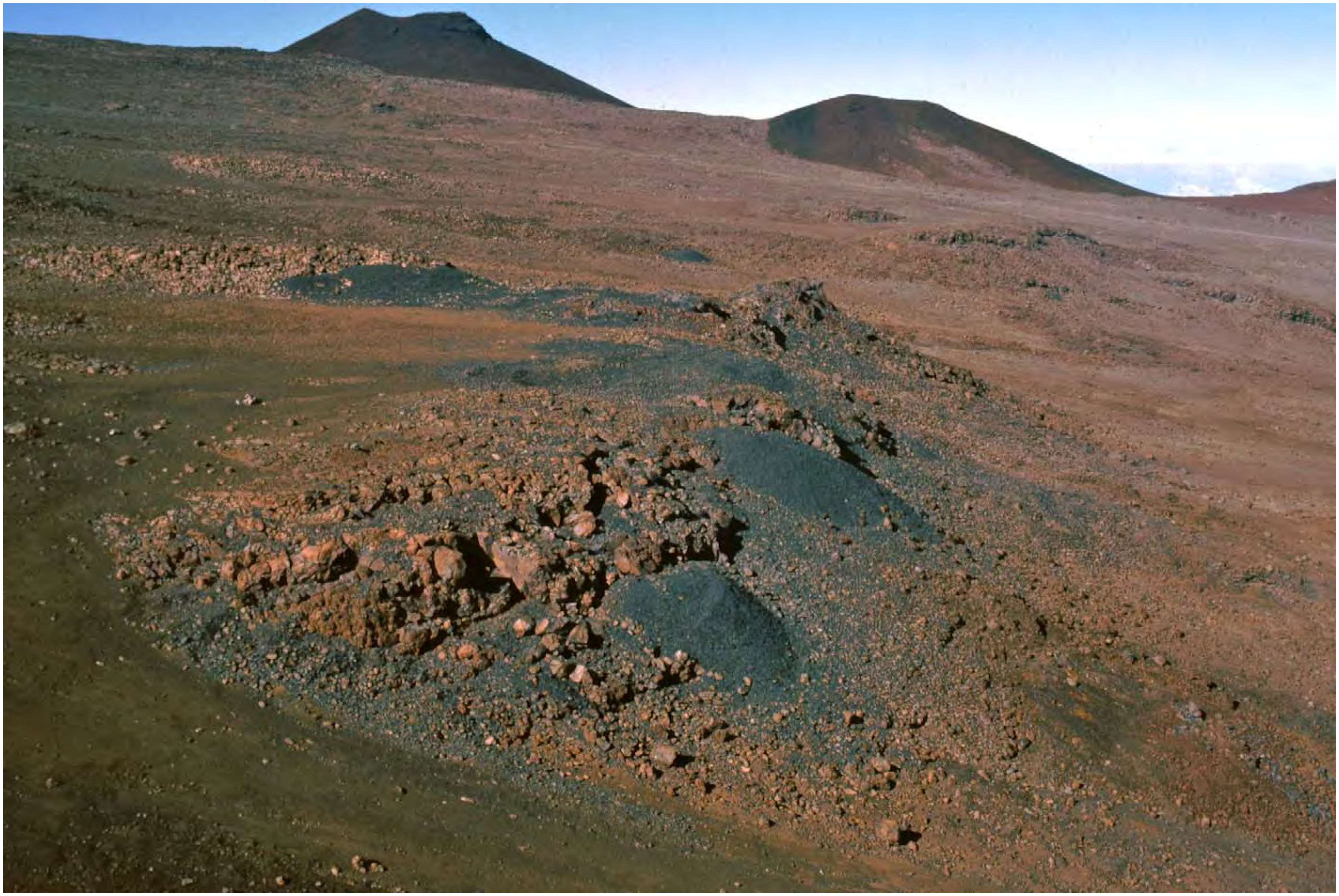
FINAL REPORT

Archaeological Inventory Survey of the Mauna Kea Ice Age Natural Area Reserve

Ka`ohe Ahupua`a, Hāmākua District, Island of Hawai`i TMK: (3) 4-4-015:10, 11

Volume 1: Inventory Survey Report



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August 2013

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Archaeological Inventory Survey of the Mauna Kea Ice Age Natural Area Reserve
Kaʻohe Ahupuaʻa, Hāmākua District, Island of Hawaiʻi
(TMK: (3) 4-4-015: 10, 11)

Volume 1: Inventory Survey Report

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EXECUTIVE SUMMARY

An archaeological inventory survey of the 3,893.5-acre Mauna Kea Ice Age Natural Area Reserve (TMK: (3) 4-4-015:10, 11) was undertaken by Pacific Consulting Services, Inc. (PCSI), beginning with a 6-day survey of roughly 43 acres at Lake Waiau in 2007 (McCoy and Nees 2009) and ending with a 10 week survey of the remainder of the NAR in 2008-2009. The primary objective of the combined surveys was to identify, record, and evaluate the significance of all of the historic properties in the NAR, and to make recommendations regarding their preservation and continued protection. The survey was viewed as the logical first step in developing a cultural resources management plan (CRMP). This report presents the results of the combined 2007-2009 surveys. For the sake of completeness, it also includes selected data from an earlier survey of portions of the NAR in 1975-76.

The 1975-76 survey was part of a research project on the Mauna Kea Adze Quarry Complex. That project, which included surveys of different intensities and selected excavations, recorded a total of 30 sites within the NAR (McCoy 1976, 1990; Allen 1981; Cleghorn 1982; Williams 1989). The archaeological inventory survey of Lake Waiau added 20 new sites to the historic property inventory for the NAR (McCoy and Nees 2009). One additional historic property, Puʻu Waiau, had been designated a Traditional Cultural Property (TCP) by the State Historic Preservation Division (SHPD) in 1999. The 2008-2009 survey recorded another 58 sites, thus bringing the total number of known historic properties in the NAR to 109. This report documents a total of 3,336 components and features within those 109 sites. No sites were found in the 143.5-acre Parcel 10 located on Puʻu Pōhaku.

The Mauna Kea Adze Quarry Complex, which was placed on the National Register of Historic Places in 1962, dominates the archaeological landscape of the NAR visually and in terms of the amount of area it covers. The quarry complex consists of:

(1) The *quarry proper*, which includes: (a) toolstone sources of generally fine-grain basalt on and along the margins of lava flows where they have been plucked by glaciers, and (b) glacial drift deposits with toolstone occurring in the form of sub-rounded to rounded basalt cobbles and boulders, and

(2) Diverse activity remains with adze manufacturing by-products located outside of the quarry proper as just defined, but which were an integral part of the quarry "industry" because of the activities that took place. This includes, for example, the immediate area surrounding Lake Waiau, which is outside of the quarry proper because there is no toolstone source for adze manufacture but which contains lithic scatters comprised of basalt flakes, and/or isolated artifacts such as adze preforms and hammerstones transported from the quarry.

The remainder of the historic property inventory in the NAR is represented by small numbers of diverse site types of pre-Contact and post-Contact age. Though undated, the pre-Contact sites are believed to include possible burials at Lake Waiau and several other localities. Amongst the historic period sites is a large cairn located on a section of the "original" Humuʻula Trail. There is evidence suggesting that this is the memorial commemorating Queen Emma's visit to the summit of Mauna Kea in the 1880s. Several historic period sites are located at Lake Waiau, including what appears to be the stand for the instruments used by the Pendulum Survey Party in 1892 and a dump site that may have been established in 1892 and used by later scientific expeditions as well as more recent recreationalists (McCoy and Nees 2009). In Waikahalulu Gulch is a site that appears to be associated with a local figure of some repute, Eben Low (aka "Rawhide Ben"), who made a failed attempt to install a pipeline at a spring in the bottom of the gulch.

The amount of data obtained in the archaeological investigations in the NAR is overwhelming when compared to most CRM projects in Hawaiʻi. This has limited the data analyses that could be undertaken to shrines, selected artifact assemblages, and floral and faunal assemblages. The shrine analysis is aimed at: (1) identifying and analyzing what are believed to be the most significant variables and attributes; (2) developing a shrine typology for descriptive and comparative purposes; and (3) examining the spatial distribution of the various attributes, shrine types, and the types or styles of uprights. The artifact analysis is focused on a sample of adze preforms and hammerstones from seven sites (not including three sites at the lake – see Lake Waiau Report [McCoy and Nees 2009]), but also includes basic analyses of volcanic glass cores and flakes from a source area and two of the habitation rockshelters excavated in 1975-76. Because of the large number of artifacts, the number of analyzed attributes was necessarily also limited in number. The floral and faunal analyses present the basic numerical data for plant remains, vertebrates and invertebrates recovered from four excavated rockshelters that on current evidence functioned as base camps.

The data collected in the survey have contributed significantly to an understanding of land use patterns in the summit region of Mauna Kea, although there are still too few absolute dates to understand diachronic changes. It is now possible, for example, to talk about culturally meaningful places within the summit region, such as the summit, Lake Waiau and Keanakākoʻi (one of the names for either a site in the adze quarry or the whole quarry). In addition, the survey data have made it possible to discuss specific cultural practices associated with each place, such as pilgrimages to the summit, Kūkahauʻula.

As a result of the survey there is a much better understanding of the size and complexity of the Mauna Kea Adze Quarry Complex as a process, rather than simply a place in the landscape. This includes the recognition of multiple routes or corridors to and from the quarry emanating from different sides of the mountain. The data support an earlier hypothesis that the quarry was something like a pan-island production center utilized by adze makers from different parts of the island, and that the workers were craft specialists supported by chiefs. The relevance of the adze quarry to issues in Hawaiian archaeology, such as craft specialization, socio-political processes at the regional level, territoriality and property rights, are discussed.

Continuity in the use of the summit area from pre-Contact times to the present is evidenced in modern altars (*lele*) and less formal rock piles without offerings. Remains that are either modern or cannot be classified with any level of confidence as historic sites because of their uncertain age, such as many of the rock piles, were recorded as “find spots,” following a practice begun by the SHPD during a reconnaissance survey of selected areas of the Mauna Kea Science Reserve in 1997. A total of 313 find spots were recorded in the two parcels that comprise the NAR. It is highly likely that some of these are actually historic properties, but to demonstrate this would require a more detailed analysis of their morphology and location.

A large number of the historic properties in the NAR are located within the proposed boundaries of the Mauna Kea Summit Region Historic District (Site 50-10-23-26869). The recently completed archaeological inventory surveys of the Mauna Kea Science Reserve and the NAR confirms that the Mauna Kea Adze Quarry Complex extends well beyond the boundaries of both of these management units. It points to the need to revise the historic district boundaries.

The sites in the NAR are contributing properties to the district, which is significant under multiple criteria. The historic district is significant under all four National Register criteria and criterion E of the Hawaii Administrative Rules, Chapter §13-275-6. The district is significant under criterion A because of the presence of the Mauna Kea Adze Quarry Complex (a National Historic Landmark), which was used over a period of 500-700 years or more and the hundreds of shrines in and outside of the quarry. Both the quarry and the shrines are associated with broad patterns and events in Hawaiian prehistory. The district is significant under criterion B because of the association with several gods who may have been deified ancestors. These include Kūkahauʻula, Līlīnoe and Waiau. The sites in the adze quarry and many of the shrines embody distinctive characteristics of traditional Hawaiian stone tool manufacture by craft specialists and a distinctive type of shrine construction found in only a few other places in the Hawaiian Islands. These make the district significant under criterion C. Studies of the Mauna Kea Adze Quarry Complex have already made a significant contribution to our understanding of Hawaiian prehistory and history, and hold the potential to make even more contributions. The district is thus significant under criterion D. Finally, the district is significant under criterion E because of the presence of numerous burials and the hundreds of shrines in the summit region. Many of the shrines have been interpreted as evidence of a previously unknown land use practice in the form of pilgrimages to the summit of Mauna Kea and Lake Waiau to worship the gods and goddesses, while those found in the adze quarry are a clear indication that the quarry was a consecrated industry.

All of the sites in the NAR will be preserved and continue to be managed by the NAR program.

PREFACE

This report has an unusual history, which requires some discussion in order to understand its contents and to avoid any possible misunderstandings in terms of what it is and what it is not. First, it is hybrid report that is part research-oriented and part CRM-oriented, although the senior author believes that there is no, or should not be, a black and white line between the two. The idea that CRM archaeologists do not do research is silly and wrong.

What distinguishes this report from the usual archaeological inventory survey reports produced today, is that it presents a substantial amount of data that were collected in an earlier research project directed by the senior author, in 1975-76, while employed at the Bishop Museum, and funded by the National Science Foundation and local grants. While some of the data collected in the 1975-76 work have been analyzed, written up, and published, a great deal of data have not.

The 1975-76 project was undertaken in a different era, of not only smaller grants, but a time when there was more volunteerism in the field of archaeology. The NSF grants were not sufficient to pay most of the field crew a salary. Except for the senior author and other personnel employed by the Museum, all of the other field workers were essentially volunteers. They were given board and room (a tent and meals) and a small stipend that averaged $200 for three months of work. The first summer we had the luxury of having a cook. In 1976, the cooking and clean-up chores were done by the crew on a rotating basis. In addition to the regular crew, many other people volunteered in the field. The same spirit of volunteerism continued with the laboratory work in Honolulu, where students and others put in uncounted hours processing the field data and collections.

Though large in comparison to most inventory survey reports in Hawai`i, this is NOT a final report on the 1975-76 project. Although much of the basic site data are presented in Volume 2, time and money have limited the analyses of the data. One would have to have some familiarity with the project to know just how much data and interpretation have been omitted. Due to the various and unavoidable constraints faced in producing this report, the senior author has taken the liberty of quoting himself in various places throughout the text.

In addition to the fact that this is not a final report on previous archaeological investigations in the NAR, this report was not produced to fulfill an historic preservation mandate. The survey of the NAR between 2007 and 2009 was not prompted by a proposed action that would require the State or one of its agencies, in this case the Department of Forestry and Wildlife, to undertake an archaeological inventory survey. Instead, the survey was done in order to obtain baseline data for developing a cultural resources management plan recommended in a State administrative audit.

Due to the large amount of data collected in the survey, the analyses that followed, and discussion of the results, the report is presented in four volumes. Volume 1 presents environmental, cultural, and historical background information; a summary of previous archaeological investigations in the high elevation areas of Mauna Kea; the findings of the 2007 Lake Waiau survey and the 2008-2009 survey of the remaining part of the NAR; data analyses, and a synthesis and discussion of the wealth of information in terms of its relevance to an understanding of human use of the Mauna Kea summit region over time and the relevance of the data to several different issues in Hawaiian archaeology.

Volume 2 contains most all of the primary site data and documentation from the 1975-76 project and Volume 3 all of the data collected during the current project in 2008-2009, as well as the site data from the 2007 survey at Lake Waiau. The bulk of Volumes 2 and 3 consist of individual site descriptions, which also include plan view maps and photographs. The partial results of the excavations undertaken in 1975-76 as part of the survey are also presented in Volume 2. Volume 4 consists of data appendices.

ACKNOWLEDGMENTS

This report, with a history going back in part more than 30 years, is indebted to so many people, in so many ways, that a list of acknowledgments is bound to fail in omitting someone or some agency. Beginning with the current survey and proceeding back to the early work in the Mauna Kea Adze Quarry Complex, in 1975-76, the senior author has compiled a long list of debts that can never be adequately repaid.

The work on which the current report is based would not have been possible without the efforts of Lisa Hadway, Manager of the Hawaiʻi Island branch of the Natural Area Reserves program that is administered by the Department of Forestry and Wildlife (DOFAW). Lisa was instrumental in securing funds to conduct the archaeological inventory survey of Lake Waiau in 2007, and the survey that followed in the remaining parts of the NAR in 2008-2009. Though funding was severely limited for a project of the magnitude of the 2007-2009 surveys, Lisa's success in acquiring the funding also made it possible to process some of the unpublished site data from the earlier work, in 1975-76, and to incorporate not only the site descriptions but other data as well into the current report. Betsy Gagne, Executive Secretary of the NARS Commission, has been a long-term advocate for the protection of the natural and cultural resources on Mauna Kea. She has seen to it that the SHPD has had an opportunity to review research proposals, particularly those that might have an adverse impact on historic properties in the Mauna Kea Ice Age Natural Area Reserve. Her unflagging support over the years is much appreciated.

Stephanie Nagata, Interim Director of the Office of Mauna Kea Management (OMKM), provided much appreciated logistical support in making arrangements for the field crews to stay at the Mid-Elevation Facility at Hale Pōhaku. She was also instrumental in obtaining funding support for the inventory survey work for the U.H. management areas on Mauna Kea, including Mauna Kea Science Reserve, the Mauna Kea Access Road corridor and Hale Pōhaku, and for the CRMP sub-plan of the Mauna Kea Comprehensive Management Plan (CMP).

The authors owe more than a simple thanks for the hard work and perseverance under very trying conditions of our current and former PCSI co-workers and other colleagues. The surveys would have never have been completed without the tireless, unflagging efforts of Keola Nakamura, Sara Collins, Valerie Park, Reid Yamasato, Jeanne Krauss, and Melanie Mintmier.

Bill Godby, former lead archaeologist at the Pohakuloa Training Area and one of his staff, James Head, assisted the field crew over a two-week period in 2008 in recording GPS points in the area of the adze quarry that had been surveyed in 1975-76, long before such technology existed. Their assistance is much appreciated. The EDXRF analyses that are reported on in Section 6 of the report were done by Dr. Peter Mills and Dr. Steve Lundblad of the University of Hawaii at Hilo.

The report would never have been completed without the help of our colleagues, Doug Hazelwood, Steve Clark, Andy Tomlinson, Keola Nakamura, Mary Riford, Jackie Walden- Pamerleau, Valerie (Park) Russell, and Melanie Mintmier. In addition to managing the project, Steve edited some of the 1975-76 site descriptions, together with Dennis Gosser. Andy scanned all of the typescript site descriptions and some of the field maps from the 1976-76 fieldwork, and produced many of the figures using GIS software. Keola produced many of the plan view field maps and scanned photo images. Jackie and Valerie produced a number of the tables and helped with the editing and formatting of the 1975-76 site descriptions, along with Denise Russell and Melanie Mintmier. Mary processed the artifact collection made in the 2007-2009 surveys, made a photographic record of each artifact and generated a catalog.

Two of the aerial photographs that appear in this report (Figures 2.1 and 2.7) were made from negatives obtained from George McEldowney, father of Holly McEldowney many years ago. Figure 5.15 was drafted by Aki Sinoto for a conference paper.

Dr. Jenny Kahn and Rowan Gard, former Bishop Museum employees, processed a loan that made it possible to scan oversized maps from the 1975-76 adze quarry project. The scanning was done through a no-fee contractual agreement with the U.S. Army and was facilitated by Bill Godby and the cultural staff at the Pohakuloa Training Area.

In 2007, Kimo Pihana, a former OMKM ranger, spent a part of one day at Lake Waiau discussing traditions and cultural practices associated with the lake. Larry Kimura, Assistant Professor Hawaiian Language and Culture at the University of Hawaiʻi at Hilo and a member of the Kahu Kū Mauna Council, kindly discussed what he knew about the Eben Low memorial and the *piko* practice at the lake. Mahalo to both.

The staff at the Visitor Information Station at the Onizuka Center for International Astronomy, and Dave Byrne in particular, provided various kinds of assistance during the surveys, which partially overlapped, of the Mauna Kea Science Reserve and the Mauna Kea Ice Age Natural Area Reserve. OMKM rangers Pablo McCloud, Kimo Pihana, Ahiena Kanahele, Kenyan Beals, Shane Fox, Don Weir, Joel Kelly and Matt Church showed a keen interest in the project and assisted us in many ways. They provided much appreciated logistical support that made it possible on numerous occasions to leave our rental vehicle at a location that eliminated the need for an arduous, time-consuming uphill climb at the end of the day.

