime removal. **Wood**: canoe building. **Nuts**: medicine, torches, *and lei*, dye. **Kernels**: oil and *‘inamona* (relish). **Gum**: protective shellac and coloring for *tapa*, glue for *pehu* drum. **Sap**: medicine, several dyes (copper or black) for tattooing and tanning. **Husk**: medicine, dye. Medicinally used for asthma, sores, ulcers, swollen womb, and laxative (Nagata 1987).
Herb	NAT	Ricinus communis Castor bean	pā’aila, kolī ka’apehā, kamākou lā’au-’aila	Medicinal oil (Wagner et al. 1990).
Fern Ally	IND	Psilotum nudum Whiskfern	moa, moa nahele, pipi	**Spore**: used medicinally as a tea and purgative in powder form; and as talcum powder. **Branches**: used by children in a game (Pukui and Elbert 1986; Neal 1965:1).

* Hawaiian words are italicized and typed in bold.
\+ END: endemic plants; NAT: naturalized plants; IND: indigenous plants; POL: Polynesian introduction.

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CHAPTER 2. ANALYTICAL UNITS

The project area was divided into two sections, the Phase I and Phase II areas (Figures 3-5). These parcels of land were recorded within two temporally discrete periods. The Phase I Area was mapped and recorded at the onset of the project and the Phase II Area was analyzed last. The Phase I Area encompasses sites analyzed on either side of the February 1995 Jason Flow. The Phase II Area consists of a 1,000 m long and 20 m wide transect. The term "phase" thus indicates both a location and temporal period.

The basic unit of analysis within the project area is a feature. Features are defined as non-portable cultural remains that form discrete archeological units. A feature can be an architectural unit, a midden concentration, a terraced slope, or a geologic formation that has been modified. The term feature is also used to describe components within features such as hearths. In general, however, components are the units that make up a feature. A feature may include several contiguous units such as a wall, a hearth and pavement. Features combine to form a site. In this report a site ideally represents specific use areas such as for sleeping, eating, food procurement etc. (agricultural areas which include a number of mounds, terraces, filled cracks etc. have been combined into single sites as long as the features appear to be related and are constructed in a similar fashion). A site also refers to one or more features that are related both spatially and functionally.

As previously noted, The Phase I Area was surveyed by Colin D. Smart, et al. (1965), of the Bishop Museum, in 1964 and 1965, as part of a park-wide survey to determine the extent of archeological resources within Hawaii Volcanoes National Park. Smart assigned a total of seven Bishop Museum site numbers (Hawaii Volcanoes National Park HV site numbers) to this area. However, due to the cursory manner of fieldwork conducted by Smart a number of features were overlooked. Thus, some of the sites within the Phase I Area do not have corresponding HV site numbers.

A total of 39 individual sites are located within the project area. This includes 67 features within the Phase I Area and 249 features within the Phase II Area. Twelve sites are located within the Phase I Area; another 27 sites are situated within the transect swath (Figures 4-5). Included within the transect are 190 agricultural features and two terraced slopes listed under the site number 50-10-63- 20436. These features were combined into one site as they were clustered together and generally homogenous in morphology. Additional site numbers were assigned to agricultural features clustered together in the *mauka* section of the transect. In the farthest upland sections of the transect, agricultural features tended to be more sparse and further apart. A complete list of site and feature numbers and corresponding site number used by Smart is located in two tables at the back of this report (Appendix A).

The Phase I Area includes two residential complexes: Residential Complex 1 and 2. Residential Complex 1 is located primarily on an *'a'ā* flow and partially on a contiguous *pāhoehoe* flow. This complex includes seven sites and a total of 29 features (Figure 4). The *makai* section of the complex (Site 50-10-63-19462) is the largest part of the site and the area where most of the habitation activities appear to have been centered. To the west of this *makai* section is a cave that includes a large gourd (Site 50-10-63-19464). An additional cave with petroglyphs (Site 50-10-63-19463) is located to the SW. Both of these caves were likely used for water collection. The *mauka* or northern most part of the section (Site 50-10-63-19467) consists of three features and is connected to the *makai* section by a stepping-stone trail (Site 50-10-63-19468). Both of these latter sites were impacted by the February 1995 lava flow. A long "J" shaped wall (Site 50-10-63-19473) forms the east side of Feature A wall at Site 50-10-63-19462. To the south of the complex is a line of petroglyphs (Site 50-10-63-19475) that continue through an opening in wall feature 50-10-63-19473. This site has been interpreted as a trail.

Residential Complex 2 is located on a mixed *'a'ā* and *pāhoehoe* surface and is composed of two sites (Site 50-10-63-19461 and Site 50-10-63-19472) and ten features (Figure 4). This residential area includes a series of enclosures, platforms and walls. Historic items such as ceramics and metal are strewn across the site clearly dating the area into the historic period. Numerous plants, including two palm trees, are located within the complex. To the north and east of the site are two large agricultural areas consisting mostly of a mound concentration (Site 50-10-63-19469) and a terraced slope (Site 50-10-63-19470).

The residential complexes are comprised of household units and include sleeping, cooking, procurement and recreational use areas. As such, the residence areas are viewed as an important source of information concerning socialization and temporal periods of use. Agricultural features within and surrounding the residential complexes further suggest that agricultural activities are what brought the inhabitants to the area in the first place. Excavations conducted within these residential areas indicate that they were both in use during early and late historic times. Tables 2 and 3 summarize the features within Residential Complex 1 and 2.

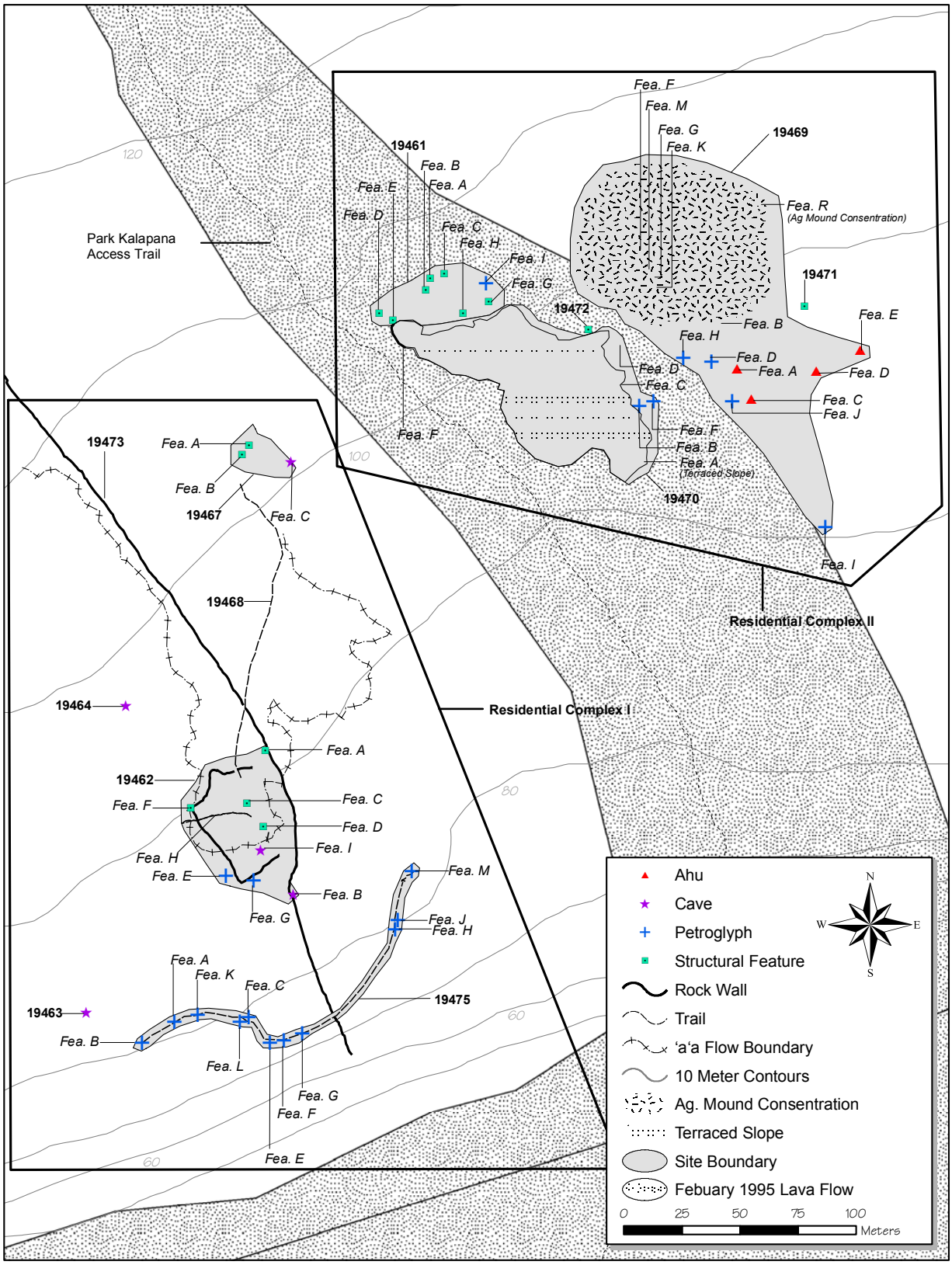

Figure 4. Phase I survey area showing Residential Complex 1 and 2.

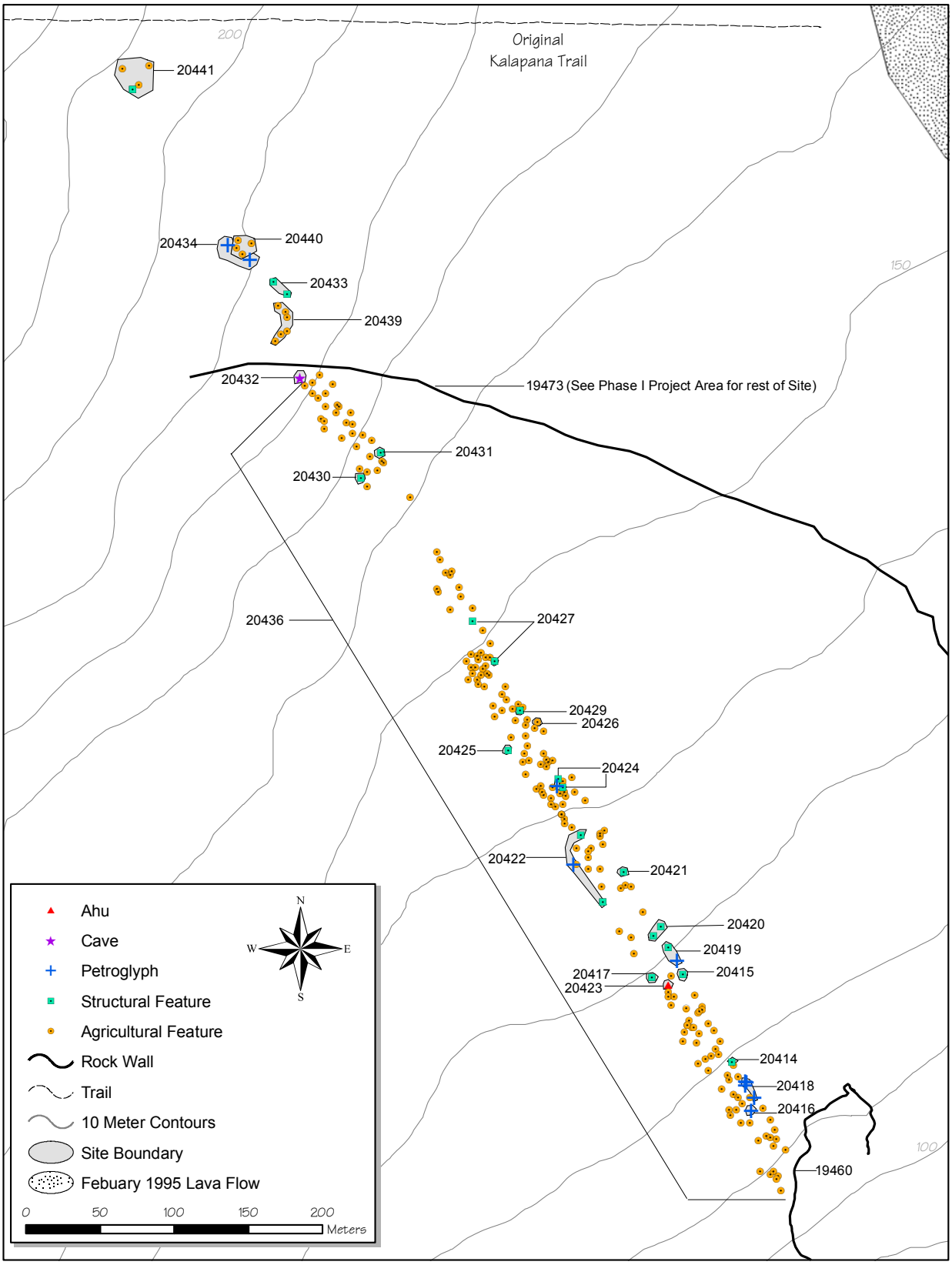

Figure 5. Phase II survey area (survey transect).

Table 2. Residential Complex 1 (Phase I Area).

Site Number 50-10-63	Bishop Museum Number	Feature Designation	Feature Type
-19462	HV 194	A	Enclosure
		B	Cave
		C	Terrace
		D	Terrace
		E	Petroglyphs
		F	Wall
		G	Papamu
		H	Trail
		I	Bashed Area
-19473	HV 194		Wall “J” shaped
-19467	HV 194	A	Enclosure
		B	Wall
		C	Cave
-19468	HV 194		Trail

Table 3. Residential Complex 2 (Phase I Area).

Site Number 50-10-63	Bishop Museum Number	Feature Designation	Feature Type
-19461	HV 189	A	Platform
		B	Enclosure
		C	Enclosure
		D	Enclosure
		E	Wall
		F	Wall
	HV 190	G	Enclosure
		H	Enclosure
		I	Petroglyphs
-19472	HV 192		Platform

Feature Types

The following typology includes all of the features found during the survey. Phase I and Phase II features are discussed together as both areas include similar features. However, not all of the features discussed in this section are necessarily located in both areas.

The features have been classified into 21 morphological types. An attempt was made to define each feature without implying function; however this was not always possible. For instance, the term "cupboard" clearly implies form and function. This feature type was utilized principally to distinguish an artificially enclosed space from a natural depression or pit.

Functional categories were assigned based on field observations, historical accounts, and previous archeological investigations conducted in the area. The following tables (Tables 4 and 5) are a summary of the features found within the project area and include the average dimension for each.

Alignments

Alignments are continuous lines of rocks that are only one course high. Only one alignment was identified within the project area. This feature is situated within the Phase II project area.

Ahu

A total of eight ahu are located within the project area. Ideally, ahu or cairns are conically shaped mounds of rocks that are stacked and at least three courses high. Ahu can, however, consist of only 1 rock if located in a prominent place. Ahu are most often used to mark trails or boundaries. Seven of the eight ahu within the project area are located within the Phase I Area. These ahu are very large and exceed the size of typical trail markers. Five of the ahu, in particular, combine to form a right angle in plan view.

Bashed Area

One feature identified as a bashed area is located within the project area. This feature (Site 50-10-63-19462 Feature I) consists of a *pāhoehoe* surface that has clearly been utilized for some pounding activity. The surface is worn and abraded over a 6 m x 2 m area. The bashed area is within Residential Complex 1 (Phase I Area).

Caves

Five caves are located within the project area. Caves are naturally found, open spaces that are located underground. All of the caves within the project area are lava tubes. Only one cave is located within the Transect/Phase II Area. This cave is quite small. The remaining four caves are quite large and are located near or within Residential Complex 1. The cave site 50-10-63-19463, includes a number of petroglyphs, most of which are anthropomorphs.

Cobble Mounds

A total of eleven cobble mounds are located within the project area. All of these features are situated within the Phase II/Transect Area. These mounds are piles of rocks that consist mostly of cobble sized rocks. These cobbles average between 2 cm to 3 cm. In general, the cobbles are located in the interior of the feature while larger *pāhoehoe* rocks line the periphery.

C-shapes

C-shapes are dry stacked walls that are formed in the shape of the "C." A total of eight C-shapes are located within the project area. All of these structures are located within the Transect/Phase II Area. Three of the C-shapes are generally free standing and placed along a flat *pāhoehoe* surface. However, five of these structures are built along the outside edge of a lava bubble, thus providing added height to the structures. These latter C-shapes are not completely free standing, but effectively utilize the natural geography for structural integrity of the features. In addition, open areas inside the bubbles provide space for storage or other functions.

Cupboards

Only one cupboard is located within the project area. This feature (T108) is within the Transect/Phase II Area. This cupboard is constructed entirely out of *pāhoehoe* blocks and large, flat *pāhoehoe* slabs and conceals a nicely protected space within (40 cm x 110 cm x 65 cm). Numerous *kukui* nutshells were found scattered within the cupboard.

Enclosures

Thirteen enclosures are located within the project area. These features consist of rock lined areas that enclose an area almost completely. The majority of enclosures are rock-filled with an interior paving. Four of the five enclosures within the Transect/Phase II area are square and include interior and exterior facings. Two of these also include interior slab-lined hearths. The enclosures in the Phase I Area are similar. Most are square, though two of the enclosures are circular and quite small with walls stacked 3 to 4 courses high. Site 50-10-63-19462 includes an enclosure (Feature A) that has high, stacked walls and an interior paved area that is stepped. In general, the construction of the enclosures makes use of the natural lava terrain to support the feature and add structural integrity. In some cases, one or more of the walls abuts the edge of a tumulus.

Filled Cracks

A total of 13 filled cracks are located within the project area. All of these features are situated within the Transect/Phase II Area. Filled cracks consist of linear cracks in the *pāhoehoe* surface, often located at the top of a tumulus, that have been filled with rocks. These features collect water and are generally observed with ferns or other plant material growing from within them.

Filled Depressions

There are a total of nine filled depressions within the project area. These features are all located within the *mauka* portion of the Phase II/Transect swath. Filled depressions are basin-shaped pits that have been filled with *pāhoehoe* rocks. They are noticeably absent from the less vegetated areas in the *makai* section of the transect.

Modified Outcrops

Eleven modified outcrops are located within the project area. All of these features are situated within the Transect/Phase II Area. Modified outcrops consist of piled rocks placed along the edge of a tumulus or *pāhoehoe* outcrop. Modified outcrops are thus not free standing like mounds. These features lack formal construction and often appear as natural aggregates of rocks. Modified outcrops are identified as cultural features due to the sheer number of rocks that are piled together. The majority of modified outcrops are located along *pāhoehoe* flows and lack soil.

Mounds

One hundred fifty seven mounds are located within the Transect/ Phase II Area. An additional ca. 120 mounds are located within Site 50-10-63-19469 (Phase I Area). Mounds are piles of rocks that lack formal construction but are free standing. Mounds are piled at least 2 courses high and can be any shape. Most of the mounds in the project area are circular, however linear mounds are also observed. The vast majority of the mounds are placed on *pāhoehoe* surfaces with only a limited amount of soil beneath them.

Mound Concentration

One mound concentration is located within the project area. This feature complex is located within the Phase I Area and is part of Site 50-10-63-19469. The mound concentration consists of ca. 120 mounds that cover an area of 116 m x 90 m. The mounds are piled with mostly boulder sized blocks of *pāhoehoe* two to three courses high. Their average size is 2 m x 2 m with varying heights. The mounds are located in a basin and are mostly circular in form. The majority of mounds are situated along open *pāhoehoe* surfaces.

Papamū

Three *papamū* boards were found within the project area. However, only one *papamū* was treated as a feature. The *papamū* at Site 50-10-63-19462 (Feature G) was the only game board that was not mobile. Instead, it was pecked directly into the *pāhoehoe* surface. The other *papamū* were pecked out of loose fragments of *pāhoehoe* and could be moved, and were thus termed artifacts. *Papamū* are game boards that include a number of holes arranged in rows and columns. The game *kōnane,* which is played on this board, is similar to Chinese checkers.

Pavement

One pavement is located within the project area, specifically within the Transect/Phase II locale. This feature (T229) consists of *pāhoehoe* blocks, placed flat and one course high on the ground surface to create a flattened area. The feature includes a *papamū* board that may have been moved from its original location. However, the board could have been on the pavement as it is placed in a level area.

Petroglyphs

A total of 47 petroglyphs are located within the project area. Thirty-three of these glyphs are situated within the Phase I Area, with the remaining 14 dispersed within the transect swath. The petroglyph forms consist of anthropomorphic, geometric, cryptic and historic lettering, though anthropomorphic forms appear to predominate. The petroglyphs have been pecked and sometimes incised into the *pāhoehoe* surface. Stone and metal tools were both probably used to create the forms. Historic lettering was isolated to the Phase II/Transect 1 Area.

Pits

There are three pits located within the project area. All of these features are within the
Transect/Phase II Area. Pits are depressed areas that are deeper than they are wide. Two of the pits are associated with contiguous mounds. All of the pits have been culturally modified either by the addition of the mounds or through excavation of *pāhoehoe* rock to increase the size of a naturally depressed area.

Terraces

A total of 7 terraces are located within the project area. Terraces are rock filled features that are faced on at least one, but up to three, sides. Terraces often abut natural outcrops or other geological features. Two terraces, other than the terraced slope, are located within the Phase I Area. These features are soil filled areas lined with rocks and with at least one side raised. The five terraces within the Phase II/Transect area tend to be rock lined and rock filled areas, with at least one side raised. In addition, these terraces are generally square and not linear, unlike those in the terraced sloped areas.

Terraced Slope

A total of three terraced *'a'ā* slopes were encountered within the project area. These features consist of interconnected, rock filled areas aligned across relatively steep 30 to 40 degree slopes. The terraces are raised on at least one side and are rock filled. In addition some terraces are aligned down the slope, creating a crosshatched effect as observed in plan view. The terraces are mostly linear in form and are constructed almost exclusively of *'a'ā* rock with some *pāhoehoe* blocks noted. These features are not generally faced and are raised on at least one side with mostly rock fill noted between the facing and the slope edge. The terraces are loosely constructed and are piled one to two courses high. The terraced slope in Site 50-10-63-19470 also includes circular alignments with central depressions, though these are located near the base of the slope. This site also includes a stacked wall with associated petroglyphs that bounds the terraced slope along the periphery.

Trails

Two stepping-stone trails are located within the project area. These trails consist of flat, *pāhoehoe* paving stones placed along an *'a'ā* flow. They are both located within Residential Complex 1 in the Phase I Area. One possible trail (Site 50-10-63-19475) is marked by a line of petroglyphs that continues through a break in a wall (Site 50-10-63-19473).

Walls

A total of eight walls are located within the project area. Five of the walls are within the Phase I Area, with the remaining walls situated within the Transect/Phase II swath. Walls are defined as stacked rock structures that are free standing and are longer than they are wide. All of the walls within the project area are stacked and most are faced. Most of the walls are fairly long and appear to enclose or exclude an area. In general, the walls are quite high (an average of 0.6 m) with at least three courses visible. The majority of walls are located near or within habitation areas. One extended "J"-shaped wall comprises Site 50-10-63-19473 and is described in the following section.

Table 4. Averages for Features within Phase I Area.

Feature Type	Number Identified	Length (m)	Width (m)	Height (m)	Artifacts	Midden	Excavated
Ahu	7	3.9	3.0	1.58	Yes	No	No
Bashed Area	1	6.0	2.0	N/A	No	No	No
Cave	4	32.7	2.3	1.11	Yes	Yes	Yes
Enclosure	8	7.6	5.9	0.85	Yes	Yes	Yes
Mound	1						
Concentration		116	90	N/A	No	No	No
Papamū	1	0.7	0.7	N/A	No	No	N/A
Petroglyph	44	N/A	N/A	N/A	No	No	N/A
Platform	2	10.5	7.5	0.71	Yes	Yes	Yes
Terrace	2	8.1	7.8	0.43	Yes	Yes	Yes
Terraced Slope	1	100	70	N/A	No	No	No
Trail	2	82.5	0.6	N/A	No	Yes	No
Wall	5	2.27	1.25	0.6	No	Yes	No

Table 5. Averages for Features within Phase II/Transect Area.

Feature Type	Number Identified	Length (m)	Width (m)	Height (m)	Artifacts	Midden	Excavated
Ahu	1	1 m	0.7 m	0.2 m	No	No	No
Alignment	1	3.2 m	2.5 m	0.6 m	No	No	No
Cave	1	7 m	6 m	0.85 m	Yes	Yes	No
Cobble Mound	12	2.1 m	1.6 m	0.65 m	No	Yes	No
C-shape	8	4.8 m	3.8 m	0.71 m	No	Yes	No
Cupboard	1	2.5 m	2.3 m	0.48 m	No	Yes	No
Enclosure	5	3.7 m	2.9 m	0.6 m	Yes	Yes	Yes
Filled Crack	13	2.9 m	1.05 m	0.25 m	Yes	Yes	No
Filled Depression	9	2.3 m	1.5 m	0.31 m	No	No	No
Modified Outcrop	11	3.7 m	1.7 m	0.3 m	No	No	No
Mound	157	2.04 m	1.5 m	0.28 m	Yes	No	No
Pavement	1	2.7 m	1.8 m	0.30 m	Yes	No	No
Petroglyph	14	N/A	N/A	N/A	No	No	No
Pit	3	1.3 m	0.93 m	N/A	No	No	No
Terrace	5	4.64 m	3.7 m	0.48 m	No	No	No
Terraced Slope	2	56 m	20 m	N/A	No	No	No
Wall	3	22.7 m	1.25 m	0.6 m	No	No	No

Site Descriptions

Phase I Area

Site 50-10-63-19461

This site consists of nine features situated on a mixed *pāhoehoe* and *'a'ā* rise. The features comprising the site include five enclosures (Features B, C, D, G, H), a platform (Feature A), petroglyphs (Feature I) (Figure 6) and two walls (Features E and F) (Figure 7). Numerous historic artifacts are strewn across the site. The site is currently in a *kipuka* (*Mo'olehua*) and is surrounded by new lava flows. The western part of the site has been inundated by the February 1995 lava flow (Jason Flow) and parts of the features have been consumed. Within the site and in the surrounding region, (generally to the north and east) are numerous agricultural features (mostly mounds). This site combines with Site 50-10-63-19472 to form Residential Complex 2.

Site 50-10-63-19462

A series of nine features located on both an *'a'ā* flow and adjoining *pāhoehoe* area comprise this site. The site includes a bashed area (Feature I), a *papamū* (Feature G), an enclosure (Feature A), two terraces (Feature C and D), a cave (Feature B), petroglyphs (Feature E), a wall (Feature F), and a trail (Feature H) (Figure 8). The southern edge of the site is located on *pāhoehoe*. The site is bounded on the west and south by a wall (Feature F). The northern and western part of the site is bounded by a long wall identified as Site 50-10-63-19473. This wall actually connects with Feature A enclosure and forms the eastern wall of the feature. A *papamū* and bashed area are pecked into the *pāhoehoe* surface along the southern edge of the site. Three petroglyphs are also noted on a tumulus at this extreme southern edge.

Site 50-10-63-19463

This site consists of a large, partially paved lava tube with petroglyphs within and outside (Photo 1) the entrance (Figure 9). The cave is a total of 30 m long x 2 m wide and up to 1.5 m high to the ceiling. Part of the cave floor is paved with flat *pāhoehoe* stones (Photo 2). A number of *'opihi* shells and charcoal areas were noted within the cave. Charcoal was collected for taxon identification and sent to

Photo 1: Petroglyphs from cave site 50-10-63-19463

Photo 2: Flat, paving stones from floor of cave site 50-10-

Gail M. Murakami of IARI Inc. All of the charcoal was composed of native species and included *koa* (*Acacia koa*) (Appendix C).

Site 50-10-63-19464
This site consists of a lava tube cave with two main arms (north and south) breaking off from the entrance (Figure 10). Outside the entrance, to the north, is a stone alignment that is 4.0 m x 0.6 m 0.52 m high.

The northern arm of the cave is very shallow, with a thin channel in the center that is 0.5 m high to the ceiling. No cultural materials were noted within this part of the cave, however, the remains of a single burial were found on a shelf along the north wall. The area just inside the entrance to the cave was the most extensively utilized. The floor is scattered with a variety of marine shells. A number of large *'opihi* were found upturned, presumably to collect water from ceiling drips. Pecking on the *pāhoehoe* shelf on the SE wall appears to have functioned to hold the "cups" in place. The midden scatter extends into the south portion of the cave. There is also an ashy deposit within the soil in this area. Small fragments of bone are also located there, possibly washed down from the burial.

A stone wall, 0.3 m to 0.35 m high, separates the lower (southern) part of the cave. This partitioned area appears to have served the purpose of water collection. A large gourd (34 cm high) was found just to the south of the interior stone wall. This gourd was found upside down with the top cut off, perhaps for use in water collection (Photo 3).

Site 50-10-63-19467
A cave (Feature C), enclosure (Feature A), and wall segment (Feature B) located on an *'a'ā* surface and at the northern edge of Residential Complex 1 comprise this site (Figure 11). This *mauka* portion of the complex is connected by a stepping-stone trail (Site 50-10-63-19468). The cave feature (Feature C) has been partially inundated by the Jason Flow (Photo 4).

Photo 3: Large gourd from interior of cave site 50-10-63-19464.

Photo 4: Lava at cave entrance of Feature C, Site 50-10-63-19467.

Site 50-10-63-19468

This site is made up of a *pāhoehoe* stepping-stone trail located on the *'a'ā* within Residential Complex 1 (Photo 5). The trail actually connects Site 50-10-63-19462 to Site 50-10-63-19467. The trail is relatively intact in areas, with stepping-stones still in place. It is clearly evident to the west of Feature A (enclosure) within Site 50-10-63-19462. From Feature A, the trail runs 350 degrees magnetic for approximately 75 m before being cut off by the February 1995 lava flow.

Site 50-10-63-19469

This site consists of a series of seven cairns (Features A-G) (Photo 6), 10 petroglyphs (Features H-Q) (Photo 7), and a mound concentration (Feature R) consisting of ca. 120 mounds. The mounds are mostly heaped and an average of 2 m x 2 m in size. The cairns form an "L" shaped alignment in plan view and are situated both north to south (323 degrees magnetic) and east to west (41 degrees magnetic). The cairns form a corner of sorts, perhaps marking a boundary. The petroglyphs are situated *makai/mauka* along a bearing of 323 degrees magnetic and parallel the long arm of the "L" on the East Side.

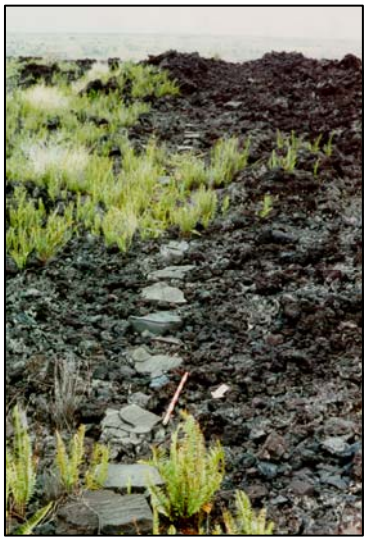

Photo 5: *Pāhoehoe* stepping-stone trail, Site 50-10-63-19468, to left.

Photo 6: Two large cairns at Site 50-10-63-19469, above.