The 1975-76 research in the Mauna Kea Adze Quarry Complex was supported by two National Science Foundation grants (BNS75-13421 and BNS76-15763), two National Historic Preservation grants-in-aid, and a grant from the Charles and Anna Cooke Foundation of Honolulu. The senior author's research in the Mauna Kea Adze Quarry owes much to Dr. Richard Gould. The very idea of conducting research on the quarry, about which virtually nothing was known in the 1970s, came from a fieldtrip with Dick to the quarry. Dick not only helped with the writing of the first NSF grant proposal, he also participated in the fieldwork as an unpaid volunteer, and provided the opportunity for several students to earn college credits through the classes he taught in 1975-76 at the University of Hawaiʻi at Mānoa. Dick was also the primary impetus behind the writing of one of the first published articles on the research in *Archaeology* magazine.

The senior author wishes to thank the numerous individuals that participated in the 1975-76 project and especially Paul Cleghorn, who as the field foreman in both seasons, was totally dedicated to the project. The names of the many crew and volunteers are listed below. The senior author is especially grateful to Holly McEldowney and Toni (Han) Palermo for all the hours they put into summarizing the 1975-76 site data that are presented in Volume 4, Appendix A. Eric Komori, yet one more former Bishop Museum employee, drafted the oversized maps of three major sites mapped with a plane table and alidade and transit. Unfortunately, it has not been possible to convert these maps to a GIS format and up-date them with color-coded map symbols and other fonts due to the absence of funding.

1975 field crew and volunteers
Patrick McCoy
Judy McCoy
Paul Cleghorn
Chuck Streck
Warren Osako
Tom Manabe
Jim McDowell
Holly McEldowney
Jenny Peterson
Marilynn Plott
Peggy Luscomb
Paul Rosendahl
Chip Luscomb
Rick Warshauer
Chris Yuen
Mike Shiroma

1975 lab workers and volunteers
Marilyn Ige
Wythe Braden
Sara Lum
Mary White
Taylor Dinerman
Warren Osako
Cathy Matsuura
Holly McEldowney

1976 field crew and volunteers
Patrick McCoy
Judy McCoy
Paul Cleghorn
Jamie Young
Tim Lui-Kwan
Toni Han (Palermo)
Monica Udvardy
Terry Hunt
Beverly Maekawa
Holly McEldowney
Jenny Peterson
Jay Aiu

1976-77 lab workers and volunteers
Ann Marshall
Jennie Peterson
Linda Cox
Barbara Moir
Barbara Smith
Debe Chamberlain
Fiona McDougall
Nathan Aipa

Alan Ziegler

Many people provided technical services and expertise in the identification of the faunal and floral remains recovered in the excavations conducted in 1975-76. The senior author will always be indebted to the late Dr. Alan Ziegler for the work he undertook, first in sorting the vertebrate faunal remains into bird, mammal and fish bone, identifying all of the mammal and bird bones that he could (or felt comfortable doing), making arrangements for Dr. Storrs Olson and Dr. Helen James at the Smithsonian Institution to continue work on the avifauna, and in his last years, finishing up the identification of the fish bones. Carla Kishinami, long-time Bishop Museum employee and assistant to Dr. Ziegler for many years, ensured that the vertebrate faunal remains were properly curated. The late Bob Pyle reviewed the list of identified birds and provided the latest taxonomic names. Dr. William Follett, Curator Emeritus of Ichthyology at the California Academy of Sciences, kindly offered to identify the fish remains. Unfortunately, his work was unfinished the time of his death, but the identifications he had made were used in a paper published by the author in1990. Besides the love for his work, Dr. Follett was one of the genuinely nicest persons the senior author has ever had the privilege to know, even though our acquaintance was short. Dr. Jack Randall, another former Bishop Museum employee, provided assistance to Dr. Follett in obtaining fish carcasses for building up a larger reference collection of Hawaiian fishes. Dr. Carl Christensen, former malacologist at the Bishop Museum, identified a number of land snails. The late Dr. Alison Kay, then at the University of Hawaiʻi at Mānoa, examined the ʻ*opihi* shells from several of the rockshelters and made some valuable comments about their habitats. In 1984, Kristen Schlech, Department of Botany at the Bishop Museum, identified two species of seaweeds.

Work in the Hopukani, Waihu and Liloe Springs area of the Mauna Kea Adze Quarry Complex, in 1984-85, was undertaken by the senior author's former consulting firm, Mountain Archaeology Research Corp. Aki Sinoto, Eric Komori and Scott Williams assisted in the fieldwork. Some of the data from the work in this part of the quarry has been incorporated into this report.

The senior author has benefited from discussions and correspondence with many people over the years, including Dr. Stephen Porter, Emeritus Professor of Earth & Space Sciences at the University of Washington. Dr. Fiorenzo Ugolini, a soil-scientist then on the faculty at the University of Washington who was working with Dr. Porter on Mauna Kea in the mid-1970s, spent some time in the field in 1976 and analyzed a sample of soils from some of the excavated rockshelters and a gelifluction lobe. The results of his analysis have had to be omitted, again due to the lack of funds. Through contacts made by Melinda Allen, Dr. Meyer Rubin of the USGS agreed to date a sample of leaves from a desiccated silversword plant found at one of the rockshelters excavated in 1976 that was given the name ʻAhinahina, after the Hawaiian name for this now rare and endangered plant.

The senior author is also grateful for the contributions made by Dr. Paul Cleghorn, whose Ph.D. dissertation on the adze manufacturing technology still remains one of the detailed studies of Hawaiian adze manufacture. Dr. Melinda Allen's M.A. thesis on the floral remains from the adze quarry, primarily from what we called

Koʻokoʻolau Rockshelter No. 1, contributed greatly to an understanding of the adze maker's food habits, perishable material culture, and the extra-areal sources of seeds and other plant remains. Scott Williams, who analyzed a sample of the flake debitage from Koʻokoʻolau Rockshelter No. 1 for his M.A. thesis, made yet one more contribution to the on-going effort to comprehend the techniques and methods used by Hawaiian adze makers.

The senior author has benefited from discussions over the years with Holly McEldowney, Paul Cleghorn, Scott Williams and Aki Sinoto regarding the archaeology of the Mauna Kea Summit region. We have not always agreed, but the exchange of ideas has been a good one.

The one person to whom the senior author is most indebted is his wife, Judy McCoy, who not only participated in the 1975-76 fieldwork, but has provided so many forms of assistance and comfort over the years that they can't be simply listed or counted. Without her long-term moral support and forbearance this report would never have seen the light of day.

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1.0 INTRODUCTION

This report presents the results of a 10-week long archaeological inventory survey of the 3,893.5 -acre Mauna Kea Ice Age Natural Area Reserve (TMK: (3) 4-4-015: 10, 11) conducted by PCSI in 2008 and 2009 for the NARS program. The report, which covers the whole of the NAR, also presents and summarizes the results of an archaeological inventory of a roughly 43-acre area surrounding Lake Waiau that was also carried out by PCSI under contract to the Office of Mauna Kea Management (OMKM) in 2007 (McCoy and Nees 2009). In addition, this report presents a summary and partial analysis of the data collected during a 7-month long research-oriented project involving survey and test excavations of selected areas and sites in the Mauna Kea Adze Quarry Complex carried out by the Bishop Museum in 1975-76 (McCoy 1976, 1990, 1999b; McCoy and Gould 1977; Allen 1981; Cleghorn 1982; Williams 1989; McCoy and Nees 2010). The earlier work in the 1970s, which has still not been fully analyzed and published, is integral to an understanding of the cultural landscape of the NAR and the different practices that took place in this remote area, from pre-Contact (pre-AD 1778) to recent times.

The 2007 and 2008-2009 projects, unlike most archaeological surveys in Hawai`i, were not triggered by a proposed action that would automatically require compliance with Chapter 6E rules and regulations. Rather, the project was developed in response to recommendations in a 2005 Legislative Audit of the Department of Land and Natural Resources to complete a cultural resources management plan for the Mauna Kea Ice Age Natural Area Reserve (Office of the Auditor Report No. 05-13:32). Like the Mauna Kea Science Reserve, which was the subject of the same audit, an archaeological inventory survey was argued to be a prerequisite to developing a management plan based on the commonsense notion that protective measures and other management actions cannot be developed without first knowing what resources exist.

While there was no action or development that would require review and approval of a report by the SHPD, the 2007-2009 surveys were nevertheless guided by HRS Chapter 6E, and Title 13 of the Hawaii Administrative Rules (HAR), Subtitle 13 (State Historic Preservation Division Rules), Chapter 276 (Rules Governing Standards for Archaeological Inventory Surveys and Reports) to ensure that the NARS program is in compliance with these rules and regulations. Even though review and approval of the Lake Waiau report (McCoy and Nees 2010) was not required under Chapter 6E regulations, the report was nevertheless submitted to SHPD. The report was approved by SHPD on September 10, 2009 (McMahon to McCoy) and is on file in the Kapolei and Hilo offices of SHPD. The current report will also be submitted to SHPD for review and approval, although once again it is not a requirement because of the nature of the 2008-2009 survey.

Unlike inventory surveys, NARS policies do require that management plans be reviewed and approved by SHPD prior to Board approval (NARS 1997:8).

1.1 THE NATURAL AREA RESERVES SYSTEM (NARS)

The NARS was created by the Legislature in 1970 with the enactment of HRS Chapter 195. The NARS program website indicates that the statewide reserves "were established to preserve in perpetuity specific land and water areas which support communities, as relatively unmodified as possible, of the natural flora and fauna, as well as geological sites, of Hawai`i."

The NARS program falls within the jurisdiction of the DLNR and is administered by DOFAW, based on HRS Chapter 209 ("Rules Regulating Activities within Natural Area Reserves"). A 1997 document, "Management Policies of the Natural Area Reserve System," identifies conservation as the main purpose of the reserves. Public use is allowed, as well as commercial use, as long as such use does not adversely affect natural resources and public use. In 2008, the NARS program completed a Strategic Plan to facilitate the development and implementation of long-term goals. The Strategic Plan outlines a number of objectives relating to cultural issues, one of which directs the NARS program to:

> Prioritize and conduct cultural and archaeological assessments that identify critical cultural and archaeological resources, evaluate appropriate uses of these resources, and recommend measures to protect and preserve these features (NewFields Companies LLC 2008:18).

1.2 The Mauna Kea Ice Age Natural Area Reserve (NAR)

The NAR was established in 1981 with the approval by the Board of Land and Natural Resources (BLNR) of Conservation District Use Permit 1340 (Letter Ono to Lee dated May 13, 1981). The NAR consists of two separate parcels, a 3,750.0 -acre pie-shaped parcel (TMK: (3) 4-4-15:10) and a 143.5-acre parcel (TMK: (3) 4-4-15:11) surrounding Pu`u Pōhaku (Figure 1.1). Prior to 1981 much of the area now contained within the boundaries of the NAR was a part of the Mauna Kea Science Reserve (TMK: (3) 4-4-15:09) that was established in 1968 when the BLNR approved a 65-year lease to the University of Hawai`i (UH) for a 13,321-acre scientific complex. When the NAR was established 2,033.2-acres of land were withdrawn from the Science Reserve, thus reducing the Science Reserve to approximately 11,277 acres.

The NAR contains within its boundaries a number of significant geological, biological and archaeological resources, including volcanic and glacial landforms, Lake Waiau, one of the highest lakes in the United States; a variety of rare plants including the silversword and a large portion of the Mauna Kea Adze Quarry Complex, which was placed on the National Register of Historic Places as a National Historic Landmark in 1962.

Though not part of its original mandate, which was focused on natural resources, the preservation and protection of cultural resources has expanded the responsibilities of Natural Area Reserve Managers. To address their needs the NARS program has contracted professional archaeologists to conduct inventory surveys and develop cultural resources management plans.

1.3 Project Objectives and Scope of Work

Prior to the start of the archaeological inventory survey of Lake Waiau, in 2007, archaeological investigations of the NAR had been focused on the more accessible and better known areas of the Mauna Kea Adze Quarry Complex. (cf. summary of 1975-76 quarry project in Section 5.3). The primary objective of the 2007-2009 inventory surveys was to identify, record, and evaluate the significance of all of the historic properties in the 3,893.5-acre NAR, and to make recommendations regarding their preservation and continued protection.

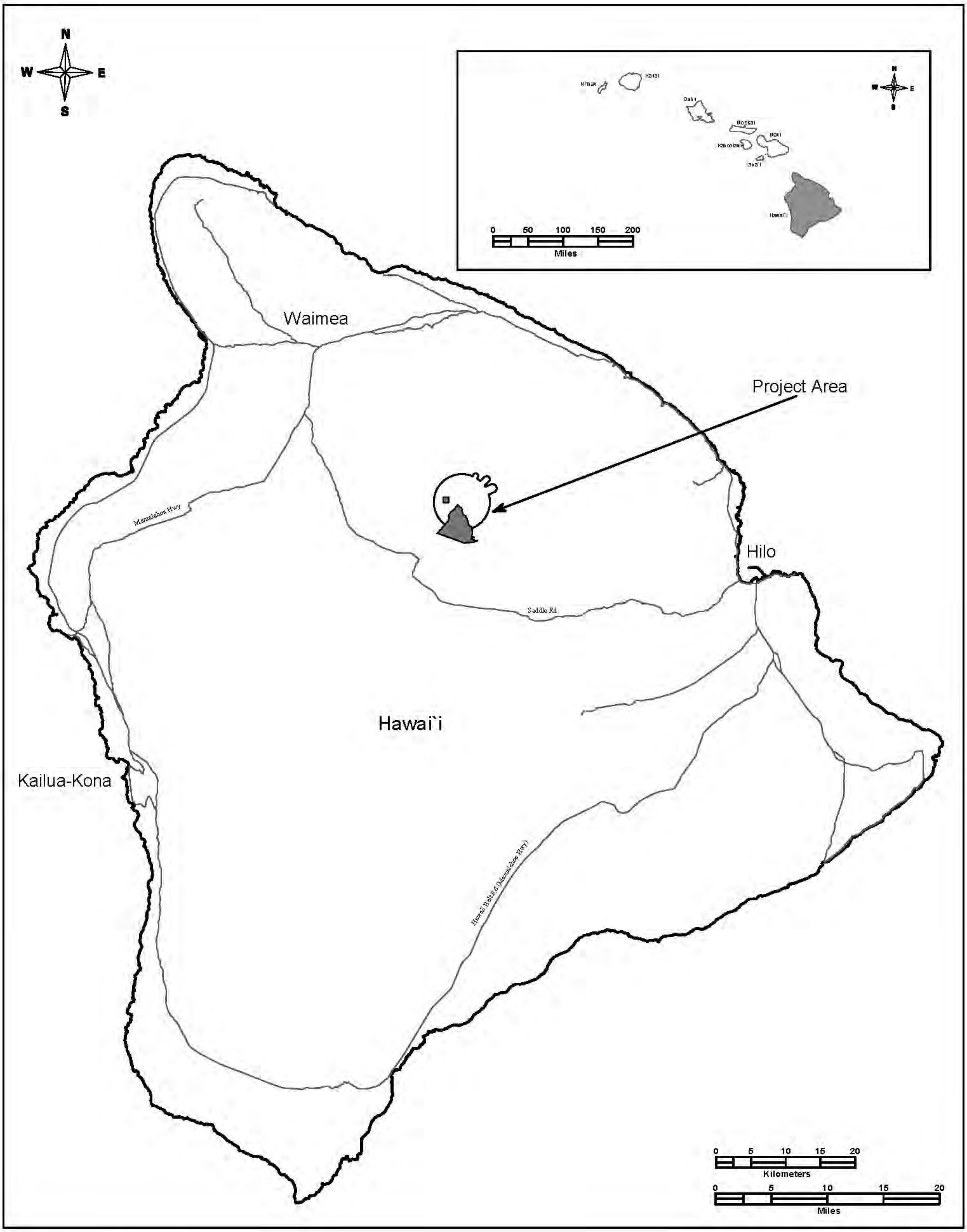

Figure 1.1 Project Area Location.

The larger project, of which the current report is one part, had two primary objectives:

> Objective 1: To complete an archaeological inventory survey of the NAR in order to more accurately determine the number, variety, location and significance of historic properties.
>
> Objective 2: To develop a Cultural Resources Management Plan (CRMP) for the NAR based on the accumulated data on historic properties and consultation with the Native Hawaiian community and other interested parties.

This report fulfills the requirements for Objective 1. Objective 1 was viewed as an essential first step in addressing the comments in the 2005 Legislative Audit. A systematic survey of the entire NAR was also viewed as an essential first step in developing a CRMP based on the conviction that the cultural landscape of the NAR could not be adequately managed without a fuller knowledge of the number, variety, location, and significance of the historic properties found within its boundaries.

The current surveys continued the practice, begun by former SHPD staff in a reconnaissance survey of selected areas of the Science Reserve in 1997, of recording cultural remains that are either obviously modern or cannot be classified with any level of confidence as historic properties because of their uncertain age and/or function (e.g., one stone or several stones on top of a boulder). The recording of these remains, originally called “locations” and now referred to as “find spots,” is part of a resource management strategy aimed at obtaining baseline data with which to evaluate long-term changes to the cultural landscape in both the Science Reserve and the NAR.

1.4 Fieldwork Schedule and Personnel

Fieldwork was limited to the summer months because of health and safety concerns related to weather conditions and the impracticability of conducting surveys at any other time of the year, although the weather in the project area is unpredictable. Though the summer months generally are somewhat warmer and less windy, inclement weather can occur at any time of the year, as the field crews witnessed first hand. The total length of the 2008-2009 field project was 10 weeks. A more detailed summary of each field season is presented in the Summary of Work in Section 5.

The Principal Investigator of all of the projects discussed in this report was Dr. Patrick C. McCoy. Rich Nees was the Field Director of the Lake Waiau survey and the surveys that followed in 2008-2009. The 2008 crew also included Keola Nakamura and Valerie Park. The 2009 crew remained the same, except for the additional participation of Dr. Sara Collins. Bill Godby and James Head, archaeologists from the environmental office at Pohakuloa Training Area (PTA) assisted the crew for two weeks in 2008 in obtaining GPS points for archaeological remains recorded in 1975-76.

1.5 Report preparation and Organization

The preparation of this report, which is a compilation of all the historic property data presently available for the NAR, has involved a tremendous amount of effort in assembling, organizing and editing site descriptions and drafting maps from the 1975-76 fieldwork, in addition to integrating the data from the 2007 Lake Waiau survey, and presenting the new data collected in 2008-2009.

The 1975-76 project, undertaken in the era when computers were still not in general use, amassed a large amount of data, only a small portion of which has been analyzed and published. Because of this situation, it became necessary to obtain a temporary loan from Bishop Museum, where all of the field records are housed, to copy the field notes and over-sized maps, the typed site and feature descriptions, and the artifact and midden catalogs. The site descriptions then had to be transferred to an electronic format using Optical Character Recognition (OCR) software. Following this, all of the newly created files had to be manually proofed to ensure 100% accuracy. As anticipated, the 1975-76 site descriptions, which were done in the field but never edited after they were typed, had to be reviewed and revisions made where there were obvious errors and other problems, such as a lack of clarity. Constraints on the budget of the current project did not allow for a thorough edit of over 600 pages of site descriptions from the 1975-76 project.

Some maps and artifact drawings had been prepared in the 1970's and mid-1980s with the meager budgets available at that time, but few site maps had been drafted. The exception was three major sites (16216, 16217, and 16218) where plane table and transit mapping was done. This left a large number of maps to be prepared, in addition to a selection of photographs. Once again, budget was a major constraint.

The current report is by no means a final report on the 1975-76 research. It is the most complete report on the quarry research prepared to date, but much work remains to be done.

This report and the CRMP that will follow mirror in many respects the archaeological inventory survey report and a cultural resources management plan that was prepared for the Science Reserve (McCoy and Nees 2010; McCoy et al. 2010). Sections 2 through 4 of this report contain essentially the same information as what appears in the Science Reserve inventory survey report.

Because of the large amount of data collected in the survey and the data analyses that followed, the report is presented in four volumes. Volume 1 is divided into nine sections, excluding the list of references, and is fundamentally a summary volume of findings, data analyses and interpretations at a variety of scales. The so-called "raw data," for the 1975-76 fieldwork which includes site descriptions and excavation summaries, are presented in Volume 2. Volume 3 presents the summarized results of the 2007 fieldwork, followed by the results of the 2008-2009 fieldwork. Volume 4 presents supplemental site information and technical data.

Section 1: Introduction--the report begins with a description of the project objectives and scope of work; the organization of the report, and a brief description of the project area location, the fieldwork schedule.

Section 2: Project Area Background--provides a summary of the environmental, cultural and archaeological context. This includes a discussion of the geoecology of the summit region, the traditional cultural context, and a chronological summary of land use practices and other cultural practices before and after European contact.

Section 3: Previous Archaeological Research and Cultural Resource Management Studies in the Alpine Desert and Sub-alpine Forest Zones of Mauna Kea--summarizes earlier archaeological research, traditional property assessments, cultural impact assessments and mitigation plans for the higher elevation regions of Mauna Kea.

Section 4: Archaeological Theory and Practice--presents an overview of archaeological theory and practice and the authors' theoretical orientation.

Section 5: Summary of Work and Findings--includes a summary of the work outlined in the scope of work; field methods and site recording procedures; limitations of the survey; the findings or results of the survey which in addition to the collection of basic site data also included the recording of artifact data on field forms, the collection of selected surface artifacts and test excavations at two sites. The number and distinguishing characteristics of each class of sites and site complexes are described in this section. Site descriptions and details on the test excavations are presented in Volume 2.

Section 6: Data Analyses--includes formal, spatial and statistical analyses of selected shrine attributes; an attribute analysis of selected artifacts from habitation rockshelters and adze manufacturing workshops; chronometric dating and wood charcoal identification, and geochemical sourcing of artifacts from various areas of the Science Reserve.

Section 7: Summary, Synthesis and Conclusions--presents a summary, synthesis and discussion of the wealth of data collected in the archaeological surveys. It includes discussions of site diversity and distribution patterns; the development of specific places in the summit area and the broader context of the summit region and its relevance to selected research topics in Hawaiian archaeology.

Section 8: Significance Evaluations--presents a discussion of the significance of the historic properties found in the survey in the context of the Mauna Kea Summit Region Historic District.

Section 9: Recommendations--are made regarding the protection and continued preservation of the historic properties in the NAR based on a preliminary list of management issues.

Section 10: References Cited.

LIST OF APPENDICES FOUND IN VOLUME 4

2.0 ENVIRONMENTAL, CULTURAL AND HISTORICAL CONTEXT OF THE MAUNA KEA SUMMIT REGION

In a departure from the orthodox practice in Hawaiian archaeology of describing the environmental and culture-historical setting of a project area as “background information,” this report employs the term context. This is based on the view that what is commonly called “background” in archaeological reports is more than what the name implies. The overview that follows is taken primarily from other reports and papers (e.g., McCoy 1982a, 1990; McCoy and Nees 2009; McCoy and Nees 2010).

2.1 GEOECOLOGY

The environment on the upper slopes of Mauna Kea evinces similarities to other high mountains, including the marked interdependency of biotic and abiotic processes that has given rise to the term “geoecology” in the recent literature on arctic and alpine environments (Troll 1972; Winterhalder and Thomas 1978; Webber 1979). The complexities that the term geoecology engenders prevent a total environmental analysis in a report of this length. The focus of attention is on what are believed to be the most relevant biogeoclimatic characteristics for understanding the archaeological record of the summit region (McCoy 1985a). The summit region as defined here encompasses the vast alpine desert ecosystem on the top of the mountain.

2.1.1 Geologic History, Landforms, Topography, and Soils

Mauna Kea, the highest (13,796 feet above mean sea level (ft amsl) and second largest of the five shield volcanoes that form the island of Hawai`i, is estimated to be between 600,000 and 1.5 million years old (Moore and Clague 1992; DePaolo and Stolper 1996; Wolfe et al. 1997; Sharp and Renne 2005). The earliest stage of volcanism consists of a basaltic shield which Stearns and Macdonald (1946) called the Hāmākua Volcanic Series. The latest stage, which caps the mountain, consists of andesitic lavas (Macdonald and Abbott 1970:142; Wolfe and Morris 1996; Wolfe et al. 1997; Sherrod et al. 2007) which were called the Laupāhoehoe Volcanic Series by Stearns and Macdonald (1946). Stephen Porter renamed these the Hāmākua Group and Laupāhoehoe Group (Porter 1979a: Figure 2). The older lavas, which are part of a tholeiitic suite, contain basalts with varying percentages of olivine and feldspars, while the younger lavas, which are grouped in an alkalic suite, consist of primarily hawaiite (Porter 1979a:Figure 5). Even though the last eruption occurred sometime between 4,580 and 8,200 years ago (Sherrod et al. 2007:470), the U.S. Geological Survey (USGS) considers Mauna Kea to be an active post-shield volcano (U.S. Geological Survey 2002).

There are numerous cinder cones and associated lava flows on what is popularly known as the summit plateau (Figures 2.1 and 2.2). One of the earliest known descriptions of the plateau was made by Hitchcock who wrote "There is a sort of plateau upon the higher part of Mauna Kea above the contour of 12,500 feet, with an area of from thirty-five to forty square miles" (Hitchcock 1909:51). A more detailed description was made by Wentworth and Powers:

> Above 11,000 to 12,000 feet is the summit plateau, a rudely circular dome 5 or 6 miles in diameter rising between 500 and 1000 feet per mile to a central area above 13,000 feet (Wentworth and Powers 1941:1197).

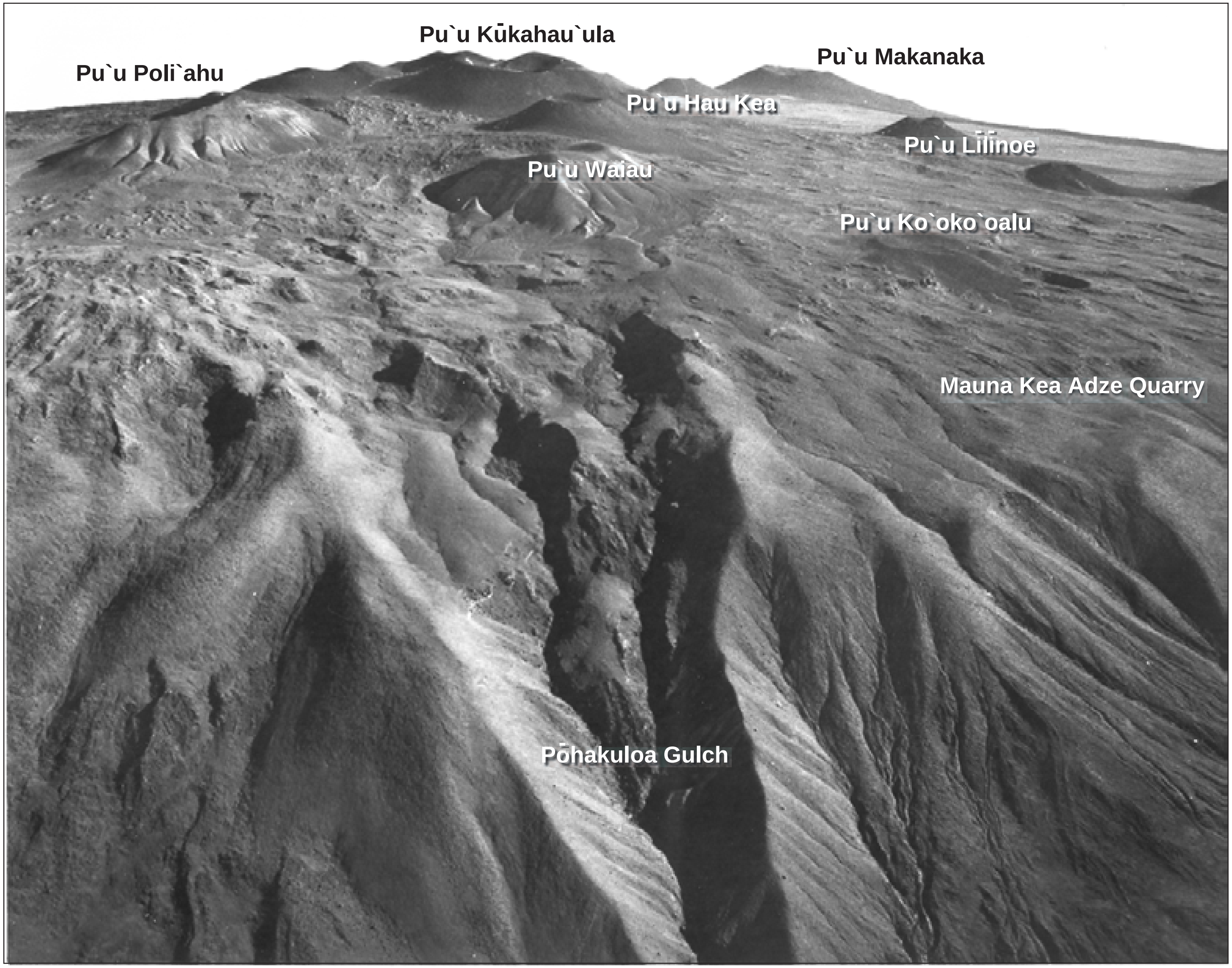

Figure 2.1. Aerial View of the Summit Plateau and Dissected Landscape Below in the Pohakuloa Gulch Area. (Source: Hawaii Air National Guard, courtesy of George McEldowney)

Figure 2.2. Photographs Showing Cinder Cones Located on the Summit Plateau.

Mauna Kea was for many years the only known mountain in the tropical mid-Pacific with evidence of Pleistocene glaciation (Daly 1910; Porter 1972, 1975, 1979b 1979c, 1987). Possible evidence for glaciation has apparently been found recently on Haleakalā (Moore et al. 1993). A number of geologists have studied the glacial deposits on Mauna Kea (e.g., Gregory and Wentworth 1937; Wentworth and Powers 1941; Stearns 1945), but the definitive study was undertaken by Stephen Porter in the 1970s. Porter mapped a succession of four glacial drift sheets, located between the ca. 2,800 m (9,184 ft) and 4,200 m (13,776 ft) elevations, which correspond to four periods of glaciation. From earliest to latest the glacial deposits were named, using local place names, the Pōhakuloa Formation, Waihu Formation, and the Makanaka Formation. The latter includes an older drift and a younger drift (Porter 1979c: Figure 2). More recent investigations suggest that there may have only been three major stages of glaciation, rather than four (Wolfe et al. 1997). Glacial moraines and associated drift deposits cover a large part of the summit region (Figure 2.3).

Porter provides a good description of the effects of glaciation on the topography of the summit plateau:

> Behind the belt of end moraines lies a broad zone of dominantly erosional topography irregularly mantled by thin patches of drift. Within this zone, lava-flow surfaces have been abraded into stoss-and-lee forms and are extensively striated, and the flanks of cinder cones have been oversteepened by glacial erosion so they stand at angles of 30 to 34, instead of the more typical 24 to 26 (Porter 1972; 1975:247).

The stoss and lee forms to which Porter refers are *roches moutonees* (Davies 1972:171), also commonly known as "whaleback ridges" (Porter 1975:247) and "muttonback ridges" (Figure 2.4). A good description of these glacial landforms appears in an early report by Gregory and Wentworth:

> A conspicuous feature of glacial erosion is the "whale-backed" smoothing (roche moutonne). Many of the ledges that extend radially down the slope of the dome (Pl. 1, fig. 2) have been eroded and smoothed on the top sides, with a stoss approach upslope and a plucked cliff or series of steps at the downslope end. In general, the roches moutonnes are long and narrow, with parallel sides and a straight rather than oval or domed longitudinal profile. The form of many, if not all of them, has been determined by the original lava flow. Commonly the irregularities of the lava flow are still in evidence, and in places the deeper pahoehoe wrinkles have not been completely removed. It appears that only a small amount of erosion and smoothing has sufficed to form rather characteristic glacial outlines and surfaces, owing to the similarity in direction of motion of the glacial ice and the lava flows (Gregory and Wentworth 1937:1733).
>
> A thin and discontinuous ground moraine overlies striated bed rock in much of the glaciated area (Pl. 1, fig. 2). It consists of fragments of lava, in many places mingled with cinders from nearby cones or with finer rock detritus washed from the slopes. Nearly all of the fragments are angular or slightly rounded at their edges, though a few are marked by minor grooves and facets and generally granular surfaces. It seems obvious that the "erratics" have not travelled far or been subjected to intense and repeated grinding. Some of them are joint blocks plucked from the underlying ledge; others are slabs broken from low cliffs over which the ice stream passed; still others seem to have been transported within, or on top of, the glaciers, without modification in shape (Gregory and Wentworth 1937:1734).

Figure 2.3. Photographs Showing Glacial Moraines.

Figure 2.4. Photographs Showing Whaleback Ridges.

The presence of fossil ice [permafrost] in the summit region is further testimony to earlier glacial conditions (Woodcock et al. 1970; Woodcock 1974; Furumoto and Woolard 1970). According to Porter, there is no evidence for renewed glaciation since the disappearance of the last ice cap more than 9,100 years ago (Porter 1975:250; 1979b 184-185).

The lower reaches of the NAR on the southwestern flank of the mountain is an area of predominantly steep topography. In one of the early reports on the glacial geology of Mauna Kea Gregory and Wentworth wrote that " between 11,000 and 7,000 feet, the general gradient is 1,600 feet, with a few small areas as steep as 2,000 feet, a mile" (Gregory and Wentworth 1937:1724). The general lack of deep radial valleys on slopes that average nearly 40 per cent in many places has been attributed to a combination of low rainfall and porous soils. Pōhakuloa and Waikahalulu, the only substantial gulches on the southwest flank of the mountain, attain a maximum depth of roughly 30 to 90 m between the 2,438 and 3,353 m elevations (Wentworth and Powers 1941:1198). Water is not totally lacking and in fact there are a number of springs and seeps perched in glacial drift deposits above and below treeline (Wentworth and Powers 1943).

The summit region resembles a stony alpine desert. The soils, like those in alpine environments generally, are poorly developed (Ugolini ms.). In the absence of a vegetative cover and, thus, a surface organic layer, the ground surface in many places is a desert pavement (Ugolini 1974:189).

2.1.2 Geomorphic Processes

Mechanical weathering by frost is the most important mass-movement process in the periglacial regime and attains real significance in landscape evolution in the absence of trees (Caine 1974; Davies 1972:11). On current evidence the effective lower limit of this regime on Mauna Kea is treeline (Ugolini ms.). The primary evidence of a periglacial climate and geomorphic processes is the occurrence of diverse forms of patterned ground, such as stone stripes (see Figure 2.2) and polygons that are widespread in the cold regions of the world (Washburn 1956, 1979). The most common type of mass-movement landform in the summit region of Mauna Kea is the stone-banked terrace or lobe (Davies 1972:49-51) which is variably called either solifluction or gelifluction terraces and lobes (Figure 2.5). Here we follow Washburn (1979) and Embleton and King (1975:97) who have noted the advantage of the term gelifluction in clearly denoting a periglacial regime as opposed to other climatic regimes, including low elevation deserts, where similar forms of patterned ground are also found (Cooke and Warren 1973:129).

While there is no evidence of renewed glaciation in the last 9,000 years or so, there is a possibility of a change to a colder and/or wetter climate having occurred during the last 1,000 years. The evidence for this change is based on Porter's interpretation of gelifluction lobe development (Porter 1975:250, 1979b:184-85).

2.1.3 Modern Climate

The climate of the higher elevations on Mauna Kea is, like all mountain climates, kaleidoscopic, consisting of a great number of individual elements that are continually changing through space and time. It exhibits all of the universal changes that occur in

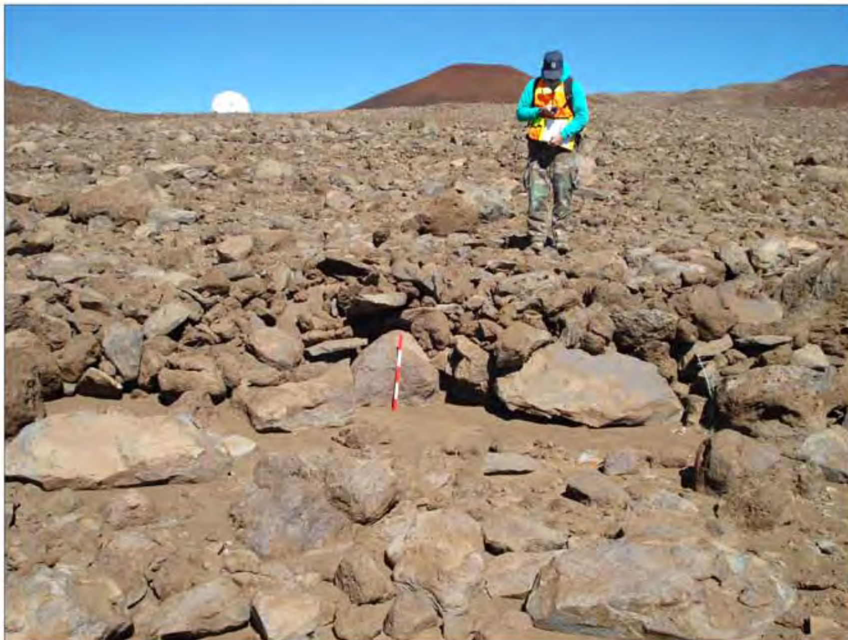

Figure 2.5 Photographs Showing Gelifluction Terraces.

the atmosphere with increasing altitude (e.g., decreasing temperature, air density and water vapor) in addition to local effects directly related to latitude and the "mountain mass effect" (Barry 1981; Price 1981). The summit region climate is both dry and cold, but there are few available statistics for evaluating annual and cyclical variability. At this latitude (19-20 degrees N) there is little difference in the mean minimum and mean maximum temperature ranges throughout the year in contrast to pronounced diurnal variation. Precipitation at the higher elevations frequently averages less than one inch in every month of the year, primarily in the form of sleet, hail and snow, which rarely accumulates below the 3,050 m elevation, however (Woodcock 1980). The prevailing winds are from the east-northeast. Fog and other forms of ground condensation are not uncommon and appear to be generally associated with increased cloudiness at midday (Powers and Wentworth 1941).

The modern climate is periglacial, a term that is inconsistently used with reference to a variety of cold climates as well as geomorphological regimes (Davies 1972:9; Embleton and King 1975:2). Mauna Kea is an example of what Tricart (1970) has called the "low latitude mountain variety" of periglacial climate. There are frequent frosts but they are of low magnitude or intensity, penetrating to only shallow depths (Davies 1972:13). As mentioned above, features attesting to a modern periglacial environment include permafrost (Woodcock 1974), gelifluction lobes and terraces (Ugolini n.d.), stone stripes and polygons, and pot-lid or ring crack fractures on smoother rock surfaces (Figure 2.6). Intensive freeze-thaw cycles are also evidenced in the splitting and upheaving of rocks on the edges of lava flows that also exhibit the plucking and abrasive effects of glacial ice movement (Gregory and Wentworth 1937; Wentworth and Powers 1941).