Photo 7: Paddler petroglyph (Feature H) at Site 50-10-63-

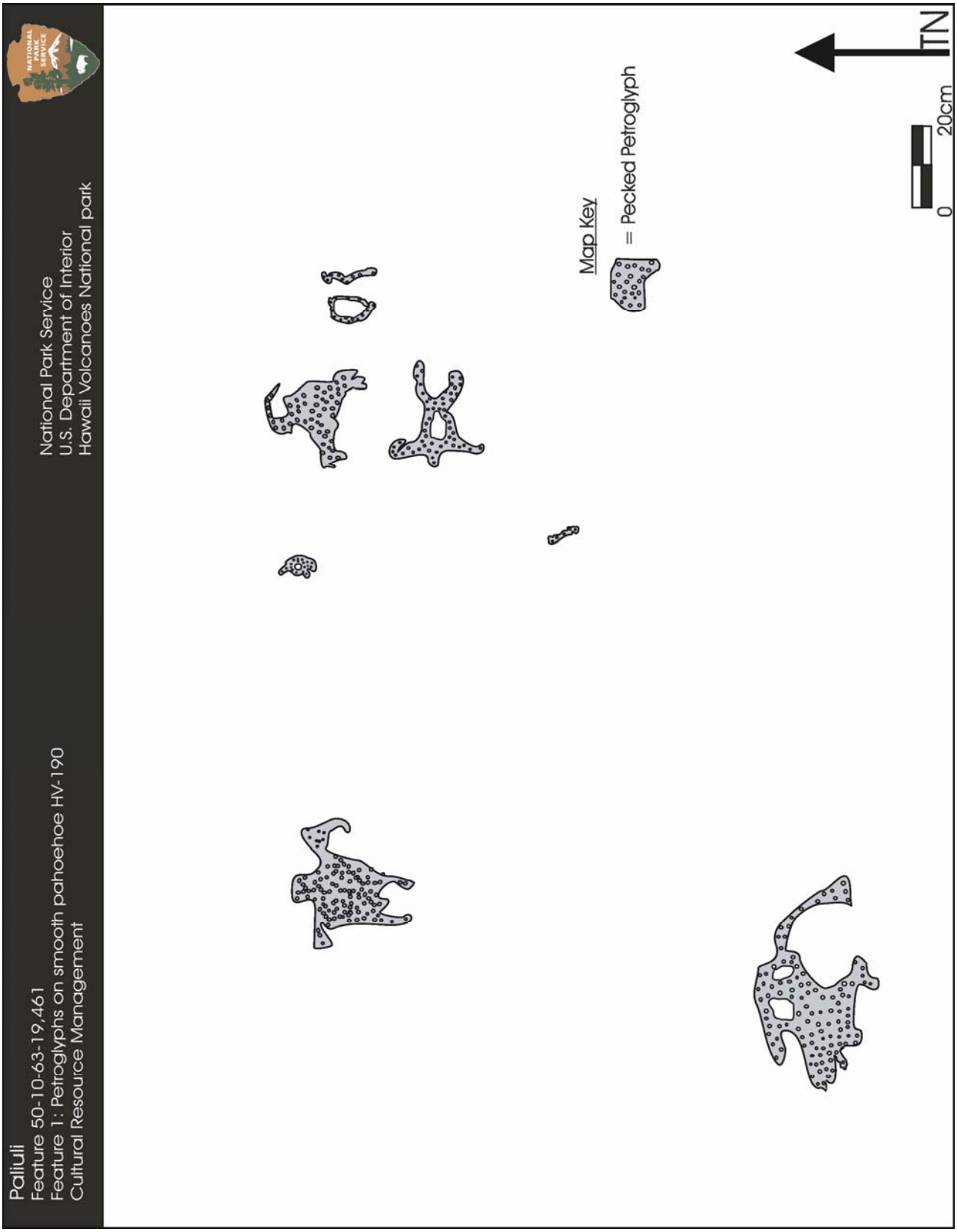

Figure 6. Drafted Map of petroglyphs (Feature I) 19461.

Site 50-10-63-19470
This site consists of a terraced slope (Feature A) and nine petroglyph features (Features B-H). The terraced slope is a series of linear terraced mounds constructed within a mixed *'a'ā* and *pāhoehoe* surface, with facings sometimes evident along the *makai* edge. Most of the linear terraces are noted across the slope, however some terraces are aligned down slope creating a cross hatched effect. This terrace slope also consists of pits that are located within the *'a'ā* surface. A wall bounds the site along the north and east edge. The petroglyphs are noted just outside the wall. Both combine to create a boundary for the agricultural area. The western and southern side of the agricultural area has been consumed by the 1995 lava flow.

Site 50-10-63-19471
This site consists of an enclosure located on the edge of a *pāhoehoe* rise with an excellent view of the surrounding area (Photo 8). Site 50-10-63-19469 is clearly visible in the basin located to the south and west. The feature, which is oriented roughly north to south, is 6.5 m x 5 m x 0.5 m high, and is roughly paved with rather large *pāhoehoe* blocks. Paving stones are noted in the north 1/4 and west 1/4 of the feature (these are smaller sized cobblestones). Both south corners are collapsed and only 1/2 of the entire enclosing wall remains intact. Facings are noted inside the enclosure along the north and west edges. Facings are also evident along the outside of the feature, especially the south and east edges where the wall is well constructed and up to five courses high.

Photo 8: Enclosure, Site 50-10-63-19,471.

Site 50-10-63-19472
This site consists of a boulder and cobble platform raised on all sides and associated with numerous agricultural features (Figure 12). The platform is aligned NE to SE (*mauka/makai*) and is located on a sloped surface, though the feature itself is level. The feature is raised fairly high on the *makai* (south) end (up to 1.3 m) with 4 to 5 stacked courses evident. The dimensions of the platform are 10 m N/S x 7 m E/W x 0.7 m high. The feature is rectangular and constructed with *'a'ā* rock; the interior of the feature is somewhat roughly paved. The rocks used are mostly 25 cm x 25 cm though some smaller cobbles are noted.

Site 50-10-63-19473
This site is a long "J"-shaped wall that stretches from Paliuli south of Site 50-10-63-19462, Residential Complex 1, *mauka* to the west, just below the Kalapana Trail. This feature attaches to the east side of Feature A at Residential Complex 1 and extends a total of 1,104 meters. In general, the wall is stacked with *'a'ā*

though the material used corresponds to the surface flow upon which it is built. The wall is stacked 3 to 4 courses and is an average of 0.7 m high. Portions of the wall are quite disturbed, revealing that it is cobble core filled with larger boulders on the exterior and base of the wall. Openings are noted in the wall where trails merge; though older stepping-stone trails are covered over by the wall.

Site 50-10-63-19475
This site consists of a series of 13 mostly anthropomorphic petroglyphs (Features A-M) located in a line (east to west) along a worn *pāhoehoe* flow. The petroglyphs parallel the edge of Paliuli Pali. A break is noted in a long "J" shaped wall (Site 50-10-63-19473) after which the petroglyphs continue. Due to the worn nature of the *pāhoehoe*, and the break in the wall, it is highly likely that the petroglyphs are marking a trail.

Phase II Area

Site 50-10-63-20414
This site is composed of a C-shaped shelter (T101) and a pavement with a *kōnane* board (T229). The C-shape is 5 m x 4 m, five courses high, and constructed with a core filled wall. The pavement is 2.7 m x 1.8 m x 0.3 m high and located just *makai* of the C-shape (Photo 9). This latter feature is a somewhat rough pavement though it consists of well placed cobble-sized rocks. The entire site is a total of 7.7 m x 5.8 m in size.

Photo 9: Feature T229 Pavement with *kōnane* board (lower right) within pavement, Site 50-63-20,414.

Site 50-10-63-20415
This site is a C-shaped shelter (T103) constructed in a lava bubble. The wall of the C-shape is constructed on the direct edge of the bubble thus giving the shelter added height. The entire feature is 4.3 m x 2 m x 0.7 m (high) and three courses high. Two *'opihi* shells are located in an interior area beneath a low overhang under the eastern edge of the lava blister.

Site 50-10-63-20416
This site (T104) consists of a male anthropomorphic petroglyph deeply pecked into the *pāhoehoe* tumulus. The figure, which faces 330 degrees magnetic, is situated with arms and legs spread and with elbows and knees bent. The feature is 55 cm x 68 cm**.**

Site 50-10-63-20417
This site (T105) is a C-shaped shelter built along the western inside edge of a *pāhoehoe* ledge. The ledge has been built up with three courses of stacked rock up to 1 m high. The feature is 8 m x 4 m.

Site 50-10-63-20418
A series of four petroglyphs figures make up this site. The first figure is anthropomorphic with upraised arms and is pecked into the *pāhoehoe* surface (T106). The petroglyph is 38 cm x 38 cm. The second set of figures consists of two anthropomorphic male figures with bent arms and legs (Photo 10). This second set is in a 70 cm x 90 cm area (T107). The fourth petroglyph is a cryptic figure shaped like a foot stirrup (T137). The entire site is a total of 11.4 m x 3 m.

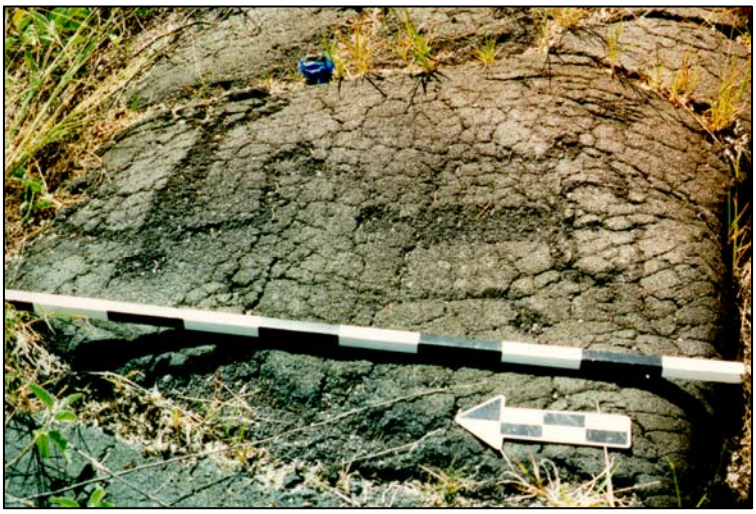

Photo 10: Two anthropomorphic petroglyphs, Feature T106, Site 50-10-63-20418 (Roll 1995-29, Frame 2).

Site 50-10-63-20419
A cupboard (T108) and petroglyph (T138) comprise this site. The cupboard is man-made with large, stacked *pāhoehoe* blocks and a constructed roof (Photo 11) (Figure 13). The feature is built above a flat *pāhoehoe* surface. The dimensions of the feature are 40 x 40 cm wide at the opening, 110 cm deep and 65 cm wide within the interior. The petroglyph is located just *makai* of the cupboard. The figure is an anthropomorphic with a hollow head and arms bent and placed on the hips. The figure is 15 cm x 16 cm.

Site 50-10-63-20420
This site is comprised of an enclosure (T109) and a "J"-shaped wall (T110) (Figure 14). The enclosure is built in a flat area between *pāhoehoe* outcrops. The floor of the structure is very roughly paved with core-filled walls generally 0.5 m thick. In the western interior is a slab-lined pit (Feature 1). The pit was excavated (EU-1) and included historic artifacts, bone, charcoal, marine shell, and *kukui* nut. The inside dimensions of the feature are 2.25 m x 1.75m x 0.5 m high; the entire feature is 3.4 m x 3.0 m. A quarried area along the *pāhoehoe* is located just north of the feature. The wall is placed just to the west of the enclosure. It is 3.25 m x 1.5 m and open to the south. The wall ranges in height from 0.2 m to 0.5 m and is a total of 3 courses. The site is a total of 10 m x 2 m.

Site 50-10-63-20421
This site (T111) is composed of an earth filled enclosure located on *pāhoehoe*. A dry stacked *pāhoehoe* wall on the west side of the feature encloses a partially earth-filled flat area. The interior of this area has rock (up to 0.15 m high), apparently from a partial wall collapse. The wall stands as high as 0.65 m on the west side and 0.45 m high on the east. The size of the feature is 8 m N/S x 6 m E/W.

Site 50-10-63-20422
This site is composed of a C-shape (T112), a terrace (T115), and two petroglyphs (T139 and T140). The C-shape is 7 m x 7 m and is composed of a *pāhoehoe* wall situated on a *pāhoehoe* bedrock. The wall is located on the north side of the feature, effectively sheltering the area from the winds. The wall is generally intact but it is slightly collapsed on the south/southeast portion. The C-shape is higher on the southeast end (75 cm) and lower (30 cm) on the northwest. The site area is a total of 22.5 m x 3 m.

The terrace is composed of a scalloped shaped rock filled area that abuts a *pāhoehoe* outcrop on the east side. The feature is flattened on the top surface and is raised on the west side. The entire feature is
2.3 m x 2 m x 0.7 m high.

The first petroglyph (T139) is composed of two small cupules (4 cm x 4 cm) and a half-circle (4 cm x 6 cm). The second glyph (T140) consists of two "D"s, a "U" and a "P" incised with metal tools.

Site 50-10-63-20423
This site consists of an *ahu* (T113) constructed on top of a *pāhoehoe* tumulus**.** The *ahu* is disturbed and is constructed of eight somewhat scattered boulders. The feature is 1 m x 0.7 m x 0.2 m high.

Site 50-10-63-20424
This site is composed of two enclosures (T119 and T120) and a petroglyph (T141) (Figure 15). The first enclosure (T119) is square and constructed of roughly faced, core-filled walls opening *makai* with a width of 1 m. The enclosure is 3.2 m x 2.9 m x 0.7 m high. The feature abuts a tumulus (0.9 m high) on the north and east sides. The NW and SW walls are low, though the NE wall is 3 to 4 courses high. A slab-lined hearth (Feature 1) is located in the interior of the feature. The hearth was excavated (EU-1) and revealed mammal, fish bone, and charcoal.

The second enclosure (T120) is less well defined. It is essentially constructed of a low wall (60 cm) that forms the SE and western edges of the feature. A *pāhoehoe* rise encloses the area on the NE side.
The entire feature is 4.2 m x 4.5 m x 0.7 m high.

The petroglyph (T141) is located on the *pāhoehoe* between the two enclosures. It consists of two "P.'s; the panel is 14 cm x 15 cm. The entire site is a total of 7.5 m x 5.5 m in size.

Photo 11: Cupboard feature T108, Site 50-10-63-20419.

Site 50-10-63-20425
This site consists of a C-shaped shelter (T122). The feature is 3.7 m x 3.2 m x 0.75 m (height) and is comprised of mostly large piled boulders with smaller cobbles interspersed. Along the interior of the feature is a crescent shaped facing built with larger boulders. The feature is disturbed with rocks that have fallen into the interior of the sheltered area.

Site 50-10-63-20426
A large mound (T123) is the single feature at this site. The mound is high and circular and a total of 3.2 m x 3.4 m x 1.1 m (height) in size. The feature has some internal structure, with the central area marked by a ring of stones. The remainder of the feature is composed of small cobbles (3 cm x 5 cm) though some larger boulders are noted around the edge.

Site 50-10-63-20427
This site is a C-shaped shelter (T125) constructed along the outside edge of a lava blister, giving the feature added height and structural integrity. The interior of the structure is roughly faced with boulder sized rocks that are one to three courses high. The feature is 1.5 m x 1.5 m x 0.35 m high and is open at the *makai* end.

Site 50-10-63-20428
This site consists of a terrace (T126) and a wall (T128). The terrace is raised on the northeast and west sides and is rock filled. The south side of the feature is open and abuts a low *pāhoehoe* outcrop. The feature is paved in areas, but is generally roughly surfaced. The entire feature is 6.7 m x 4.5 m x 0.5 m high. The wall essentially encloses an area and is constructed along the edge of a *pāhoehoe* outcrop to give it added height (Figure 16). The wall is roughly stacked without facings. It is a total of 42 m x 17.7 m x 0.25-0.7 m high. The entire site is 45 m x 26 m in size.

Site 50-10-63-20429
This site is a C-shaped shelter (T127) up to three courses high and constructed of stacked *pāhoehoe* boulders (25 cm x 30 cm). The C-shape runs north to south with the outside edge positioned against the winds. Rock fall along the inside edge of the feature indicates some disturbance (the feature was probably up to 5 courses high at one time). The C-shape abuts an outcrop on the northwest side, but is otherwise on a flat, grassy surface. The feature is 2.8 m x 1.6 m x 0.6 m high. Figure 17 is a drafted map of the C-shape and surrounding agricultural features (Site 50-10-63-20436).

Site 50-10-63-20430
This site consists of an “L”-shaped wall (T131). The long arm of the “L” is fairly straight and stacked three courses high. The northeast side, along with the small arm of the “L” is collapsed and only 1 to 2 courses high. The wall is 4.5 m x 1.5 m and up to 0.55 m high on the southwest side.

Site 50-10-63-20431
This site is composed of two partially collapsed C-shaped shelters (T132). The features are on the edge of two quarried agricultural pits. The *mauka* C-shape is as high as 0.9 m from the floor of the pit and 0.45 m high on the east side of the wall. The *makai* C-shape is 0.55 m high from the floor of the pit and 0.40 m high on the east side. The C-shapes are 2.8 m x 1.6 m x 0.45 m high and 2 m x 1.5 m x 0.4 m high, respectively. The entire site is a total of 6.5 m x 2.2 m in size.

Site 50-10-63-20432
The site consists of a cave (T133) with a shard from a blue and white Asian ceramic bowl and shell midden. The cave has two entrances, both of which were quarried. The main chamber of the cave is about 6 m x 7 m (*mauka/makai*) with a maximum ceiling height of 0.85 m. The entrance is 0.4 cm high. Water was dripping from the ceiling within the cave on a relatively dry day.

Site 50-10-63-20433
The site consists of a terrace (T134) and an enclosure (T135). The paved central portion of the enclosure is an average of 0.32 m below the existing walls, which are partially collapsed. Wall facings are evident in some places with a wall thickness between 0.4-0.5 m. Rocks used for the walls are as large 25 cm x 30 cm x 50 cm. The structure is 11.5 m x 9.5 m x 0.55 m high.

Site 50-10-63-20434
This site consists of four petroglyphs. T143 is a cryptic panel pecked into the side of a *pāhoehoe* tumulus. T144 a is a cryptic figure shaped like a “C.” T144b is a series of historic lettering with an “E” followed by a “B”, “A” and “B”, and an unknown letter (Photo 12). These letters are difficult to decipher though they are well incised into a flat *pāhoehoe* surface. The remaining petroglyph (T144c) consists of a square and a circle.

Photo 12: Historic petroglyph Feature T144b, Site 50-10-63-20434.

Site 50-10-63-20436
This feature complex is composed of 190 features including an alignment, cobble mounds (12), filled cracks (9), filled depressions (6), mounds (145), modified outcrops (10), pits (3), terraces (2) and two terraced slopes. The features are designated as T114, T116-T118, T121, T124, T129, T130, T136, T201-228, T230-374, and T385-T391. The site is a total of 650 m long x 30 m wide.

Site 50-10-63-20439
This site including mounds (3), filled depressions (2), and a filled crack. These features are designated as T375-T380. The entire site is a total of 30 m x 15 m in size.

Site 50-10-63-20440
This site consists of feature complex including mounds (5), filled cracks (2), a filled depression, and a modified outcrop. The features are designated T381-T382; and T392-T398. The entire site is 40 m x 14 m wide.

Site 50-10-63-20441
Four features including three mounds and a filled crack (T383-T384, T386 and T399). The entire site is 21 m x 18 m in size.

Figure 7. Drafted fold-out map of Site 19461, western portion.

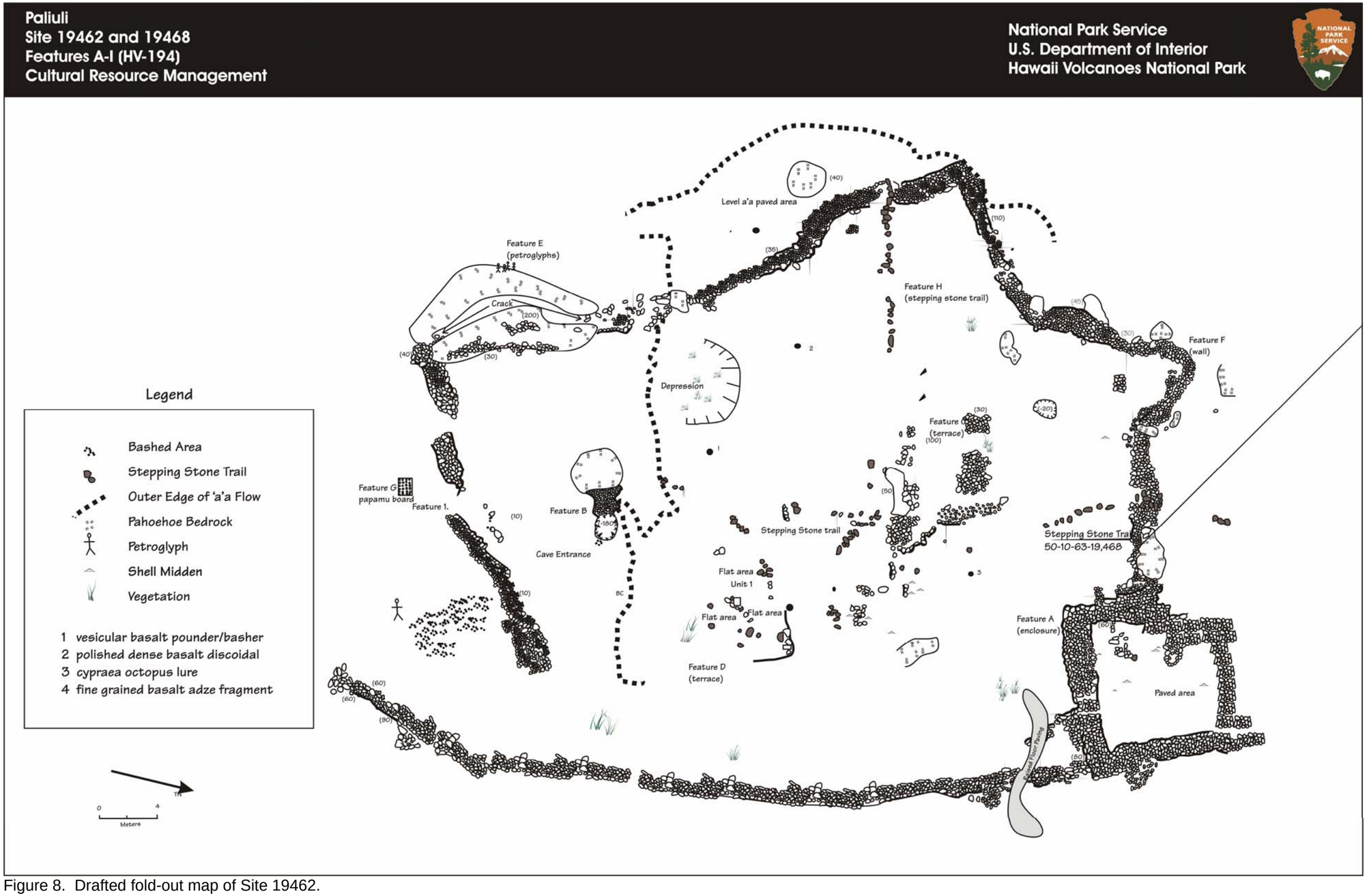

Figure 8. Drafted fold-out map of Site 19462.

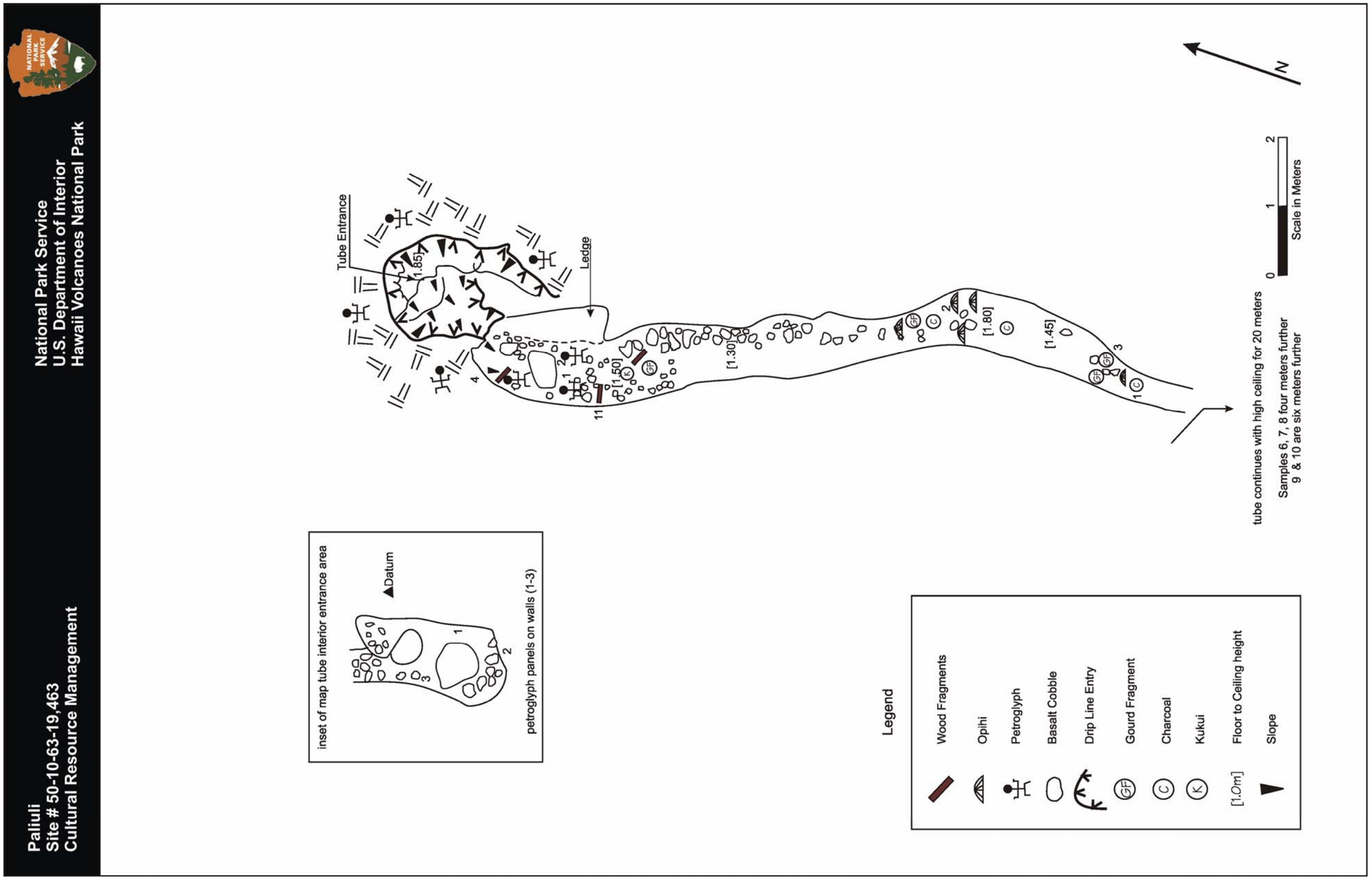

Figure 9. Drafted map-showing Site 19463 petroglyph and water cave.

Although this map was originally identified by the authors for inclusion in the final report and a draft map was presumed to have been completed, no map was found during the finalization of this report in 2006. Therefore, this image is missing from this final report.

Figure 10. Drafted map of 50-10-63-19464 water, gourd and burial cave.

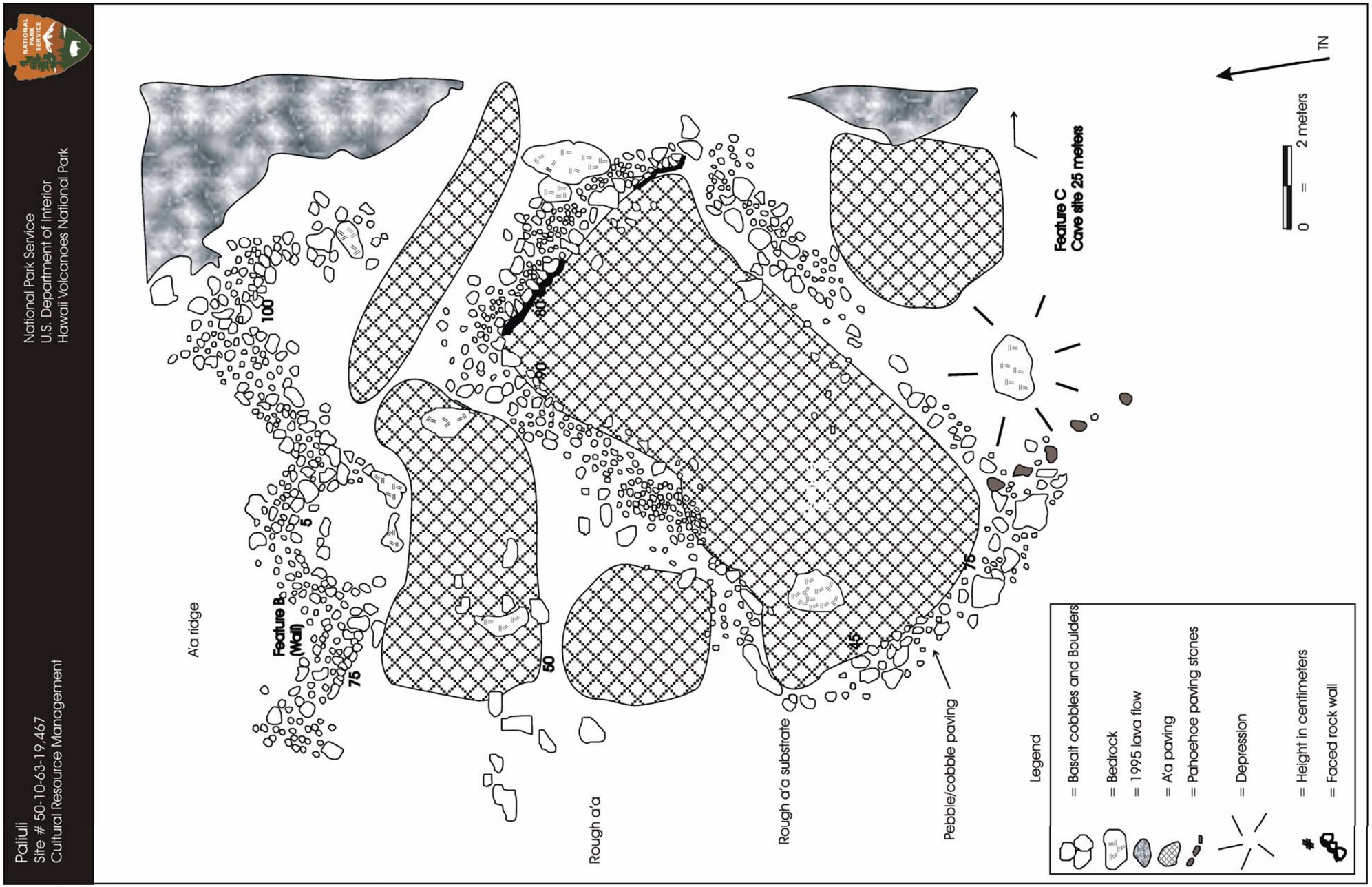

Figure 11. Drafted plan view of selected features at Site 50-10-63-19467.