2.1.4 Biota

The biota is predictably impoverished in this oceanic, high mountain ecosystem as the result of extreme isolation which is reflected in a high degree of endemism among a few closely related taxa. The alpine ecosystem on Mauna Kea, as with all high mountain ecosystems, is "at the upper ends of environmental and evolutionary gradients that originate in the surrounding lowlands" (Billings 1979:101). In the summit region there is an "aeolian zone" occupied by a variety of insects (Howarth and Montgomery 1980; Papp 1981) that are believed to have been the only resident fauna in the alpine desert prior to European contact.

The vegetation above the 3,000 m elevation has been classified as a semiarid, barren alpine tundra (Krajina 1963). It consists of lichens, mosses, and a few bunch grasses such as *Trisetum glomeratum* and *Agrostis sandwichensis* (Hartt and Neal 1940; Krajina 1963; Mueller-Dombois and Krajina 1968; Smith et al. 1982). A lower xerophytic scrub zone, extending down as far as the 2,100 m elevation, is characterized by the presence of *Styphelia douglasii, Vaccinium peleanum* and *Coprosma* spp. in addition to the higher elevation species. There is some evidence, including the discovery in the course of archaeological investigations of the adze quarry in 1975-76 of the remains of a silversword colony (*Argyroxiphium sandwichensis*) at the 3,475 to 3,658 m elevation, that this zone formerly contained a much richer flora, such as the arborescent Dubautias (Allen 1981:46). Porter (1979b:178-185), in a discussion on the paleoclimatic implications of the latest ice-cap glaciation, suggests that the treeline was depressed to about the 2,000 m (6,560 ft) elevation.

Figure 2.6. Photographs Showing Stone Stripes (top) and Pot-lid Fractures (bottom).

W.D. Alexander's account of his survey trip in 1892 [see below] noted that "The upper limit of the mamane tree is not far from 10,000 feet. The Raillardia, apiipii, extends a thousand feet higher. The beautiful Silver Sword (Argyroximphium), once so abundant is nearly extinct, except in the most rugged and inaccessible localities" (Alexander 1892).

The first systematic study of the flora at Lake Waiau was made by the1935 Hawaiian Academy of Science Expedition. Constance Hartt and Marie Neal, the expedition botanists, described their findings in two publications:

> Near the lake a fenced area about forty paces square showed what might result by protection from wild and tame grazing animals. It enclosed approximately 800 plants, most chickweed, grasses, dandelion, and sorrel. Three tiny planted pine trees were merely existing (Neal 1939:7).

> More species of plants were found in Waiau Crater than elsewhere in the summit area, probably because that is the chief destination of pack animals and because of the moisture from melting snow. In addition to the fern and grass just named, the following plants were found near Lake Waiau upon a rocky terrain: *Stellaria media*, *Cirsium vulgatum*, *Erigeron linifolus*, *Taraxacum officinale*, *Poa annua*, and *P. pratensis* (Hartt and Neal 1940:256-257).

> A census was taken of the plants in the area enclosed by a fence (fig. 21), located in the crater of Lake Waiau. The enclosure was 46 by 43 paces. No planted trees labeled *Juniperus* or *Picea* were found alive; three living specimens of *Pinus contorta* were found, all very short (6 to 8 inches in height) (Hartt and Neal 1940: 257-258).

A fossil diatom flora has been found in the bottom sediments (Massey 1978).

2.1.5 Hydrology

Lake Waiau (see Figures 1.2 and 2.7), the only permanent body of water on the summit plateau and one of the few lakes in Hawai`i (Maciolek 1982), is located in a glacially scoured cinder cone named Pu`u Waiau (Woodcock 1980). Two intermittent streams, Pōhakuloa Gulch and Waikahalulu Gulch, originate in the environs of the lake. The highly dissected landscape on the south leeward slope of Mauna Kea (see Figure 2.1) is due in large part to the retreat (melting) of the Waihu and Makanaka glaciers rather than modern stream flow. The effects of the hydrological regime on the local topography and reasons for the absence of permanent streams are described by Wentworth and Powers:

> Despite the fact that that the average slope approaches 40 per cent in many places, erosion by running water has been feeble in consequence of the extremely porous character of the cinder and lava surfaces and the relatively light precipitation occurring at the higher levels. Stream channels more than 25 to 50 feet deep, or wider than small ravines, are uncommon. The deepest of these radial valleys are Pohakuloa, Waikahalulu, and Hanipoe gulches on the southwest, south, and north, respectively (Wentworth and Powers 1941:1198).

> Only one flowing stream was observed above 7,000 feet by the writers in July, 1939, namely the west branch of Pohakuloa Gulch for a short distance above the 10,000-foot level. Here a water table, very likely of the perched type, is held up by a bed of early glacial drift and gives rise to a flow of small volume where the channel is cut through overlying lavas...Nevertheless, abundant freshly scoured

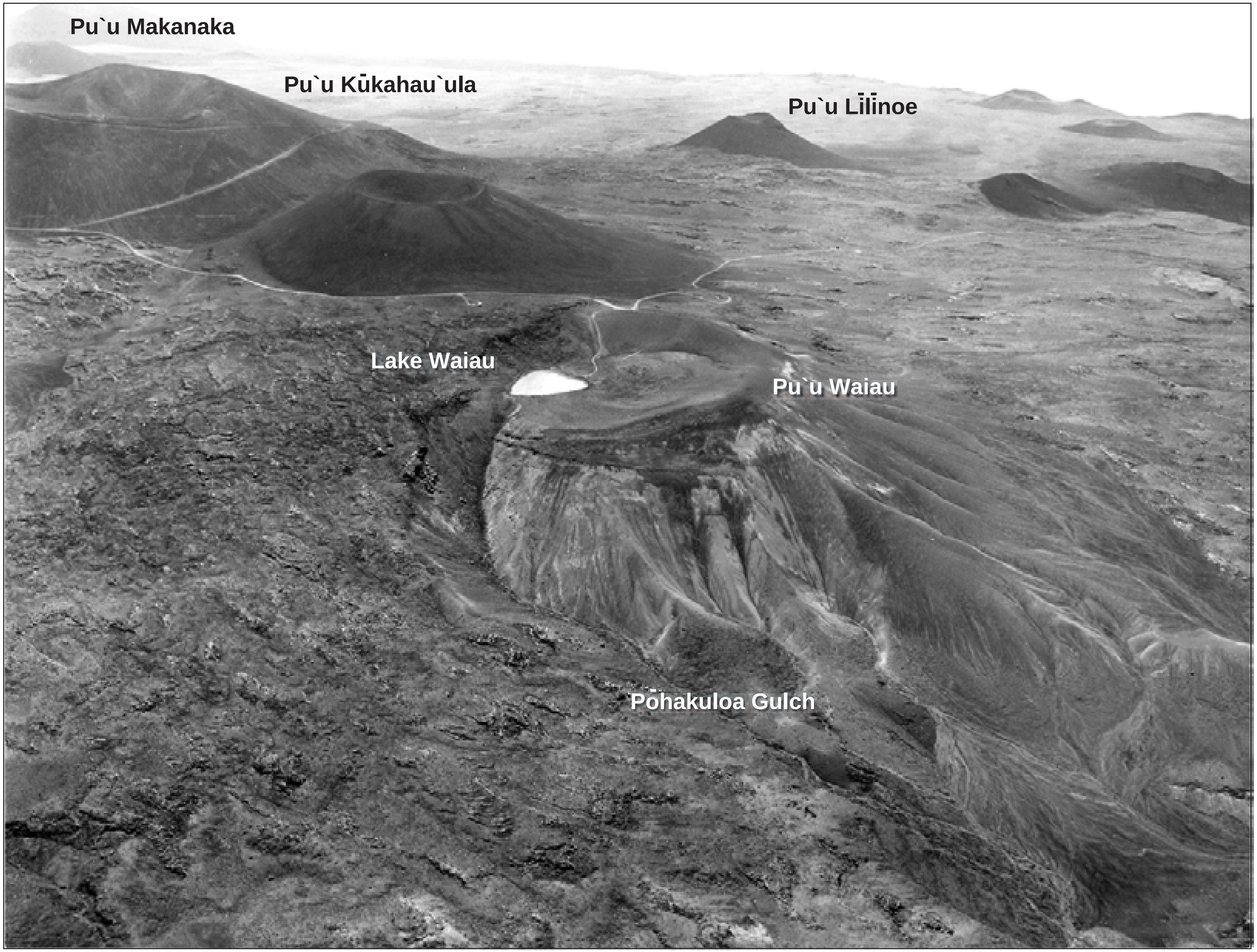

Figure 2.7. Aerial View of Lake Waiau and Surrounding Landscape.

> potholes and rock channels are found throughout most of the gulches (Pl. 3, Fig. 1), indicating effective stream flow and scour presumably when the snowcap of the summit area melts. The character of these channels throws light on the former glaciation of Mauna Kea. Stream scour, effective even now, must have been much greater during melting of the icecap when stream flow was able to carry boulders up to 6 feet in size far beyond the ice margin (Wentworth and Powers 1941:1198-1199).

The most detailed study of the springs and seeps was undertaken by Wentworth and Powers, in 1937 and 1939. Their research, primarily in the area they called the Waihu branch of Pōhakuloa Valley [this gulch is the one that contains Hopukani, Waihu, and Liloe Springs], led them to conclude that the ground water supplying the springs is perched in and on top of permeable glacial drift deposits, some of which are buried under later lava flows (Wentworth and Powers 1943:543). Stearns (1945:274) questioned the glacial origin of the springs based on his reinterpretation of the glacial stratigraphy of Mauna Kea in the type localities in Pōhakuloa and Waikahalulu gulches. The glacial thesis appears to be correct, however, based on evidence collected by Porter regarding the origin of Lake Waiau and, thus, probably all of the freshwater lenses at higher elevations on Mauna Kea.

There are a number of different theories concerning the geologic origin of the lake. One of the first was advanced by Gregory and Wentworth who recognized that the interior of Pu`u Waiau was not an ordinary crater and that the lake may have been created by the retention of glacial ice:

> Lake Waiau lies in the bowl of Puu Waiau—a cone built chiefly of fine-grained and much-weathered cinders and ash. On its north side, the cone is breached and thus forms an outlet for the lake at high water stages. As the average depth of the lake when full of water is about 15 feet and the muck at its bottom as much as 8 feet, the floor of its basin lies 23 feet below the lowest part of its rim. In superficial view, Waiau has the appearance of an ordinary crater, but striae directed toward the basin from the northeast, morainal deposits high up on its southern slope, and scour marks on its outlet bar, show that it was occupied by glacial ice. It seems probable that ice to a depth of 100 feet or more was forced into the basin and after a temporary halt was forced to join the larger ice tongues moving down Pohakuloa Gulch. Scouring by the ice doubtless deepened the original basin, and it may be that some ice remained after the glaciers disappeared. The possibility is suggested that downward seepage of lake water is impeded not only by fine-grained ash and organic material but also by ground ice that probably forms each year (Gregory and Wentworth 1937:1736).

Stephen Porter summarized earlier interpretations and offered his own views regarding the origins of the lake:

> Gregory and Wentworth (1937) suggested that water is retained in the basin because downward percolation is impeded not only be fine-grained ash and organic matter but also by ground ice. The discovery of permafrost in the crater of Summit Cone (Woodcock, 1974) and its probable existence in Douglas Cone and Goodrich Cone (A.J. Woodcock, 1971, personal communication.) has enhanced the hypothesis that impermeable ground ice may be responsible for Lake Waiau. However, lakes are not present in the craters of cones where permafrost has been found. The crater floor of Puu Waiau lies at the top of the hyaloclastite core of the cone and probably has been somewhat deepened by ice scour, as inferred by Gregory and Wentworth (1937), whereas the crater floor of Summit Cone lies above the seismic discontinuity that may represent the upper

> limit of a hyaloclastite core. Consequently, the presence of water in the closed crater basin of Puu Waiau and its absence in the similarly closed crater of Summit Cone suggest that the relatively impermeable hyaloclastite, rather than permafrost, is the primary reason for the lake (Porter 1979c:1039).

Edward Wolfe and his colleagues, who carried out geological investigations at a later date, agree that reduced permeability explains the retention of water in the lake but for reasons different from those offered by Porter:

> The ice-contact flow that originates at the base of Puu Hau Kea buried the north rim of Puu Waiau. A small lobe of this flow extended into the crater, where an isolated remnant now occurs, along with Makanaka drift, on the south side of Lake Waiau (Wolfe et al. 1997:52).

> In both cones, the alteration products weakly cemented the pryoclasts and reduced the permeability of warm water or steam through the cone during or soon after its eruption. Because of reduced permeability, such cones are more susceptible to gullying; water runs of instead of percolating downward. The reduced permeability also apparently accounts for retention of water to form a small permanent lake (Lake Waiau) within the crater of Puu Waiau (Wolfe et al. 1997:51).

Pu`u Waiau is one of the most eroded cones in the summit region (see Figure 2.7) Gregory and Wentworth (1937:1734) noted that:

> Headway cutting by the Pohakuloa stream, which at times of spring melting must carry considerable volumes of water, has reached to within about 100 feet of the margin of Lake Waiau. Blocks of basalt of many tons weight have broken off and tumbled down the steep channel side, probably to be shoved a bit farther by the stream torrent at its occasional maximum.

The depth of the lake sediments was determined in 1966 to be more than 7.5 m based on a probe using a steel rod. Two radiocarbon dates were obtained at this time from the upper 2.0 m of lake sediments from one of two cores collected in 1966 (Pow-Foong Fan 1978:219). At one meter the deposit dated to 2,270 +/- 500 years (Sample W-1834) and at 2.0 m, 7,160 +/- 500 years (Sample W-1833) (Woodcock et al. 1966:647). Radiocarbon dating of organic material from cores indicates that sediments began accumulating in the lake basin between roughly 13,000 and 14,000 years ago (Dorn et al. 1991:460).

The springs in the Pōhakuloa Gulch area are briefly mentioned in two accounts of expeditions to the summit of Mauna Kea. The first was made by W.D. Alexander who wrote, "A spring on the southern side of the mountain, called ‘Wai Hu’, is believed by the natives to be connected to this lake" (Alexander 1892). The second reference is in an amusing story of the experiences of a Sol. N. Sheridan in an article illustrated by the well-known photographer, Alonzo Gartley:

> Afterwards, when we had had the coldest drink in these islands, from a mountain spring at an elevation of 10,500 feet that is probably seepage from the Crater Lake [Lake Waiau], Rawhide Ben [the nickname of Eben Low] and the Secretary went off to shoot wild bullocks, leaving the balance of us hanging in the air on a pinnacle just above the forest line, to which we had descended by a series of long slides (Anonymous 1911:410).

The spring referred to in this account is in all probability Hopukani which is located at the 10,400 ft elevation and is the largest of the springs in the Pōhakuloa Gulch area (see Figure 1.1; cf. also Woodcock 1980: Fig. 5).

2.1.6 The "Effective Environment"

On current evidence the "effective environment" of the summit region, defined as the ecosystem that humans both adapt to and influence (Smith and Winterhalder 1981:8), has been since the end of the last ice age an alpine desert ecosystem. The biogeoclimatic characteristics common to most high-altitude environments (cf. Winterhalder and Thomas 1978:32; Thomas 1979:146-147; Billings 1979:119; Allen 1981:37), including the Mauna Kea summit region, are the following:

(1) reduced partial pressure of oxygen and carbon dioxide, low absolute vapor pressure, and high background radiation;

(2) rugged topography and poorly developed soils;

(3) low temperature with pronounced diurnal variation and frequent frosts, which can occur in any season;

(4) low and irregular monthly distribution of precipitation occurring in various forms (rain, hail, sleet and snow), periodic droughts; and

(5) extreme biotic impoverishment.

What are believed to have been the primary environmental constraints on life and work in this region and the adze quarry in particular are summarized below:

> For humans, it is a particularly difficult environment in which to work and live because of the physiological effects of high altitude (Van Wie 1974), low temperatures and biotic impoverishment (McCoy 1990:91).
>
> The quarry environment is above all else a 'non-subsistence' environment, incapable of supporting a population of any size for any length of time without the introduction of food, clothing, and firewood. The only sources of fuel above treeline are the few arborescent plants and silverswords (Westervelt 1902:15) which would have been hardly adequate or sufficient in terms of the amount of heat they give off and their long-term availability. The biotic environment is an undependable resource and in fact the only subsistence requirement that this environment afforded in any abundance were the margins of lava flows that could be utilised as shelters (McCoy 1990:91-92).

2.2 TRADITIONAL CULTURE-HISTORIC CONTEXT

Much of what is known concerning the traditional culture history of the summit region of Mauna Kea was summarized by Holly McEldowney in a 1982 report, based on a review of early journal accounts and maps, ethnographic collections, and the Boundary Commission Book for Hawai'i (McEldowney 1982). More recent research by Kepa Maly (1998, 1999) and Charles Langlas (Langlas et al. 1997; Langlas 1999), both of whom have conducted oral interviews in addition to archival research, have provided additional information on the traditions associated with Mauna Kea and its cultural and spiritual significance for Hawaiians today. A major compilation of native traditions, historical accounts and oral history interviews on Mauna Kea and surrounding lands can be found in a study entitled "Mauna Kea—Ka Piko Kaulana o Ka `Aina (Mauna Kea—the Famous

Summit of the Land) by Maly and Maly (2005) that was commissioned by OMKM. The overview that follows is based on these studies which should be consulted for more detailed information.

2.2.1 Socio-political Context

The summit of Mauna Kea is located in an *ahupua`a* (a territorial unit generally equated with the community) called Ka`ohe in the Hāmākua District (Figure 2.8). Ka`ohe is perhaps the classic example of the unusually large *ahupua`a* found in what Lyons referred to as the "almost worthless wastes of interior Hawaii" in the following account:

> Then there are the large ahupuaas which are wider in the open country than the others, and on entering the woods expand laterally so as to cut off the smaller ones, and extend toward the mountain till they emerge into the open interior country; not however to converge to a point at the tops of the respective mountains. Only a rare few reach those elevations, sweeping past the upper ends of all the others, and by virtue of some privilege in bird-catching, or some analogous right, taking the whole mountain to themselves...The whole main body of Mauna Kea belongs to one land from Hamakua, viz., Kaohe, to whose owners belonged the sole privilege of capturing the *ua`u*, a mountain-inhabiting but sea-fishing bird.
>
> These same lands generally had the more extended sea privileges. While the smaller ahupuaas had to content themselves with the immediate shore fishery extending out not further than a man could touch bottom with his toes, the larger ones swept around outside of these, taking to themselves the main fisheries much in the same way as that in which the forests were appropriated. Concerning the latter, it should here be remarked that it was by virtue of some valuable product of said forests that the extension of territory took place. For instance, out of a dozen lands, only one possessed the right to *kalai wa`a*, hew out canoes from the koa forest. Another land embraced the *wauke* and *olona* grounds, the former for kapa, the latter for fish-line (Lyons 1875:111).

The boundaries of Ka`ohe, as shown on modern maps, are open to question. A map of the adjoining *ahupua'a* of Humu`ula made by S.C. Wiltse in 1862 (Register Map No. 668) included the adze quarry and Lake Waiau, which was labeled on the map as "Pond Poliahu" (Figure 2.9). Maly and Maly note that "By the time the Commissioners of Boundaries were authorized to certify the boundaries for lands brought before them in 1874, disputes over the boundary of Humu`ula and Ka`ohe had arisen" and "by the time of settlement in 1891, the boundary of Humu`ula was taken down to around the 9,000 foot elevation, with Ka`ohe taking in the entire summit region" (Maly and Maly 2005:280). The testimony of Kahue of Humu`ula, presented in Maly and Maly (2005:287), mentions the boundary running from a gulch called Kahawai Koikapue, where mele were sung, to Waiau and then to the summit which was called Pu`uokūkahau`ula. In parentheses there is a notation that "half of the water in the gulch belonging to Ka`ohe and half to Humu`ula".