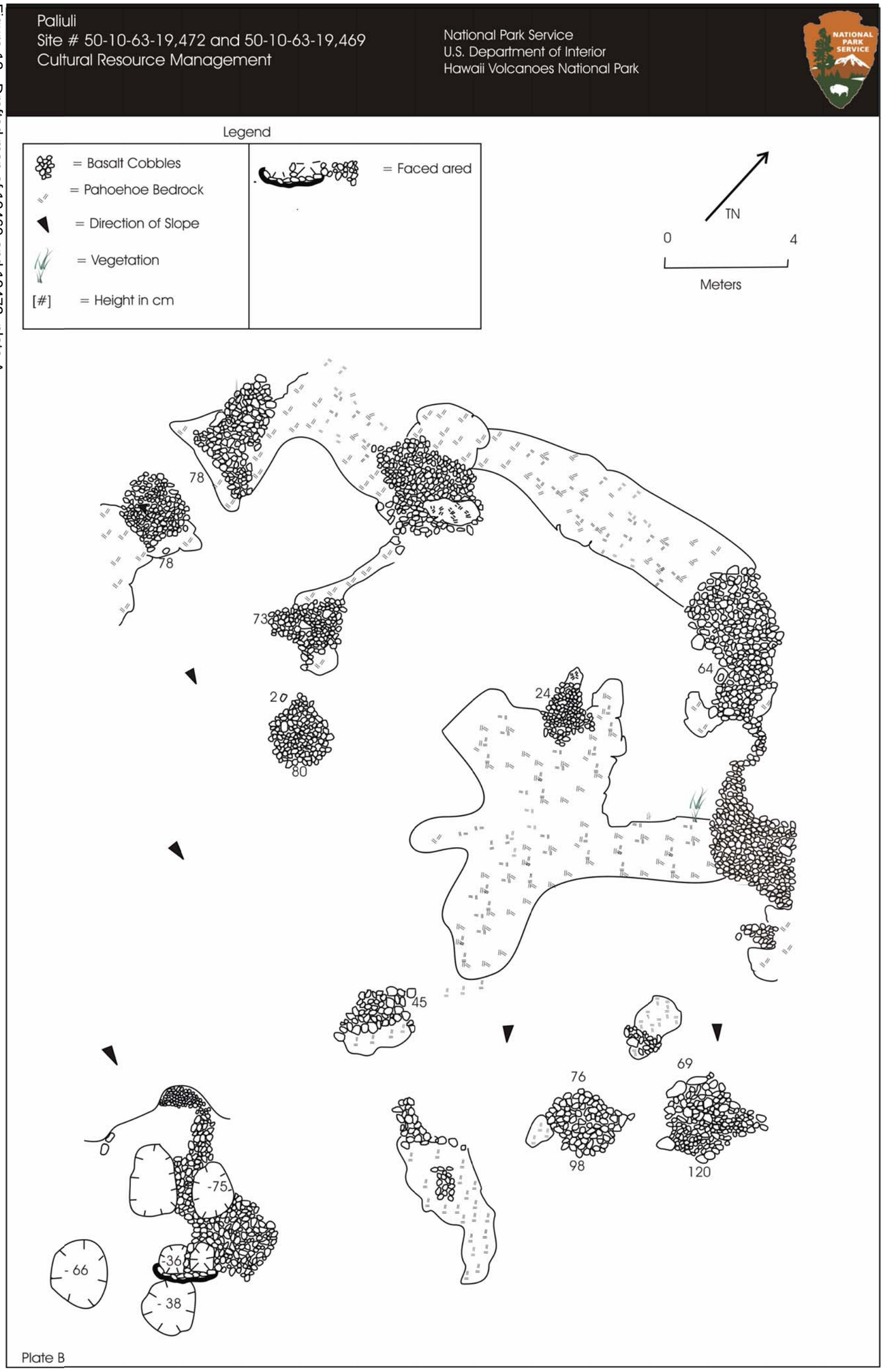

Figure 12. Drafted map of 19469 and 19472, plate A.

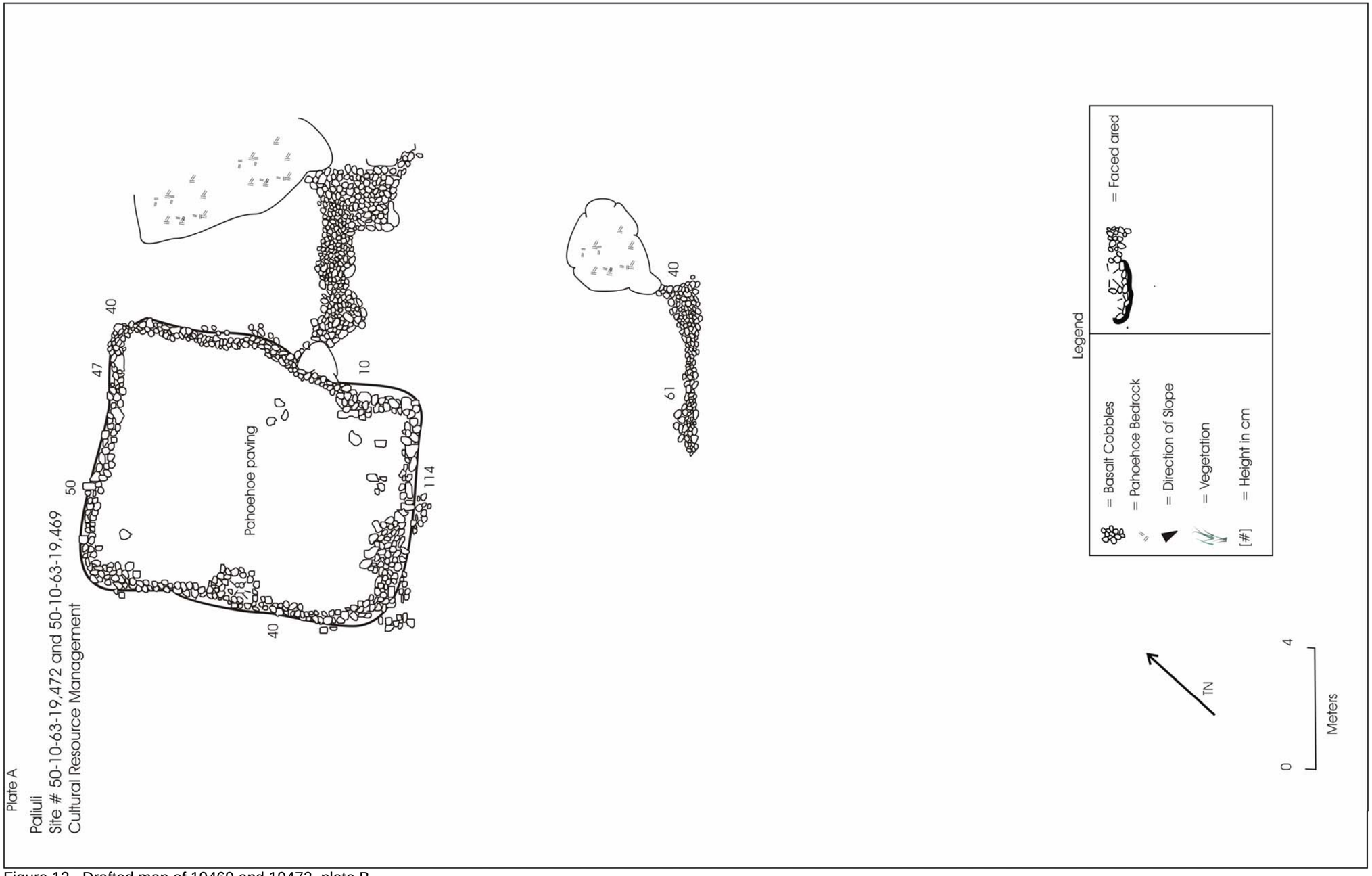

Figure 12. Drafted map of 19469 and 19472, plate B.

Figure 13. Drafted Map of T108 Cupboard; Site 50-10-63-20419.

Figure 14. Drafted map of Site 50-10-63-20420.

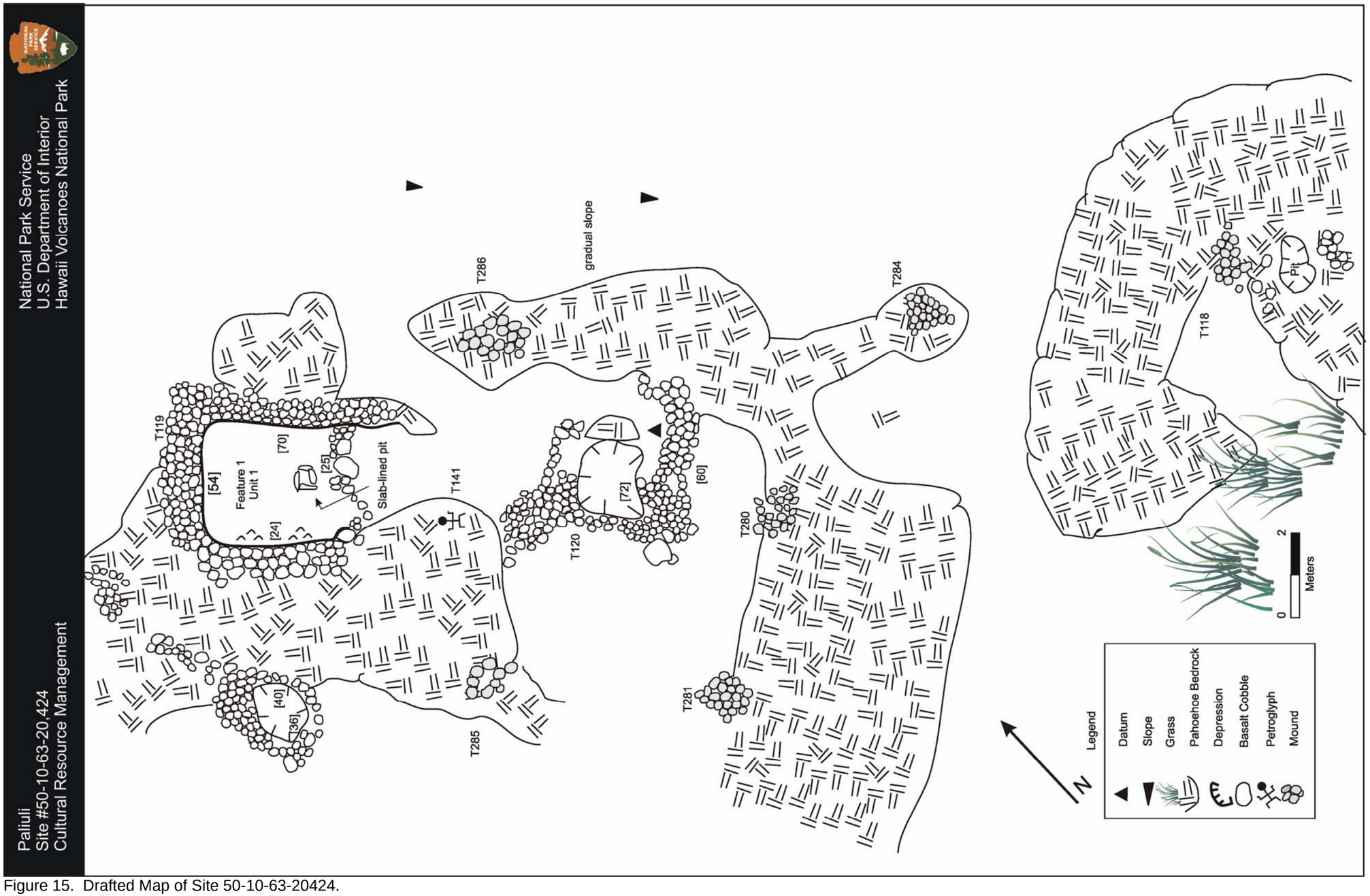

Figure 15. Drafted Map of Site 50-10-63-20424.

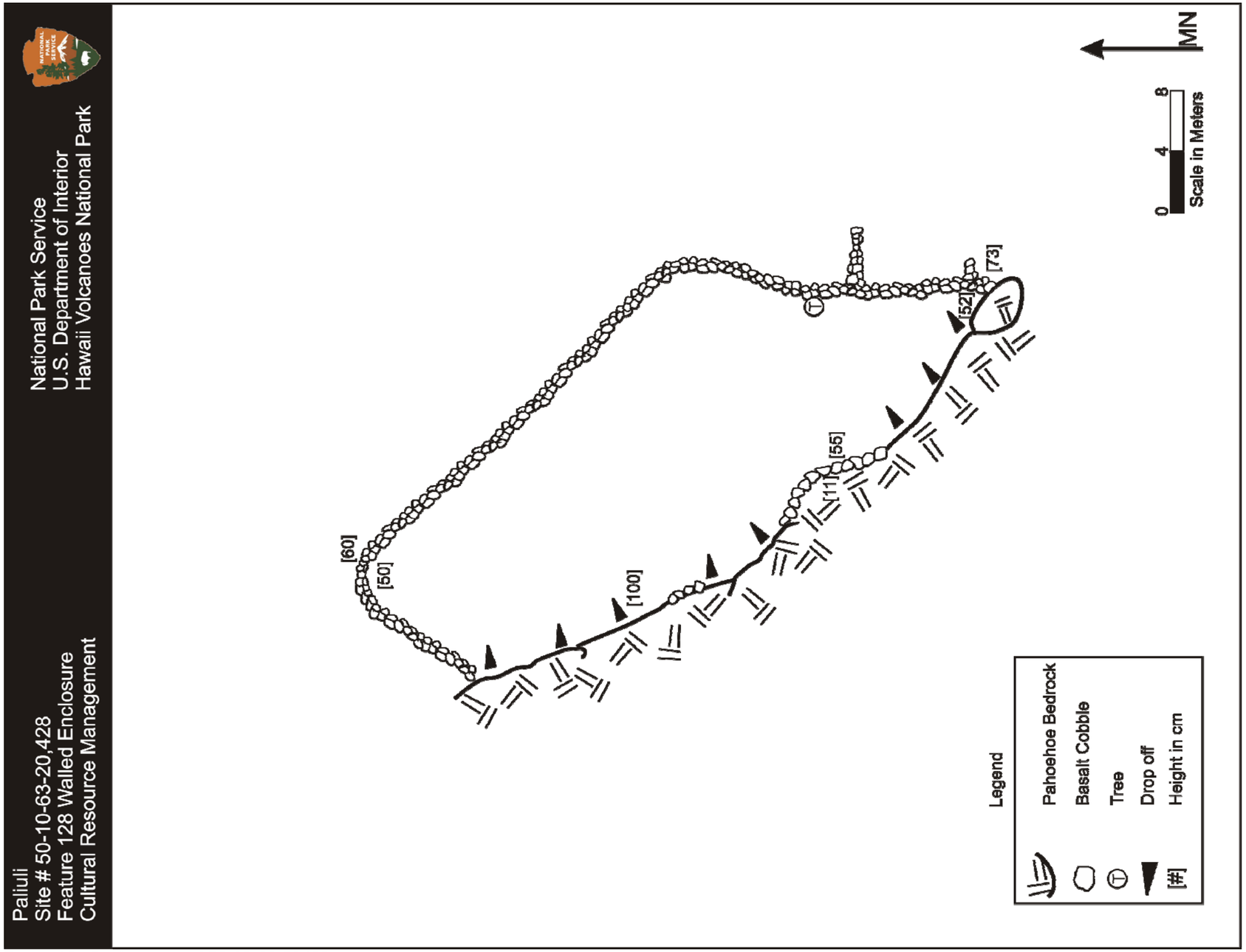

Figure 16. Drafted map of 50-10-63-20428.

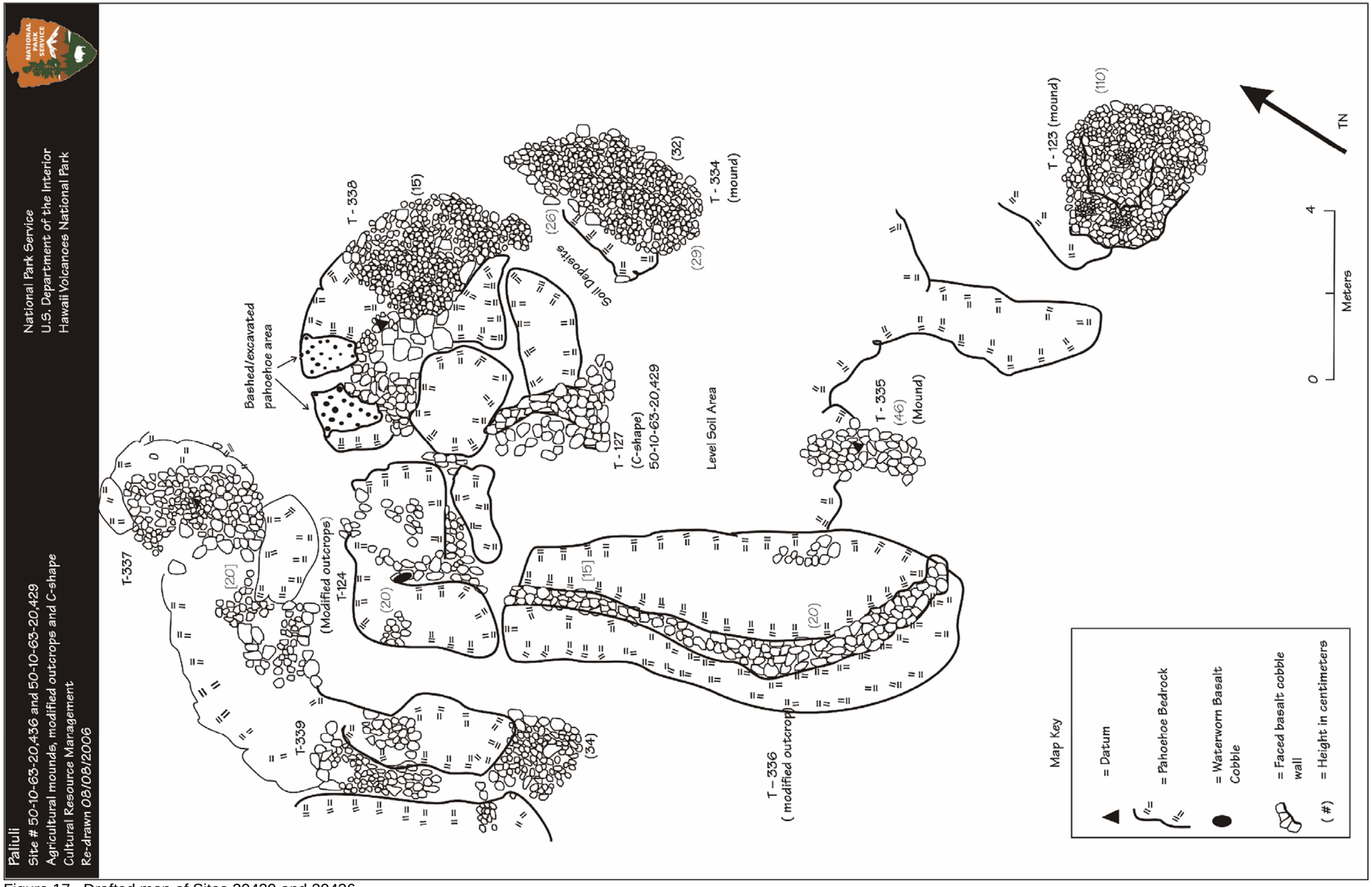

Figure 17. Drafted map of Sites 20429 and 20436.

CHAPTER 3. EXCAVATIONS

Limited excavations were conducted within the project area. This was due to financial concerns and the extreme difficulty of removing samples from the field. The hiking time from the project area to the Chain of Craters Road was a minimum of 45 minutes. In the *mauka* portion of the transect area, the time for the hike out was over an hour long. In addition, the difficult terrain, including the necessity of climbing up and down the steep Paliuli Pali edge with a rope, limited our ability to remove samples, particularly bulk soil samples, from the field. Patricia Spears directed excavations within the Phase I area. Catherine Glidden supervised excavations in the Phase II Area.

A total of 14 units were placed within both the Phase I and Phase II areas (Table 6). All of the excavations were conducted with respect to natural stratigraphic layers. Ten centimeter arbitrary levels were further used for added control. Units were numbered consecutively beginning with EU-1 at each site. Six component features were excavated. These are summarized in Table 7.

Unit EU-8, which was placed in a slab-lined pit at 50-10-63-19461, Feature A, was not excavated with the same care and attention as the other excavation units. The feature was excavated with respect to stratigraphic layers, though levels were not used. Unit EU-8 was excavated prior to the beginning of the project when the 1995 lava flow was still active, and was located about 20 meters east of the flow. At the time, it was believed that the entire site would be lost. Thus, the slab-lined pit was excavated primarily in order to remove potentially important artifacts necessary to date the site. This feature did in fact produce the highest concentration of historic artifacts from the entire project area. These artifacts were bagged with the associated provenience noted.

Excavations were first conducted to determine the temporal range for the project area. The second purpose was to determine if the area was inhabited on a semi-permanent or permanent basis. Third, the excavations were conducted to determine what kinds of subsistence activities were being conducted. Fourth, it was hoped that the excavations would reveal to what extent the sites within the project area were contemporaneous and subsequently related. This final question was tackled through excavation of both habitation and agricultural features.

Only two units were excavated within the Phase II Area. Both units were placed in habitation enclosures with central slab-lined pits. These excavations were primarily conducted to obtain charcoal samples for dating. In addition, it was hoped that the range of artifacts and midden material would reveal information concerning subsistence activities in the *mauka* sections of the transect. No excavation units were placed within the more numerous agricultural features due to financial limitations. It was hoped, at the time of this project, that future work in the area would include excavation of at least one of each agricultural feature type. However, subsequent lava flows in the area have covered most of the sites and this goal is no longer possible.

Excavations Units

Phase I Area

Site 50-10-63-19461

EU-1: This 0.5 m x 0.5 m unit was placed in the center of a soil filled area within a circular, low-walled stone enclosure, open at the *makai* end (Feature C). This location was chosen under the assumption that the area would reveal charcoal, midden and other habitation related materials. Only one layer was encountered within the unit. The soil-filled area was quite shallow and *pāhoehoe* bedrock was reached at 3 cm. b.s. in the northwest corner. *Kukui* nutshells, marine shell, metal fragments, glass, fish, avian, and other small and/or medium vertebrate bone, marine shell, and charcoal flecks were removed from the excavation unit.

> Layer I: 0-3/19 cm. b.s. No Munsell. Fine, dark brown silts.

EU-2: This 1 m x 0.6 m unit defined the edge of a natural crack in the *pāhoehoe* located just west of Feature A platform. The unit was excavated, as the crack appeared to be a trash pit. A number of small boulders were lodged within the crack effectively sealing the area and were removed. Removal of these boulders indicated the presence of a soil filled midden area, with historic artifacts such as glass sherds dated to the 19th century and machine cut nails dated to post 1800 A.D. Also found were mammal bone, *kukui* nutshell, marine shell, crab, and charcoal. One single layer contained cultural material all the way to the base of the unit. The crack was identified as a feature and designated as Feature 2.

> Layer I: 0-15cm. b.s. Silt soil with charcoal throughout entire layer. Dry Munsell 10YR 2/1:black. Wet Munsell 10YR 2/1:black. Soil dry consistence is soft: weakly coherent. Soil dry consistence is very friable. Soil moist consistence is slightly sticky. Soil is nonplastic. Soil peds are very fine-grained and weak in structure.

EU-3: A 0.5 m x 0.5 m unit was placed in enclosure Feature B. This unusual feature consists of a retaining wall 0.9 m high which extends on the *makai* end into a vaguely rock defined enclosure. Only one layer was encountered in this unit. A number of historic items such as machine cut nails and unidentified metal fragments were recovered beginning with the first level. Other items recovered include fish, and mammal bone, *kukui* nutshells, charcoal, crab and marine shell.

> Layer I: 0-16/23 cm. b.s. Sandy and gravely silt loam soil. Dry Munsell 10YR 3/2:very dark grayish brown. Wet Munsell 10YR 2/1:black. Soil dry consistence is extremely hard. This is primarily due to the abundance of sand and gravel in the soil. The moist consistence is firm; wet consistence is slightly sticky. Plasticity is not noted. Soil peds are very fine-grained crumb in type and weak in structure.

EU-4: A 0.5 m x 0.5 m unit placed in the center of a linear rock terrace (running northeast to southwest), believed to have been utilized agriculturally. The excavation was placed in this particular area to determine the time period for agriculture activities and to collect pollen samples for identification (ID). This small unit was enlarged to a maximum 0.5 m x 0.6 m as larger boulders prevented excavation to the surface below the *makai* terrace facing. Relatively little soil was removed from the rock filled terrace. Boulders 25 cm in diameter were removed along with some cobble fill in the center of the terrace. Below the rock fill of the terrace was what appeared to be a cultural layer without historics. This layer included marine shell, *kukui* nutshell, charcoal, mammal, fish and avian bone. The layer has been dated to within a 2 sigma range from A.D. 1665 to 1950 A.D. by Beta Analytic Inc. (See Table 8 for C14 dates). In addition, a pollen sample (Sample 3069) obtained from layer II at 72 cm. b.s. was sent to Jerome Ward for analysis. He found the soil to be devoid of agricultural cultigens. The soil did include an *Asteraceae* (Lophate type) grain dated to the post-contact period (Appendix B). It is possible that Layer II represents a habitation surface utilized prior to construction of the terrace feature.

> Layer I: 0/3-62 cm. b.s. Dry Munsell 7.5YR 2.5/1:black. This layer consisted mostly of subangular, boulder sized *pāhoehoe* rocks noted along the surface and smaller cobble fill within the first 25 cm; minimal soil was removed. Below the cobble fill were placed larger boulders at the very base of the rock layer. Two small *'opihi* shells were found within the layer.
>
> Layer II: 62-72 cm. b.s.: Dry Munsell: 5YR 2.5/1:black; wet Munsell 10YR 2/1:black. A granular silt loam soil layer noted below the rock terrace. Soil dry consistence is loose; moist consistence is very friable; wet consistence is slightly sticky. Soil is nonplastic. Soil peds are very fine-grained and crumb in type. Of note within this layer is the beginning of a fair amount of cultural material devoid of historics including fish, rat and bird bone, charcoal, marine shell and *kukui* nutshell.

EU-5: A 0.5 m x 0.5 m unit was placed in the center of Feature H, a small, circular high-walled enclosure, probably used as a storage facility. The excavation proceeded in order to rule out the possibility that the feature functioned as an agricultural planting structure. The feature consisted of two layers though the second layer was sterile. All of the cultural material was found within the first 20 cm, with the densest concentration within the first 10 cm. The cultural material included volcanic glass flakes, mammal bone, unidentified metal fragments, and charcoal.

> Layer I: 0-34 cm. b.s. Dry Munsell 7.5YR 3/3: dark brown; wet Munsell 10YR 2/2: very dark brown. Soil is a gravely silt loam. Dry consistence is loose; moist consistence is loose; wet consistence is slightly sticky. Soil is nonplastic. Soil is structureless with very fine crumb type peds.
>
> Layer II: Unexcavated, sterile layer.

EU-6: This "unit" actually consisted of a mound 1.3 m in diameter that was bisected in half. Two soil layers (Layer II and III) were encountered beneath the mound. The mound itself was Layer 1. The purpose of excavating this feature was to determine the function of the mound, and to collect pollen samples for ID. Of particular interest was whether this and the other numerous mounds in the region were constructed to clear the area of rock or were used as actual agricultural planters. Unfortunately, a pollen sample (Sample 3078) taken from Layer III beneath the mound was found to be negative for agricultural cultigens of any kind (See Ward, Appendix B). A profile of the unit stratigraphy is presented in Figure 18.

Layer I: 0-28/35 cm. b.s. Rocks from mound.

Layer II 28/31 -38/41 cm. b.s. Dry Munsell 10YR 2/1: black; wet Munsell 10YR 2/1. Soil is silt loam. Dry consistence is soft; moist consistence is friable; wet consistence is slightly sticky. Soil is slightly plastic with weak to moderate, fine crumb peds.

Layer III: 31/41-36/51 cm. b.s. Munsell 7.5YR 3/2: dark brown. No soil description.

EU-7: A 0.5 m x 0.5 m unit placed in a soil-filled area just *makai* of a linear terrace feature. This feature was initially placed in this location to collect soil for pollen ID. The pollen sample (Sample 3088) was analyzed by Ward and did not indicate agricultural activities. Numerous flakes and cores of poor quality volcanic glass were found just below the surface. Small flecks of charcoal were noted throughout the grainy, dark brown soil matrix from Layer II. The unit revealed two layers and was devoid of historic cultural material. The presence of both volcanic glass and charcoal are good indicators that the terrace was used for agricultural purposes.

Layer I: 0-10 cm. b.s. Mostly soil with some rock. Wet and dry Munsell 10YR 2/1:black. Soil dry consistence is loose; moist consistence is friable; wet consistence is slightly sticky. Soil is slightly plastic. Soil has a moderate ped grade and consists of very fine to fine crumb type peds.

Layer II: 10-28 cm. b.s. Munsell 5YR 2.5/2:dark reddish brown. Granular dark brown/orange loam excavated down to bedrock.

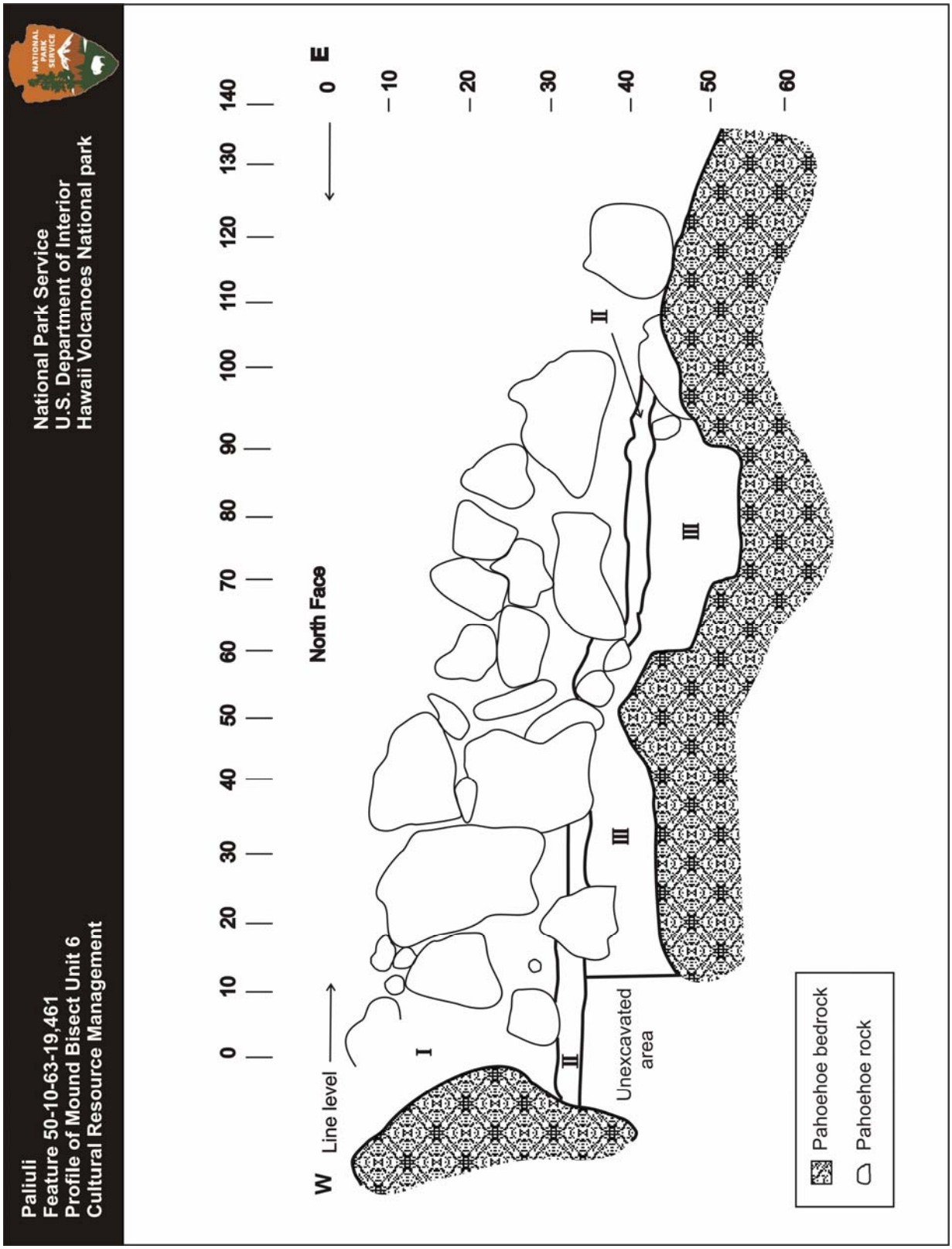

Figure 18. Profile of mound bisect unit 6 Site 50-10-63-19461.

EU-8: This 0.5 m x 0.3 m unit was placed within an oval slab-lined pit (Feature 1) within platform Feature A. The area of the feature itself defined the size of the unit. This unit was not excavated with respect to levels though notes on stratigraphy were taken. Only two layers were noted within the unit. A large number of historic items were removed from the unit including ceramics, metal nails, buttons, a clay pipe stem, and glass beads. Most of the items date from the mid 19th to the 20th century. In addition, avian, mammal and fish bones, and charcoal, marine shell, and *kukui* nutshell were collected.

> Layer I: 0-70 cm. b.s. Rock and boulder fill with silt loam soil and some organic leaf material. Most of the historics found within this layer. Dry Munsell is 10YR 3/2: very dark brown. Wet Munsell is 10YR 2/1:black. Soil dry consistence is loose; moist consistence is loose; wet consistence is slightly sticky. Soil is slightly plastic. Soil grade is structureless with very find crumb type peds.
>
> Layer II: 70-80 cm. b.s. Less cultural material noted. Soil is a gravely sandy loam. Dry Munsell is 10YR 2/2: very dark brown; wet Munsell is 10YR 2/1:black. Soil dry consistence is soft; moist consistence is firm; wet consistence is slightly sticky. Soil is slightly plastic. Soil has moderate ped structure with fine, crumb type peds.

Site 50-10-63-19462

EU-1: A 0.5 m x 0.5 m unit was placed in a soil filled area toward the center of terrace Feature D. The area appeared to be a living floor as it was relatively level and yielded marine shell, echinoderm, *kukui* nutshell, charcoal, fish and other small and/or medium vertebrate bone. The unit was excavated to a depth of 40 cm. b.s. Below Layer 1 was another layer consisting of packed *'a'ā* rock that was not excavated.

> Layer I: 0-40 cm. b.s. Most of the cultural material was noted in the first 20 cm. Soil is a sandy loam. Dry and wet Munsell are 10YR 2/1:black. Soil dry consistence is hard; moist consistence is very firm; wet consistence is slightly sticky. Soil is slightly plastic. Soil grade is moderate with fine, blocky peds.

EU-2: An additional 0.5 m x 0.5 m unit was excavated in terrace Feature D. This unit was placed toward the north part of the feature. Numerous rocks were removed as part of the terrace structure. A number of *'a'ā* rocks were located on the surface between the soil fill. The unit consisted of only 1 layer. Below this layer were tightly packed *'a'ā* rocks with a reddish color. Layer I yielded *kukui* nutshell, echinoderm, fish scales, fish bone, shell midden, volcanic glass, and charcoal.

> Layer I: 0-30 cm. b.s. Dry and wet Munsell are 2.5Y 2.5/1:black. Soil is a sandy loam with fewer rocks than EU-1. Soil dry consistence is hard; moist consistence is very firm; wet consistence is slightly sticky. Soil is slightly plastic. Soil grade is moderate with

fine, blocky peds. Midden density was greatest within the first 15 cm. b.s., though fish bone was only identified below 15 cm. b.s.

EU-3: This 0.25 m x 0.5 m unit was placed against a large bedrock boulder within cave Feature B**.** Cobble size roof fall rocks were first removed from the surface. Dense charcoal with echinoderm, marine shell, mammal, and fish bone was excavated and recorded as Feature 1, a probable hearth. The unit was fairly shallow and consisted of a single layer.

Layer I: 0-13 cm. b.s. Soil within the first 5 cm consists of charcoal blackened silt loam. Dry and wet Munsell is 2.5Y 2.5/1:black. Soil dry consistence is soft to slightly hard; moist consistence is friable; wet consistence is slightly sticky. Soil is slightly plastic. Ped grade is weak to moderate. Peds vary in size between very fine and fine, and are crumb in type. Layer I includes Feature 1 Upper which consists of the first 5 cm. Feature 1 Lower consists of soil within 5 to 8 cm. b.s. In parts of the unit, Feature I Lower continued to a depth of 13 cm. b.s.

EU-4: This "unit" actually consisted of a mound that was bisected inside Feature B, a cave. The mound consisted of cobble sized rock and was located just east of the northwest entrance to the cave. The rock mound was 2 m x 1.75 m in diameter and 0.6 m high. Within the rock mound, approximately 8 cm below the top of the mound, was a lens of charcoal; ash and fire affected rock. In addition, shell midden, bone and a basalt flake were found within the unit. The mound was defined as a hearth area and named Feature 2. The entire feature was excavated with five layers evident. The depth of collected material was noted as "above" and "below" ash lens. The profile for EU-4 is presented in Figure 19.

Layer I: 0-8 cm. b.s. Charcoal blackened silt loam soil with charcoal and cobble sized rock. Dry and wet Munsell 2.5YR 2.5/1:black. Soil dry consistence is slightly hard; moist consistence is friable; wet consistence is slightly sticky. Soil is slightly plastic to plastic. Peds are weak, with a very fine crumb type. Large charcoal fragments were noted directly beneath the layer.

Layer II: 8-10 cm. b.s. Ash lens with loam soil. Wet Munsell 2.5Y 2.5/1:black with 2.5Y 7/2:pale yellow ash inclusions. Moist consistence is firm; wet consistence is sticky. Soil is slightly plastic. Soil grade is weak with very fine crumb type peds.

Layer IIIa: 10-25 cm. b.s. Charcoal ash and silt loam soil. Dry Munsell 7.5YR 2.5/2: very dark brown; wet Munsell 7.5YR 2.5/1:black. Soil dry consistence is soft to slightly hard; moist consistence is firm; wet consistence is slightly sticky. Soil is slightly plastic. Soil grade is moderate with fine to medium sized blocky peds.

Layer IIIb: 25-40 cm. b.s. Fire-affected rocks and charcoal chunks.

Layer IV: 40-46 cm. b.s. Charcoal, marine shell and limited fire affected rock. Charcoal from this layer (40 cm. b.s.) was sent to Beta Analytic Inc. for analysis. The charcoal yielded a 2 sigma calibrated C14 age range of 1450 A.D. to 1950 A.D. (See Table 8).

Phase II Area

Site 50-10-63-20420

Feature T109

EU-1: A 0.5 m x 0.5 m unit was placed to fit within a slab-lined pit feature within enclosure feature T109. The pit was identified as Feature 1**.** A number of rocks had fallen into the pit and needed to be removed before the excavation proceeded. A total of five layers were revealed within the unit. Figure 20 illustrates the plan views and profile for this unit.

Layer I: 0-10 cm. b.s. Hearth slabs and rocks removed from surface. Mostly disturbed rock layer.

Layer II: 10-14/16 cm. b.s. Fine loam to silty loam soil mixed with leaf litter. Dry Munsell is 10YR 3/1 very dark gray. Abundant charcoal was found throughout the layer. *Kukui* nuts, marine shell, and machine cut iron nails were also recovered.

Layer III: 14-19/26 cm. b.s. Dry Munsell is 10YR 3/ very dark gray. Compacted loam soil with small rootlets with iron fragments, *kukui* nutshell, marine shell, mammal and fish bone, charcoal, ash and fire affected rock.

Layer IV: 19-26/28 cm. b.s. No Munsell. Very fine, light gray ash mixed with small charcoal fragments. Echinoderm and marine shell collected.

Layer V: 26-61 cm. b.s. Munsell 10YR 2/1 black. Cobble mixed in with a sandy loam soil. Marine shell collected from this layer.

Site 50-10-63-20424

Feature T119

EU-1: A 0.5 m x 1 m unit was placed within paved enclosure feature T119. The unit was situated to include a slab-lined pit (Feature 1) and the area outside and to the west of the pit. Only 1 layer was encountered within the unit (Figure 21). Mammal and fish bones, marine shell, and charcoal were recovered from inside the pit area. No cultural material was found in the area outside the slab-lined pit.

Layer I: 0-20 cm. b.s. Wet Munsell 10YR 2/1: black. Soil is dark brown silty loam w/ abundant roots and rootlets. Soil color changed gradually at about 16 cm. b.s. with a grayer color and slightly increased clay content.

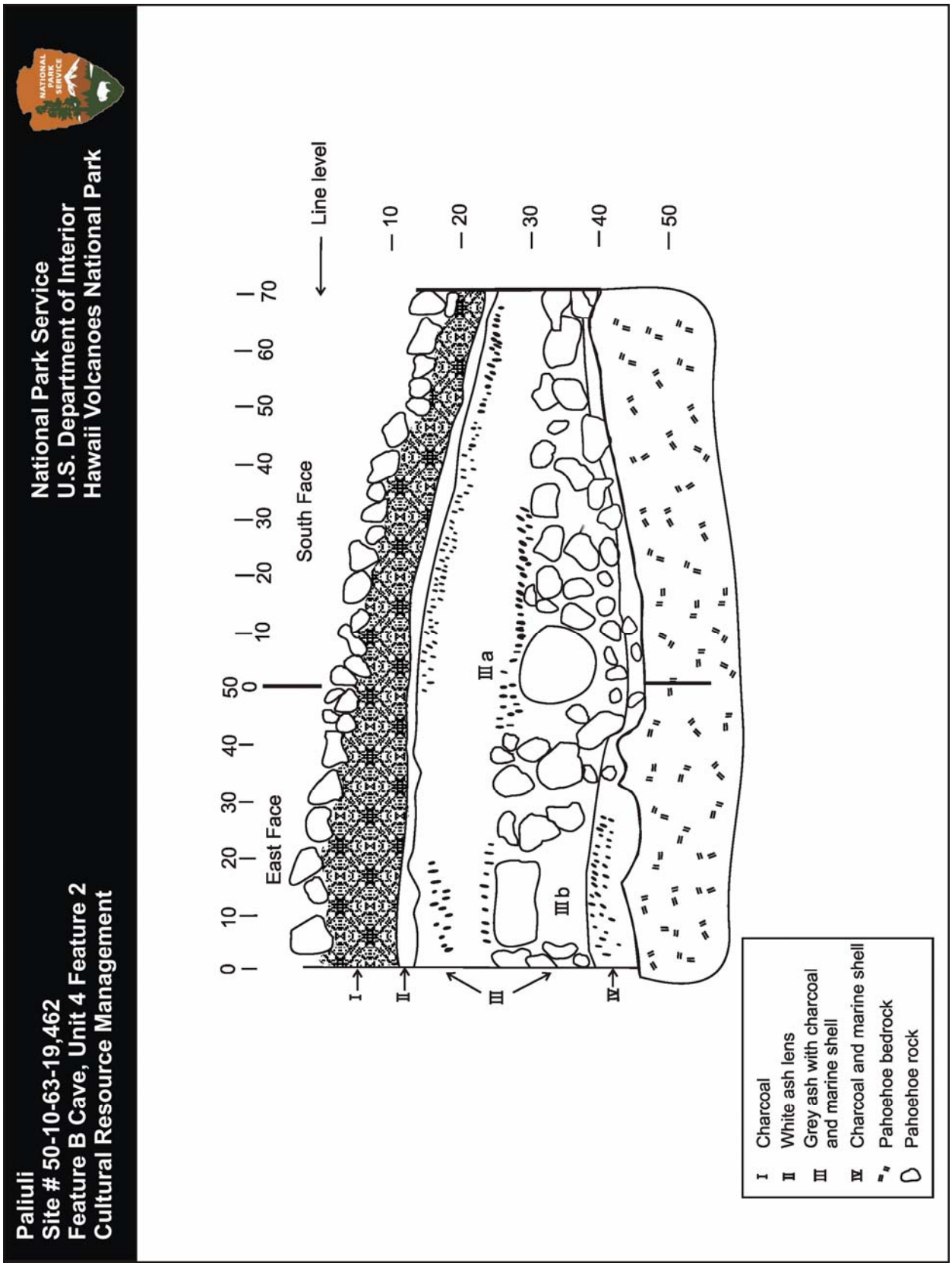

Figure 19. Profile for EU-4, 50-10-63-19462, Feature B.

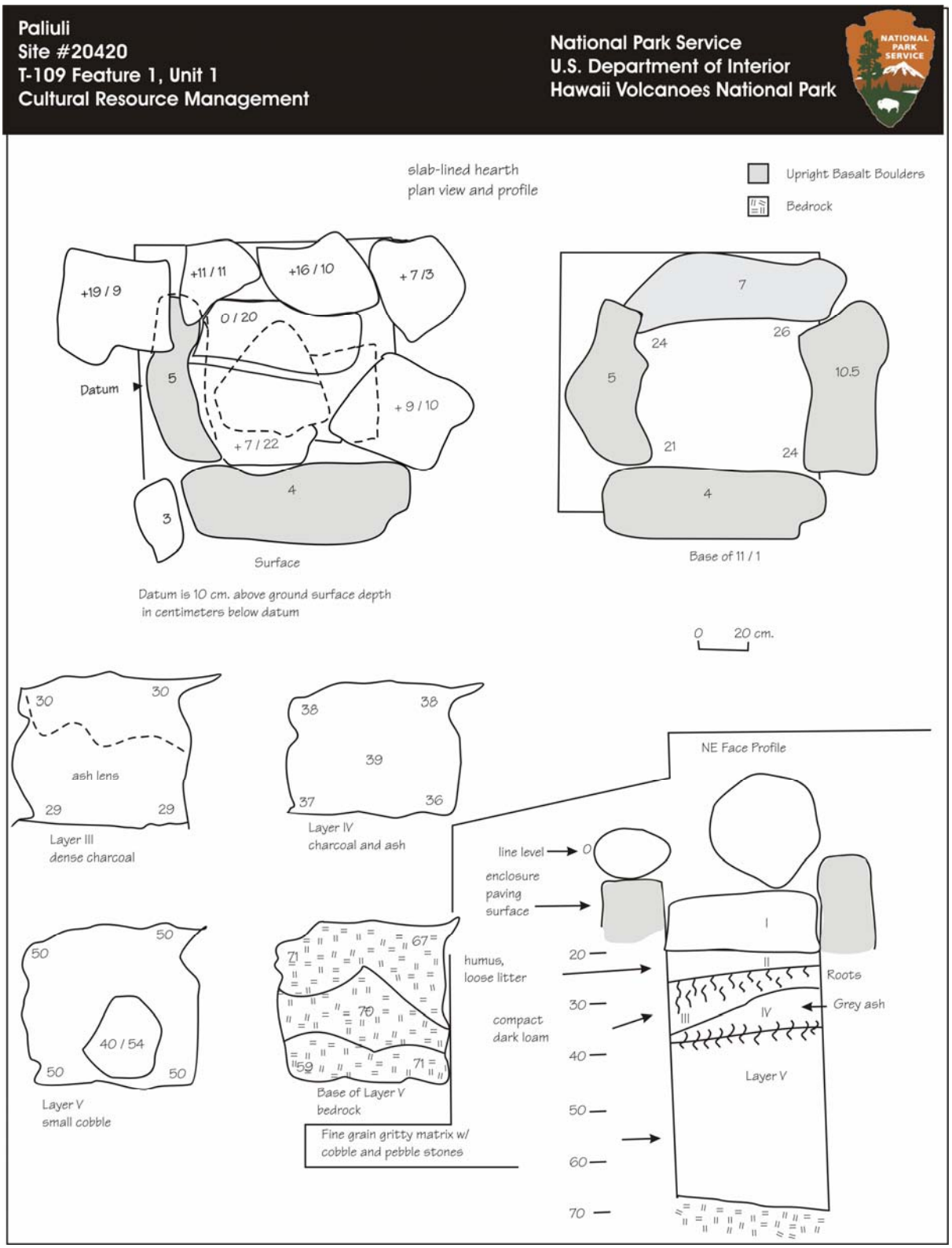

Figure 20. Profile and plan view for T-109 Feature 1, Unit 1 Site 50-10-63-20420.

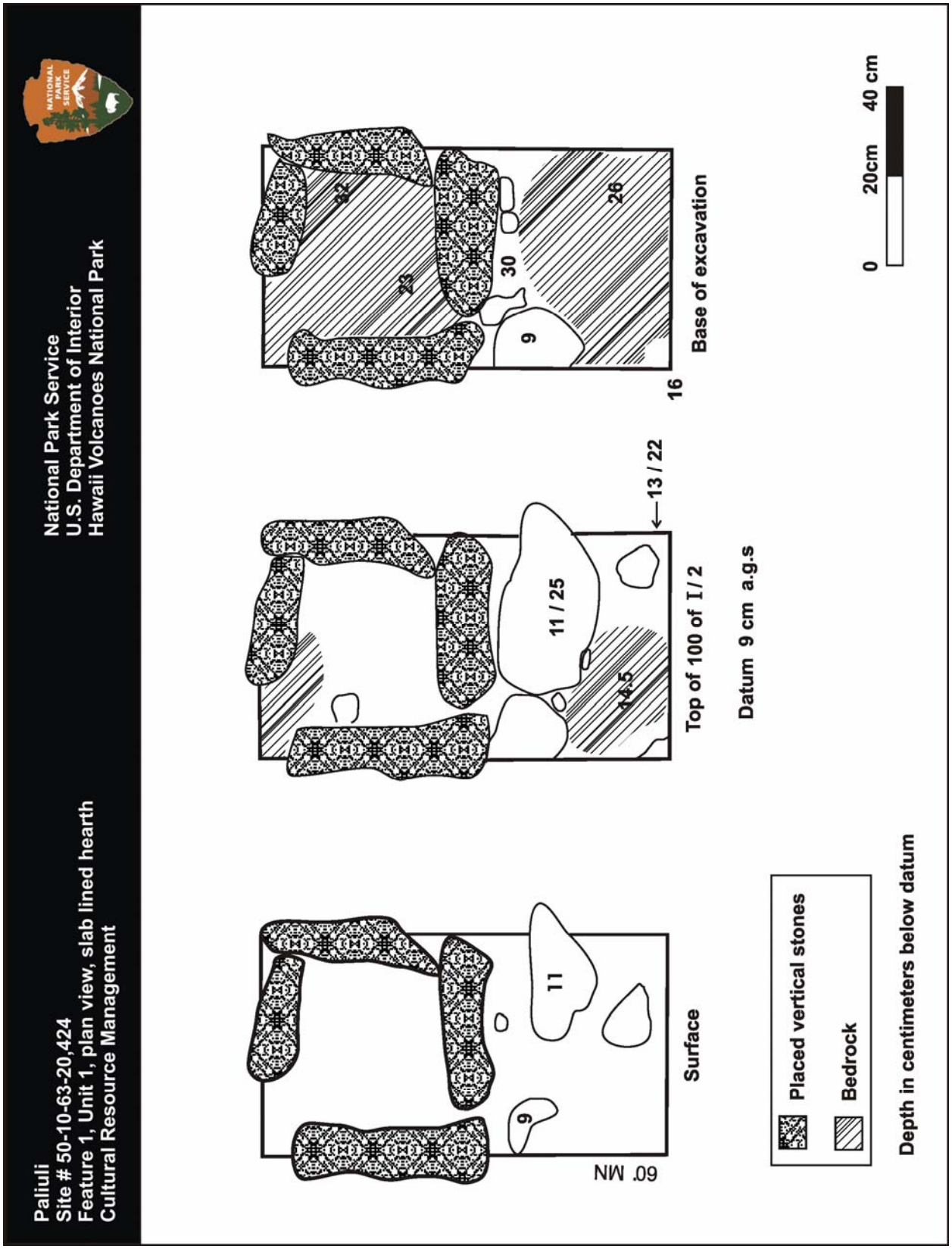

Figure 21. Plan view for EU-1, Feature 1, T119 Site 50-10-63-20424.

Table 6. Summary of Excavation Units within Project Area.

Area	Site 50-10-63	Feature	Feature Type	Unit	Size (m)	Material Collected
PHASE I	19461	C	Enclosure	EU-1	0.5 x 0.5	Historic artifacts, bone, *kukui* shell, marine shell, charcoal, and soil sample.
		2	Refuse Pit	EU-2	1 x 0.6	Historic and indigenous artifacts, bone, charcoal, marine shell, soil sample, and pollen sample.
		B	Enclosure	EU-3	0.5 x 0.5	Historic artifacts, bone, charcoal, and soil sample, *kukui* shell, and marine shell.
		-	Terrace	EU-4	0.5 x 0.6	Marine shell, bone, charcoal, *kukui* shell, soil sample, pollen sample.
		H	Enclosure	EU-5	0.5 x 0.5	Historic artifacts, volcanic glass, bone, charcoal, soil sample, pollen sample.
		-	Mound	EU-6	Bisect	Soil sample, pollen sample.
		-	Terrace	EU-7	0.5 x 0.5	Volcanic glass, charcoal, soil sample, pollen sample.
		A	Platform	EU-8	0.5 x 0.3	Historic artifacts, bone, charcoal, shell, *kukui* shell, soil sample, pollen sample.

Table 6. continued.

Area	Site 50-10-63	Feature	Feature Type	Unit	Size (m)	Material Collected
	19462	D	Terrace	EU-1	0.5 x 0.5	Bone, charcoal, marine shell, *kukui* shell, soil sample.
		D	Terrace	EU-2	0.5 x 0.5	Bone, charcoal, volcanic glass, *kukui* shell, soil sample.
		B	Cave	EU-3	0.5 x 0.25	Bone, charcoal, marine shell, *kukui* shell, soil sample, basalt flake.
		B	Mound in Cave	EU-4	0.5 x 0.7	Bone, charcoal, marine shell, basalt flake, soil sample, column sample.
PHASE II	20420	T109	Enclosure	EU-1	0.5 x 0.5	Historic artifacts, bone, charcoal, marine shell, *kukui* shell, soil sample.
	20424	T119	Enclosure	EU-1	1 x 0.5	Bone, marine shell, charcoal, soil sample.

Table 7. Summary of Excavated Component Features within Project Area.

Site Number 50-10-63 and Feature	Feature No.	Feature Type	Layer	Grid	Dimension (m)	Description and Comments
19461 Feature A Platform	1	Slab-lined Pit	I, II	EU-8	0.5 x 0.3	A pit lined with four, smooth waterworn boulders. Abundant historic artifacts, soil and midden.
19461	2	Refuse Pit	I	EU-2	1 x 0.6 Crack	A crack in the *pāhoehoe* which functioned as a refuse pit. A number of small boulders were lodged in the crack. Below rocks was dense midden material and charcoal.
19462 Feature B Cave	1	Burn Area	I	EU-3	Approx. 0.5 x 0.5 mound	A charcoal concentration with marine shell, *kukui* nutshell bone.

Table 7. continued.

Site Number 50-10-63 and Feature	Feature No.	Feature Type	Layer	Grid	Dimension (m)	Description and Comments
19462 Feature B Cave	2	Mound and Hearth	I	EU-4	2 x 1.75 x 0.6 high mound	A mound in a cave with a dense ash lens below and within mound. Included is marine shell, bone and a basalt flake. A probable hearth.
20420 T109 Enclosure	1	Slab-lined Pit	I-V	EU-1	0.55 x 0.6	A slab-lined pit located in the center of an enclosure. The pit included abundant charcoal and ash. Probable cooking use. Historic artifacts include machine cut nails.
20424 T119 Enclosure	1	Slab-lined Pit	I	EU-1	0.6 x 0.6	A slab-lined pit located within a paved enclosure. Pit includes marine shell, bone, and minimal charcoal.

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CHAPTER 4. LABORATORY RESULTS

In this chapter lab analysis of the material collected on the surface and excavated during this project is discussed. Specific analysis included radiocarbon dating, midden identification (invertebrates and vertebrates), and pollen and charcoal identification. Discussion of indigenous and historic artifacts is found in chapters five and six.

Radiocarbon Dating Analysis

Four radiocarbon samples were sent to Beta Analytic, Inc. for C14 radiocarbon dating analysis. Three of the samples came from the Phase I Area. The remaining sample was collected from a slab-lined pit within the Phase II/Transect Area. Of particular interest is the relative lack of early dates from the region. One of the dates, from Site 50-10-63-19463, was modern dating to around 1950 A.D. This date is probably incorrect as the last residents of the park were known to have left before 1950 A.D. The earliest possible date corresponds to a mound feature within a cave (Feature B) at site 50-10-63-19462. This window ranges from A.D. 1450 to A.D. 1825. The earliest possible date could be explained by Hawaiians periodically stopping at the cave on trips to and from upland areas. These trips would have provided valuable resources to villagers living permanently along the coast.

The dates from Layer II of an agricultural terrace at Site 50-10-63-19461 indicates that the area could have been cultivated as early as A.D. 1665. According to Burtchard (1994: 45), the period between A.D. 1600-1778 was marked by political competition and agricultural intensification of more marginal areas. Stannard (1989) has suggested that during this period, the population had reached its carrying capacity or a state of population flux. Upland and more marginal areas were being utilized intensively with less and less success; at the same time population was beginning to decline. Burtchard places the beginning of intensification in the Puna and Hilo Districts as early as the 15th and 16th century. He (1994:45) notes that this period "should have represented a substantial increase in human use" of these areas.

All of the remaining dates firmly place the area well into historic times. These historic-era dates match well with the historic artifacts, which date between the late 19th and early 20th century. The dates listed on the following page are at least within a feasible range as they all precede the lava flows upon which they are built. These have been dated between 1200-1450 A.D. (Holcomb 1980). The following table (Table 8) is a summary of the radiocarbon results.

Midden

A fair amount of midden (non-artifactual cultural material) was obtained as a result of excavation within the project area. The midden material included *mollusks* (marine shell), *echinoderms* (sea-urchin spines, body, mouth fragments), *crustaceans* (crab), and fish, mammal, and bird bones. The marine midden material was examined and sorted under the direction of Patricia Spears, BA. The faunal material was analyzed exclusively by Alan C. Ziegler, Ph.D., zoological consultant. Floral material was dominated by *kukui* nutshells (*Aleurites moluccana*), and wood charcoal. Jerome Ward analyzed the pollen (Appendix B) and Gail Murakami of International Archaeological Research Institute, Inc analyzed the wood charcoal (Appendix C.

The total weight for the midden material, excluding *kukui* nutshell and charcoal, from the entire project area was 632.88 grams. Shell midden accounted for 573.15 grams, or 90.6% of this midden material. Next in frequency was the bone, which amounted to 54 grams, or 8.5% of the midden. Echinoderm accounted for only 4.35 grams or 0.7% with Crustacea amounting to 1 gram or 0.2 %, and coral representing .40 grams or <0.1% of the total midden weight.

Within the Phase I Area, shell midden amounted to 524.7 grams or 91.0% of the total midden weight of 576.6 grams. Bone accounted for 47.5 grams or 8.2% of the midden, with the echinoderm being present as 3.05 grams or 0.5%. 1 gram of crab (<0.2%) and 0.4 grams of coral (<0.1%) were also present in the midden.

Within the Phase II Area, shell midden represented 48.5 grams or 86.2% of the midden weight, with the remaining material consisting of 6.5 grams (11.5%) of bone and 1.3 grams (2.3%) of echinoderm.

Invertebrates

Gastropods were the only type of mollusk recovered within excavation units. These shellfish were regularly consumed by Hawaiians in both prehistoric and historic times. As such, finding them within the project area is not surprising, though the presence of shell indicates that the community that thrived in this inland area was depending on products gathered from the sea. This fact lends credence to the idea that Hawaiians, even in historic times, sought sustenance from all areas within specific *ahupua'a*. However, the limited quantity of shell indicates that the area may have been inhabited on an intermittent, rather than a regular basis. Surface shell midden scatters were also rare within the project area, further indicating that this form of foodstuff was only occasionally relied upon as a main food staple. Of course, it is possible that much of the shell midden was simply not visible on the surface and still remains buried. The fact remains however, that a prehistoric community would have likely relied more on products gathered from the sea, with visible signs more evident along the surface of the habitation sites.

Shell

Four families of gastropods were recovered from excavation units within the project area. The families and identified genera are Patillidae (*Cellana*), Neritidae (*Nerita)*, Cypraeidae (*Cypraea*), and Thaididae (*Drupa, Neothais*).

Shell from the family Patillidae *(Cellana* sp., *Cellana sandwicensis*) was the most abundant shell type found within the excavation units. Shells represented by the genera *Cellana,* also known as *'opihi*, thrive in the littoral fringe zones of the ocean and were an important food source for Hawaiians. *Cellana* represented 71.5% of the shell recovered from excavation units within Site 50-10-63-19461 and 84.5% of the shell from units at Site 50-10-63-19462. This compares with the Transect/Phase II Area where *Cellana* represented only 25.8% of shell from Site 50-10-63-20420 and 37.93% at Site 50-10-63-20424. Of note is the larger percentage of *Cellana* at sites closer to the ocean. This trend holds true for the other types of shell recovered from the project area.

Shells from the family Neritidae (*Nerita sp., Nerita picea*) comprised 5.8% of the shell from Site 50-10-63-19461 and 5.1% of the marine shell from Site 50-10-63-19462. This type of shell was recovered in negligible amounts within the Transect/ Phase II Area. Shell from the genera *Nerita* are similar to *'opihi* in that they were a food source also found in the coastal surge zone. *Nerita picea*, which is also known as *pipipi*, accounted for 0.3% of the shell at Site 50-10-63-19462. This mollusk was consumed with the shells traditionally used for making lei (Kay 1979:63*).*

Cypraea sp. was also found within the midden material. Shell species of the general *Cypraea* were important as a food source, as ornaments, and for use as fishing lures by Hawaiians in the past. *Cypraea* sp. accounted for 6.0% of the shell at Site 50-10-63-19462, and was completely absent from the midden material at Site 50-10-63-19462. *Cypraea* sp. was noted within both units excavated within the Phase II Area. *Cypraea* sp. accounted for 17.8% of the shell species at Site 50-10-63-20424 and 5.9% at Site 50-10-63-20420.

The last type of shellfish found within the project area is from the family Thaididae (species *Drupa* sp. and *Drupa morula*). This type of shellfish comprised 8.6% of the shell midden at Site 50-10-63-19461 and 4.0% at Site 50-10-63-19462. Within the Transect/Phase II Area, Thaididae comprised 40.8% of the shell from Site 50-10-63-20420 and 33.4% at Site 50-10-63-20424. This shellfish is collected from rocky surge zones and was exploited as a food source by Hawaiians in prehistoric and historic times.