The name of the gulch does not appear on any known maps, but in all probability is what is now called Pōhakuloa Gulch, since this is not only the major gulch below the

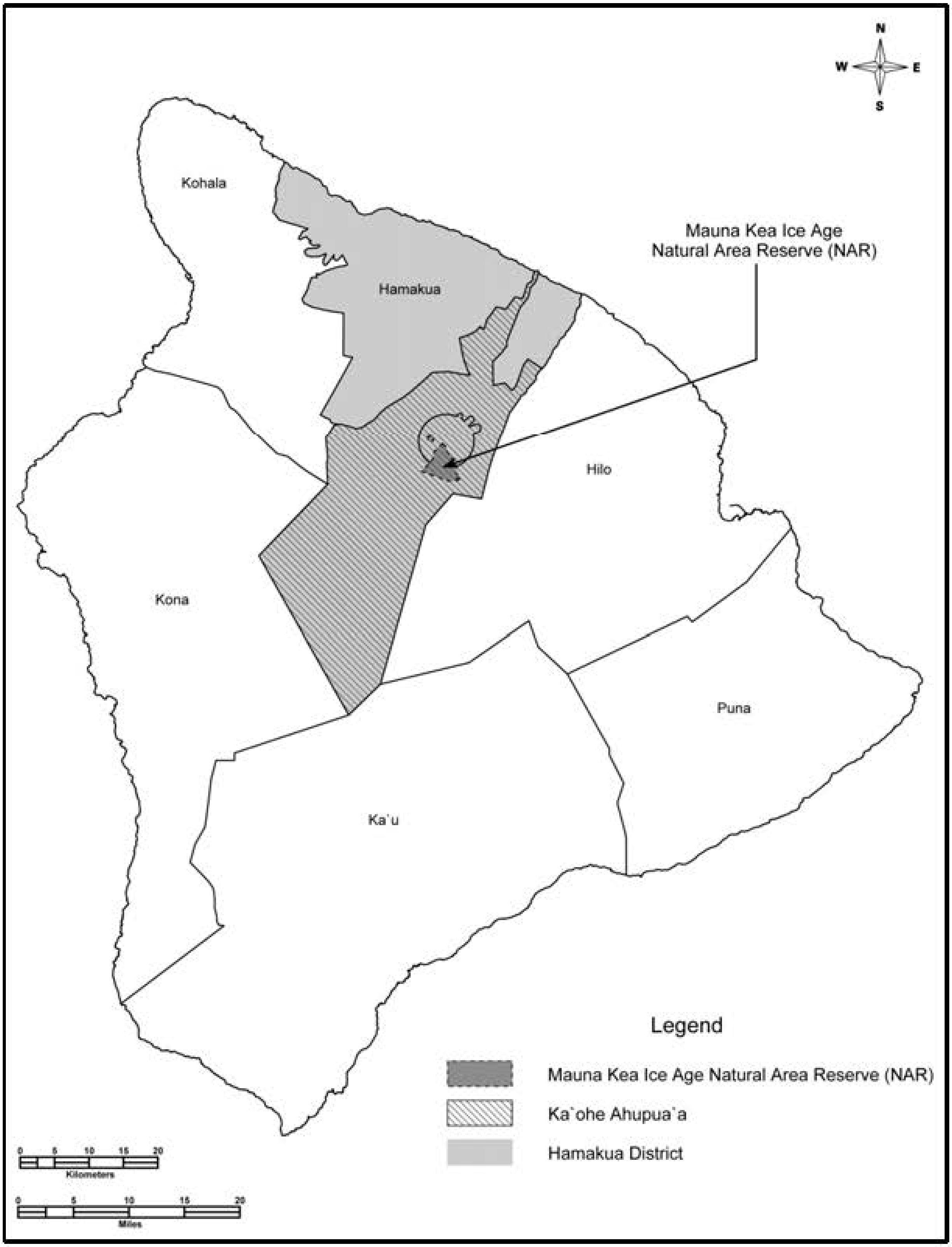

Figure 2.8 Socio-Political Map of the Island of Hawai`i Showing the Location of the Project Area in Ka`ohe Ahupua`a, Hāmakuā District

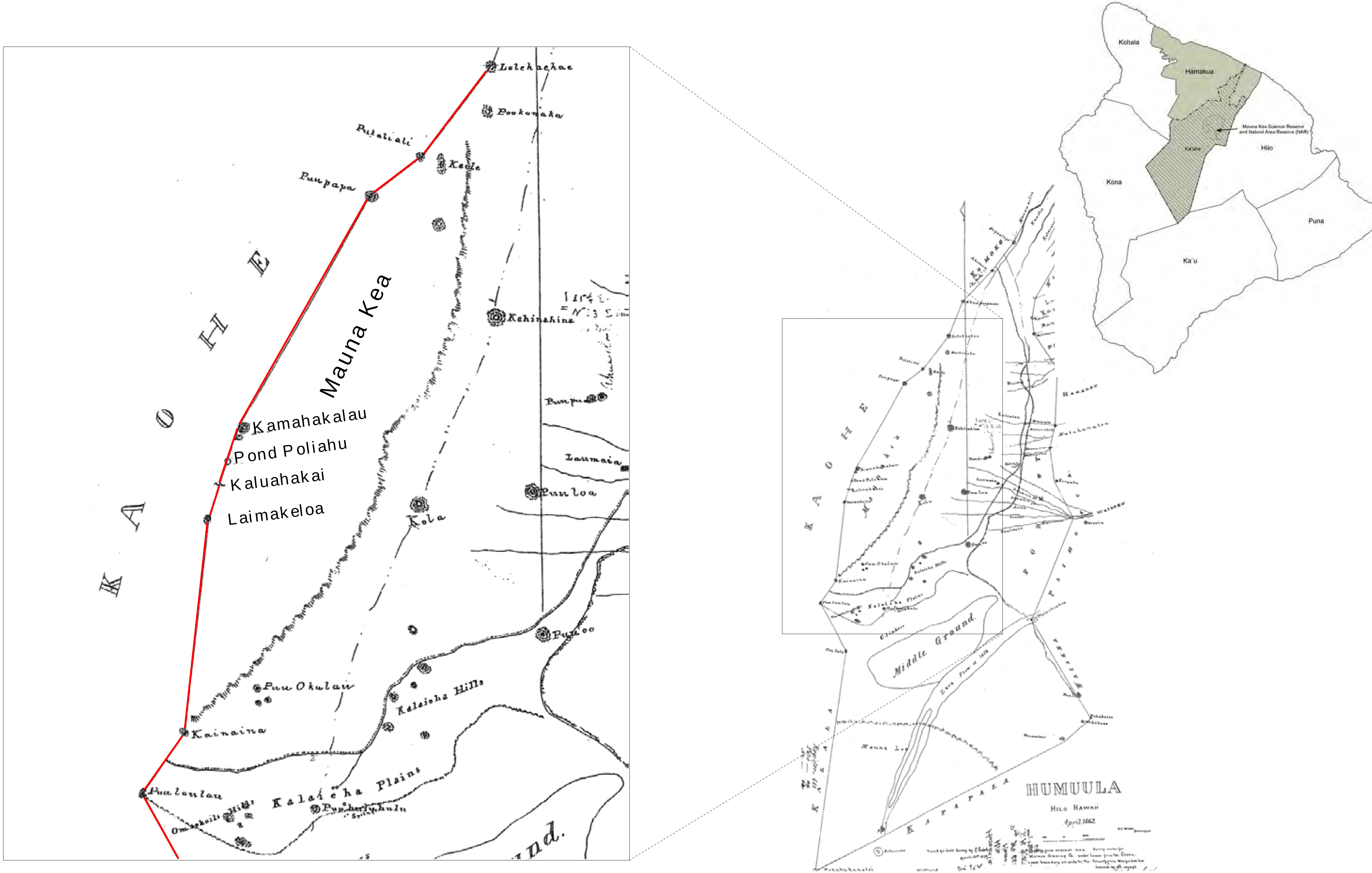

Figure 2.9. 1862 Wiltse Map Showing Boundary of Kaohe. Register Map No. 668, the Land of Humuula (S.C. Wiltse, April 1862). (Modified from Kumu Pono Associates LLC 2005:281).

lake but the only one on the south side of the mountain that is described in historic and modern times as containing running water. The reference to Waiau is presumably to the cinder cone, rather than the lake which according to the name on the 1862 Wiltse map was associated with the goddess Poli`ahu, although Waiki [or Haiki], a contemporary of Kahue, claimed the lake was called Waiau.

Waiki, who gave testimony at the same time as Kahue (McEldowney 1982:1.7), claimed that Kaluakaakoi, "the cave where they used to get stone adzes out" was in Ka`ohe as was Poliahu, which he described as a cave where Līlīnoe used to live (Maly and Maly 2005:291).

> They told me Kaohe bounded Humuula from Pohakuhanalei down Mauna Loa, on the Kona side. I never heard my parents say that Kaalaala joined Humuula. The pond of water called Waiau is on Kaohe and not on Humuula. My parents told me Humuula went to Kaluakaakoi and Poliahu. We used to go there after adzes for the Humuula people (Maly and Maly 2005:292).

In addition to the district and ahupua`a system of land tenure, there were other traditional land classifications, including one that employed the term *wao* for a series of natural and cultural zones (Malo 1951:16-18). According to some descriptions the *wao kanaka* was a low-lying coastal area where the *maka`āinana* were free to move and inhabit. The *wao kele* was the upland forested area that the *maka`āinana* could only access for gathering purposes. The *wao akua*, which was believed to be inhabited by *akua*, was the subalpine desert region above the tree line. The *maka`āinana* were hesitant to venture into the *wao akua* and could do so only by offering prayer and displaying great respect (NASA 2005:3-18, 3-19).

The Mauna Kea summit region is commonly described today as lying within the *wao akua,* which is different, however, from Malo's description of this zone which placed it at a lower elevation in forested lands (Malo 1951:17). As noted in the footnotes to Malo's *Hawaiian Antiquities* (Malo 1951:18), *wao akua* can also be understood to mean "a remote desolate location where spirits, benevolent or malevolent, lived and people did not live. Usually these places were deep interior regions, inhospitable places such as high mountains, deserts and deep jungles. These areas were not necessarily *kapu* but were places generally avoided out of fear or respect" (PHRI 1999:24). Indeed, when Rev. William Ellis toured the island in 1823, he noted the reluctance of native Hawaiians to venture into the summit areas of Mauna Kea.

> …numerous fabulous tales relative to its being the abode of the gods, and none ever approach the summit---as, they say, some who have gone there have been turned to stone. We do not know that any have been frozen to death; but neither Mr. Goodrich, nor Dr. Blatchely and his companion, could persuade the natives, whom they engaged as guides up the side of the mountain, to go near its summit (Ellis 1979:292).

Today, the *ahupua`a* system of land and resource management, with *kapu* restrictions, is no longer in existence legally, due to the collapse of the *ali`i – maka`āinana* social and cultural system. Still, knowledge of the some traditional *kapu* restrictions endures, although both traditional and contemporary cultural practices and belief are apparent. One cultural practitioner, Pualani Kanaka`ole Kanahele reveals traditional knowledge of *kapu* restrictions and her traditional cultural practice regarding entering *kapu* areas. She learned from her *kūpuna* that the forested regions are not the realm of humans; instead, the forest's *kupa* (citizens) are the trees. Kanahele says that "when I go *maha`oi* [intrude] in their realm, I have to ask permission to be up there"

(Maly 1999:A-371). In a similar sense, Irene Loeyland Lindsey-Fergerstrom reveals, in the context of taking *piko* up to the Mauna Kea summit, that her *tūtū* (grandmother) had knowledge of the *kapu* restriction that only *ali`i* were permitted on the summit. Yet, Lindsey-Fergerstrom's *tūtū* instructed her to take her family's *piko* to the summit anyways, saying "it's not like we going be *ali`i*, but at least you can try…" (Maly 1999:A-390).

2.2.2 Land Uses

On present evidence the slopes of Mauna Kea, above the limits of agriculture and permanent settlement, were a vast montane "wilderness" probably known to only a small number of Hawaiians engaged in primarily "special purpose" activities, such as bird-catching, canoe making, stone-tool manufacture, or burial of the dead (McEldowney 1982). Ethnographic information relating to a specific locality in this and other mountainous regions in Hawai'i is either sketchy, or, as is more frequently the case, lacking altogether.

Little is known ethnographically about the uses of the alpine and sub-alpine zones on Mauna Kea except for brief accounts about adze manufacture and burials. Most of what is known regarding traditional land uses is the result of archaeological investigations undertaken since the mid-1970s.

2.2.3 Myths, Legends, and Traditional Histories

Native Hawaiian traditions state that ancestral *akua* (gods, goddesses, deities) reside within the summit area. These personages are embodied within the Mauna Kea landscape – they are believed to be physically manifested in earthly form as various *pu`u* and as the waters of Waiau. Because these *akua* are connected to the Mauna Kea landscape in Hawaiian genealogies, and because elders and *akua* are revered and looked to for spiritual guidance in Hawaiian culture, Mauna Kea is considered a sacred place.

Native Hawaiian genealogical *mele* (poems, chants) explain the centrality of Mauna Kea within Hawaiian genealogy and cultural geography. *Mele* recount that as a result of the union of Papa and Wākea, who are considered the ancestors of Native Hawaiians, the island of Hawai`i was birthed. In the *Mele a Paku`i*, a chant describing the formation of the earth, Mauna Kea is likened as the first-born of the island children of Papa and Wākea, who also gave rise to Hāloa, the first man from whom all Hawaiians are descended (Kamakau 1991:126 in Maly and Maly 2005:7-8). A *mele hānau* (birth chant) for Kamehameha III, who was born in 1814, describes the origins of Mauna Kea:

> *Born of Kea was the mountain,*
> *The mountain of Kea budded forth.*
> *Wākea was the husband, Papa*
> *Walinu`u was the wife,*
> *Born was Ho`ohoku, a daughter,*
> *Born was Hāloa, a chief,*
> *Born was the mountain, a mountain-son of Kea*
> (Pukui and Korn 1973:13-28 in Maly and Maly 2005:9).

Some contemporary Native Hawaiian cultural practitioners continue to view Mauna Kea as a first-born child of Papa and Wākea, and thus, the mountain is revered as "the *hiapo*, the respected older sibling of all Native Hawaiians" (Kanahele and Kanahele 1997 in Langlas 1999:7). Cultural practitioner Kealoha Piscotta explains that this link to Papa and Wākea "is the connection to our ancestral ties of creation" (Orr

2004:61). Pualani Kanaka`ole Kanahele states that “the very fact that it is the ‘Mauna a Wākea’ tells you that it is the *mauna* that is meeting Wākea” (Maly 1999:A-368).

Traditional genealogical *mele* (poems, chants) and *mo`olelo* (stories, traditions) recount associations between Mauna Kea and the following *akua* – Poli`ahu, Līlīnoe, Waiau, and Kahoupakane. In a *mo`olelo* recounting the travels of Pūpū-kani-`oe, it was said that Mauna Kea was a mountain “on which dwell the women who wear the *kapa hau* (snow garments)” (Maly and Maly 2005:31). Yet another *mo`olelo*, which dates to the 1300s, explains that Ka-Miki was sent atop Mauna Kea’s summit to the royal compound of Poli`ahu, Līlīnoe, and their ward, Ka-piko-o-Waiau, to fetch water for use in an *`ai-lolo* ceremony (Maly and Maly 2005:42-43).

In the post-Contact period, Native Hawaiian historian S.N. Haleole transcribed *Ka Mo`olelo o Laiekawai* in 1844, which tells that after Poli`ahu broke her engagement to Aiwohikupua, she took up residence on Mauna Kea along with her three maidens Līlīnoe, Waiaie (Waiau), and Kahoupakane (Maly and Maly 2005:20-26). As well, other 19th century ethnographers published on the associations between Mauna Kea and Poli`ahu, Līlīnoe, and Waiau.  W.D. Westervelt claimed that Poli`ahu, Līlīnoe, and Waiau were snow goddesses “who embodied the mythical ideas of spirits carrying on eternal warfare between heat and cold, fire and frost, burning lava and stony ice” (Westervelt 1963:55-56). Westervelt, who viewed Poli`ahu as the rival of the fire-goddess, Pele, said that she battled Pele on numerous occasions, and credits her with having “kept the upper part of the mountain desolate under her mantle of snow and ice” (Westervelt 1963:62).

In 1931, Emma Ahu`ena Taylor, a historian of Hawaiian descent and with genealogical ties to the lands of Waimea and Mauna Kea, reported on Poli`ahu’s residence at Mauna Kea, but also described the creation of Lake Wai`au. She wrote:

> Poliahu, the snow-goddess of Mauna-kea, was reared and lived like the daughter of an ancient chief of Hawaii. She was restricted to the mountain Mauna-kea by her godfather Kane. She had a nurse Lihau who never left her for a moment. Kane created a silvery swimming pool for his daughter at the top of Mauna-kea. The pool was named Wai-au. The father placed a supernatural guard [Mo`o-i-nanea] at that swimming pool so that Poliahu could play at leisure without danger of being seen by a man… (Maly and Maly 2005:53).

According to Taylor, on Mauna Kea, Poli`ahu’s attendants – Līlīnoe, Lihau, and Kipu`upu`u drove away her suitor, Kūkahau`ula (the pink-tinted snow god). But Mo`o-i-nanea allowed the snow god to embrace Poli`ahu, and to this day, Taylor reports, “Ku-kahau-ula, the pink snow god, and Poli`ahu of the snow white bosom, may be seen embracing on Mauna-kea” (Maly and Maly 2005:53).

In modern-day accounts, Poli`ahu continues to be commonly referred to as “the beautiful snow goddess of Mauna Kea” while Līlīnoe is called “a goddess of the mists and younger sister of the more famous Poliahu” (Pukui and Elbert 1971:392, 396). Langlas reports that Pualani Kanaka`ole Kanahele told him that three *pu`u*—Poli`ahu, Līlīnoe, and Wai`au, were sister goddesses who are female forms of water and that all three of the cinder cones or *pu`u* that bear their names are important religious sites (Langlas 1999). McEldowney (1982:1.3-1.4) recounts that Fornander included Līlīnoe as a person in his genealogies and legends, including a reference to her as the “wife of Nu`u, the “Noah”, of the discredited Hawai`i Loa legend involving a great flood. McEldowney (1982:1.4) noted that Kamakau called Līlīnoe “the woman of the mountains" and named her as ancestress of Pae, a *kahuna* of Umi's time (Kamakau 1961:215)."

There are several myths concerning Poli`ahu and Līlīnoe. W.D. Westervelt claimed that Poli`ahu was one of four snow goddesses "who embodied the mythical ideas of spirits carrying on eternal warfare between heat and cold, fire and frost, burning lava and stony ice" and who, according to several legends, was the rival of the fire-goddess, Pele (Westervelt 1963:55). Poli`ahu, who battled Pele on numerous occasions, is credited by Westervelt as having "kept the upper part of the mountain desolate under her mantle of snow and ice… (Westervelt 1963:62). Poli`ahu continues to be commonly referred to as the "The beautiful snow goddess of Mauna Kea" (Pukui and Elbert 1971:396). Kealoha Piscotta also retains knowledge that Mo`o Ina`ne`a was the guardian for Poli`ahu and Līlīnoe (Orr 2004:51).