Echinoderms

Echinoderms not identified to a specific species were noted in negligible amounts within both the Phase I and Phase II area. Echinoderms are edible and were consumed by Hawaiians in historic and prehistoric times. Sea urchin was discovered at Site 50-10-63-19461 within EU-4, which was placed within an agricultural feature. The echinoderm accounted for only 7.1% of the total midden weight from the unit.

At Site 50-10-63-19462, within the Phase I Area, echinoderm consisted of 0.8% of the midden weight within EU-1, which was placed in Feature D Terrace. EU-2, which was also located within Feature D Terrace, revealed echinoderm that amounted to only 0.4% of the total midden weight. Two units situated within Feature B Cave also provided negligible amounts of echinoderm. Echinoderm within EU-3 amounted to 0.3% of the total midden weight, while EU-4 midden consisted of < 0.02% echinoderm.

Echinoderm was also noted within the Phase II Area. At Site 50-10-63-20420, echinoderm accounted for 0.7% of the total midden weight. While echinoderm species represented 3.0% of the total midden at Site 50-10-63-20424.

Crustacea

A small amount of crustacean remains consisting of unidentified crab species was recovered from excavation units within the project area. At Site 50-10-63-19461 crustacean remains were noted in the midden from EU-1, Feature C where it amounted to 11.1% of the total midden weight. Within Feature B of the same site, crustacea represented 1.6% of the total midden weight. Crustacea was not present within any other units at sites within the project area.

A breakdown of the amount of invertebrates taxa and weight collected in each excavation unit is presented in Tables 9-20.

Vertebrates

The analysis of faunal material from the entire project area was conducted by Alan Ziegler, Ph.D, zoological consultant. All faunal material was identified to the lowest taxonomic level. This was not possible in every case due to the fragmentary nature of some of the bones. In sum, the faunal analysis indicates the presence of birds, mammals, and fish species in the midden material excavated, with the latter most frequently identified.

Within the Phase I Area, the faunal material consisted of 378 bones or bone fragments. These were categorized as 43.62% mammal, 42.9% fish species, 11.1% unidentified vertebrate and 2.38% avian species. By weight the faunal material within the Phase I Area consisted of 88.7% mammal bone, 8.2% fish and 3% avian bone.

The two units excavated within the Phase II/Transect Area contained a total of 84 bones. This faunal material was identified as 88.1% fish species, 8.3% unidentified vertebrate, and another 3.6 % mammal bone. In terms of sheer weight the bone was comprised of 47.7% mammal bone, and 46.2% fish bone and 6.1% from an unidentified vertebrate.

None of the faunal material analyzed by Ziegler showed signs of modification for use as artifacts. He does note, however, that some of the bones including goat/sheep show cut marks made with a "sharp-bladed instrument" (Ziegler Memo 1995), either a knife or a stone tool.

According to Ziegler, the general pattern of faunal material suggests human occupation areas, though not long-term habitation. In a memo included with his report he writes that "there are not a significant number of bones of chicken, wild birds, dog and pig that would be expected in an area of normal extended occupation" (Ziegler Memo 1995). He suggests instead that the project area is more indicative of short-term or even sporadic occupation with hunting of wild goat and pig in addition to the collection of in-shore species of fish during both Polynesian and historic cultural periods. Ziegler notes however that the unusually small number of bird bones in the assemblage, specifically the lack of shearwaters and petrels in the assemblage is more suggestive of a historic period habitation area.

The specific results of the analysis are summarized below beginning with surface finds. These results are organized in tabular form in Tables 21-31.

Surface Vertebrate Material

The results of surface finds of faunal material indicate human hunting activities as well as natural deposition of animals in situ. A nearly complete skeleton of a medium Artiodactyl, probably a domestic goat or sheep, was found near the cave opening at Site 50-10-63-19463. Ziegler wrote that this animal was quite young, with 30 or more bones included. He indicated that this individual might have been naturally deposited, as no cut marks are visible. Based on Ziegler's analysis, it is quite possible that the animal simply fell into the cave and died of natural causes. The general nature of the cave indicates that it was utilized for water collection as midden material is extremely sparse and consists primarily of *kukui* nutshells and wood charcoal.

A total of 16 bones collected along the surface at the entry of cave site 50-10-63-19462 (Feature B) indicate the presence of at least one individual of the *Capra hircus/Ovis sp.* species, or domestic goat/sheep. According to Ziegler, the individual was probably shot with a shotgun pellet, as indicated on a tibia fragment. It is likely then, that the animal was shot and then consumed in the cave. The cave includes a number of charcoal burn areas and a feature identified as a hearth (Feature 1). This feature was excavated and included a variety of bone including goat or sheep.

Excavated Vertebrate Material

Phase I Area

Overall, the faunal material from the Phase I Area indicates the consumption of fish, mammal and bird species. Other bone from the area includes the introduced Polynesian rat. The overall pattern of faunal material from this site indicates the procurement of meat from wild goat or sheep, and the possible domestication of chicken for consumption. In addition, it is evident that in-shore-fishing activities provided a further source of protein for the inhabitants. Specific faunal material collected from the excavation units is summarized below, beginning with Residential Complex 1. All of the percentages computed are calculated with respect to the total number of bones or bone fragments per species.

Residential Complex 1
Three excavation units (EU-1 through EU-3) within Residential Complex 1 included faunal material (Table 21 - 23). Both EU-1 and EU-2 within the Feature D, a terrace at Site 50-10-63-19462 contained bone. Excavation of the lower level within EU-1 included 5 bones (Table 21). Four of these were from fish species (80%), with one identified as a Scarid type, which are generally in-shore species. The remaining bone has been identified as a medium vertebrate (20%). EU-2 within Feature D contained 10 fish bones, with nine (90%) unidentified to species, and one (10%) of a Labrid type, which consist predominately of in-shore species (Table 22).

An additional unit that revealed bone was excavated within a hearth (Feature 1) inside Feature B, a cave at Site 50-10-63-19462. EU-3 contained a total of 77 bones from two levels (Table 23). Forty-two (54.5%) of the bones were mammalian in nature. The mammal bones included one bone (1.3%) from a cat (*Felis catus*), seven bones (9.1%) from either a pig (*Sus scrofa*) or goat/sheep (*Capra hircus/Ovis sp.*), and 34 (44.2%) bones from an unidentified small to medium mammal. Twenty-four (31.2%) of the bones were from an unidentified fish with the 11 remaining bones (14.3%) derived from a small or medium vertebrate.

Residential Complex 2
Excavation in the interior of Feature C, an enclosure (EU-1) at Site 50-10-63-19461 included a total of nine bones. These consisted of fish, unidentified vertebrate, and avian bone (Table 24). In total, 67.6% of the bone was from an unidentified fish, with two bones identified as a Cirrhitid type, an in-shore species. The unidentified vertebrate remains accounted for 24.3% of the overall faunal material. An unidentified bird bone constituted the remaining fauna.

Excavation (EU-2) of trash pit (Feature 2) within a crack near Feature A, an enclosure indicated the presence of 54 bones or bone fragments (Table 25). Sixty-three percent of the bone in this unit consisted of an unidentified medium mammal. The remaining bones were comprised of *Rattus exulans* (Polynesian rat) (1.85%), fragments of goat or sheep bone (3.7%), and bone from a small and /or medium mammal (31.5%).

Faunal material was removed from EU-3 located within Feature B, an enclosure (Table 26). This unit contained a total of 103 bones or bone fragments. These were comprised of 46.6% mammal, 51.4% fish and 2.0% unidentified vertebrate species. The fish fauna included 26 bones from in-shore fish species including Balistid, Sparid and a larger deep-sea fish of the Carangidae family. The remaining 27 fish bones could not be identified to the family level.

Excavation of EU-4 within an agricultural terrace included a number of bones or bone fragments (Table 27). These were recovered at 62-72 cm. b.s., or below the terrace feature itself. Only 14 bones were removed from this unit. These include one bone (7.1%) from a Cirrhitid fish, an in-shore species, and seven (50%) from an unidentified fish. Five bones (35.7%) were comprised of an unidentified bird with one bone identified as a Polynesian rat (*Rattus exulans*).

Feature H, a probable habitation enclosure was excavated as EU-5 (Table 28). This unit only included three bones or bone fragments; all from mammals, with two identified as either a goat or sheep (*Capra hircus/Ovis sp.*) and the remaining bone identified as a medium mammal.

Excavation in the interior of Feature A, an enclosure at Site 50-10-63-19461 indicated the presence of a variety of faunal material (Table 29). In all, a total of 75 bones or bone fragments were removed from this unit. All of the bone was found in the same context with historic artifacts, thus indicating that they are likely of historic origin. The excavation unit (EU-8) was not excavated stratigraphically though it is likely that the deposit was disturbed.

The faunal material removed from EU-8 consisted of 36 fish bones (48%) with one (1.3%) from an Acanthurid, an in-shore species; and 35 (46.7) other unidentified fish bones. A total of three avian bones (4%) were discovered in this unit. Avian bone collected included one species of a medium Galliform, possibly a chicken, and two other bones (2.6%) of an unidentified bird (Ziegler noted that the possible chicken bone could also have been derived from historically introduced pheasant). One bone from a goat or sheep (1.3%) was collected as well as 28 bones (37.3%) identified as a small to medium mammal, 5 (6.6%) bones from a medium mammal, and two bones (2.7%) from a medium vertebrate.

Phase II Area

Faunal material was removed from both units excavated within the Phase II Area (Tables 30 and 31). The first unit (EU-1) was excavated in a slab-lined pit within Feature 109, an enclosure. This unit contained a total of 28 bones including 24 unidentified fish bones (85.7%), one bone from a medium mammal (3.8%), and three bones from a small and/or medium vertebrate (10.7%).

The second unit (EU-1) within the Phase II Area was placed in slab-lined pit within Feature T119, an enclosure. A total of 56 bones were removed from this unit. The faunal material included 45 unidentified fish bones (80.4%), five Carangid type fish bones (8.9%), one possible goat or cow bone (1.8%), a small to medium mammal/or medium mammal bone, (1.8%) and four medium vertebrate bones (7.1%). The relatively high incidence of fish bone within both of the units

described above indicates that these inland features were inhabited by individuals that spent some time by the coast engaged in fishing activities.

Pollen Analysis

A total of three soil samples were sent to Jerome Ward of Pacific Palynology for pollen analysis. All of the samples were removed from agricultural features at Site 50-10-63-19461. Sample 3069 was a base sample collected from EU-4 within Layer II (at 85 cm. b.s.) of a linear agricultural terrace. Sample 3078 was obtained from Layer III (31-51 cm. b.s.), below a mound feature within EU-6. Sample 3088 was removed from within Layer I/2 (between 18-25 cm. b.s.) of EU-7 which was placed in a soil pocket near a linear agricultural terrace.

According to Ward, none of the samples indicate agricultural use of the area. Most of the samples include charcoal to some degree, but not in amounts indicative of agricultural burning. In addition, sweet potato pollen was completely absent from all of the samples. It is probable, however, that sweet potato was grown within the project area and simply wasn't evident in the sample. Sweet potato pollen is rarely present in pollen samples collected from archaeological sites, even when sweet potato was known to have grown in an area. In a cover letter included with his report, Ward writes that "several of the ethnographic plants are shy pollen producers, produce fragile pollen that does not produce" (Appendix B). He also notes that sweet potato is not often seen in the pollen record due to the large size and relatively scarce number of pollen produced.

Sweet potato tubers have been found in carbonized form in early Hawaiian sites, thus proving that the crop was grown in Hawai'i before European contact (Rosendahl and Yen 1971). However, this form of evidence is rare and generally found only in the highest and most arid places (i.e. Mauna Kea).

Of note is the presence of one grain of *Asteraceae* (lophate type) of the Sunflower family in a base of excavation sample 3069. According to the report by Ward (Appendix B), this plant pollen was introduced after European contact. If correct, this evidence would indicate that the Phase I Area is likely a historic settlement. He cautions, however, that the sample could have been contaminated. Nevertheless, this species was not found in the plant specific survey of the area conducted in 1995. Interestingly, no historic items were uncovered in context with the Layer/level from which the sample was obtained.

Another plant identified within the pollen analysis includes *Lycopodium cernuum*. This plant is commonly found in Hawai'i, particularly "in open glades and on the outskirts of forests" (Hillebrand 1888:45). Nevertheless, this species was not found in a cursory survey of the area. In general, the most common plant forms found in the analysis indicate a disturbed environment. This would be expected in areas that had been cleared for agricultural activities.

Charcoal Analysis

Gail M. Murakami of International Archaeological, Inc. in Honolulu performed charcoal analysis. Two charcoal samples were sent for analysis of wood species. A summary of her results is presented below. A more detailed report is located within Appendix C of this report.

The most striking result of the charcoal analysis was the complete absence of alien plant species from the samples. This is surprising as the project area is dominated by Java plum (*Syzygium cumini*) and guava (*Psidium guajava*). According to Murakami (Appendix C) the absence of these species from the charcoal samples probably indicates habitation activities that pre-date the introduction of these plants. She estimates that Java plum and guava were introduced in the late 1800's to early 1900's. Prior to this time the *mauka* slopes within Hawaii Volcanoes National Park were covered with native vegetation including the plants found in the samples.

The first sample (Cat # 3097) was collected from the surface of a cave floor (Site 50-10-63- 19463). The result of the charcoal analysis indicated a number of different plant taxa no longer located in the immediate area. Included were *koa* (*Acacia koa*), *alahe'e* (*Canthium odoratum*), '*akoko* (*Chamaesyce* spp.), *'a'ali'i* (*Dodonaea viscosa*), and *Myrsine* sp. (*kōlea*). Also present was a key from the pandanus tree (*Pandanus tectorius*). '*A'ali'i* is currently found within the project area, but in relatively limited amounts. *Alahe'e* is also found within the *mauka* slopes, but is not located near the cave.

Koa trees are completely absent from the area and are generally not found within the park except at a higher elevation (ca. 4,000 ft.). The evidence of *koa* within the cave sample is telling as it indicates that people were bringing resources from the *mauka* areas to more coastal locations. *Koa* trees were utilized prehistorically for a number of purposes including canoe building. However, Murakami suggests that the presence of *koa* in the sample may be from the burning of a utilitarian object such as a bowl or simply to supply fuel for fires within the cave.

The presence of a *hala* (*Pandanus tectorius*) key within the sample may indicate a number of things. *Hala* trees generally grow by the coast, but are still quite rare within the park. According to Stone and Pratt (1994: 61), stands of *hala* trees used to grow at Kamoamoa and Kalapana but have since been destroyed by lava. It is likely, however, that *hala* trees grew more frequently by the coast in early historic and prehistoric times. Stone and Pratt (1994:61) write that "*hala* was propagated and planted near Hawaiian homes and villages." The number of uses for the *hala* tree were many and included the use of leaves (*lauhala*) for thatching, mats, baskets, cordage and other items (Abbott 1992:71-74). The key or fruitlet part were generally used as brushes and for leis in prehistoric and early historic times (Pukui and Elbert 1986:50). This possible artifact may thus have become burned accidentally, or may have been thrown in the fire due to damage.

A small amount of charcoal from *Myrsine* sp. was also found within the sample from this same site. Within the park, this small shrub generally grows in the understory of the rain forests. As such the presence of this plant at this elevation

is also surprising, though not for a culture that frequently travels between the coast and mountain areas. According to Stone and Pratt (1994:181), the sap and bark of these plants were used as die for *kapa* with the timber use to build houses. They note that other, rarer species of the shrub do grow at lower elevations, though infrequently.

Murakami suggests that most of the charcoal samples derived from this cave were wood types used for fuel. This assumption does seem to be justified. The cave itself was likely used for water collection due to the numerous, light charcoal burn areas through out the cave, the presence of large '*opihi* shells, and the general lack of midden material. Murakami does note, however, that presence of parenchymatous tissue. This material could have been derived from a number of plants including "from the starchy swollen stems of sweet potatoes or yams" (Appendix C: 7). This tissue may suggest, at the very least, that some sort of material may have been consumed in the cave, or as she suggests "inadvertently burned."

The second sample (Cat #3139) analyzed by Murakami was collected from Cave Feature B at Site 50-10-63-19462. The charcoal sample was represented by five taxa. The most numerous plant identified was '*a'ali'i* (*Dodonaea viscosa*). This indigenous plant is relatively common within the park in both the lowlands and higher elevations (Stone and Pratt 1994). The strong wood from this shrub was used for posts in the construction of houses (Abbott 1992:68) and for spears. The other plant species included in the sample were represented in descending frequency by *'akoko* (*Chamaesyce* spp.), *lama* (*Diospyros sandwicensis*), a pandanus (*Pandanus tectorious*) key, and '*Ōhi'a lehua* (*Metrosiderors polymorpha*).

The presence of '*Ōhi'a lehua* in the sample is not surprising. This tree does not grow abundantly within the project area itself, however, it is common in the surrounding area. As noted by Stone and Pratt (1994:11) "the '*Ōhi'a lehua* is the most abundant and widespread native tree in the Hawaiian Islands." The wood, which was associated with the gods Kū and Kāne, was carved into sacred images or *ki'i* and erected at temples of worship. The trunk was fashioned as rafters for the construction of houses (Abbott 1992).

It is possible that the *'ōhi'a lehua* grew more abundantly in the area when the cave was first occupied. '*Ō'hia lehua* tend to be some of the earliest colonizers of new lava flows after which "mature stands of forest may die synchronously" (Stone and Pratt 1994:12). It is likely that the trees were more common in the area after 1200 A.D. to 1450 A.D. (the age of the lava flows in the area) or before the introduction of alien species.

Table 8. Radiocarbon Dates for Project Area (Computed by Beta Analytic Inc.).

Site Number 50-10-63	Feature and Unit	Layer/ Level	Depth	Calibrated Results 2 sigma, 95% prob.	Intercept Data*	Lab #
19461	Terrace EU-4	II	62-72 cm bs	A.D. 1665 to 1950	cal. A.D. 1700 cal. A.D. 1720 cal. A.D. 1820 cal. A.D. 1855 cal. A.D. 1860 cal. A.D. 1920	83630
19462	Mound in Cave Feature B. EU-4	Below mound (lowest feature)	Below mound (lowest feature)	A.D. 1450 - 1825 A.D. 1835 - 1880 A.D. 1915 - 1950	cal A.D. 1650	83632
19463	Area 4 in Cave	Surface	Surface	Modern	Modern	83631
20420	T109, Slab-lined pit in Enclosure (EU-1).	IV/3	20-28 cm bs	A.D. 1640 - 1950	cal A.D. 1690 cal A.D. 1735 cal A.D. 1815 cal A.D. 1925	83634

*Intercepts of radiocarbon age with calibration curve.

Midden Material from Phase I Area

Table 9. Invertebrate weights (in grams) from EU-1, Feature C, Enclosure, Site 50-10-63-19461.

MIDDEN MATERIAL	I 0-19 cmbs
SHELL	
Gastropoda	
Patillidae (Family)	
Cellana sp.	0.20
Unidentified Gastropod	0.10
TOTAL SHELL	0.30
CRUSTACEA	
Crab	0.15
TOTAL	0.75

Table 10. Invertebrate weights (in grams) from EU-2, Feature 2 Refuse pit, Site 50-10-63-19461.

MIDDEN MATERIAL	I 0-15cmbs
SHELL	
Gastropoda	
Neritidae (Family)	
Nerita sp.	0.40
Patillidae (Family)	
Cellana sp.	5.30
Thaididae (Family)	
Drupa sp.	0.20
TOTAL SHELL	5.90

Table 11. Invertebrate weights (in grams) from EU-3, Feature B, Enclosure, Site 50-10-63-19461.

MIDDEN MATERIAL	I/1 0-10 cmbs	I/2 10-23 cmbs	Total
SHELL			
Gastropoda			
Neritidae (Family)			
Nerita sp.	1.80		1.80
Patillidae (Family)			
Cellana sp.	15.50	11.00	26.50
Thaididae (Family)		0.30	0.30
Drupa sp.	5.90		5.90
Unidentified Gastropod	3.10	5.10	8.20
TOTAL SHELL	26.30	16.40	42.70
CRUSTACEA			
Crab		0.85	0.85
GRAND TOTAL	30.90	22.40	53.30

Table 12. Invertebrate weights (in grams) from EU-4, Agricultural Terrace, Site 50-10-63-19461.

MIDDEN MATERIAL	**I** **0-62 cmbs**	**II** **62-72 cmbs**	**Total**
SHELL			
Gastropoda			
Neritidae (Family)			
Nerita sp.	0.30		0.30
Patillidae (Family)			
Cellana sp.	9.30	18.85	28.15
Thaididae (Family)	0.25	0.60	0.85
Unidentified Gastropod	0.10	2.85	2.95
TOTAL SHELL	9.95	22.30	32.25
ECHINODERMATA		2.50	2.50
GRAND TOTAL	19.90	47.10	67.00

Table 13. Invertebrate weights (in grams) from EU-5, Feature H Enclosure, Site 50-10-63-19461.

MIDDEN MATERIAL	I 0-20 cmbs
SHELL	
Gastropoda	
Patillidae (Family)	
Cellana sp.	0.10
Unidentified Gastropod	1.35
TOTAL SHELL	1.45

Table 14. Invertebrate weights (in grams) from EU-8, Feature A Slab-lined pit, Site 50-10-63-19461.

MIDDEN MATERIAL	I/6 60 cmbs	I/7 60-70 cmbs	II/1 70-75 cmbs	II/2 75-80 cmbs	Total
SHELL					
Gastropoda					
Neritidae (Family)					
Nerita sp.		0.45	1.75	0.55	2.75
Patillidae (Family)					
Cellana sp.		1.00	0.90	1.80	3.70
Thaididae (Family)					
Neothais harpa			0.40		0.40
TOTAL SHELL		1.45	3.05	2.35	6.85

Table 15. Invertebrate weights (in grams) from EU-1, Feature D Terrace, Site 50-10-63-19462.

MIDDEN MATERIAL	I/1 0-20 cmbs	I/2 20-40 cmbs	Total
SHELL			
Gastropoda			
Cypraeaidae (Family) .			
Cypraea sp.	1.10		1.10
Neritidae (Family)			
Nerita sp.	0.05	0.35	0.40
Patillidae (Family)			
Cellana sp.	5.10	1.60	6.70
Thaididae (Family)	4.35		4.35
Unidentified Gastropod		0.10	0.10
TOTAL SHELL	10.60	2.05	12.65
ECHINODERMATA		0.10	0.10
GRAND TOTAL	10.60	2.15	12.75

Table 16. Invertebrate weights (in grams) from EU-2, Feature D, Site 50-10-63-19462.

MIDDEN MATERIAL	**I** **0-30 cmbs**
SHELL	
Gastropoda	
Cypraeidae (Family)	
Cypraea sp.	1.50
Neritidae (Family)	
Nerita picea	1.35
Patillidae (Family)	
Cellana sandwicensis	20.10
Thaididae (Family)	1.40
Unidentified Gastropod	0.40
TOTAL SHELL	24.75
ECHINODERMATA	0.10
GRAND TOTAL	24.85

Table 17. Invertebrate weights (in grams) from EU-3, Feature B, Cave, Site 50-10-63-19462.

MIDDEN MATERIAL	0-5 cmbs Fea. 1 Lower	5-8 cmbs Fea. 1 Upper	Total
Gastropoda			
Neritidae (Family)			
Nerita sp.	1.70	0.70	2.40
Patillidae (Family)			
Cellana sp.	57.80	45.80	103.60
Thaididae (Family)			
Drupa sp.	0.10		0.10
Unidentified Gastropod	1.00		1.00
TOTAL SHELL	60.60	46.50	107.10
ECHINODERMATA	0.20	0.10	0.30
GRAND TOTAL	60.80	46.60	107.40

Table 18. Invertebrate weights (in grams) from EU-4, Feature B, Cave, Site 50-10-63-19462.

MIDDEN MATERIAL	**I/1 0-8cmbs**	**II/1 8-10cmbs**	**III/1 10-25 cmbs**	**V/1 40-46 cmbs**	**Total**
SHELL					
Gastropoda					
Cypraeidae (Family)					
Cypraea sp.				23.60	23.60
Neritidae (Family)					
Nerita sp.	0.30		1.00	16.80	18.10
Patillidae					
Cellana sp.	2.40	0.10	41.60	193.10	237.20
Thaididae (Family)					
Drupa sp.			0.25		0.25
Drupa morola				11.40	11.40
Unidentified Gastropod		>0.05	0.10		0.15
TOTAL SHELL	2.70	0.15	42.95	244.90	290.70
ECHINODERMATA	>0.05				0.05
MISCELLANEOUS					
Coral		0.40			0.40
GRAND TOTAL	2.75	0.55	42.95	244.90	291.15

Midden Material from Phase II Area

Table 19. Invertebrate weights (in grams) from EU-1, Feature T-109, Enclosure, Site 50-10-63-20420.

MIDDEN MATERIAL	**II/1 10-16 cmbs**	**III/1 14-26 cmbs**	**IV/1 19-28 cmbs**	**V/1 26-40 cmbs**	**V/2 40-50 cmbs**	**V/3 50-61 cmbs**	**Total**
SHELL							
Gastropoda							
Cypraeidae (Family)							
Cypraea sp.	-	-	-	1.05	-	-	1.05
Patillidae (Family)	-	-	-	-	-	-	-
Cellana sp.	-	0.60	0.80	1.55	0.40	1.20	4.55
Thaididae (Family)	-	0.80	-	-	3.35	-	4.15
Drupa sp.	-	-	2.80	0.25	-	-	3.05
Unidentified	2.75	1.60	0.30	-	0.20	-	4.85
TOTAL SHELL	2.75	3.00	3.90	2.85	3.95	1.20	17.65
ECHINODERMATA	-	-	0.10	0.10	>0.05	-	0.25
GRAND TOTAL	2.75	3.00	4.00	2.95	4.00	1.20	17.90

Table 20. Invertebrate weights (in grams) from EU-1, Feature T119 Enclosure, Site 50-10-63-20424.

MIDDEN MATERIAL	**I/1 0-10 cmbs**	**I/2 10-20 cmbs**	**Total**
SHELL			
Gastropoda			
Cypraeidae (Family)			
Cypraea	3.50	2.00	5.50
Neritidae (Family)			
Nerita sp.	0.50		0.50
Patillidae (Family)			
Cellana sp.	8.60	3.10	11.70
Thaididae (Family)		0.30	0.30
Drupa sp.	9.00		9.00
Neothais harpa	1.00		1.00
Unidentified Gastropod	1.45	1.40	2.85
TOTAL SHELL	24.05	6.80	30.85
ECHINODERMATA	0.60	0.45	1.05
GRAND TOTAL	24.65	7.25	31.95

Table 21. Faunal Data: Site 50-10-63-19462, EU-1, Feature D Terrace.

FAUNA	I 0-20 cmbs	I 20-40 cmbs	Total NISP
OSTEICHTHYES (Bony Fishes)			
Scarid	0	1	1
Unidentified Fish	0	3	3
VERTEBRATE			
Medium vertebrate	0	1	1
GRAND TOTAL	0	5	5

Table 22. Faunal Data: Site 50-10-63-19462, EU-2 Feature D Terrace.

FAUNA	I 0-30cmbs	Total NISP
OSTEICHTHYES (Bony Fishes)		
Labrid	1	1
Unidentified Fish	9	9
GRAND TOTAL	10	10

Table 23. Faunal Data: Site 50-10-63-19462, EU-3 Feature B Cave.

FAUNA	I 0-5 cmbs Fea. 1Upper	I 5-8 cmbs Fea. 1Lower	NISP
OSTEICHTHYES (Bony Fishes)			
Fish	11	13	24
MAMMALIA			
Felis catus	1		1
Sus scrofa or Capra hircus/Ovis sp.	1		1
Capra hircus/Ovis sp.	6		6
Small to medium mammal	34		34
VERTEBRATE			
Small and/or medium vertebrate	9		9
Medium vertebrate		2	2
GRAND TOTAL	62	15	77

Table 24. Faunal Data: Site 50-10-63-19461, EU-1Feature C Enclosure.

FAUNA	0-19 cmbs	NISP
OSTEICHTHYES		
(Bony Fishes)		
Cirrhitid	2	2
Unidentified Fish	25	25
AVES		
Medium Bird	1	1
VERTEBRATE		
Small and/or medium Vert.	9	9
GRAND TOTAL	37	37

Table 25. Faunal Data; Site 50-10-63-19461, EU-2 Feature 2 Trash pit.

FAUNA	0-15 cmbs	Total NISP
MAMMALIA		
Rattus exulans	1	1
Capra hircus/ Ovis sp.	2	2
Med. mammal	34	34
VERTEBRATE		
Small and/or medium vert.	17	17
GRAND TOTAL	54	54

Table 26. Faunal Data: Site 50-10-63-19461, EU-3 Feature B Enclosure.

FAUNA	I/1 0-10 cmbs	I/2 10-23 cmbs	Total NISP
OSTEICHTHYES (Bony Fishes)			
Balistid		24	24
Scarid	1		1
Carangid	1		1
Fish	12	15	27
MAMMALIA			
Capra hircus/ Ovis sp.		1	1
Medium mammal	18	22	40
Small to medium or medium mammal	2	5	7
VERTEBRATE			
Small and/or medium vertebrate	1	1	2
GRAND TOTAL	35	68	103

Table 27. Faunal Data: Site 50-10-63-19461, EU-4 Terrace.

FAUNA	0-62 cmbs	62-72 cmbs	Total NISP
OSTEICHTHYES (Bony Fishes)			
Cirrhitid		1	1
Unidentified Fish		7	7
AVES			
Medium bird		5	5
MAMMALIA			
Rattus exulans		1	1
GRAND TOTAL		14	14

Table 28. Faunal Data: Site 50-10-63-19461, EU-5 Feature H Enclosure.

FAUNA	0-20 cmbs	Total NISP
MAMMALIA		
Capra hircus/Ovis sp.	2	2
Medium mammal	1	1
	3	3

Table 29. Faunal Data: Site 50-10-63-19461, EU-8 Feature A Enclosure.

FAUNA	I/7 60-70 cmbs	II/1 70-75 cmbs north end	II/1 70-75 cmbs south end	II/2 75-80 cmbs	Total NISP
OSTEICHTHYES (Bony Fish)					
Acanthurid	1				1
Unidentified Fish	2	23	6	4	35
AVES					
Medium Galliform		1			1
Medium bird		1			1
Medium or large bird				1	1
MAMMALIA					
Capra hircus/Ovis sp.		1			1
Small to medium or medium mammal	1	27			28
Medium mammal	2		1	2	5
VERTEBRATE					
Medium vertebrate			1	1	2
GRAND TOTAL	6	53	8	8	75

FAUNAL DATA FROM TRANSECT 1/ PHASE II AREA

Table 30. Faunal Data: Site 50-10-63-20420, EU-1 Feature T109 Enclosure.

FAUNA	I/1 0-10 cmbs	II/1 10-16 cmbs	III/2 14-26 cmbs	IV/3 20-28 cmbs	V/4 27-40 cmbs	V/5 40-50 cmbs	V/6 50-60 cmbs	Total NISP
OSTEICHTHYES (Bony Fishes)								
Fish			24					24
MAMMALIA								
Medium mammal			1					1
VERTEBRATE								
Small and/or medium vertebrate			3					3
GRAND TOTAL			28					28

Table 31. Faunal Data: Site 50-10-63-20424, EU-1 Feature T119.

FAUNA	I/1 0-10 cmbs East 1/2 Hearth	I/1 0-10 cmbs West 1/2	I/2 10-20 cmbs East 1/2 Hearth	I/2 10-20 cmbs West 1/2	Total NISP
OSTEICHTHYES (Bony Fishes)					
Carangid	4			1	5
Unidentified Fish	6	16	16	7	45
MAMMALIA					
Capra hircus/Ovis sp.			1		1
Small to medium mammal/or medium mammal			1		1
VERTEBRATE					
Medium vertebrate	1	1	2		4
GRAND TOTAL	11	17	20	8	56

CHAPTER 5. INDIGENOUS ARTIFACTS

By Catherine Glidden and Leslie Morlock

A total of 244 artifacts were collected from the project area. One hundred and fifty-five of the artifacts (63.5%) are historic. The remaining 89 (36.5%) artifacts are indigenous, or traditional Hawaiian types. The indigenous artifacts include an adz fragment, a polished discoidal basalt stone, one polished basalt flake, a hammerstone, 76 volcanic glass flakes and 21 cores. The historic artifacts include metal, glass beads, buttons, bottle glass, ceramics and plastic. The indigenous artifacts are reviewed in text form with the addition of a table summarizing the volcanic glass flakes. Historic artifacts are described separately in Chapter 6 which was written by Susam Lebo who analyzed all of the historic material.

Basalt

Adz Fragment

An adz fragment (approximately 1/3) consisting of polished dense basalt with numerous flake scars was recovered from the surface at Site 50-10-63-19462 (Figure 22). The artifact weighs 232.9 grams and is 5.5 cm x 4.24 cm x 4.45 cm in size. The general appearance of the fragment is in square cross-section with all of the sides clearly modified. The top surface of the artifact is nicely polished with at least seven flake scars visible. The underside of the adz fragment is somewhat polished and includes a damaged area with a large chunk of basalt gone. The remaining two sides of the adz are partially polished with flake scars (some longitudinal) apparent.

Basalt Disc

A small discoidal basalt stone was removed from the surface near Feature C at Site 50-10-63- 19462 (Figure 23). This artifact is polished on all sides and flattened along the edges. One of the edges has been flaked on both sides, with at least five flake scars visible.

It is likely that the stone was utilized for two purposes. The smooth, polished and flattened surfaces of the stone implies a specialized usage probably as a gaming piece for the ‘*ulu maika* game. It is possible that the stone became damaged later on and was then flaked for use as a small hammerstone.

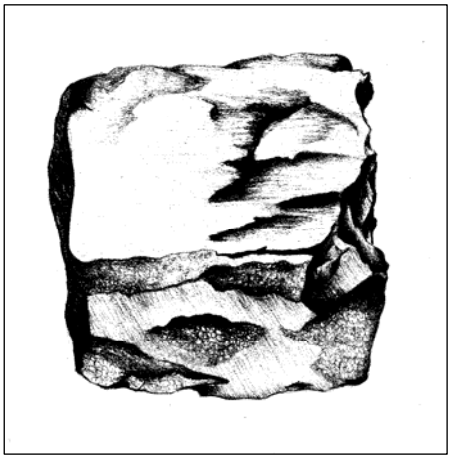

Figure 22. Drawing of adz fragment from surface Site 50-10-63-19462 (right).

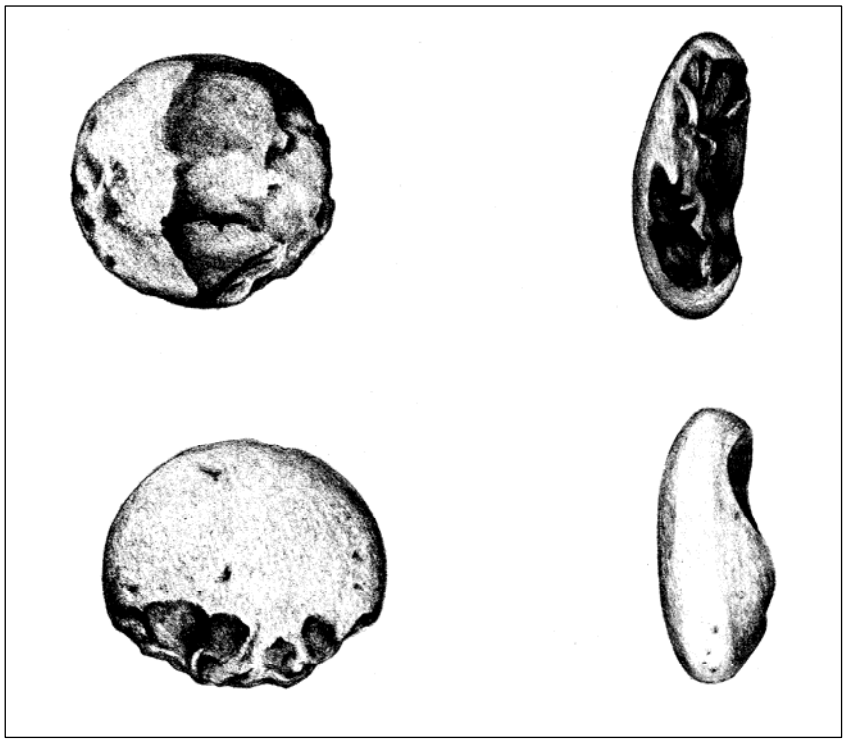

Figure 23. Drawing of basalt disc from surface at Feature C, Site 50-10-63-19462.

Hammerstone

A water worn, vesicular basalt stone 11.2 cm x 6.15 cm x 7.1 cm in size was removed from the interior surface of Enclosure Feature C at Site 50-10-63-19461 (Photo 13). The oblong shaped artifact has been battered on one end, possibly by some sort of pounding activity. Due to the number of *kukui* nut trees in the area, the artifact could have been used to smash *kukui* nuts.

Photo 13: Basalt Hammerstone Site 51-10-63-19461.

Basalt Flake

A thin, dense basalt flake, weighing 2.55 grams was recovered from a cave (Feature B) within Site 50-10-63-19462. This artifact was excavated from the southern upper-most section of EU-4, which was placed within a possible hearth (Feature 2). The dimensions of the flake are 2.75 cm x 2.45 cm x 0.2 cm. The flake is nicely polished on one side and was therefore likely removed from an adz.

Volcanic Glass

Investigation of Sites 50-10-63-19461 and 19462 resulted in the collection of 97 cores and flakes composed either of a poor coarser quality, or a higher quality, fine-grained volcanic glass. A summary of information concerning the artifacts is presented in Table 32. Some of these artifacts exhibit basaltic cortices though most show no cortex, with a weathered smoothness and duller sheen on their formerly outermost surfaces.

Flakes constitute 78.4% of the total number of volcanic glass artifacts. Examination of the flake edges revealed no sign of retouch or use wear with the exception of the smallest

flake. This flake is fairly small (1 cm x 0.5 cm x 0.10 cm) thus the wear noted can be most probably attributed to incidental factors. However, it is worth noting that as these lithics were found inland rather than near the sea they were most likely employed on flora. This latter function would not necessarily have left any observable use-wear on the edges. Of the 76 flakes in the sample, seven (or 9.2%) show a percussion bulb or possible percussion bulb. The flakes range in size from 0.5 cm x 0.4 cm x 0.1 cm to 2.6cm x 1.8 cm x 1.6 cm.

Cores constitute the remaining 21.6% of the sample and of these six of the 21, or 29%, show definite basaltic cortices. The cores range in size from 1.1 cm x 1 cm x 0.8 cm to 2.4 cm x 1.5 cm x 1 cm.

All 21 of the cores and 64 of the 76 flakes were of the higher quality volcanic glass which was fine grained, homogenous, and showed no visible vesicles; the remaining 12 flakes were of the lower grade, more basaltic glass which included visible vesicles. The sample as a whole was comprised of 12.4% poor quality and 87.6% fine grained volcanic glass.

Floral Material

Gourd

Investigation of the interior of a cave (Site 50-10-63-19464) revealed the presence of a large gourd. The gourd was a total of 34 cm in diameter and was found upside down with the top facing the ground. The gourd had been carved with a sharp instrument on the upper side with the stem removed and a large area cut away. This cut area was presumably made to make use of the gourd for a drinking vessel or container.

Table 32. Summary of Volcanic Glass Artifacts from Project Area.

State Site Number 50-10-63	Feature / Structure / Grid Unit	Depth (cm bs)	Layer / Level	Artifact Type / Number	Size Range	Description	Catalogue Number
19461	Fea. H / Unit 5	0 - 20		5 flakes	.5 x .4 x .1 - .7 x .7 x .3 cm	Fine grained	3070
19461	Fea. H / Unit 5	0 - 20		4 cores	2.4 x 1.5 x 1 -1.1 x 1 x .8 cm	Fine grained	3070
19461	Unit 7	0 - 10	I / 1	8 flakes	.9 x .7 x .2 - 2.7 x 1 x .5 cm	Vesicular Basalt	3079
19461	Unit 7	0 - 10	I / 1	19 flakes	.55 x .65 x 1.10 - 1.55 x .85 x .30 cm	Fine grained	3079
19461	Unit 7	0 - 10	I / 1	3 cores	1.20 x 1.10 x .55 - 2.6 x 1.8 x 1.6 cm	Fine grained	3079
19461	Unit 7	6	I / 1	1 flake	1.15 x 1 x .30 cm	Fine grained	3080

Table 32 continued.

State Site Number 50-10-63	Feature / Structure / Grid Unit	Depth (cm bs)	Layer / Level	Artifact Type / Number	Size Range	Description	Catalogue Number
19461	Unit 7	8 - 10		1 flake	2 x 2.2 x .7 cm	Fine grained	3081
19461	Unit 7	8 - 10		3 cores	1.7 x 1.5 x 1.1 - 3 x 1.9 x 1 cm	Fine grained with cortex	3081
19461	Unit 7	8 - 10	I / 1	2 flakes	1.6 x 6 x .2 - 2 x 1.3 x .3 cm	Fine grained	3082
19461	Unit 7	8 - 10	I / 1	2 cores	1.3 x 8 x .6 - 1.4 x .7 x .7 cm	Fine grained	3082

Table 33. Summary of Volcanic Glass Artifacts from Project Area continued.

State Site Number 50-10-63	Feature / Structure / Grid Unit	Depth (cm bs)	Layer / Level	Artifact Type / Number	Size Range	Description	Catalogue Number
19461	Unit 7	10 - 20	II / 1	15 flakes	.9 x .9 x .5 - 2.4 x 1.4 x .5 cm	Fine grained	3084
19461	Unit 7	10 - 20	II / 1	7 cores	1.6 x 1.2 x .5 - 3.5 x 2.7 x 1.5 cm	Fine grained	3084
19461	Unit 7	10 - 28	I / 2	3 flakes	1.25 x .55 x .20 - 1.80 x 1.45 x .30 cm	Vesicular basalt	3085
19461	Unit 7	10 - 28	II / 1	20 flakes	.45 x .40 x .10 - 2.10 x 1.10 x .50 cm	Fine grained	3085
19461	Unit 7	10 - 28	II / 1	2 cores	1.50 x 1.30 x 1.50 - 1.65 x 1.10 x 1.10 cm	Fine grained with cortex	3085

Table 33 continued.

State Site Number 50-10-63	Feature / Structure / Grid Unit	Depth (cm bs)	Layer / Level	Artifact Type / Number	Size Range	Description	Catalogue Number
19462	Fea. D / Unit 2	0 - 30		1 flake	.9 x .55 x .1 cm	Fine grained	3113
19462	Fea. B / Unit 4	0 - 60	Fea. 2 South Upper	1 flake	2.75 x 2.45 x .20 cm	Vesicular basalt	3138

CHAPTER 6. HISTORIC ARTIFACTS

By Dr. Susan A. Lebo and Catherine Glidden

A total of 155 historic artifacts were recovered from the project area and were analyzed by Dr. Susan A. Lebo, Historical Archaeologist. Historic artifacts were collected both as surface finds and from excavation units. The majority of the historic artifacts were found within Residential Complex 2 at Site 50-10-63-19461. Many of these items were uncovered as a result of excavation (EU-8) of a slab-lined pit (Feature 1) located within Feature A, a habitation enclosure. Excavations of a slab-lined hearth (EU-1) located in an enclosure (T109) within the Transect/Phase II Area also yielded a number of historic finds. A summary of these artifacts is presented in Table 33.

The historic artifacts collected from the project area include ceramics (European-American and Chinese), bottle and lamp glass, iron nails, unidentified iron metal fragments, and a small number of personal items (beads, buttons, comb fragments, and a tobacco pipe stem fragment). Most of the artifacts date to the late nineteenth century, however the assemblage includes material spanning from the early nineteenth century to the twentieth century. All of these historic artifacts are included in the museum collection and cared for at Hawaii Volcanoes National Park.

Metal

Iron

The most common type of metal collected from the project area was iron, including 33 machine-cut nails (Nelson 1968). Machine-cut nails were available in Hawaii by the early 1800's, with large numbers available after Missionary settlement began in the 1820's (Photo 14). They were replaced by wire nails, first imported to Hawaii about 1894 (Hurst and Allen 1992). Machine-cut nails were found at Site 50-10-63-19461 and Site 50-10-63-20420. The remaining nails were fragments that could not be categorized. Additional five iron items were identified as wire nails.

Other iron fragments probably originated as parts of metal tools or hardware/machinery parts. These unidentified iron fragments ranged in thickness from very thin to thick with some flat pieces. It is likely that some of these latter fragments are from tin cans. Possible tin can fragments were recovered from Feature T109 at Site 50-10-63-20420 within the Phase II/Transect Area. An iron or steel button was removed from Site 50-10-63-19461 Feature A, EU-8 (Cat. no. 3016). This artifact was found at a depth of 70 cm-75 cm. b.s (Photo 15). It is a single-element, 4-hole, sew-through button with a concave front (see Stone 1974; and Storm 1976 for classifications). It probably dates to the mid- to late nineteenth century or early twentieth century

and was likely used on pants or underwear (e.g., Herskovitz 1978: Figure 12 t; see also Crown Publishers 1969; Isreal 1976).

Brass/Copper

One brass button was collected (Cat. no. 3014) from the north end of EU-8 between 70 cm and 75 cm. b.s. This button is a 2-element, 4-hole, sew-through button (Stone 1974; Storm 1976) with the back missing. It has a concave front with an unreadable pattern (Photo 16). The button could have been manufactured in either the nineteenth or early twentieth century. It is an overall or suspender button (see Herskovitz 1978: Figure 12 s-u; see also Crown Publishers 1969; Isreal 1976). In addition to this button, three unidentified, thin brass or copper fragments were collected (Cat. no. 3012).

Glass

Beads

A total of four glass beads were found within the project area, all of which probably date to the nineteenth century. All of the beads were collected from Site 50-10-63-19461, Feature A within the slab-lined hearth (Feature 1), EU-8. They were identified using Sprague (1985), Stone (1974), and Storm (1976); see also Carter (1979), and Rosendahl and Carter's (1988) discussion of beads recovered from John Young's Homestead, Kawaihae, Hawaii. Exterior diameters were measured in millimeters using electronic calipers, with the interior bore diameter being measured using Singer sewing machine needles of known sizes.

The first bead (Cat. no. 3007) is a faceted and pressed, yellow to light green glass bead with an exterior diameter of 13.86 mm and a variable bore diameter (Photo 17). This bead was collected at a depth of 65 cm. b.s. The second bead (Cat. no. 3025) is a whole, wound, pink, glass seed bead (Photo 18). It has an exterior diameter of 3.033 mm with an interior bore diameter that corresponds in size to a size 16 Singer sewing machine needle. This bead was found at a depth of 70 cm to 75 cm. b.s. in the south 1/2 of the unit. The third bead (Cat. no. 3034) is a drawn, red trade bead with an exterior diameter of 4.12 mm and a bore diameter that is smaller than a size 9 Singer sewing machine needle (Photo19). This bead was found at a depth of 75 cm to 80 cm. b.s. The fourth bead (Cat. no. 3033) is a whole, wound, pink, and glass seed bead with an exterior diameter of 2.57 mm. It also has a bore diameter smaller than a size 9 Singer sewing machine needle.

Photo 14: Top photo. Machine cut nails.

Photo 15. Middle photo. Iron or steel, single element, 4-hole, sew through button with a concave front. From Site 50-10-63-19461, Feature A, EU-8.

Photo 16. Bottom photo. A brass button with a concave front and an unreadable pattern. From Site 50-10-63-19461, Feature A, EU-8.

Photo 17: Top photo. A faceted and pressed, yellow to light green glass bead. From Site 50-10-63-19461, Feature A, EU-8

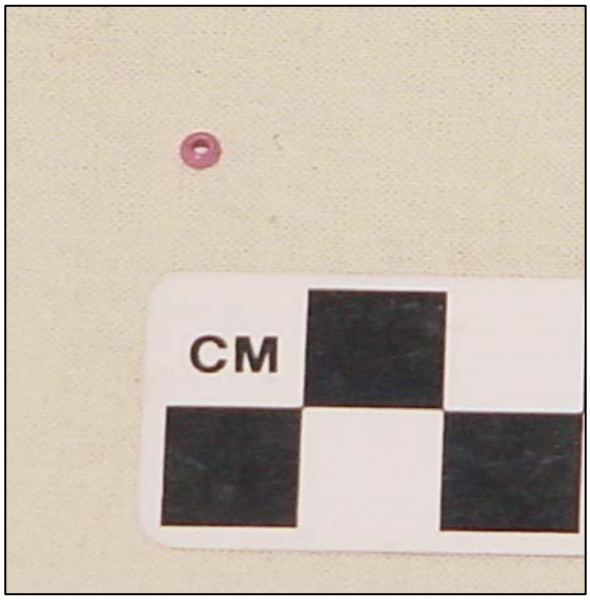

Photo 18. Middle photo. A whole, wound, pink glass seed bead. From Site 50-10-63-19461, Feature A, EU-8.

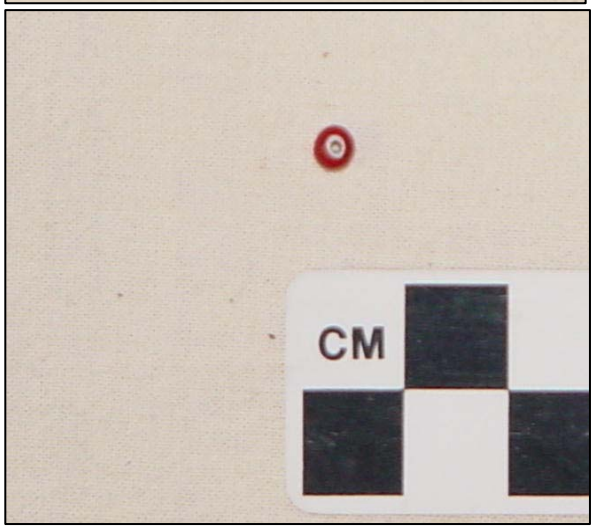

Photo 19. Bottom photo. A drawn, red trade bead. From Site 50-10-63-19461, Feature A, EU-8.

Button

One press-molded, black, glass button with a metal shank was found at 72 cm. b.s. within EU-8, Feature A at Site 50-10-63-19461. This glass button (Cat. no. 3026) has a flat front with a faceted edge and a convex back (Photo 20). It is a 2-element, sew-through button, which was found in the slab-lined hearth (Feature 1), and probably dates to the second half of the nineteenth century. A matching button was found in the same location at 75 cm. b.s. (Cat. no. 3019).

Bottle Glass

A total of five undiagnostic bottle glass sherds were recovered from the project area. Two of these glass sherds (Cat. no. 3031) were recovered from Site 50-10-63 19461, Feature A, EU-8 at a depth of 75 cm to 80 cm. b.s. One sherd is from an aqua bottle and the other is clear in color. Both bottles probably date to the late nineteenth to early twentieth century. A glass sherd from a clear bottle that has been heat-affected was recovered from Site 50-10-63 19461, Feature C, EU-1 at a depth of 0-19 cm. b.s. (Cat. no. 3044). This bottle glass sherd probably dates after circa 1880, when clear glass became extremely common. Two glass sherds were recovered from a refuse pit (Feature 2) at Site 50-10-63 19461 within EU-2 at a depth of 0 to 15 cm. b.s. One of these sherds is from an olive-green bottle (this color is commonly associated with nineteenth-century Spirits bottles; other bottle types can occur in this color). The other is a nineteenth-century, non-applied, light aqua rim sherd from a mold-blown bottle (Baugher-Perlin 1982; Lorrain 1968), and possibly a medicine bottle. Mold-blown bottles, largely made before 1910, are the most frequently occurring bottles on nineteenth century sites in Hawaii.

Other Glass

One glass fragment (Cat. no. 3041) recovered from the surface of a wall (Feature F) at Site 50-10-63 19461 was identified as a lamp base fragment (Photo 21). This manganese-decolorized lamp base has a pressed diamond pattern. Manganese-decolorized glass most frequently dates from the late nineteenth to early twentieth century (e.g., Lorrain 1968 provides a date range of circa 1880 to 1925), and results from the addition of nickel, which produces a range of purple shades in bottles that have been exposed to light for a period.

Ceramic

Yellowware

A single body sherd from a yellowware hollowware (e.g., bowl) vessel was collected as a sample from the surface of Feature A at Site 50-10-63 19461 (Cat. no. 3000) (Photo 22). This sherd is possibly from a nappy (a stackable series of bowls with flared sides, flat bases, and plain rather than rolled rims (Ketchum, Jr. 1987:32). Nappies are the most common bowl form found on nineteenth century sites in Hawaii (e.g., Ka'ahumanu, Marin Tower, Kikihale, Kekaulike in downtown Honolulu), and were manufactured by most yellowware

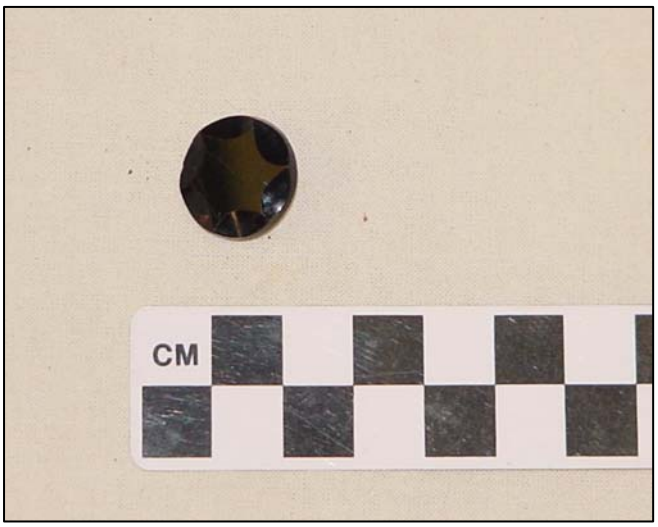

Photo 20: Top photo. A press-molded, black, glass button with a metal shank. From Site 50-10-63 19461, Feature A, EU-8 (cat no. 3026). Roll 1995-21, Frame 22.

Photo 21. Middle photo. A sherd from yellowware hollowware vessel. From Site 50-10-63-19461, Feature A, EU-8.

Photo 22. Bottom photo. Body sherd from a yellowware hollowware (e.g., bowl) vessel was collected as a sample from the surface of Feature A at Site 50-10-63 19461.

potteries (Ketchum, Jr. 1987). They may occur in Hawaii before 1840, but appear most common during the later half of the nineteenth century. Yellowware nappies were made in both England and America and were used for food preparation, storage, and serving (Ketchum, Jr. 1987; Liebowitz 1985).

Porcellaneous Stoneware

A single sherd from a Chinese porcellaneous stoneware dish was recovered from Site 50-10-63-19461, Feature A, EU-8 at 30 cm. b.s. (Cat. no. 3003) (Photo 23). This sherd has a cobalt blue *Sino-Islamic*, *Allah* or *Chrysanthemum* pattern. This pattern is described by Willetts and Poh (1981:4) as having been found on pottery in insular and peninsular Southeast Asia, South Asia, including India, and elsewhere that *"... émigré* Chinese found home or work, or where Chinese export pottery other than that specifically designed for Europeans found a ready sale" (Willetts and Poh 1981:4).

Such Chinese porcellaneous stoneware dishes have been recovered from nineteenth century sites on Oahu, including sites in the historic downtown area of Honolulu (e.g., Marin Tower [see Goodwin, et al. 1996]; Ka'ahumanu [see Lebo, et al. 1994]), as well as more rural locations on the Windward side of O'ahu (e.g., Maunawili project area [RHCC: Reconnaissance Phase I, II Survey, and Monitoring of Proposed Maunawili Golf Course, Bishop Museum Temporary Loan Collection No. 1988.123]). These dishes have also been found on Hawai'i Island, including the John Young Homestead (Rosendahl and Carter 1988: Figure 46 [top left] and Figure 47 [right end of center row]). These *Allah* or *Chrysanthemum* dishes occur on sites occupied by varying ethnic groups, including Hawaiian, Europeans, and Euro-Americans, not occurring exclusively or primarily on overseas Chinese sites in Hawaii. This dish form is a type of flatware (i.e., plate, saucer, and platter form) which most commonly occurs at sites in Hawaii in the plate-size range (9-11 inches in diameter).

Porcelain

Two white porcelain buttons were recovered from Site 50-10-63-19461, Feature A, EU-8 at a depth of 70 cm to75 cm. b.s. The first button is a 2-element, porcelain button with a metal shank (Cat. no. 3015). It is very small, like a shoe-button, but it may have been from an article of clothing. It probably dates to the late nineteenth or early twentieth century (Photo 24). The second button is called a *China or Prosser* button with a concave front and convex back (Cat. no. 3017) (Photo 25). It is a 4-hole, sew-through, single-element button, also dating from the late nineteenth to early twentieth century (Luscomb 1967; Storm 1976). This button measures 15 ligne or line in size, being probably from a shirt, blouse, dress, or similar article (e.g., 1902 Sears Roebuck Catalogue, reprinted by Crown Publishers [1969]).

Photo 23: Top photo. A sherd from a Chinese porcellanous stoneware dish. From Site 50-10-63 19461, Feature A EU-8.

Photo 24. Middle photo. A two element porcelain button with a metal shank. From Site 50-10-63 19461, Feature 8, EUA

Photo 25. Bottom photo. A China or Prosser button with a concave front and a convex back. From Site 50 10-63-19461, Feature A, EU-8.

Kaolin

A white kaolin, tobacco pipe stem fragment was recovered from Site 50-10-63-19461, Feature A, EU-8 (Cat. no. 3020). This nineteenth century pipe fragment has an unidentified design on the stem composed of diagonal rows of lines with circles between the rows (Photo 26). Kaolin tobacco pipes have been found on a number of nineteenth century sites in Hawaii.

Plastic

Bakelite

Three Bakelite comb teeth were found at Site 50-10-63-19461, Feature A, EU-8 (Cat. no. 3021). They were found at a depth of 70 to 75 cm. b.s. Bakelite is a synthetic form of plastic that Luscomb (1967:19) reports was invented between 1907 and 1909 and is made from a combination of carbolic acid, formaldehyde, and lye.

Photo 26. A white, kaolin, tobacco pipe stem fragment. From Site 50-10-63-19461, Feature A, EU-8.

Historic Artifact Summary

The historic artifacts from Feature 1 at Site 50-10-63-19461 indicate that this slab-lined pit located within Feature A, a habitation enclosure, was filled in during the late nineteenth to early twentieth century. Interestingly, older material was recovered from some of the upper deposit, including the Kitchen Ch'ing porcellaneous stoneware dish sherd, some of the beads, and the machine-cut nails. Wire nails were found at lower depths (70 cm-75 cm. b.s.) than many of the machine-cut nails, although wire nails largely replaced machine-cut nails, following their introduction to Hawai'i in the 1890's (cf. Hurst and Allen 1992). The bakelite comb teeth, also early twentieth century in manufacture, occurred at a lower depth than the nineteenth century Kitchen Ch'ing ceramic sherd, the kaolin tobacco pipe stem, and many of the beads. These data suggest that this feature either contained disturbed fill from another context or that Feature 1 was filled sometime in the early twentieth century, possibly in multiple episodes.

The historic artifacts from other contexts at Site 50-10-63-19461, including Features B, C, F, and H, also appear to date within the late nineteenth to early twentieth century range. These contexts contained domestic-related material, but in insufficient amounts to make meaningful interpretations.

Only metal fragments, including nails and unidentified pieces were found in Feature T109 at Site 50-10-63-20420. These remains date to the same time period as the historic artifacts from Site 50-10-63-19461, but are too limited in frequency and diversity to make meaningful interpretations.

Table 34. Historic Artifacts from Project Area.

Site Number 50-10-63	Feature	Artifact Type and Count	Layer/Level (cmbs) and Excavation Unit	Artifact Description	Estimated Date	Catalog Number
19461	A	Ceramic (1)	Surface	Yellowware sherd from possible nappy, undecorated. English or American.	early/mid-19th to early 20th century	3000
19461	A	Nails (4)	Surface	Machine-cut iron nail fragments.	early 1800's to circa 1894	3001
19461	A	Ceramic (1)	30 cmbs, Feature 1, EU-8	Kitchen Ch'ing porcellaneous stoneware dish sherd w/Allah or Chrysanthemum pattern. Chinese.	early 1800's to late 19th century	3003
19461	A	Iron fragments (4)	40 cmbs, Feature 1, EU-8	Iron fragments w/rivet possibly from an unidentified tool.	19th to 20th century	3004
19461	A	Nails (3)	60 cmbs, Feature 1, EU-8	Machine-cut iron nail fragments.	early 1800's to circa 1894	3005
19461	A	Iron fragment (1)	60 cmbs, Feature 1, EU-8	Unidentified thick iron fragment.	19th to 20th century	3005

Table 33. continued.

Site Number 50-10-63	Feature	Artifact Type and Count	Layer/Level (cmbs) and Excavation Unit	Artifact Description	Estimated Date	Catalog Number
19461	A	Bead (1)	65 cmbs, Feature 1, EU-8, west side	Faceted and pressed, yellow to light-green glass bead. Exterior diameter = 13.86 mm.	19th century	3007
19461	A	Nails (8)	70-75 cmbs, Feature 1, EU-8, north end	Machine-cut nail fragments.	early 1800's to circa 1894	3012
19461	A	Copper/Brass fragments (3)	70-75 cmbs, Feature 1, EU-8, north end	Unidentified thin copper or brass fragments.	19th to 20th century	3012
19461	A	Iron fragments (23)	70-75 cmbs, Feature 1, EU-8, north end	3 thin wire fragments; 20 unidentified thin to thick, large and flat iron fragments.	19th to 20th century	3012
19461	A	Button (1)	70-75 cmbs, Feature 1, EU-8, north end	Brass, 2-element, 4-hole, sew-through button with missing back. Concave front with unreadable letters or design.	19th to early 20th century	3014

Table 33. continued.

Site Number 50-10-63	Feature	Artifact Type and Count	Layer/Level (cmbs) and Excavation Unit	Artifact Description	Estimated Date	Catalog Number
19461	A	Button (1)	70-75 cmbs, Feature 1, EU-8, north end	White porcelain clothing or shoe button w/iron shank.	19th to early 20th century	3015
19461	A	Button (1)	70-75 cmbs, Feature 1, EU-8, north end	Iron or steel, single-element, 4-hole, sew-through button with concave front.	19th to early 20th century	3016
19461	A	Button (1)	70-75 cmbs, Feature 1, EU-8, north end	White porcelain "China" or "Prosser" button, single-element, 4-hole, sew-through button with concave front and convex back.	19th to 20th century	3017
19461	A	Button (1)	75 cmbs, Feature 1, EU-8, NE ¼	Black glass button with missing shank, flat front with cut design, and convex back.	19th century	3019

Table 33. continued.