Today, in regards to Lake Waiau, cultural practitioner Pualani Kanaka`ole Kanahele believes that because the waters of Waiau have not "had a chance to come down to the rest of us, then it is sacred water…that water, Waiau, is the most sacred because it isn't the water that has been spilled, it is still up there in the realm of Wākea" and in her estimation, "water is the source of life" (Maly 1999:A-368, A-370). Kealoha Piscotta believes the cultural significance of Lake Waiau rests in several facts - the Kūmulipo creation chant describes a lake that resides in the heavens, the ancient trails meet at the lake, the lake is a navigational gourd, and it is a jumping off point for ancient Hawaiian souls (Orr 2004:44-45).

While there are a number of myths and legends associated with the summit area of Mauna Kea, the higher elevation areas of the mountain do not figure prominently in Hawaiian traditional histories, which McEldowney points out:

> …revolve mainly around the lives and exploits of prominent chiefs, as passed down through genealogies, chants, and stories, and recorded primarily in works by Fornander an Kamakau (Barrere 1962:62-63. No major events from these histories occur within the summit plateau of Mauna Kea (McEldowney 1982:1.4).

The origins of Mauna Kea and its central place in Hawaiian genealogy and cultural geography are told in myths and chants. Pualani Kanaka`ole Kanahele and her deceased husband, Edward Kanahele, who were interviewed by Dr. Charles Langlas for the Hawaii Defense Access Road and Saddle Road Improvement Project in 1998, referred to two chants, Mele a Paku`i and `O Hānau ka Mauna a Wakea. These chants:

> describe, respectively, the birth of Hawai`i island from the union of Papa and Wakea, the ancestors of Native Hawaiians, and the birth and "budding upward" of Mauna Kea a mountain named for Wakea. As the firstborn of Papa and Wakea, Hawai`i island is the <u>hiapo</u>, the respected older sibling of all Native Hawaiians. The mountain of Mauna Kea is the <u>piko</u> or origin point for the island, more specifically for its northern half, and therefore is a place of great <u>mana</u>. Because of the mana of the mountain and of Lake Wai`au at its summit, Queen Emma went there to bathe in the water in 1874 (Langlas 1999:7).

The second goddess of Mauna Kea is Līlīnoe, who according to Pukui and Elbert (1971:392) was "a goddess of the mists and younger sister of the more famous Poliahu." Westervelt claimed that Līlīnoe was another of the four snow goddesses. McEldowney (1982:1.3-1.4) recounts that Fornander included Līlīnoe as a person in his genealogies and legends, including a reference to her as the "wife of Nu`u, the "Noah", of the discredited Hawai`i Loa legend involving a great flood. McEldowney (1982:1.4) noted that “Kamakau called Lilinoe “the woman of the mountains” and named her as ancestress of Pae, a *kahuna* of Umi’s time” (Kamakau 1961:215).

Waiau is also mentioned as a goddess in several legends. Westervelt wrote that she was another of the snow-goddesses or maidens, as he sometimes referred to them (Westervelt 1963:56). Langlas reports that Pua Kanahele told him that three *pu`u*—Poli`ahu, Līlīnoe, and Wai`au, were sister goddesses who are female forms of water and that all three of the cinder cones or *pu`u* that bear their names are important religious sites.

While there are a number of myths and legends associated with the summit area of Mauna Kea, the higher elevation areas of the mountain do not figure prominently in Hawaiian traditional histories, which McEldowney points out:

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2.2.4 Mortuary Practices

There are numerous references to human burials on the high elevation northern and eastern slopes of Mauna Kea (see discussion in McEldowney 1982). The practice of burying the dead in remote, high elevation areas may have been a common practice, based on the information collected by Thomas Thrum for Haleakala on Maui:

> The use of the craters within Haleakala as burial places, far removed from places of habitation, is quite in keeping with ancient Hawaiian practice. Distances and difficulties were no bar to faithful execution in carrying out the instruction of a dying relative or friend (Thrum 1921:258).

One reason, but undoubtedly not the only one, for taking the dead to remote areas was the fear that the bones might be used to make fishhooks. A person named Nainoa gave such an explanation in testimony before the Boundary Commission:

> In old times, if anyone died, could not wail, but people come and steal shin bones for fishhooks, so used to carry body secretly and bury in mountains (quoted in McEldowney 1982:1.9).

There are a couple of early accounts of burials having been found in the general vicinity of Pu`u Līlīnoe. E.D. Preston’s account of his work at Lake Waiau, in 1892, noted that “At an elevation of nearly 13,000 feet, near Līlīnoe, a burying ground was found, where the ancient chiefs were laid to rest in the red volcanic sand” (Preston 1895:601). W.D. Alexander’s surveying party saw what they interpreted as graves on the top of Pu`u Līlīnoe, also in 1892:

> The same afternoon [July 25, 1892] the surveyors occupied the summit of Lilinoe, a high rocky crater, a mile southeast of the central hills [the ‘summit’] and a little over 13,000 feet in elevation. Here, as at other places on the plateau, ancient graves are to be found. In olden times, it was a common practice of the natives in the surrounding region to carry up the bones of their deceased relatives to the summit plateau for burial (Alexander 1892).

Kamakau indicated that Queen Ka`ahumanu, who like Fornander also considered Līlīnoe a person, made an unsuccessful attempt to recover her bones on Mauna Kea in 1828 (McEldowney 1982:1.4). Kamakau added that the body of Līlīnoe “was said to have lain for more than a thousand years in a well-preserved condition, not even the hair having fallen out” (Kamakau 1961:285). Kamakau’s description of Līlīnoe’s body is probably the source of modern stories about a mummified body having been found on Mauna Kea and removed to some unknown location.

Of the many locations with confirmed and possible burial sites, Pu`u Mākanaka is perhaps the best known. The 1925-26 USGS survey team found human remains on the summit of Pu`u Mākanaka:

> To set up Camp Four at 12,400 feet near Puu Makanaka, we had difficulty finding a small flat area for the tents. Makanaka is the largest and most perfectly formed cone in the summit area, 1,500 feet in diameter at the rim and 300 feet deep, while the base is more than 600 feet below the rim at one point. On the rim I found a partially uncovered grave, eroded by high winds, with an incomplete human skeleton. This was unknown, as far as I could discover, to anyone familiar with the area. The name Puu Makanaka means “Hill crowded with many people” and the grave must have been ancient (Kilmartin 1974:15).

Ed Stevens maintains that “oral history and traditions tell us that…the bones of very special personages were placed in the *pu`u* at or near the summit for safekeeping… they were the special ones” (Maly 1999:C-10, 13). Daniel Kaniho Sr. suggests that “they were all *ali`i*…they were kind of high-ranking people” (Maly 1999:A-169).

2.2.5 Trails and Trail Markers

Not surprisingly, perhaps, scant information exists about ancient trails in the summit area of Mauna Kea. A *mo`olelo* associated with chief Pili-a-Ka`aiaea, and thus dating from the 1300s, recounts the journey of two brothers, Ka-Miki and Maka-iole, who traveled around the island using ancient *ala hele* (trails). Sent up to the Mauna Kea summit, Ka-Miki was guided by the following traveling *mele:*

> *The path goes to the uplands*
> *The path goes to the lowlands*
> *It is a lonely path to the mountain*
> *A damp dreary path*
> *A fire will be the wrap*
> *Warming you along the sacred trail…*
> (Maly and Maly 2005:42)

Kamakau wrote of a battle that ensued between `Umi-a-Liloa and the chief of Hilo in the 1500s, wherein `Umi-a-Liloa and his warriors traveled from Waipi`o to Hilo via Mauna Kea. Kamakau states that “it was shorter to go by way of the mountain to the trail of Poli`ahu and Poli`ahu’s spring at the top of Mauna Kea, and then down toward Hilo. It was an ancient trail used by those of Hāmākua, Kohala, and Waimea to go to Hilo” (Kamakau 1961:16 in Maly and Maly 2005:453). Maly and Maly (2005:454) contend that ancient trail systems across all the mountain lands afforded travel to burial sites and facilitated travel for the collection of resources like adze stone, canoe *koa*, and bird feathers.

The ancient trails were essentially footpaths, which, by the 1840s, proved inadequate for travel with the newly-imported horses, wagons, and wagon team animals associated with cattle ranching and bullock-hunting activities; hence, formal wagon road developments, funded by the Hawaiian Kingdom, ensued in the lowland mountain slope regions (Maly and Maly 2005:454). However, the mountain’s summit region remained accessible only by trails, on foot or horseback. The difficulty of travel on the terrain by horse and on foot is well documented in historical accounts by European visitors and surveying expedition field notes. Formalized road developments continued in the lowlands into the early 20th century, with the CCC (Civilian Conservation Corps) and the U.S. Army Corps of Engineers improving existing roads, such as the Saddle Road, to accommodate vehicular traffic (Maly and Maly 2005:482).

There are two major named trails in the summit region of Mauna Kea, the Mauna Kea-Humu`ula Trail and the Mauna Kea-Umikoa Trail. The better known of the two, is the Humu`ula Trail which apparently began in the Kalaieha area where the Humu`ula Sheep Station is located. The earliest map showing the upper part of the trail was made by W.D. Alexander's survey party in 1892 (Alexander 1892; Preston 1895). The Alexander map and the 1930 edition of the USGS Mauna Kea Quadrangle map show the trail going around the eastern flank of Pu`u Keonehehee and onward up the mountain to Lake Waiau. This alignment closely follows the modern road (Figure 2.10).

An account of the Alexander survey, published in the *Pacific Commercial Advertiser* on September 14, 1892, indicated that the Humu`ula Trail did not pass through the adze quarry and that the site marked on later maps as Keanakako`i was in fact some 100 yards west of the trail:

> The trail next turned to the east, winding around an immense sand crater called "Keonehehee," 11,500 feet in elevation, which stands on the edge of the summit plateau. Further to the southeast we were shown a pillar of stones which was raised to commemorate Queen Emma's journey over the mountain to Waimea in 1883 [1882] (Maly and Maly 2005:183).

The Alexander map of the summit plateau published in Preston (1895:602, Illustration 34) also shows the trail, which is labeled Trail to Kalaieha, cutting across the south and eastern slope of Keonehehee. This indicates that the Queen Emma memorial was southeast of the trail, contrary to Maly's interpretation (Maly and Maly 2005:Figures 8b and 8c) that it is located on the rim of Pu`u Ko`oko`olau, which is in the adze quarry and the middle, rather than edge of the summit plateau (see Figure 2.10). Preston mentions that there was more than one cairn:

> Some interesting pyramids of stones, built to commemorate Queen Emma's visit, were seen on the edge of the plateau, and at elevation of 12,000 feet was found Keanakakoi, a famous quarry opened by the natives many centuries ago for the manufacture of battle axes (Preston 1895:601).

The 1928 Walter E. Wall map of the Island of Hawai`i shows both the Humu`ula and Umikoa trails, neither of which are labeled as such, however. The map shows two other unnamed trails in the summit area. One leads to Pu`u Poliahu from a junction with the old Waimea Road that passed through the area between Mauna Kea and Mauna Loa that is commonly referred to as the "Saddle." The second trail, which is joined to the Pu`u O`o Trail on the eastern side of the mountain, is a straight line path that crosses over the Umikoa Trail and ending at the summit (Figure 2.11).

The 1930 USGS Mauna Kea quadrangle map (Figure 2.12) shows the Humu`ula Trail joining a second trail just below the lake. This trail, which is not named, is labeled on the later USGS maps as the Umikoa Trail. This trail is not mentioned in any early accounts, however. While it may very well have been an ancient trail, the name would appear to be modern and most likely derived from the Umikoa Ranch, where some of

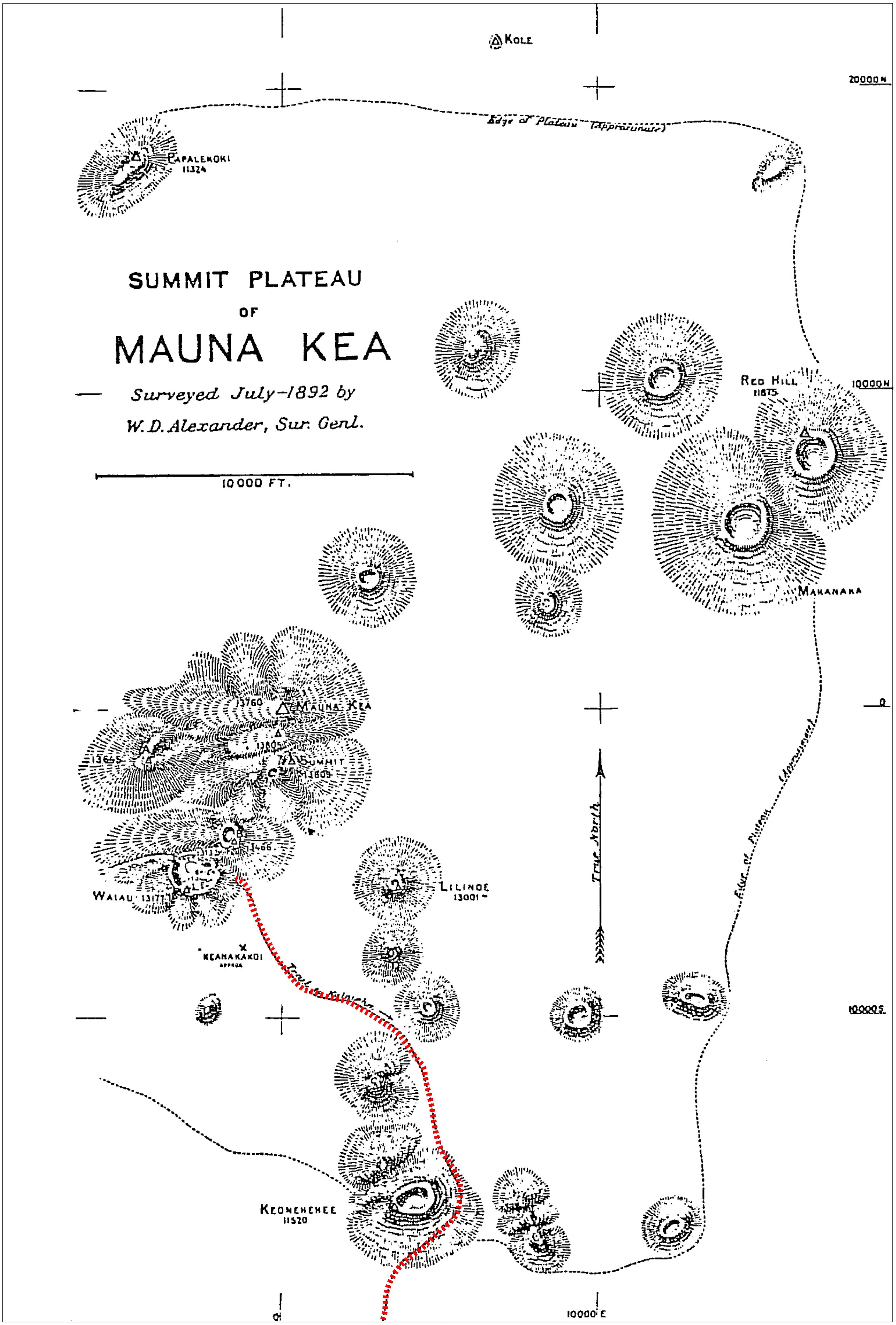


Figure 2.10. 1892 Alexander Map of the Summit Plateau and Alignment of the Humu`ula Trail.

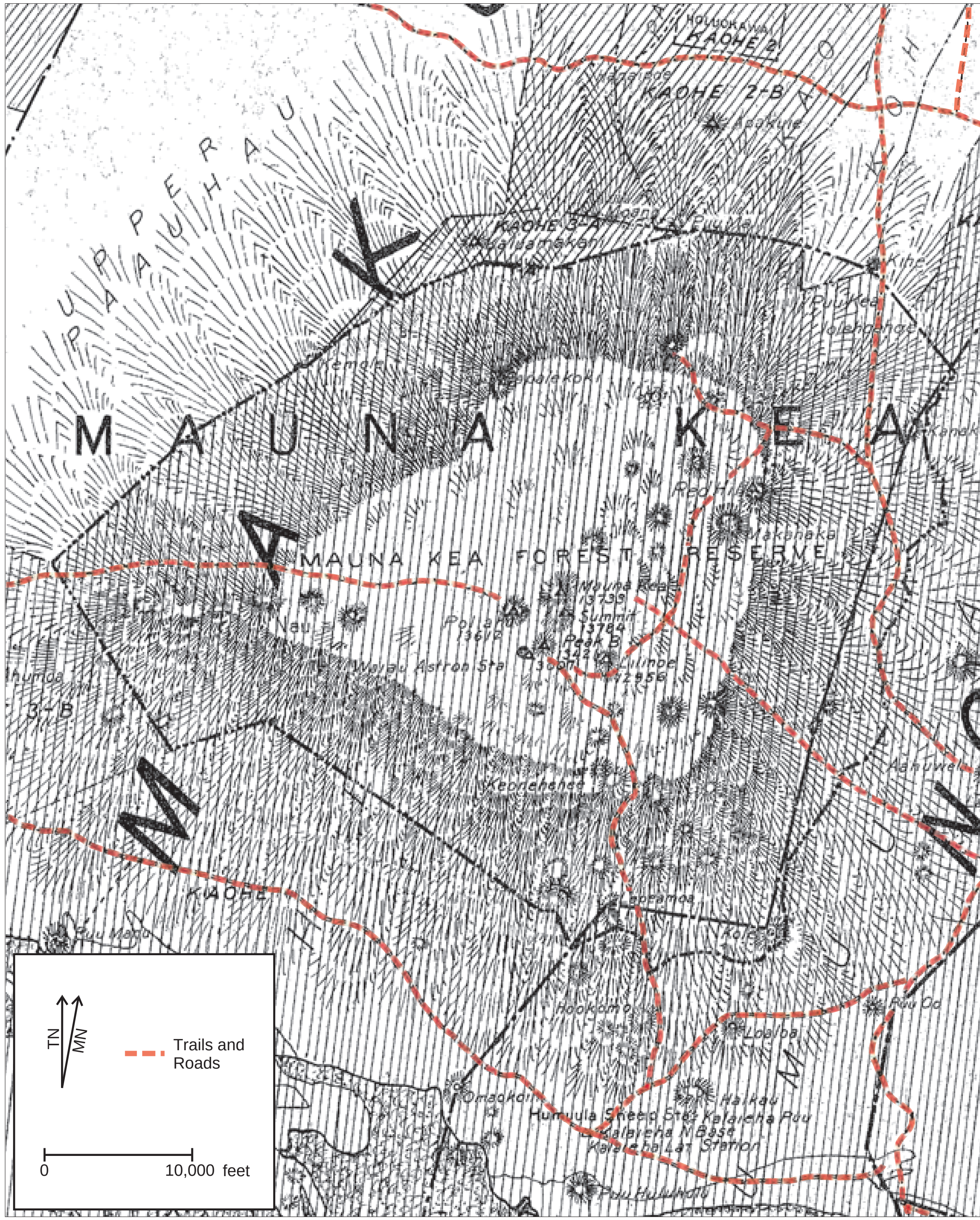


Figure 2.11. 1928 Walter E. Wall Map of the Island of Hawaii Showing Trails and Roads in the Summit Area and Lower Elevations.

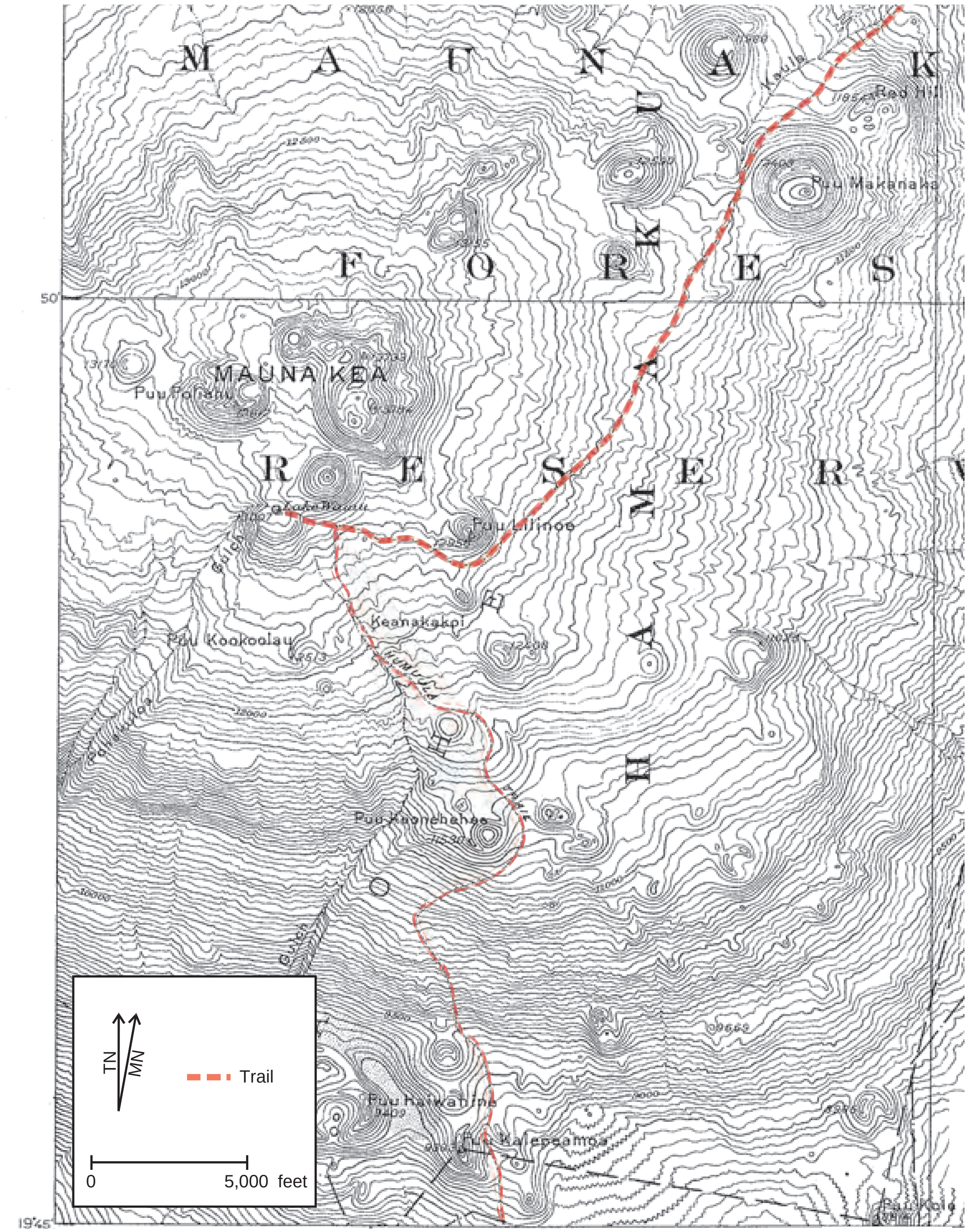


Figure 2.12. 1930 U.S.G.S. Mauna Kea Quadrangle Map Showing Trails in the Summit Area and Lower Elevations.

the horseback trips to the summit area in the early part of the 20th century and possibly earlier began. The unpublished manuscript of the 1935 Hawaiian Academy of Sciences Expedition noted that "In recent years a few people have visited the summit in small parties on horseback, with a guide from Umikoa or Humuula" (Wentworth et al. n.d.:1-2).

A new section of the Humu`ula Trail was built by the Civilian Conservation Corp (CCC) in the 1930s that took a straighter course to the west of Pu`u Keonehehee (see Figure 2.12). The new trail was described by L. Bryan in a 1939 article in *Paradise of the Pacific*:

> During the past few years this lake has been visited by increasingly large numbers of visitors. Three years ago the Civilian Conservation Corp reconstructed an old trail from near the Humuula Sheep Station (Kalaieha), past Hookomo and Halepohaku to Lake Waiau and thence to the summit. This trail is well made and carefully marked on the ground with Ahus or piles of stones and the trip to the lake and on to the summit can easily be made by strangers without the assistance of a guide (Maly and Maly 2005:257).

The Umikoa Trail, which is labeled the Mauna Kea-Umikoa Trail on some maps, first appears as a named trail on the advance sheet of the Lake Waiau Quadrangle that was based on the mapping by J.O. Kilmartin in 1925-26. This trail, and the Mauna Kea-Humu`ula Trail are shown as terminating at Lake Waiau on the Kilmartin map. The absence of the Umikoa Trail on the 1892 map may be significant.

McEldowney came to the conclusion that the Humu`ula and Umikoa trails are probably more recent:

> After comparing the evidence for trails on historic maps, in descriptions of routes taken throughout the historic period, and in native boundary testimonies, it appears that the major trails or formalized routes as shown on the present U.S.G.S. Quadrangle are of recent origin, and that any specific trails or routes existing in the early historic or possibly prehistoric periods are not discernible in the literature (McEldowney 1982:1.12).

McEldowney (1982:A-9) found references to "commemorative and religious features as well as boundary and trail markers" in the Boundary Commission Book for Humuula (Vol. B), as well as mention of "formalized resting places (*o`io`ina*), areas "where mele were sung," and localities where propitiation would be made to various gods or spirits to insure safe passage or completion of a task" (McEldowney 1982:A-9). None of the accounts applied specifically to the higher elevation lands on Mauna Kea, however.

2.2.6 Place Names

The place names in the summit region are a mix of traditional names and modern names (see discussion in McEldowney 1982 and Tables 1.1 and 1.2 from her report). The origin and meaning of some names is unknown. The name Mauna Kea itself is open to various interpretations. The commonly accepted, literal translation as "White Mountain" appears in this early account by the Rev. William Ellis who toured the island of Hawai`i in 1823:

> The snow on the summit of the mountain, in all probability, induced the natives to call it Mouna-Kea, (mountain white), or, as we should say, white mountain. They have numerous fabulous tales relative to its being the abode of the gods, and none ever approach the summit---as, they say, some who have gone there have been turned to stone. We do not know that any have been frozen to death; but

> neither Mr. Goodrich, nor Dr. Blatchely and his companion, could persuade the natives, whom they engaged as guides up the side of the mountain, to go near its summit (Ellis 1979:292).

As already noted, the reference to Mauna Kea as the abode of the gods is emphasized in some native Hawaiian traditions in which the word "Kea" is taken to be an abbreviated form of Wakea, the male god who procreated with Papa to form the mountain. In an account of Queen Emma's trip to the lake in 1881 or 1882 and the mele that were written about that trip, Kihei and Mapuana de Silva present some more detail about the names of the mountain and the lake. They note, following Puakea Nogelmeier, that Emma's poets refer to the summit as Piko o Wakea and that:

> Although Maunakea is popularly translated as "white mountain," Kea is also an abbreviated form of Wakea, the sky father who, with Papa, the earth mother, stands at the apex of Hawaiian genealogy. Mauna Wakea is thus viewed traditionally as the sacred meeting point of sky and earth, father and mother, Wakea and Papa. Emma's poets were well-acquainted with the older name and its lasting significance; they refer to Waiau as "ka piko on Wakea"—as the mountain's navel/genital/umbilical/connecting-point/center (de Silva and de Silva 2007: footnote 7).

The name for the summit, which unlike many mountain summits does not consist of a single peak, is now widely accepted as Kūkahau`ula ("Kūkahau`ula of the red-hewed dew or snow") instead of the formerly used name Pu`u Wekiu. On present evidence the name Kūkahau`ula referred to both a legendary figure and to a character in traditional histories and genealogies. The latter includes references to Kūkahau`ula as the husband of Līlīnoe and as an *`aumakua* (family deity) of fishermen (Hibbard 1999). The place name evidence indicates that the "summit" was at the very least a legendary place or *wahi pana* (Pukui and Elbert 1971). Maly and Maly (2005:vi) give the name as Pu`u o Kūkahau`ula, which they say was "named for a form of the god Ku, where the *piko* of new-born children were taken to insure long life and safety. This practice is still participated in at the present time." According to Maly and Maly (2005:vi):

> The name Pu`u of Kukahau`ula is the traditional name of the summit cluster of cones on Mauna Kea, appearing in native accounts and cartographic resources until c. 1932. The recent names, Pu`u Wekiu, Pu`u Hau`oki and Pu`u Haukea, have, unfortunately, been used since the 1960s (since the development of astronomy on Mauna Kea), and have displaced the significant spiritual and cultural values and sense of place associated with the traditional name, Pu`u o Kukahau`ula.

The names Kūkahau`ula and Līlīnoe are both attributed to cinder cones in the summit region: Kūkahau`ula to the summit and Līlīnoe to a cone immediately to the southeast of the summit cluster. These names, along with that of Waiau, appear on the earliest reliable maps in 1884 and are repeated in the next survey of the summit region in 1892 by Alexander in 1892. Kūkahau`ula is given as the name of "the highest peak" even earlier in 1873 land boundary testimonies. Of all the place names in the summit region, these three are applied the earliest and most consistently to specific landmarks on the mountain. In compiling the 1892 map of Mauna Kea, W.D. Alexander refers to these as "genuine native names." The place name Poli`ahu appears in traditions and native testimonies as being applied to a trail, spring, pond, and cave, but it is not consistently applied to a single and identifiable landscape feature until 1892 when W.D. Alexander proposes attaching this name to "a nameless peak" in honor of the demigoddess, Poli`ahu, who appears in the tale of Laieikawai (McEldowney 1982:14; Table 2.1).

Some other place names date to the 1930s (Table 2.2). Gregory and Wentworth made a point of noting that they assigned names to cinder cones that did not have official names at the time (Gregory and Wentworth 1937:1725 footnote 14):

> As an aid in description, names have been adopted for the following cones not recorded on official maps: Puu Mahoe (Twin Cones), Puu Poepoe (Round Cone), Puu Hoaka (Crescent Cone), Puu Ala (Trail Cone), Puu Waiau (incloses Lake Waiau), Puu Kea (White Cone), Goodrich Cone (Joseph Goodrich, Hawaiian missionary, 1823), Macrae Cone (James Macrae, botanist of the *Blonde*, 1825), Douglas Cone (David Douglas, Hawaiian botanist, 1884), Summit Cone (highest point on Mauna Kea).

In a 1973 letter to Libert Landgraph, District Forester, L.W. Bryan wrote that he had obtained the following names from the "old Hawaiians" in the 1920s.

1. The summit cone, 13,796 is called Puu Wekei.
2. Goodrich cone is called Puu Hau Kea
3. Macrae Cone is known as Puu Hau Oki
4. Douglas Cone is called Puu Pohaku

He added that he had no objection to Pu`u Mahoe, Pu`u Ala and Pu`u Poepoe, but that "I wonder how Lake Waiau and Puu Waiau secured their names? Waiau is not descriptive of the lake. Hau Oki would be more applicable" (Bryan 1973). In a letter dated January 16, 1974 Robert Schmitt, Chairman of the Advisory Committee on Geographic Names, presented recommended changes in some place names, particularly those named after Europeans. He suggested that Puu Wekei be changed to Puu Wekiu because he could not find the word *wekei* in the dictionary whereas wekiu was included and translated as summit. He added that the Pukui and Elbert book on Hawaiian place names wrote Pu`u Hau Oki as Pu`u Hau`oki. Place names currently in use for localities and trails in the summit area are shown on Figure 2.13.

Waiau appears now to be the universally accepted name of the lake, rather than other names, such as Pond Poliahu, that appeared on the 1862 Wiltse map. Waiau, like other place names in the summit region, has been variously translated. In *A Dictionary of the Hawaiian Language*, published by Lorrin Andrews in 1865, Waiau was translated as "A place where water runs continually; water where one can always bathe" (Andrews 2003:513). According to Westervelt (1963:56), "The name Wai-au means water of sufficient depth of bathe." In an article published in *Paradise of the Pacific* in 1939, L. Bryan, a forester, remarked that:

> The name "Waiau" has several meanings, for example, "water to swim in." However, it is questionable whether much use was ever made of this water for swimming or whether this exact meaning was intended by the Hawaiians when they named it. It could mean, "the place of the water" (Maly and Maly 2005:257).

Table 2.1. Earliest Recorded Place Names for the Mauna Kea Summit Region

					Within Summit Plateau	
Documentation	Summit	Waiau and Lake	Poli`ahu	Adze Quarry	South Section	North Section
Wiltse Map (1862)		Pond Poli`ahu	Pond Poli`ahu	Kaluahakai	Laimakeloa	Kamahakalau
Boundary Commission Book for Hawaii (1873)	Pu`u o Kūkahau`ula (highest peak)	Waiau (water in gulch)	Poli`ahu (on side of the mountain)	Kaluahaakoi (a cave … stone adzes)	Lanikepue (a pali)	Makanaka (a large ahu)
		Waiau (pond of water)	Poli`ahu (cave where Lilinoe lived)	Kaluakaakoi (two times)		Kamakahalau (a hill)
		Waiau (three times)	Poli`ahu (five times)			Kamakahalau (one time)

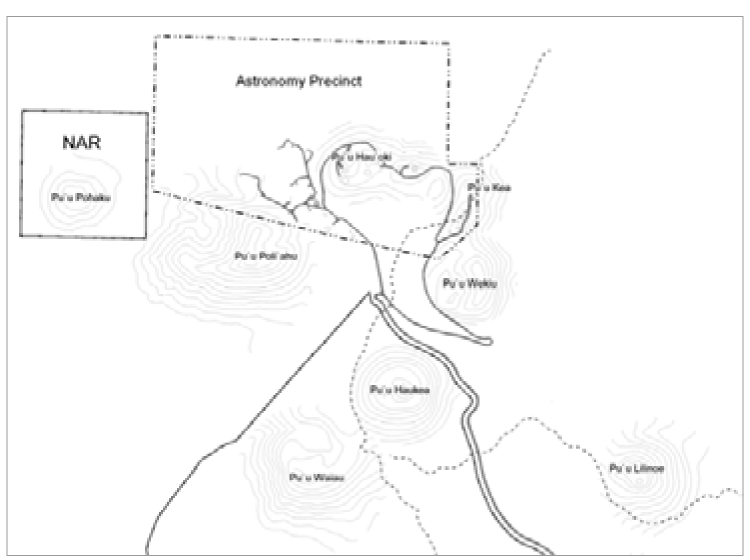
Table 2.2. Correlations Between Named Cinder Cones (and Peaks), Mauna Kea Quadrangle (modified after McEldowney 1982)

Map	Place Names of the Summit Region Cones (between 1884-1956)									Place Names of the Summit Plateau Region (between 1884-1956)								
1884-91 Lyons[1]	Summit Kukahau`ula						Waiau		Lilinoe								Kaupo Red Hill	White Hill Makanaka
1892 Alexander	Summit[2]	Mauna Kea		Poli`ahu[2]			Waiau	Waiau[2]	Lilinoe	Keonehehee[2]		Keanakāko`i					Red Hill Kaupo	Makanaka
1925-26 U.S. Coast and Geodetic Survey	Summit			Pu`u Poli`ahu			Lake Waiau	Waiau Crater	Lilinoe	Keonehehee[2]	Pu`u Ko`oko`olau	Keanakāko`i					Red Hill	Pu`u Makanaka
1928 U.S.G.S.	Summit	Mauna Kea		Poli`ahu		Peak B	Waiau Astrom. Station		Lilinoe	Keonehehee							Red Hill	Makanaka
1937 Gregory and Wentworth		Puu Kea	Macrae Cone	Pu`u Poliahu	Douglas Cone	Goodrich	Lake Waiau	Pu`u Waiau	Pu`u Lilinoe	Keonehehee[2]		Keanakāko`i	Pu`u Mahoe	Pu`u Poepoe	Pu`u Ala	Pu`u Hoaka		Pu`u Makanaka
1956 U.S. Geological Survey	Puu Wekiu[3]	Puu Kea	Puu Hauoki[3]	Pu`u Poli`ahu	Pu`u Pōhaku[3]	Puu Hau Kea[3]	Lake Waiau	Puu Waiau	Pu`u Lilinoe	Keonehehee[2]	Pu`u Ko`oko`olau	Keanakāko`i	Pu`u Mahoe	Pu`u Poepoe	Pu`u Ala	Pu`u Hoaka	Red Hill	Pu`u Makanaka
Currently Used Place Names	Kukahauula	Pu`u Kea	Pu`u Hau`oki	Pu`u Poli`ahu		Pu`u Haukea	Lake Waiau	Pu`u Waiau	Pu`u Lilinoe	Pu`u Keonehehee	Pu`u Ko`oko`olau		Pu`u Mahoe		Pu`u Ala			Pu`u Makanaka

[1] Some place names and accompanying notes on this map appear to have been written at different times and/or by different people. These variations are in keeping with the map's title (i.e., Information Map) and time span given on the label, but they raise the possibility that names from different time periods were added.

[2] Names reported by Alexander to be "genuine native names" with the exception of Poliahu. He attached the name Poliahu to this "nameless peak" in honor of the "demi-goddess" who appears in the "Legend of Laieeikawai." In Alexander's table, the highest peak is listed as Kukakauula, although this name does not appear on his 1892 map (Preston 1895:596).

[3] Names given to L.W. Bryan "by the old Hawaiians in the early 1920"s (Schmitt 1974a).