Site Number 50-10-63	Feature	Artifact Type and Count	Layer/Level (cmbs) and Excavation Unit	Artifact Description	Estimated Date	Catalog Number
19461	A	Pipe Stem (1)	75 cmbs, Feature 1, EU-8, NE ¼	White kaolin tobacco pipe stem fragment with unidentified design.	19th century	3020
19461	A	Comb Teeth (3)	70-75 cmbs, Feature 1, EU-8, north end	Bakelite comb teeth.	early 20th century	3021
19461	A	Nails (3)	70-75 cmbs, Feature 1, EU-8, S ½	Wire nail fragments.	circa 1894 to 20th century	3023
19461	A	Iron fragments (5)	70-75 cmbs, Feature 1, EU-8, S ½	Unidentified, thick, flat iron fragments.	19th to 20th century	3025
19461	A	Bead (10	70-75 cmbs, Feature 1, EU-8, S ½	Pink, whole, wound glass seed bead. Exterior diameter = 3.033 mm.	19th century	3026

Table 33. continued.

Site Number 50-10-63	Feature	Artifact Type and Count	Layer/Level (cmbs) and Excavation Unit	Artifact Description	Estimated Date	Catalog Number
19461	A	Button (1)	72 cmbs, Feature 1, EU-8, S 1/2	Pressed, 2-element, sew-through, black glass button with metal shank, flat front with faceted edge, convex back.	19th century	3031
19461	A	Glass sherds (2)	75-80 cmbs, Feature 1, EU-8	Nondiagnostic bottle glass sherds.	Prob. 19th century	3032
19461	A	Nails (9)	75-80 cmbs, Feature 1, EU-8	Wire nail fragments.	circa 1894 to 20th century	3033
19461	A	Bead (1)	75-80 cmbs, Feature 1, EU-8	Pink, whole, wound glass seed bead. Exterior diameter = 2.57 mm.	19th century	3034
19461	A	Bead (1)	75-80 cmbs, Feature 1, EU-8	Drawn, red trade bead. Exterior diameter = 4.12 mm.	19th century	3040
19461	A	Nail (1)	Surface, 1.5 m SW of Feature 1	Machine-cut nail w/missing tip.	early 1800 to circa 1894	3041

Table 33. continued

Site Number 50-10-63	Feature	Artifact Type and Count	Layer/Level (cmbs) and Excavation Unit	Artifact Description	Estimated Date	Catalog Number
19461	F	Lamp Glass (1)	Surface, Feature F	Manganese-decolorized lamp base fragment with diamond pattern.	circa 1880 to 1920	3043
19461	C	Metal (8)	Layer I/0-19 cmbs EU-1	Unidentified iron fragments.	19th to 20th century	3044
19461	C	Glass sherd (1)	Layer I/0-19 cmbs EU-1	Clear, nondiagnostic, heat-affected bottle glass sherd.	circa. 1880 to 20th century	3047
19461	2	Nails (5)	Layer I/0-15 cmbs EU-2	Machine-cut nail fragments.	early 1800 to circa. 1894	3047
19461	2	Nails (2)	Layer I/0-15 cmbs EU-2	Wire nail fragments.	circa 1894 to 20th century	3048
19461	2	Glass sherds (2)	Layer I/0-15 cmbs EU-2	1 olive-green body sherd; 1 light aqua rim sherd.	circa late 19th to 20th century	3053
19461	B	Nails (4)	Layer I/1, Feature 3, EU-3	Machine-cut nail fragments.	early 1800 to circa. 1894	3053
19461	B	Iron fragments (6)	Layer I/1, Feature 3, EU-3	Unidentified, thin, flat metal fragments.	19th to 20th century	3057

Table 33. continued.

Site Number 50-10-63	Feature	Artifact Type and Count	Layer/Level (cmbs) and Excavation Unit	Artifact Description	Estimated Date	Catalog Number
19461	B	Nails (5)	Layer I/1, Feature 3, EU-3	Machine-cut nail fragments.	early 1800 to circa. 1894	3057
19461	B	Iron fragments (5)	Layer I/1, Feature 3, EU-3	Unidentified, thin, flat, iron fragments.	19th to 20th century	3072
19461	H	Iron fragments (3)	0-20 cmbs EU-5	Unidentified, thin, flat, iron fragments.	19th to 20th century	3201
20420	T109	Iron fragments (4)	Layer II/1 16-21.5 cmbd EU-1	Unidentified, thin, flat, iron fragments.	19th to 20th century	3207
20420	T109	Nails (2)	Layer III/2 21.5-30 cmbd EU-1	Machine-cut nail fragments.	early 1800's to circa. 1894	3207
20420	T109	Iron fragments (7)	Layer III/2 21.5-30 cmbd EU-1	Unidentified, thin, flat, iron fragments.	19th to 20th century	3212
20420	T109	Nail (1)	Layer IV/3 30-40 cmbd	Machine-cut nail fragment.	early 1800's to circa. 1894	3212
20420	T109	Iron fragments (1)	Layer IV/3 30-40 cmbd	Unidentified iron fragments.	19th to 20th century	

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CHAPTER 7. CONCLUSION

The primary purpose of the 1995 Paliuli Emergency Salvage Project was to document, as quickly as possible, a number of sites in the Paliuli area that were threatened by the 1995 lava flow. This project was not intended to be all-inclusive; that is, the level of analysis possible under the circumstances was not all encompassing. In an ideal situation, more extensive investigations would have been conducted including intensive excavations and detailed analysis. For instance, additional radiocarbon dating would have been necessary from a broader range of feature types in order to make definitive conclusions about the dates and function of the sites within the project area. Unfortunately, the scope of this project was restricted and therefore limited due to the emergency situation, and the time constraints imposed therein. It is for this reason that the conclusions summarized below must be viewed as preliminary.

Phase I Area

Residential Complex 1

The sites that have been included within Residential Complex 1 are most likely of both late prehistoric and post-contact origin. Evidence suggesting a historic component will be discussed first. Feature A, a terrace within Site 19462 is connected to a high enclosing wall (Site 19472) that extends quite a distance *mauka* beyond the Kalapana Trail. This wall actually represents the West Side of Feature A. Close inspection of both the wall and enclosure indicates that the building technique for both is very similar indicating that Feature A may have been built at the same time as the wall. Long, high walls such as these are generally associated with the historic period and the import of cattle and goats. An additional wall encloses the remaining part of the complex to the north, west, and south. Though lower, this type of wall was also commonly built in historic times, functioning to keep roaming cattle and goats from eating the *pili* grass thatching used on houses located within the enclosures. The same holds true for high walled enclosures, like those of Feature A. Still, the exact age of this latter structure can not be determined without the addition of excavations and there are no dates available for the surface features within Residential Complex 1.

Indications that the site has an earlier and possible prehistoric component are also evident. First, no historic artifacts were found either along the surface or within excavated units within the complex. Artifacts that were recovered were all indigenous in nature and included volcanic glass, basalt flakes, an adz fragment, and basalt disc. The site was built on an *'a'ā* flow and includes Type A stepping stone trails, generally associated with prehistoric times (Apple 1965). Ladefoged (1987:113) noted a similar pattern for residential sites in *mauka* areas of the Kamoamoa *ahupua'a*. He too observed that the surrounding area was characterized as *pāhoehoe* flows with frequent mounds and other types of agricultural features.

An earlier component is likely of Feature B, a cave within Site 19462. The cave does not appear to be modified to the same degree as the surface sites and includes the earliest radiocarbon date from the project area as a whole. The site encompasses a dated range between A.D. 1450-1825 (2 sigma, 95% probability) indicating that it could have been in use soon after the lava flow was created (AD 1450). In addition, charcoal analysis of samples recovered from the cave revealed a complete absence of exotic plants such as java plum (*Syzygium cumini*) and guava (*Psidium guajava*) that now dominate the region. This finding likely indicates that the cave predates the historic introduction of these plants (late 1800's to early 1900's). The charcoal samples that were identified from this site include *lama* (*Diospyros sandwicensis*), '*a'ali'i* (*Dodonea viscosa*), (*Metrosideros polymorpha)* and a *hala* (*Pandanus tectorius*) key. According to Murakami (this report; Appendix C) the combination of these plants indicate a "lowland open vegetation." She notes that at the time the cave was occupied, a "forest of native trees and shrubs" grew in the project area. It is thus likely that the cave feature represents an earlier use of the area, perhaps for stopovers during the collection of resources in more *mauka* areas. The other two caves within this complex also appear to be prehistoric in origin.

Cave

Site 50-10-63 19463 is a lava tube with indigenous style petroglyphs located within and outside the entrance. This site included charcoal along the floor and was found to be dripping water. An additional cave (Site 50-10-63 19464) within the complex was discovered with a complete gourd in the *makai* section. Both caves were undoubtedly used for collecting water for the inhabitants within the residential area.

The majority of the features within Residential Complex 1 were probably used on an intermittent basis, though perhaps for a longer duration than the cave features. The lack of extensive midden deposits and the limited number of bone recovered from the area substantiate this assumption.

Residential Complex 2

The majority of features within Residential Complex 2 are almost certainly of historic origin. Many artifacts were recovered from the site complex, most dating from the late 19th to the early 20th century with some artifacts (machine-cut nails) possibly dating to the early 1800's. Most of the artifacts were excavated from a slab-lined pit (Feature 1) within Terrace Feature A. Particular items recovered include ceramics, a pipe stem, buttons from various types of clothing, and part of a lamp. These types of recovered artifacts would be expected in a community engaged in typical residential activities within this *mauka* region.

Greg Burtchard has developed a land-use model for the East Rift Zone of Kilauea Volcano. This model, drawn from McEldowney's (1979) earlier work, attempts to predict the frequency and distribution of archaeological sites from coastal to upland zones. Based on his model, (1994) the project area typifies an inland Leeward agricultural zone. As described by Burtchard (1994:57), this zone is "linked to agricultural land use, possibly in isolated pockets of suitable agricultural sediments."

The "isolated pockets" to which Burtchard refers are clearly evident within Residential Complex 2. Here the residential areas are located in a densely vegetated region, just *mauka* of a terraced slope (19470, Feature A) with considerable, deep soil deposits. To the east is a dense concentration of mounds (Site 19469 Feature R) with over 200 such features. Also, located within Site 19469 are a series of seven cairns (Features A-G) that create an "L" in plan view. These possibly denote the corner of an agricultural field area. Ten anthropomorphic petroglyphs situated *mauka* /*makai* also appear to create a field boundary. Other anthropomorphic petroglyphs bound the East corner of the terraced slope (Site 19470 Features A-H). Based on these observations, it is thus likely Residential Complex 2 represents a historic era community tending crops on an intermittent basis. The large number of mound and terrace features surrounding this residential complex attests to rather intensive agricultural activities that most certainly occurred here.

The type of crops likely to have been grown in this Leeward region include sweet potato (*Ipomoea batatas*), gourd (*Lagenaria siceraria*), and sugar cane (*Saccharum officinarum* L.). Unfortunately, pollen analysis conducted on soil collected from an agricultural terraces at the site did not reveal any sweet potato pollen or pollen from any other cultivate. Still, as noted by Ward, sweet potato plants "are shy pollen producers" and thus not finding pollen in the samples does not preclude that sweet potatoes were grown here. Indeed, the limited amount of soil, and water would severely limit the kinds of crops that could possibly be grown in this area. The precise use of these types of features, particularly the pit and mounds, for growing crops is unclear. For instance, were the mounds, so ubiquitous in the project area (19469 Feature R), piled to prepare the surrounding land area for crops? Or, were the mounds themselves used as growing planters?

Archaeological analysis of the Kona Field System has supplied some answers to these questions. This system exemplifies an eclectic use of the landscape for agricultural purposes. Crops of various kinds were alternately grown in small mounds, terraces and the *kuaiwi* walls that ran down and across the slopes of Mt Hualalai and Mauna Loa. The Amy Greenwall Botanical Gardens represents a portion of the Kona Field System currently under plantation. Today, dozens of crops are grown in the mounds and walls of this garden with sweet potato, yam, pandanus, *kukui*, and dry land taro to name a few.

Archaeological investigations of extant sections of a similar field system in North Kohala have been conducted over the years beginning with Paul H. Rosendahl in 1968. Rosendahl recently (1994) summarized the fieldwork he directed in Lapakahi. Excavations conducted by Sugiyama in 1970 (1973:266-271) indicated that mounds could have been utilized in a number of ways. For instance, mounds placed directly on top of *pāhoehoe* without soil underneath were likely used to allow the vines of the sweet potato or gourd crops to grow. The plant itself would have grown in the cleared, soil areas next to the mounds. This suggestion seems reasonable considering the pattern of growth exhibited by the morning glory, a plant closely related to the sweet potato (they are both species of *Ipomoea*). The morning glory is ubiquitous in Hawaii Volcanoes National Park and can be seen growing in large numbers along the roadsides with vines spread over the rocky *pāhoehoe* or *'a'ā* boulders.

Mounds built on top of piled soil areas would have had a different function. In this case, the plant would have been grown directly in the mound with the soil underneath allowing the plant to take root. The mound itself would allow for frequent aeration of the sweet potato or gourd roots. Both types of features were observed in the project area, particularly within Transect 1. Ethnographic accounts are available describing these various uses of mounds for planting. Some of these sources are listed below.

Handy and Handy (1972:131) supply the following ethnographic account of sweet potatoes grown directly in mounds (*pu'e*).
Where potatoes are planted in crumbling lava combined with humus, as on eastern Maui and in Kona, Hawaii, the soil is softened and heaped carelessly in little pockets and patches utilizing favorable spots on slopes. The crumbling porous lava gives ample aeration without much mulching (Handy and Handy 1972:131).

Ethnohistorical data collected in the 1800's indicates that the pit features that generally accompany mounds were also used for growing sweet potato. Chester A. Lyman wrote the following account in 1846 while visiting Kamoamo in the Puna District:

We passed a potato patch in the broken lava, which exceeded anything I had seen. Not a particle of soil was anywhere to be seen, and the holes dug among the stones to receive the potatoes were some of them 6 feet in depth-thus securing a degree of moisture and shelter from the sun-though no more solid than on the surface (Lyman 1924:101)

Other ethnographic accounts provide additional detail concerning the use of pits and mounds for growing agricultural crops. Handy and Handy (1972:128-129) describe the process of growing crops in pit features. They relate a story told by Mary Kawena Pukui in which she said this way of growing crops "was to rot weeds where the soil was good and then carry them to fill the hollows made on the *pāhoehoe"* (Handy and Handy 1972:131). They write that crops could easily have been grown by adding mulching material to patches with "decomposing lava." The combination of mulching material to decomposing lava rock or cinder would have been a suitable substrate for growing sweet potato, a plant that requires an aerated rocky soil (Yen 1974). Handy and Handy (1972:129) term these types of sweet potatoes *makaili.*

Some general conclusions concerning the use of pits and mounds is included in the discussion below for the Phase II Area.

Phase II Area

Transect 1

The 1000 m long x 30 m wide transect swath was surveyed 100% and included over 300 features most of which have been classified as having an agricultural function. Types of features encountered include depressions, C-shapes, terraces, filled cracks, pits, mounds, and modified outcrops. Depressions, filled cracks, and pits probably served as ideal planting areas for sweet potato and gourd crops, particularly since they tend to be much wetter than flat or raised areas. These areas were generally found filled with rock with some soil underneath and were often observed with vegetation growing out of them. The small C-shaped structures that were frequently encountered were generally observed with walls placed to block the prevailing wind. These features were also devoid of hearths or surface midden. It is thus likely that at least some of the C-shapes located within the transect were used for an agricultural purpose. This function for C-shapes was also noted by Ladefoged et al (1987) in the in the Kalapana Extension DSA.

Some observations concerning the incidence of agricultural features in the transect area have been made. First, agricultural features appear to be more frequent in areas with that are not densely vegetated. The transect swath is moderately vegetated overall and the incidence of agricultural features in this area is fairly consistent. However, in the more *mauka* section of the transect where the vegetation is denser, and soil development greater, the number of agricultural features drops off dramatically. This reduction in the density of agricultural features is evident above the elevation of 600 feet. Second, during the survey of the transect, a distinction was made between mounds with boulders and those with cobble sized rock. Later analysis of these two types of features indicates that the cobble mounds are more predominant in areas with less soil development. Perhaps the cobbles were used in addition to mulch material in areas where soil development was too minimal for the growth of crops. The use of gravel would not have been necessary in areas with deeper soil deposits. An additional observation made for the entire project area is that steep slopes, particularly when they are located on *`a`ā* flows tend to have

terraces or linear mound features as opposed to smaller agricultural features such as mounds and modified outcrops, found along more gradual slopes. In addition, steep *`a`ā* slopes appears to have increased soil development and more vegetation.

A number of habitation features were encountered within the transect swath. These can be classified as enclosures, terraces and C-shaped shelters. Though these types of features were not abundant, their incidence appears to be non-random, with indications that each cluster of residence areas may be associated with particular families. Based on the limited associated midden they appear to have been used for short term or intermittent use, perhaps as shelters while attending to agricultural crops grown in the area. Two habitation sites (50-10-63 20424 and 50-10-63 20420) included hearths and were thus excavated. These sites included historic artifacts such as metal nails, fish bone, mammal bone, shell midden, and charcoal.

In sum, it appears that the project area as a whole is consistent with a shifting resident pattern with intermittent habitation for the purpose of attending agricultural fields. This residence pattern, as defined by Kirch (1983:14), was observed by Latefoged et al. (1987) in inland areas of the Kamoamoa DSA. Temporally, the project area dates primarily to the late prehistoric and historic period with some of the cave features perhaps dating to an earlier time. This is congruent with general theories concerning the habitation of more marginal areas of the island of Hawaii.

GLOSSARY OF HAWAIIAN WORDS

'a'ā Lava rock that is craggy and rough.

ahu A conical shaped pile of stones that have been stacked. *Ahu* were traditionally used to mark a trail or boundary.

ahupua'a Political land unit that begins at the sea and terminates in the mountains. Hypothetically, *ahupua'a* are pie shaped tracts of land upon which a family subsisted.

ali'i A member of an elite group in Hawaiian society. Chiefs, chiefesses and other high ranking people were generally of the *ali'i* class.

hale A house.

heiau A temple used to worship to specific gods.

'ili 'ili Small, pebble sized water worn rocks.

kapu *Kapu* items include those things that are sacred, holy, or forbidden.

kipuka An oasis of sorts in which an area of vegetated land is surrounded by newer lava.

kōnane A game played on a stone board with a number of vertical and horizontal holes. The game resembles Chinese checkers.

Makahiki Yearly festival that spans a four month period from October through January. The festival coincides with the coming of the winter rains and with the return of *Lono*, god of the *makahiki*. It was during the *makahiki* that taxes were collected by the *konohiki* at the *ahupua'a* boundaries.

makai A geographic term meaning toward the ocean.

mauka A geographic terms meaning towards the mountains.

'ohana Extended Hawaiian family.

pāhoehoe Smooth, ropy lava rock.

papamū Game board upon which *kōnane* is played.

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APPENDIX A-Feature Function

PHASE I AREA

Site Number 50-10-63	Bishop Museum Number	Feature Designation	Feature Type	Function
19461	HV 189	A	Platform	Habitation
		B	Enclosure	Habitation
		C	Enclosure	Habitation
		D	Enclosure	Habitation
		E	Wall	Habitation
		F	Wall	Habitation
	HV 190	G	Enclosure	Habitation
		H	Enclosure	Habitation
		I	Petroglyphs	Unknown
19472	HV 192		Platform	Habitation
19462	HV 194	A	Enclosure	Habitation
		B	Cave	Habitation
		C	Terrace	Agriculture
		D	Terrace	Habitation
		E	Petroglyphs	Unknown
		F	Wall	Habitation
		G	Papamu	Activity Area
		H	Trail	Transportation
		I	Bashed Area	Activity Area
19463			Cave	Habitation
19464	NA		Cave	Burial, Habitation, Water Collection
19467	HV 194	A	Enclosure	Habitation
19467	HV 194	B	Wall	Habitation
	HV 194	C	Cave	Habitation

PHASE I AREA continued.

Site Number 50-10-63	Bishop Museum Number	Feature Designation	Feature Type	Function
19468	HV 194		Trail	Transportation
19469	HV 188	A	Ahu	Boundary Marker
		B	Ahu	Boundary Marker
		C	Ahu	Boundary Marker
		D	Ahu	Boundary Marker
		E	Ahu	Boundary Marker
		F	Ahu	Boundary Marker
		G	Ahu	Boundary Marker
		H	Petroglyph	Boundary Marker
		I	Petroglyph	Boundary Marker
		J	Petroglyph	Boundary Marker
		K	Petroglyph	Boundary Marker
		L	Petroglyph	Boundary Marker
		M	Petroglyph	Boundary Marker
		N	Petroglyph	Boundary Marker
		O	Petroglyph	Boundary Marker
		P	Petroglyph	Boundary Marker
		Q	Petroglyph	Boundary Marker
		R	Mound Concentration	Agriculture
19470	HV 191	A	Terraced Slope	Agriculture
		B	Petroglyph	Unknown
		C	Petroglyph (3)	Unknown
19470	HV 191	D	Petroglyph	Unknown
		E	Petroglyph	Unknown
		F	Petroglyph	Unknown
		G	Petroglyph	Unknown
		H	Petroglyph	Unknown
19471	HV 187		Enclosure	Habitation

PHASE I AREA continued.

Site Number 50-10-63	Bishop Museum Number	Feature Designation	Feature Type	Function
19473	HV 194		Wall	Unknown
19475	N/A	A	Petroglyph (5)	Trail Marker
		B	Petroglyph (4)	Trail Marker
		C	Petroglyphs	Trail Marker
		D	Petroglyph (1)	Trail Marker
		E	Petroglyph (1)	Trail Marker
		F	Petroglyph (2)	Trail Marker
		G	Petroglyph (1)	Trail Marker
		H	Petroglyph (1)	Trail Marker
		I	Petroglyph (1)	Trail Marker
		J	Petroglyph (3)	Trail Marker
		K	Petroglyph	Trail Marker
		L	Petroglyph	Trail Marker
		M	Petroglyph	Trail Marker

Functions for Features within Phase II/Transect 1 Area.

Site Number 50-10-63	Feature Number	Feature Type	Function
20414	T101	C-shape	Habitation
20414	T229	Pavement w/*kōnane*	Habitation
20415	T103	C-shape	Habitation
20416	T104	Petroglyph	Unknown
20417	T105	C-shape	Habitation
20418	T106	Petroglyph	Unknown
20418	T107a	Petroglyph	Unknown
	T107b	Petroglyph	Unknown
20418	T137	Petroglyph	Unknown
20419	T108	Cupboard	Habitation
20419	T138	Petroglyph	Unknown
20420	T109	Enclosure	Habitation
20420	T110	Wall (J-shaped)	Habitation
20421	T111	Enclosure	Habitation
20422	T112	C-shape	Habitation
20422	T115	Terrace	Habitation
20422	T139	Petroglyph	Unknown
20422	T140	Petroglyph	Unknown
20423	T113	Ahu	Marker
20424	T119	Enclosure	Habitation
20424	T120	Enclosure	Habitation
20424	T141	Petroglyph	Unknown
20425	T122	C-shape	Habitation
20426	T123	Mound	Possible Burial

Functions for Features within Phase II/Transect 1 Area continued.

Site Number 50-10-63	Feature Number	Feature Type	Function
20427	T125	C-shape	Habitation
20428	T126	Terrace	Habitation
20428	T128	Wall	Unknown
20429	T127	C-shape	Habitation
20430	T131	Wall	Unknown
20431	T132	C-shape	Agriculture
20432	T133	Cave	Habitation/Water Collection
20433	T134	Terrace	Habitation
20433	T135	Enclosure	Habitation
20434	T143	Petroglyph	Unknown
20434	T144a	Petroglyph	Unknown
	T144b	Petroglyph	Unknown
	T144c	Petroglyph	Unknown
20436	T114	Terrace	Agriculture
20436	T116	Filled Crack	Agriculture
20436	T117	Alignment	Agriculture
20436	T118a	Pit	Agriculture
	T118b	Mound	Agriculture
20436	T121a	Pit	Agriculture
	T121b	Mound	Agriculture
20436	T124	Modified Outcrop	Agriculture
20436	T129	Terraced Slope	Agriculture
20436	T130	Terraced Slope	Agriculture
20436	T136	Terrace	Agriculture
20436	T201	Modified Outcrop	Agriculture
20436	T202	Modified Outcrop	Agriculture

Functions for Features within Phase II/Transect 1 Area continued.

Site Number 50-10-63	Feature Number	Feature Type	Function
20436	T203	Mound	Agriculture
20436	T204	Mound	Agriculture
20436	T205	Mound	Agriculture
20436	T206	Mound	Agriculture
20436	T207	Modified Outcrop	Agriculture
20436	T208	Mound	Agriculture
20436	T209	Mound	Agriculture
20436	T210	Mound	Agriculture
20436	T211	Mound	Agriculture
20436	T212	Mound	Agriculture
20436	T213	Mound	Agriculture
20436	T214	Mound	Agriculture
20436	T215	Mound	Agriculture
20436	T216	Mound	Agriculture
20436	T217	Modified Outcrop	Agriculture
20436	T218	Filled Crack	Agriculture
20436	T219	Mound	Agriculture
20436	T220	Mound	Agriculture
20436	T221	Mound	Agriculture
20436	T222	Mound	Agriculture
20436	T223	Mound	Agriculture
20436	T224	Mound	Agriculture
20436	T225	Mound	Agriculture
20436	T226	Cobble Mound	Agriculture

Functions for Features within Phase II/Transect 1 Area continued.

Site Number 50-10-63	Feature Number	Feature Type	Function
20436	T227	Mound	Agriculture
20436	T228	Cobble Mound w/ faced edge	Agriculture
20436	T230	Mound	Agriculture
20436	T231	Mound	Agriculture
20436	T232	Mound	Agriculture
20436	T233	Mound	Agriculture
20436	T234	Cobble Mound	Agriculture
20436	T235	Mound	Agriculture
20436	T236	Mound	Agriculture
20436	T237	Mound	Agriculture
20436	T238	Mound	Agriculture
20436	T239	Cobble Mound	Agriculture
20436	T240	Mound	Agriculture
20436	T241	Modified Outcrop	Agriculture
20436	T242	Mound	Agriculture
20436	T243	Mound	Agriculture
20436	T244	Mound	Agriculture
20436	T245	Mound	Agriculture
20436	T246	Mound	Agriculture
20436	T247	Cobble Mound	Agriculture
20436	T248	Filled Crack	Agriculture
20436	T249	Cobble Mound	Agriculture
20436	T250	Mound	Agriculture

Functions for Features within Phase II/Transect 1 Area continued.

Site Number 50-10-63	Feature Number	Feature Type	Function
20436	T251	Mound	Agriculture
20436	T252	Mound	Agriculture
20436	T253	Pit	Agriculture
20436	T254	Mound	Agriculture
20436	T255	Mound	Agriculture
20436	T256	Mound	Agriculture
20436	T257	Mound	Agriculture
20436	T258	Mound	Agriculture
20436	T259	Mound	Agriculture
20436	T260	Filled Crack	Agriculture
20436	T261	Filled Crack	Agriculture
20436	T262	Mound	Agriculture
20436	T263	Mound	Agriculture
20436	T264	Cobble Mound	Agriculture
20436	T265	Mound	Agriculture
20436	T266	Mound	Agriculture
20436	T267	Mound	Agriculture
20436	T268	Mound	Agriculture
20436	T269	Mound	Agriculture
20436	T270	Mound	Agriculture
20436	T271	Mound	Agriculture
20436	T272	Cobble Mound	Agriculture
20436	T273	Mound	Agriculture
20436	T274	Filled Crack	Agriculture
20436	T275	Mound	Agriculture
20436	T276	Mound	Agriculture
20436	T277	Mound	Agriculture
20436	T278	Mound	Agriculture
20436	T279	Mound	Agriculture
20436	T280	Mound	Agriculture
20436	T281	Mound	Agriculture
20436	T282	Mound	Agriculture

Functions for Features within Phase II/Transect 1 Area continued.

Site Number 50-10-63	Feature Number	Feature Type	Function
20436	T283	Mound	Agriculture
20436	T284	Mound	Agriculture
20436	T285	Mound	Agriculture
20436	T286	Mound	Agriculture
20436	T287	Mound	Agriculture
20436	T288	Mound	Agriculture
20436	T289	Mound	Agriculture
20436	T290	Mound	Agriculture
20436	T291	Mound	Agriculture
20436	T292	Mound	Agriculture
20436	T293	Mound	Agriculture
20436	T294	Mound	Agriculture
20436	T295	Mound	Agriculture
20436	T296	Mound	Agriculture
20436	T297	Mound	Agriculture
20436	T298	Mound	Agriculture
20436	T299	Mound	Agriculture
20436	T300	Mound	Agriculture
20436	T301	Mound	Agriculture
20436	T302	Mound	Agriculture
20436	T303	Cobble Mound	Agriculture
20436	T304	Filled Crack	Agriculture
20436	T305	Cobble Mound	Agriculture
20436	T306	Cobble Mound	Agriculture
20436	T307	Cobble Mound	Agriculture
20436	T308	Mound	Agriculture
20436	T309	Mound	Agriculture
20436	T310	Mound	Agriculture
20436	T311	Mound	Agriculture
20436	T312	Mound	Agriculture
20436	T313	Mound	Agriculture

Functions for Features within Phase II/Transect 1 Area continued.

Site Number 50-10-63	Feature Number	Feature Type	Function
20436	T314	Mound	Agriculture
20436	T315	Mound	Agriculture
20436	T316	Mound	Agriculture
20436	T317	Mound	Agriculture
20436	T318	Mound	Agriculture
20436	T319	Mound	Agriculture
20436	T320	Mound	Agriculture
20436	T321	Mound	Agriculture
20436	T322	Mound	Agriculture
20436	T323	Mound	Agriculture
20436	T324	Filled Crack	Agriculture
20436	T325	Mound	Agriculture
20436	T326	Mound	Agriculture
20436	T327	Mound	Agriculture
20436	T328	Mound	Agriculture
20436	T329	Mound	Agriculture
20436	T330	Mound	Agriculture
20436	T331	Mound	Agriculture
20436	T332	Mound	Agriculture
20436	T333	Mound	Agriculture
20436	T334	Mound	Agriculture
20436	T335	Mound	Agriculture
20436	T336	Filled Crack	Agriculture
20436	T337	Modified Outcrop	Agriculture
20436	T340	Mound	Agriculture
20436	T341	Mound	Agriculture
20436	T342	Mound	Agriculture
20436	T343	Mound	Agriculture
20436	T344	Mound	Agriculture
20436	T345	Mound	Agriculture
20436	T346	Mound	Agriculture

Functions for Features within Phase II/Transect 1 Area continued.

Site Number 50-10-63	Feature Number	Feature Type	Function
20436	T347	Mound	Agriculture
20436	T348	Mound	Agriculture
20436	T349	Mound	Agriculture
20436	T350	Mound	Agriculture
20436	T351	Mound	Agriculture
20436	T352	Mound	Agriculture
20436	T353	Mound	Agriculture
20436	T354	Mound	Agriculture
20436	T355	Mound	Agriculture
20436	T356	Mound	Agriculture
20436	T357	Mound	Agriculture
20436	T358	Mound	Agriculture
20436	T359	Mound	Agriculture
20436	T360	Mound	Agriculture
20436	T361	Mound	Agriculture
20436	T362	Mound	Agriculture
20436	T363	Mound	Agriculture
20436	T364	Mound	Agriculture
20436	T365	Filled Depression	Agriculture
20436	T366	Mound	Agriculture
20436	T367	Mound	Agriculture
20436	T368	Filled Depression	Agriculture
20436	T369	Filled Depression	Agriculture
20436	T370	Mound	Agriculture
20436	T371	Filled Depression	Agriculture
20436	T372	Modified Outcrop	Agriculture
20436	T373	Mound	Agriculture
20436	T374	Filled Depression	Agriculture
20436	T385	Filled Depression	Agriculture
20436	T387	Mound	Agriculture
20436	T388	Mound	Agriculture
20436	T389	Mound	Agriculture

Functions for Features within Phase II/Transect 1 Area continued.

Site Number 50-10-63	Feature Number	Feature Type	Function
20436	T390	Mound	Agriculture
20436	T391	Mound	Agriculture
20439	T375	Filled Crack	Agriculture
20439	T376	Filled Depression	Agriculture
20439	T377	Filled Depression	Agriculture
20439	T378	Mound	Agriculture
20439	T379	Mound	Agriculture
20439	T380	Mound	Agriculture
20440	T381	Filled Depression	Agriculture
20440	T382	Mound	Agriculture
20440	T392	Modified Outcrop	Agriculture
20440	T393	Mound	Agriculture
20440	T394	Filled Crack	Agriculture
20440	T395	Filled Crack	Agriculture
20440	T396	Mound	Agriculture
20440	T397	Mound	Agriculture
20440	T398	Mound	Agriculture
20441	T383	Mound	Agriculture
20441	T384	Mound	Agriculture
20441	T386	Filled Crack	Agriculture
20441	T399	Mound	Agriculture

APPENDIX B – PALIULI POLLEN ANALYSIS

By Jerome V. Ward

The goal was to document evidence of land use history, including plant introductions, and the presence of fire in the vicinity. Of particular concern was detection of sweet potato (Ipomoea batatas) pollen since archaeological remains suggested that it was cultivated in the vicinity. The samples were processed using standard methodology for Pacific sediments.

Methods

In order to calculate the palynomorph and charcoal particle concentrations, two exotic *Lycopodium* spore tablets, in known concentration, were added to a measured sample in a beaker. The tablets, obtained from Department of Quaternary Geology, Lund University, Sweden, contain ca 12,542 spores each (Batch No. 124961).

The samples were initially treated with HCL to dissolve the *Lycopodium* tablets and carbonates. This procedure was followed by KOH to solubilize organics, and HF to dissolve the silica fraction (Moore et al., 1991). Acetolysis solution, advocated by Herngreen (n.d.), was used to break down the abundant cellulose, and dilute HNO_3 was used to oxidize the remaining microscopic plant debris, including lignin. After final rinsing the pollen residue was stained with Bismark Brown and mounted in glycerine jelly following Erdtman's (1960) technique.

Palynomorphs, which include pollen, pteridophyte spores, and other organic-walled microfossils are usually less than the 200 mm size fraction (Tschudy and Scott, 1969). These were identified using published pollen floras that include Pacific types, chiefly Selling (1946, 1947) for Hawai'i, Cranwell (1953) and Moar (1993) for New Zealand, Huang (1972) for Taiwan, and Roubik and Moreno (1991) for types of Neotropical origin. A personal reference collection of pollen and spores from the Pacific was also employed that includes about 500 specimens.

Charcoal particles were counted using an eyepiece graticle, with a 10 x 10 grid square pattern (Patterson et al., 1987). Exotic marker *Lycopodium* spores counted along with the particles provided the necessary control for calculating the concentration. Charcoal was counted in grid square size classes and the total area in mm^2 was determined. The charcoal values were converted into concentration values using the formula from Birks and Bergen (1992):

Charcoal concentration = initial *Lycopodium* concentration (#/cc) x total charcoal area (mm^2/cc) / *Lycopodium* spores counted (#)

The pollen concentration was calculated in a similar fashion:

Pollen concentration = initial *Lycopodium* concentration (#/cc) x total number of palynomorphs (#) / *Lycopodium* spores counted (#)

The count data are presented in Table 1. The pollen is separated into ecological groups: Herbs, Dry-Mesic Forest, and Mesic-Wet Forest, while the Pteridophytes are divided on the basis of morphology, whether monolete or trilete.

Recovery

The samples contained an abundance of fungal spores, pteridophyte (fern) spores, woody plant debris, charcoal particles, and to a lesser degree, angiosperm pollen and plant cuticles (Plates 2 and 3). Pollen and spores showed good to poor preservation and occurred in low to medium concentrations. The palynomorph concentrations in samples 3088 and 3069 were low to very low with values of 678 and 3629 per cc, respectively (Table 1). Samples 3078 and 3151 clustered together with much higher concentrations of 34361 and 33485 grains per cc, respectively.

All of the samples were dominated by pteridophyte (fern) spores, especially those of the monolete, psilate and monolete, verrucate type. A minor amount of Dry-Mesic Forest pollen types were recovered with *Chamaesyce* being most common. In the Herb category, grass pollen was also common. A very weak signal was seen in the Mesic-Wet Forest category.

Special attention was given to the recovery and identification of *Ipomoea* pollen, especially I. *batatas*. *Ipomoea* is adapted for insect pollination; its pollen is relatively large (usually > 100 mm), covered with spines, and the pollen is produced in low numbers. Since the initial pollen frequency in the flower is low, recovering *Ipomoea* pollen in the catchment is made more difficult. Therefore, after routine processing, the pollen residue was sieved through 100 mm mesh nylon screens in an effort to concentrate the fraction containing *Ipomoea* pollen. Several slides of the > 100 mm fraction pollen residue were prepared and scanned for *Ipomoea* pollen. However, after scanning several slides from each sample no I. *batatas* pollen was seen (Appendix 1). *Ipomoea* pollen was found in samples 3069 and 3151 (Table 1 and Plate 1) and this has been tentatively identified as *I. indica* based on spine proportions and pore spacing.

No pollen record is known for sweet potato cultivation in Hawai'i which is most probably a function of the poor dispersibility of the grains from the parent plant. One report of archaeological sweet potato pollen has been rejected as the photographs depict a type similar to that of *Ipomoea indica* based on pore spacing and diameter, however no differential diagnosis was given (Bennett, 1983).

Discussion of samples

Sample 3078

Sample 3078 is dominated by an unknown spore type at 63 percent, with description in Table 1 as being large and finely verrucate. This spore type, unlike any depicted in Selling (1946), was consistently recovered from the four samples from common to abundant. Second in abundance at 16 percent in this

sample were monolete spores from the psilate or smooth category which includes a number of species. Monolete psilate spores are frequently encountered in tropical deposits that have experienced some type of disturbance, whether natural or human-induced. Other disturbance indicators include the pteridophytes *Lycopodium_cernuum* and *Gleichenia_linearis*. The minor contribution of pollen suggests an arid setting with representatives from the grass (Poaceae), sunflower (Asteraceae), and myrtle (Myrtaceae) families and from *Chamaesyce* and *Dodonaea*. The occurrence of a few grains of *Prosopis_pallida* pollen, a widely naturalized species, suggests that this sample is historic.

Charcoal is present in this sample at 23 mm^2/cc, which indicates the presence of fire in the vicinity.

Sample 3088

Sample 3088 is similar in composition to sample 3078 but the preservation is poorer with only 27 pollen grains recovered out of a total sum of 482 or 5.6 percent. Except for Asteraceae, the pollen types are the same as those found in sample 3078. Again, the sample is dominated by fern spores, especially those of the monolete category, however here the dominance is shared equally by the unknown verrucate type and the psilate type, each at 29 percent. This is followed by *Lycopodium_cernuum* spores at 14 percent and *Gleichenia* at 2 percent of the total. While it is not known what habitat is preferred by the fern producing the unknown verrucate spores, judging by the its association with other disturbance indicators (monolete psilate, *L. cernuum*, *Gleichenia*), it is assumed that it too thrives in open habitats under full sun. This sample also contains a high number of palynomorphs that are listed as reticulate, tuberculate spores in Table 1. These spores are commonly encountered in wet soils in temperate and topical environments (Wilson, 1977; Kurmann, 1985; Athens et al., 1992).

The charcoal concentration is similar to that in sample 3078 at 21.5 mm^2/cc suggesting fires in the vicinity.

Sample 3069

Sample 3069 was distinct from the others in that it contained ca 43 percent pollen which was dominated by grass and *Chamaesyce*. Minor amounts of Asteraceae (high-spined), Dodonaea, and Myrtaceae were also seen. In addition, a single grain of Asteraceae (lophate type) was recovered which is indicative of historic period since this pollen type was produced by species introduced after European contact. It is possible that this single pollen grain represents an airborne contaminant introduced after the sample was collected. The pteridophyte spores, while still conspicuous, were recorded in lower percentages than in any other sample. The monolete psilate spores contributed to 16 percent of the total while the verrucate, large type registered 26 percent. Of the trilete spores, *Gleichenia* and *Lycopodium* comprised ca 10 percent of the total.

The charcoal concentration in this sample was negligible at 0.76 mm^2/cc indicative of very minor fire activity.

Sample 3151

Sample 3151 is most comparable to number 3078 in frequency of monolete verrucate spores. However, in this sample the abundance soars to 73 percent of the total pollen and spores. This dominance is followed by spores of the monolete psilate category at 14 percent and both Gleichenia and Lycopodium at 2 percent each. Together these spore records total 91 percent and are assumed to be indicative of disturbed habitats. The pollen contribution in this sample is minor and all of the types previously seen (Asteraceae, *Chamaesyce*, *Dodonaea*, and Myrtaceae) are each represented by < 1 percent. The exception is grass pollen which at 2 percent was similar to levels found in numbers 3078 and 3088.

The charcoal particle concentration shows that fire was common in the vicinity as the concentration was 15.6 mm^2/cc.

Conclusions

The four samples all contain evidence of being derived from disturbed habitats but unfortunately no direct evidence of agricultural activity, especially the presence of sweet potato cultivation. Pteridophyte spores found abundantly in these samples and associated with disturbed or open sites in the tropics include those of the monolete psilate category, *Lycopodium_cernuum*, and *Gleichenia linearis*. An unknown monolete verrucate spore type found at 26 to 73 percent in these samples also is likely indicative of disturbed conditions. The pollen, found in much lower frequencies, is typical of dry habitats and includes grass, high-spined Asteraceae, *Chamaesyce*, and *Dodonaea*. Myrtaceae may be found in a variety of habitats. Except for sample 3069, the charcoal particle concentration data are consistent with common fire activity in the area.

Table 1. Palynomorphs from Paliuli Project, Hawai'i Island. Designations of naturalized (nat) taxa after Wagner et al. (1990). Percentages of key types indicated in parentheses. Sum is based on total pollen and pteridophyte spores.

Site Number	194 61	194 61	194 61
Catalog Number	307 8	308 8	306 9
	Dep th (cm)	Dep th (cm)	Dep th (cm)
Species or type	25	18- 25	85
HERBS:			
Cyperaceae (sedge)		1	7
Poaceae (grass)	40 (3)	9 (2)	170 (17)
Ipomoea cf. I. indica			2
Total Herbs:	40	10	179
DRY-MESIC FOREST:			
Antidesma			
Asteraceae (high-spined)	8 (<1)		10 (<1)
Asteraceae (lophate type) (nat)			1
Cheno-am (some nat)			1
Chamaesyce	44 (3)	11 (2)	108 (11)
Chamaesyce (small type)	8		29
Colubrina			3
Diospyros sandwicensis	2		2
Dodonaea viscosa	18 (1)	3 (<1)	14 (1)
Elaeocarpus bifidus-type			
Erythrina sandwicensis			
Myrtaceae	28 (2)	1 (<1)	41 (4)
Pandanus	5	1	18
Platydesma	1		
Prosopis pallida (nat)	8		
Sida	1	1	9
Solanaceae			1
Wikstroemia			1
Total Dry-Mesic:	123	17	238

MESIC-WET FOREST:			

Site Number	194 61	194 61	194 61
Catalog Number	307 8	308 8	306 9
Rubiacaeae (tricolporate)	1		
Rubiaceae (triporate)	2		1
Tetraplasandra gymnocarpa			
Total Mesic-Wet:	3	0	1
UNKNOWN POLLEN:			
Tricolporate:			
Reticulate, cf. Araliaceae ca 25 mm	33 (2)		11 (1)
TOTAL POLLEN:	199	27	429
PTERIDOPHYTES:			
MONOLETE SPORES:			
Marattia			
Polypodium pellicidum type	1	3	1
Foveolate	5	2	1
Gemmate	6		
Granulate	21	47	14
Granulate/foveolate	8	18	5
Perinate			
Psilate	233 (16)	141 (29)	164 (16)
Verrucate	3	5	
Verrucate, fine, lg. type	911 (63)	138 (29)	265 (26)
Total Monolete:	118 8	354	450
TRILETE SPORES:			
Cibotium	22 (2)	9 (2)	33 (3)
Gleichenia linearis	20 (2)	10 (2)	33 (3)
Lycopodium cernuum	23 (2)	68 (14)	58 (6)
L. phyllanthum		1	
Pteridium		8	
Pteris			1
Echinate		1	
Psilate		4	
Total Trilete:	65	101	125
TOTAL SPORES:	125 3	455	575
TOTAL POLLEN AND	145	482	100

Site Number	19461	19461	19461
Catalog Number	3078	3088	3069
SPORES:	2		4
Markers	212	3569	1388
Starting volume (ml)	5	5	5
Markers/cc	5017	5017	5017
Palynomorph concentration (number/cc)	34361	678	3629
OTHER PALYNOMORPHS:			
Horn-shaped object		5	
Pseudoschizaea			1
Reticulate, tuberculate spore	3	286	2
CHARCOAL:			
Markers	160	333	1443
Starting volume (ml)	5	5	5
Markers/cc	5017	5017	5017
Charcoal particles	658	582	219
No. grid squares	1232	2397	368
Total area (mm^2)	0.73	1.43	0.22
Charcoal concentation (mm^2/cc)	23.0	21.5	0.76

Appendix 1.

Notes on pollen morphology of native *Ipomoea* species

The following notes on pollen characters which may be used to distinguish the native Hawaiian species of *Ipomoea* are based on measurements made from pollen reference material. It is not meant as an all inclusive survey of their morphology, but only as a guide for differential diagnosis of Hawaiian natives.

Ipomoea batatas

Pores are numerous, estimated at ca 150 (Roubik and Moreno, 1991). About 10 pores may be counted across grain along diameter. The spines measure ca 12 mm long, 6-7 mm wide at base, and 3.5 mm at rounded apex. The slope of the taper changes slightly about halfway up the spine forming a very steep shoulder. The mean grain size is ca 125 mm (Selling, 1947).

Ipomoea imperati

This species is unique in having spines which form bi- tri- or multi-furcations giving a cusp-like appearance. The size is variable, dependent on number of spines in a given cluster, but they can be as large as 9 x 4.5 mm.

Ipomoea indica

The spines in this species, which taper uniformly from base to apex, measure about 11 x 8 x 3.5 mm. About 7 pores may be counted across the grain along the diameter. The grain size is estimated to be ca 170 mm from a reference slide.

Ipomoea littoralis

This species may be easily identified even if a small portion of the grain is preserved since the spines are shaped like school bells. The basal or bell-shaped portion measures about 6 mm across and 4 mm wide with the apex or handle portion being about 1 x 4 mm in size giving the spine a total length of 8 mm. About 7 pores may be counted across the grain along the diameter.

Ipomoea pes-caprae

The spines in *I. pes-caprae* are relatively long being about 15 x 7 x 2 mm and gradually tapering. About 7 pores may be counted across the grain along the diameter.

Ipomoea tuboides

The spines in this species are the narrowest of all. The acuminate spines, which are rarely nodding or bifurcating, measure ca 11 x 5 mm and taper gradually to a pointed tip. About 6-7 pores may be counted across the grain along the diameter.

The following notes on the naturalized *Ipomoea* species of Hawaii are based on the available pollen morphology literature. These represent some of the *Ipomoea* species that are considered 19th to 20th century introductions to Hawaii and which now exist as wild populations. No descriptions for *I. ochracea, I. triloba,* and *I. violacea* could be found.

I. alba (Pl. 50: Huang, 1972). Size ca 120 mm; spines 10-13 mm.

I. aquatica (Pl. 37: Bonnefille and Riollet, 1980). Size ca 96 mm; spines 8 x 4 mm. Pores at grain diameter number ca 6-7.

I. cairica (Pl. 50: Huang, 1972). Size ca 70 mm; spines 9-12 mm.

I. hederifolia (Pl. 37: APLF, 1974). Size ca 137 mm; spines 10 x 5 mm. Pores at grain diameter number ca 6-7.

I. obscura (Pl. 51: Huang, 1972). Size ca 70 mm; spines 9-15 mm.

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APPENDIX C – IDENTIFICATION OF CHARCOAL TAXA

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Samples from Two Caves in Kalapana, Hawai'i

INTRODUCTION

Two charcoal samples from cave sites in Puna, Hawai'i, were examined for taxa identification. The samples were recovered during an archaeological project, conducted by the National Park Service, to document the past use of these caves. This analysis will attempt to address cultural and environmental questions regarding these human activities. Identification of charcoal taxa has the potential of not only determining the kinds of wood burned as fuel for cooking fires or light sources but also the nature of the vegetation which served as a resource for these activities. Since the caves are found in relative close proximity of one another and in the same vegetation zone, it would be interesting to see if differences in function are reflected in the taxa composition. Finally, a chronology of vegetation change may also be proposed with the identified taxa, the associated radiocarbon dates, and the present vegetation.

METHODS

Each sample was sorted into groups using anatomical features seen in freshly fractured transverse facets. All sorting was accomplished with the aid of an American Optical Stereoscan dissecting microscope with maximum 40x magnification. Laboratory numbers were assigned to all groups which were not identified during the macroscopic examination. Representative charcoal pieces, selected from the numbered groups, were carefully shaved to expose the three facets necessary for taxa identification. The faced pieces were slowly infiltrated with Spurr's epoxy resin (Spurr 1969) in a procedure modified from Smith and Gannon (1973) and polymerized in size 00 embedding capsules. After polymerization the resin embedded charcoal pieces were sectioned with a steel knife on a Reichert sliding microtome. The thin sections of the transverse, radial, and tangential facets of the charcoal were permanently mounted on microscope slides. These slides were incorporated into the Archaeological Wood Collection at the Wood Identification Laboratory, International Archaeological Research Institute, Inc., Honolulu. Identifications were made by comparing the thin sections of the charcoal with those of known wood from the Pacific Islands Wood Collection at the Department of Botany, University of Hawaii, and published descriptions of Hawaiian or exotic woody genera.

RESULTS

Seven pieces of charcoal from two samples were embedded and sectioned. Five taxa were identified from anatomical characteristics in the thin sections while three taxa were recognized from macroscopic characteristics seen under the dissecting microscope during the sorting process. These taxa (Table 2) are described in the review which follows. Taxonomy and nomenclature used are those of Wagner, Herbst, and Sohmer (1990). In the summary of results (Table 1), "s. n." refers to those taxa which were not given laboratory numbers and "cf." indicates that the taxon closely resembles the genus or species specified. Table 3 presents the occurrence of the taxa among the samples analyzed in percent sorted weight.

Review of Taxa

Ebenaceae

Diospyros sandwicensis (A. DC) Fosb. (Lama)

This small endemic tree which may be 2 to 10 m tall, is found in wet or dry regions of all the main islands (Rock 1913: 395; Wagner et al. 1990: 587). *Lama* has been found in areas within the Park which have been designated as coastal lowland and submontane seasonal which includes both dry and mesic forests (Higashino et al. 1988). Its hard wood was used by Hawaiians for houses, enclosures for certain idols (Malo 1951: 21), and chisel handles (Buck 1957: 38). Hillebrand (1888: 275) reported that the small fruits were eaten by the natives.

Euphorbiaceae

Chamaecyse spp. ('Akoko)

The endemic members of this genus consists of 15 species which may be found in ecological regimes ranging from coastal to dry to wet forests as shrubs to small trees (Wagner et al. 1990: 602-617). *'Akoko* has been found in the coastal lowland and submontane seasonal regions of the Park (Higashino et al. 1988). Hillebrand (1888: 396) believed the Hawaiians valued *'akoko* for firewood. The milky sap was once considered a possible source for rubber (Rock 1913: 261).

Fabaceae

Acacia koa A. Gray (*Koa*)

One of the largest endemic trees in Hawai'i, *koa* may attain 35 m in height at higher elevations (Wagner et al. 1990: 641-642) and not branch until 12 m or more above the ground (Rock 1913: 175). This straight trunk was especially useful for canoes as well as paddles, and surfboards (Malo 1951: 126, 223). *Koa* trees, which are also found at lower elevations in the dry regions, have a distribution range of 60 to 2,060 m on all the main islands except Ni'ihau and Kaho'olawe (Wagner et al. 1990: 641). *Koa* naturally occurs in the rain forests, montane seasonal, and subalpine regions of the Park (Higashino et al. 1988) which are far above the project area.

Myrsinaceae

Myrsine sp. (Kōlea)

Three of the 20 endemic trees or shrubs of this genus occur on the island of Hawai'i (Wagner et al. 1990: 937-947). All three species, *Myrsine lanaiensis*, *M. lessertiana*, and *M. sandwicensis*, have been found in the submontane seasonal and rain forest regions of the Park (Higashino et al. 1988). The red sap from the trunk and branches and charcoal made from the wood were used as *kapa* dyes. The wood was also used in house construction (Neal 1965: 664).

Myrtaceae

Metrosideros polymorpha Gaud. ('Ōhi'a lehua)

This endemic species ranges in habit from prostrate shrubs to tall trees and in distribution from sea level to 2200 m elevation in many ecological situations (Wagner et al. 1990: 967). *'Ōhi'a lehua* is found throughout the Park, including the project area (Higashino et al. 1988). The hard wood was used for making spears and mallets, idols, posts and rafters for houses, and enclosures around temples (Buck 1957: 87; Malo 1951: 20; Neal 1965: 638).

Pandanaceae

Pandanus tectorius S. Parkinson ex Z (Hala, pūhala)

This indigenous species is a tree up to about 10 m tall which occurs in mesic coastal sites and low elevation slopes of mesic valleys at 0 to 610 m elevations on all of the main islands except Kaho'olawe (Wagner et al. 1990: 1479-1481). *Hala* is most abundant in the coastal lowlands but has also been found in the submontane seasonal region of the Park (Higashino et al. 1988). The leaves were used for house thatching, mats, baskets, and fans (Buck 1957: 103-105; Handy and Handy 1972: 201; Neal 1965: 52). The wood was used to make calabashes, troughs and boards to mash sweet potatoes (Handy and Handy 1972: 202). *Lei* are made today from the colorful fruit segments or keys but in the past were not favored for important occasions as another meaning for *hala* was failure (Pukui and Elbert 1986: 51).

Rubiaceae

Canthium odoratum (G. Forster) Seem. (*Alahe'e*)

This indigenous shrub or small tree is usually 3 to 6 m tall but may be up to 15 m. It has been found in dry shrublands and dry to mesic forests at 10 to 1,160 meter elevation on all of the main islands except Ni'ihau and Kaho'olawe (Wagner et al. 1990: 1119). *Alahe'e* has been found in the coastal lowland and submontane seasonal regions of the Park (Higashino et al. 1988). Its hard wood was once used for making 'ō'ō digging sticks) and its leaves made a black dye (Handy & Handy 1972: 117; Pukui & Elbert 1986: 17; Rock 1913: 437).

Sapindaceae

Dodonaea viscosa Jacq. ('A'ali'i)

These indigenous shrubs or small trees stand 2 to 8 m tall and range in distribution from coastal dunes to dry, mesic, and wet forest, at 3 to 2,350 m elevations (Wagner et al. 1990: 1227-1228). This species ranges from the coastal lowland to subalpine regions of the Park (Higashino et al. 1988). The red papery fruit capsule clusters and leaves of some varieties were made into *lei* (Pukui & Elbert 1986: 3).

Table 1. Summary of Charcoal Taxa Identifications in Samples From Kalapana, Hawai'i.

Catalog #	Site	Feature	Provenience	Remarks	WIDL #	Taxa	Count	Weight, g	% Weight
3139	19462	B	Unit 4	South, Below ash lens	2083	Metrosideros polymorpha	1	0.41	3.1
3139	19462	B	Unit 4	South, Below ash lens	2084	Dodonaea viscosa	13	6.68	50.7
3139	19462	B	Unit 4	South, Below ash lens	s.n.	Pandanus tectorius key	1	0.82	6.2
3139	19462	B	Unit 4	South, Below ash lens	s.n.	Chamaesyce spp.	6	3.50	26.6
3139	19462	B	Unit 4	South, Below ash lens	s.n.	Diospyros sandwicensis	4	1.77	13.4
3139	19462	B	Unit 4	South, Below ash lens	Total	All	25	13.18	100.0
3097	19,463	Petroglyph cave	Area 5		2086	Dodonaea viscosa	11	0.16	8.0
3097	19,463	Petroglyph cave	Area 5		2087	Canthium odoratum	44	1.35	67.9
3097	19,463	Petroglyph cave	Area 5		2088	Myrsine sp.	1	0.01	0.5
3097	19,463	Petroglyph cave	Area 5		2089	Acacia koa, cf.	17	0.29	14.6
3097	19,463	Petroglyph cave	Area 5		s.n.	Parenchyma	1	0.01	0.5
3097	19,463	Petroglyph cave	Area 5		s.n.	Chamaesyce spp.	8	0.17	8.5
3097	19,46	Petroglyph	Area 5		Total	All	82	1.99	100.0

	3	cave							

Table 2. Taxa Identified in Charcoal Samples from Puna, Hawaii.

Scientific Name	Common	Origin	Habit	Part
Acacia koa	Koa	Endem	Tree	Wood
Canthium	Alahe'e	Indige	Shru	Wood
Chamaesyce spp.	'Akoko	Endem	Shru	Wood
Diospyros	Lama	Endem	Tree	Wood
Dodonaea	'A'ali'i	Endem	Shru	Wood
Metrosideros	'Ōhi'a	Endem	Tree	Wood
Myrsine sp.	**Kōlea**	Endem	Shru	Wood
Pandanus	Hala,	Indige	Tree	Fruit wall

Table 3. Occurrence of Charcoal Taxa Among Samples From Puna, Hawai'i, in Percent Weight.

Taxa	Site 19462 : Cat. # 3139	Site 19,463: Cat. # 3097
Acacia koa, cf.		14.6
Canthium odoratum		67.9
Chamaesyce spp.	26.6	8.5
Diospyros sandwicensis	13.4	
Dodonaea viscosa	50.7	8.0
Metrosideros polymorpha	3.1	
Myrsine sp.		0.5
Pandanus tectorius key	6.2	
Parenchyma		0.5

DISCUSSION

Past Vegetation

The eight taxa identified in this study reveal a vegetation much different from what is found at the project area today. The lava flow's age of 1250 -1400 AD places a cap on the earliest occupation of the caves. At that time the vegetation would have been limited to early lava flow pioneers such as hardy ferns and shrubs, sparsely distributed in cracks. It is likely then that the caves were used much later when more vegetation was available to fuel the fires.

In the 600 to 750 years since the formation of these caves, the vegetation in the surrounding areas has changed into one dominated by guava and java plum which thrive in rich soil and moisture. The introduction of guava and java plum in the late 1800's to early 1900's and their absence from the charcoal samples suggest that native vegetation must have existed in the 400 years between their establishment on the lava and the introduction of the alien species. This argument makes the assumption that the alien species would have been used if they were available.

The charcoal consisted of native woody plants such as *alahe'e* (*Canthium odoratum*), *'akoko* (*Chamaesyce* spp.), *lama* (*Diospyros sandwicensis*), *'a'ali'i* (*Dodonaea viscosa*), and *Ōhi'a lehua* (*Metrosideros polymorpha*). Together these taxa suggest a lowland open vegetation not unlike what is seen today on the open lava fields of lower Kalapana. However, all of these taxa can grow in denser stands within an area of greater soil development. Such a community of *lama*, *wiliwili* (*Erythrina sandwicensis*), *alahe'e* and *Ōhi'a lehua* once stood in the kipuka at Waha'ula which is now covered with lava. It is easy to envision that in the areas now occupied by guava and java plum a forest of native trees and shrubs once stood.

Implications of the Charcoal Taxa

The taxa identified from the charcoal samples indicate that these fires were commonly composed of shrubs of *'akoko*, *'a'ali'i*, and small branches broken off from larger *alahe'e*, *lama*, and *Ōhi'a lehua*. *'A'ali'i* was found in every sample, suggesting its abundance or perhaps preference possibly as kindling. *'Akoko* was found in two samples and may also have served as kindling. Dense woods such as *'a'ali'i*, *alahe'e*, *lama*, and *Ōhi'a lehua* could have provided a long burning fire if large pieces of wood were gathered. This potential for a sustained fire is indicated by all three samples.

The sample from the possible habitation site (19462) was recovered at some depth and may represent some of the earliest fire events. Although the purpose of these fires cannot be further defined by the taxa burned, the absence of food remains does not eliminate the possibility that these were cooking fires. The presence of the *hala* (*Pandanus tectorius*) key whose fleshy portion is edible suggests the possibility of food consumption near this fire.

The sample from Site 19,463 (Cat# 3097) differs from the others since it is a surface collection and has many more differing taxa represented. The major portion (83.5% by weight) are taxa unique to this sample which may be due to its context or the fires purpose. It is also possible that more than one event is represented. This sample is interesting in the presence of *koa* (*Acacia koa*)

whose current distribution range is at much higher elevations than the project area. *Koa* wood could have been brought to the cave already formed as a utilitarian object such as an implement or bowl and may have been tossed into the fire after it was worn out or broken. Also contained in the sample was a small piece of parenchymatous tissue. This tissue of undifferentiated plant cells can be found in seeds, fruits, storage organs or pith. Thus, the charcoal may represent the remains of a kernel or embryo of *kukui* or *hala*. It could also have come from the starchy swollen roots or stems of sweet potatoes or yams. Another possibility is the starchy pith from the inner stem of ti (*Cordyline fruticosa*) or tree ferns such as *hapu'u* (*Cibotium* spp.) or *'ama'u* (*Sadleria* spp.). Although the identification is inconclusive, an inference could be made from the presence of terraces that a crop cultivated in the area was inadvertently burned in this cooking fire.

Conclusions

The taxa identified in three charcoal samples from cave sites have shown that the woods burned in these firepits represent a native vegetation which preceded the current vegetation of introduced guavas and java plums. These identifications cannot determine that at the time represented by the fires the native vegetation grew in rich soil or scattered across a lava field. However, it may be inferred from the presence of terraces that there was sufficient soil development for crop cultivation and to support a forest of native shrubs and trees.

The presence in these cave samples of *hala,* which grows near the coast, and *koa,* which today inhabits higher elevations, suggest the movement of people between the coast and locations further up the mountain. Although the remains of crops were not conclusively identified in the charcoal samples, the discovery of the terraces imply that the visit to the caves may not have been just a rest stop but may have been to tend and harvest the crops cultivated in those terraces.

The interpretation of the identifications from these charcoal samples clearly is limited by the small sample size. Further investigation of these cave sites and the addition of other sites may confirm the present hypothesis or perhaps suggest new ideas on the past activities associated with caves.

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