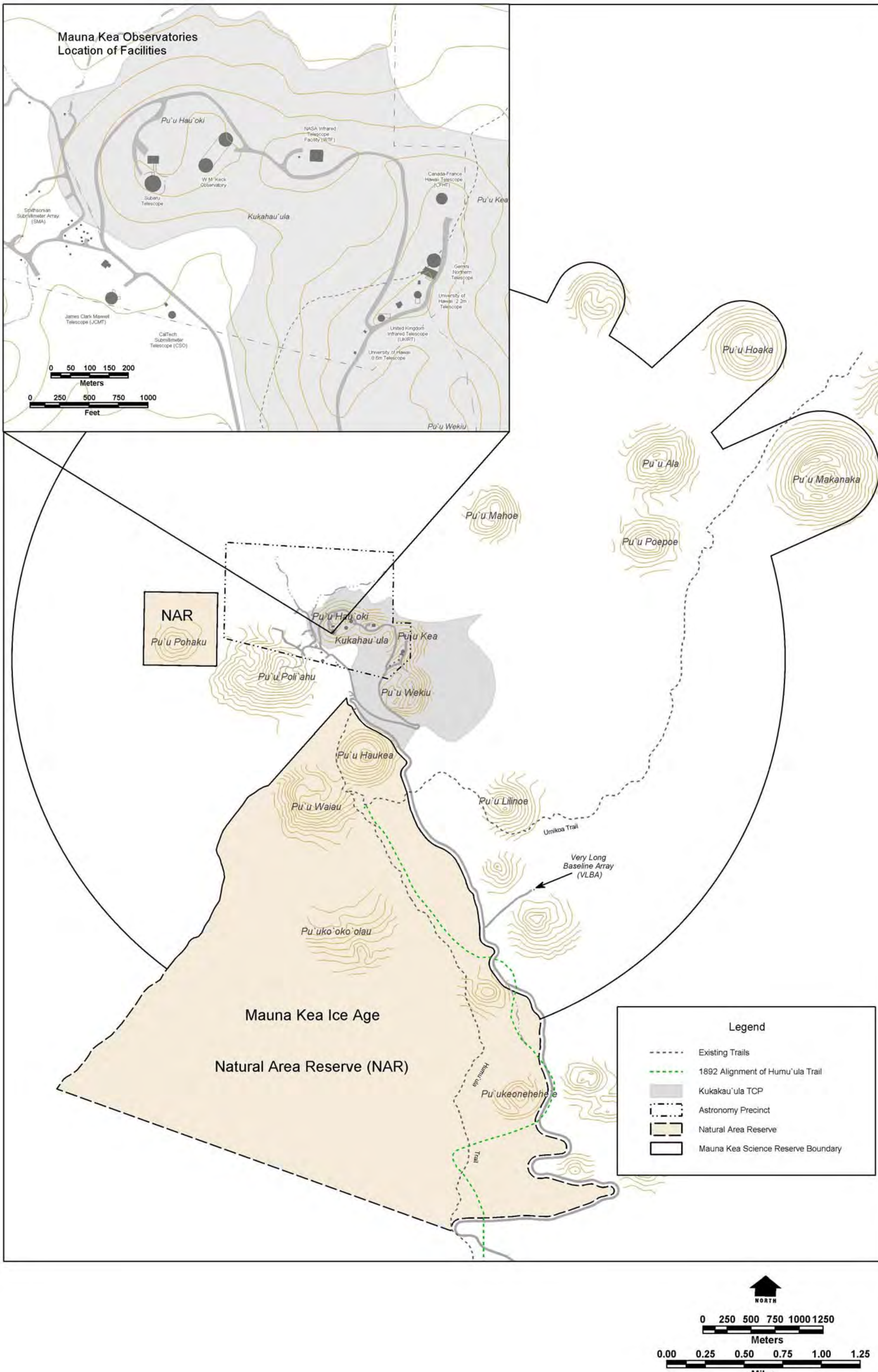


Figure 2.13. Place Names Currently in Use for Localities and Trails in the Summit Region of Mauna Kea.

According to Pukui and Elbert (1986:377) Waiau means “swirling water of a current.” Maly and Maly (2005:vi) give the following account of Waiau:

> **Waiau**, named for the mountain goddess, Waiau (Ka piko o Waiau), and home of the *mo`o* (water-form) goddess Mo`o-i-nanea. Place where piko of newborn children were taken to ensure long life; and from which “ka wai kapu on Kane” (the sacred water of Kane) was collected. These practices are still participated in at the present time.

Charles Langlas, who conducted a traditional cultural property assessment of Mauna Kea, commented on the cultural significance of the lake:

> Taken together, Lake Wai`au and Pu`u Wai`au which contains it are the best attested specific ritual site at the top of Mauna Kea. Kupuna X was taught that the water of the lake had *mana* and was used traditionally to purify and heal. The newspaper story noted by the Kanahele’s about Queen Emma bathing in the lake water to gain spiritual power in her competition with David Kalakaua bears out the Hawaiian belief in the *mana* of the lake. Kupuna X and Kupuna Y both describe it as a place where children’s naval cords were placed, with the ritual purpose of giving the children long life. Belief in the spiritual power of the lake and ritual activities connected with it go back in time to the time of their great-grandparents and before. The use of the name Waiau goes back at least to the nineteenth century. The name Waiau [presumably Wai`au] was given by elderly Hawaiians testifying to Boundary Commission in 1873 and was given by Alexander in 1892 as a “genuine native name” (McEldowney 1982:14, Table 1.2). Protection of the lake’s *mana* is still important to Kupuna X, who indicated that individuals who entered the lake carelessly could contaminate its *mana* (Langlas 1999:9-10).

Below Lake Waiau and west of Pōhakuloa Gulch, are three named springs – Hopukani, Waihu, and Liloe. None of the springs are listed in *Place Names of Hawaii* (Pukui, Elbert, and Mookini 1974). The names of all three springs first appeared on the 1927 U.S.G.S. Ahumoa Quadrangle (1:31,680) topographic map. On this same map there is a second locality labeled Waihu, a short distance below Liloe Spring. This may be a general place name since there is a similar name (Waiku) in the same area on the 1911 edition of the United States Coast and Geodetic Survey map of the island of Hawai`i. According to the Ka-Miki legends translated by Maly the proper name of Waihu Spring is Ka-wai-hu-a Kane as noted in the following account:

> …at that time, the guardians [Pohakuakane and Pohakuloa] saw the water rippling, and overflowing from the spring. As they went to investigate, they saw a shadow pass them. Because of the overflowing of the water, the spring came to be called Ka-wai-hu-a-kane (The-overlowing-waters-of-Kane), and so it remains named to this day [Figure 6]. It overflowed because Ka-Miki scooped the water, filling the `awa bowl of the god (Maly and Maly 2005:47).

Maly (1999: D-26) notes variations of Hopukani, including Houpo-o Kane and Ka-houpo-o-kane. Maly (1999:D-26) added, “Interestingly, at Ka-haupo-o-kane are found the waters of Pohakuloa, Hopukani, and Waihu (also known by the name “Ka-wai-hu-a Kane.”

2.3 Chronological Summary of Land Use and Other Practices and Beliefs

For the purposes of this initial overview the culture history of the Mauna Kea summit region has been arbitrarily divided into two time periods: (1) the Pre-Contact

Period (pre-1778), and (2) the Post-Contact Period. Continuing cultural practices and beliefs are summarized in Section 2.3.3.

2.3.1 Pre-Contact Period

While there is good reason to believe that the summit region was known to early Hawaiians because of the probable desire to investigate the snow-capped mountain, the only activity that is known with certainty to have occurred in the pre-contact period is the manufacture of stone adzes. Radiocarbon dates on wood charcoal and ^{230} Thorium dates on branch coral indicate that the adze quarry was in use over a period of possibly as much as 700 years between ca. A.D. 1100 and 1800 (McCoy 1986:Figure 28; 1990: Figure 4), although a shorter chronology of perhaps just 500 years now seems more likely. When the quarry was abandoned is unknown and may never be known with any certainty, but there is some evidence that it may have occurred as late as European contact in 1778 or shortly thereafter.

An interesting account of the adze quarry was published by Brigham at the turn of the 20th century:

> Let us climb to the workshop of the adze maker. All these were in high places, and one on Mauna Kea, Hawaii, was nearly 12,900 ft. above the sea. As good clinkstone was not found in many places the known quarries hardly exceeded half-a-dozen. On Hawaii was the most important of all, that on Mauna Kea, where the workmen could only work in favorable seasons for the snow frequently covered the quarry, but from the immense quantity of fragments and chips the work must have extended over many generations; so far as known, this was the earliest quarry exploited, and it is puzzling how the place was discovered when we consider the aversion the Hawaiians had to even visiting those high, bleak and desert regions, the supposed abode of spirits not always friendly. It is possible that the tradition which speaks of the survivor of the deluge of Kahinalii grounding on Mauna Kea and following the receding waters to the lower levels, discovering the koi pohaku on the way, may point to the considerable antiquity of adze-making in this place, but I am inclined to believe that all traditions of the Hawaiian deluge date after the coming of the Spanish discoverers. It has always seemed strange that the axe-makers did not bring the raw material down to their homes and work it up in comfort instead of freezing in their kapa garments at this great altitude. It may be that the mystery of the place and its very solitude kept the trade in few hands and so enhanced the value of a tool that so many must have (Brigham 1902:75-76).

Brigham's account, though lacking documentation of some of the information presented, is nevertheless of great interest for a couple of reasons, including: (1) the reference to a legend connected with the discovery of the source; (2) the general agreement between the legendary evidence and the immense quantity of waste material in pointing to a quarry of great antiquity compared to the few others known at the time; (3) the reference to the aversion of Hawaiians to high desolate places and the discomfort of working under such conditions, and (4) the possible link between environmental conditions and the labor component of the production process and the probable influence this had on the value of a tool that as he so neatly puts it "so many must have." The quarry and Brigham’s interpretations of it are discussed in more detail in Sections 5-7.

2.3.2 Post-Contact Period

Changes to the traditional Hawaiian lifestyle began soon after the arrival of Captain James Cook in 1778. One significant change was the rapid adoption in the major trading centers and nearby communities of Western tools, clothing and other items, initially by the chiefs and then the common people. The impact on traditional technologies is known in a general way from historic accounts, such as diaries and newspapers, but for remote centers of traditional crafts, such as the Mauna Kea Adze Quarry, there is little or no information on how long they continued to be utilized before abandonment.

The first recorded ascent of Mauna Kea by a European was made by the Rev. Joseph Goodrich on August 26, 1823 (Goodrich 1833:200). A number of visits followed shortly thereafter, including ones by such prominent figures as the renowned botanist David Douglas (see Maly and Maly 2005 for a comprehensive overview of early visits and expeditions to the top of Mauna Kea). Macrae mentions that Goodrich found a "heap of stones" on a cinder cone which many have interpreted as located on the summit. Macrae's description suggests a cinder cone at a lower elevation on the edge of the summit plateau:

> Rev. Joseph Goodrich, who, on this occasion, was unfortunately laid up with mountain sickness, had on 26th August, 1823, reached the summit of Mauna Kea. This is the first recorded instance of the ascent of this mountain, although Mr. Goodrich mentions that on reaching the top of one of the terminal cones that encircle the main plateau of Mauna Kea, he discovered a heap of stones, probably erected by some former visitor. Who this former visitor was is unknown, but he was probably one of the white men that in the early years of the nineteenth century got a living by shooting wild bullocks that roved on the side of Maunt Kea. It is very unlikely that any native had reached the top of the terminal cones on the summit, owing to being unprovided with warm clothing to resist the great cold and also to the fact that the natives had a superstitious dread of the mountain spirits or gods. About six months after the date of the first ascent of Mauna Kea by Mr. Goodrich, the peak was scaled by Dr. Abraham Blatchley and Mr. Samuel Ruggle, both connected with the American Mission (Macrae 1922:55).

There are other early references to the building of cairns on the "summit," including one by Jarves in 1844:

> My companions, not having seen the snow, disbelieved the guide's statement the evening previous, and started themselves to seek the summit. Having ascended the hill which the guide had pointed out, they found another arising two hundred or more feet above that, which, after great labor, they scaled. These hills are composed of loose sand, into which one slips knee deep at every step. The second one was frozen hard. This was found to be the highest point; it was covered with slag, lava, and gravel. The snow, or rather ice, lay in chasms, in a few spots, in masses ten feet deep, fourteen wide, and three hundred long...Having piled a cairn, as a memorial of their success, they returned in all haste to the camp (Jarves 1844:228).

Kamehameha, in the company of Kekuhaupi`o, is reported as having made an offering close to Lake Waiau (Desha 2000:94; Maly and Maly 2005:50). Of the many people that made the arduous ascent of the mountain in the 19th century, the trip made by Queen Emma in 1881 or 1882 is one of the best known (de Silva and de Silva 2007). The Queen Emma trip, which was made on horseback, started at Mānā in Waimea.

From there the party rode to Kalaieha [the name for the area occupied by the Humu`ula Sheep Station] where the night was spent before riding to the summit the next day. Mary Kalani Ka`puni Phillips, a descendant of W.S. Lindsey, one of the guides that accompanied the Queen, has written that:

> Queen Emma rode on the back of Waiaulima, and he swam around Waiau pond at Mauna Kea. And then he lifted Queen Emma, and carried her to a rocky place. The people were amazed to see Queen Emma's on-the-back swim, and they returned and told the mo`olelo to us (de Silva and de Silva 2007:3).
>
> The historical record of pilgrimages to Maunakea is not limited to Emma's mele and Phillips's mo`olelo. Steve Desha writes, that as a young man, Kamehameha Pai`ea went to Waiau to pray and leave an offering of `awa. Kamakau tells us that Ka`ahumanu made the same journey in 1828 in an unsuccessful attempt to retrieve the iwi of her ancestress Lilinoe. Kauikeaouli visited Waiau and the summit in 1830, Alexander Liloliho in 1849 and Peter Young Ka`eo in 1854 (de Silva and de Silva 2007:5).

As the summit area of Mauna Kea became better known to the public, it also began drawing the attention of scientists toward the end of the 19th century. The first major scientific study was conducted at Lake Waiau in 1892. W.D. Alexander, Surveyor General of the Kingdom and E.D. Preston, an astronomer with the U.S. Coast and Geodetic Survey, organized an expedition that is sometimes referred to as the "Pendulum Survey Party" because of Preston's objective of making pendulum and meteorological observations. A number of other individuals participated in the Pendulum Party survey which is described in detail in Maly and Maly (2005). The Alexander party found a cairn on the summit, which may have been the one described by Jarves in 1844:

> On Monday, the 25th, the thermometer stood at 20 deg. at sunrise. Messrs. Muir and Alexander ascended the second highest peak on the northwest, overlooking Waimea, 13645 feet height to continue their survey. In the cairn on the summit a tin can was found, which contains brief records of the visits of five different parties from 1870 to the present time, to which we added our own. A party of eight girls from Hilo, "personally conducted" by Dr. Wetmore and D.H. Hitchcock, Esq., in 1976, must have been a merry one. Cpt. Long of H.B.M.'s Ship Fantome had visited this spot in 1876, and Dr. Arning with several Kohala residents in 1885 (Alexander 1892).

The early 20th century for all practical purposes marked the beginning of a new era in the land use history of Mauna Kea. Large numbers of wild sheep were devastating the forests below the summit in the early part of the century. The extent of the devastation was the impetus for a monumental fencing program undertaken by the CCC in the 1930s. The CCC was also engaged at the same time in improving roads and building facilities for visitors. In 1936 the CCC made improvements to what is believed to have been a section of the old Mauna Kea-Humu`ula Trail, from near the Humu`ula Sheep Station at Kalaieha to the summit (Bryan 1939:11). According to Bryan (1939:11), the first stone cabin, from which Hale Pōhaku takes its name (Hale Pōhaku-"House of Stone'), was built by the CCC about this same time. Prior to the construction of a road above Ho`okomo, the cabin at Hale Pōhaku provided a convenient overnight rest spot for hikers and ski enthusiasts (McCoy 1984c:8).

Beginning with the Alexander survey party in 1892, Lake Waiau was used as a base camp by scientists. The geologist, Herbert Gregory, for example, camped at the lake on August 5-6, 1921 and spent some additional time there on July 23, 1926. The

1925-26 USGS mapping team also camped at the lake (Kilmartin 1974). In addition to research, Mauna Kea continued to attract the curious and even resulted in the formation of an organization called the Mauna Kea Association, Limited as described in the following account:

> At the highest point, an elevation of 13,825 feet, a mound of rocks is built, and in this a can lines that contained lists of the names of those who, in recent years, had climbed the mountain, and deposits of silver money made toward a fund for a monument there, and divers [sic] articles, the leaving of which had suited the taste and fancy of the depositor. One had left a small compass, another a bunch of sulphur matches, another a brass button, another a penny.
>
> We copied the names of those who had been there before us, and left our own and gave each of a bit of silver the Summit Monument. Then we be-though ourselves that as the sum in the can had reached the amount of $4.05, it was time some steps were taken looking to the carrying out of the purposes of the contributors. And so we then and there perfected the organization of the Mauna Kea Association, Limited, and elected Joseph G. Pratt, president, Eben P. Low secretary and collector, and A.L.C. Atkinson treasurer. The amount of the collection was turned over to the treasurer, and it was determined that any person who has made the ascent of Mauna Kea, the highest point in the Hawaiian Islands, shall be eligible for membership upon proof that he has been on top of the mountain, and that each member contributing to the monument fund shall receive a certificate stating the date of his ascent and acknowledging the amount of his contribution (Anonymous, Mid-Pacific Magazine 1911:408).

In 1935 the Hawaiian Academy of Science organized the first multi-disciplinary scientific expedition to Mauna Kea. The expedition included specialists in a number of different fields, including the team leader, Chester Wentworth. With the assistance of the U.S. Army, the expedition established three camps. The Humu`ula Sheep Station was the main base camp. Above that was the Ho`okomo Ranger cabin. The uppermost camp was at Lake Waiau which was occupied between July 30 and August 21, 1935. An unpublished account of the expedition, titled *The Mauna Kea Expedition of 1935: Hawaiian Academy of Science*, by Chester Wentworth, John Coulter and Constance Hartt, is on file at Bernice P. Bishop Museum. A popular account of the expedition, *Mauna Kea Here We Come*, was published by one of the members, Ed Bryan, in 1979.

On August 12, 1935 several members of the Hawaiian Academy of Science Expedition took part in the first and perhaps only radio broadcast from the summit. The event is briefly described in Ed Bryan's booklet:

> In the morning Raine and Downing had taken the radio to the top and Downing had set up and operated the first radio station on the top of the Pacific. Six messages were sent and one received. The set was worked for approximately one hour and then carried back to Lake Waiau. The trip took one hour, each of the two carrying about forty pounds of equipment. Thinking that it would be a good time to test the merits of the Pep Caramels, a few of them were taken along but chewing them interfered with breathing so that no comprehensive tests could be made (Bryan 1979:33-34).

The description of this highly momentous event was recorded on film by Raine, who photographed Downing sitting on a stool beside a stone cairn on which was placed the radio equipment. The photographs of this cairn (Bryan 1979:35) indicate that this is Site 21209 (McCoy and Nees 2010: Volume 2, page 4-7).

Gregory and Wentworth commented on the high probability of unrecorded visits to the summit and a greater knowledge of the upper mountain area in the late 19th century:

> There have doubtless been many unrecorded visits to the summit of Mauna Kea since Goodrich's time. Indeed, it is probable that fifty or more years ago, when ranch operations were of relatively greater importance and the old Makahalau-Keanakolu trail was in general use as a route from Kawaihae and Waimea to Hilo, the upper slopes of the mountain were more generally known to the residents of Hawaii than they are today (Gregory and Wentworth 1937:1722).

Construction of the Saddle Road, begun in 1943 for what would become the Pōhakuloa Training Area, was extended after World War II. The completed road, which linked Hilo and Waimea, provided easier access to the south side of Mauna Kea. The first road to the summit of Mauna Kea was completed in 1964. The first astronomy facility, the Lunar and Planetary Station located on the summit of Pu`u Poli`ahu (Group 70 International 2000: Figure IX-1), was opened in July of 1964. Improvements to the original jeep road in the 1970s made access to the mountain top much easier, resulting in more public and commercial activities and as a consequence, conflicts between different public user groups.

2.3.3 Continuing Cultural Practices and Belief

Cultural practices and beliefs involving Mauna Kea have been changing since the arrival of the earliest Polynesian settlers, a process that continues today. Absent a written language, Hawaiian practices and beliefs were originally recorded in chants and oral histories that were passed on from generation to generation for over 1,000 years. The earliest written records of native Hawaiian beliefs and practices were created by European explorers and settlers in the late 18th century.

The arrival of European and Asian settlers also marked the beginning of wide-spread changes in cultural practices and beliefs throughout much of Hawai`i. Because of the evolutionary nature of cultures and beliefs, current cultural practices and beliefs involving Mauna Kea are diverse. Over the last 200 years, many practices have been modified or abandoned altogether as non-Hawaiian religious and cultural practices were introduced to the islands.

A variety of cultural and religious beliefs and practices pertain to and are occurring on the mountain today. Whereas some traditional and customary Hawaiian practices and beliefs have survived and have gained wider practice in recent generations, other traditional and customary cultural practices and beliefs appear not be in practice. In addition, recent archaeological and ethnographic studies of Mauna Kea show that contemporary practices and beliefs have developed based on modern beliefs or have evolved from a traditional practice or belief. The difficulty in thoroughly documenting cultural practices is increased by the reluctance of some cultural practitioners to describe their practices and beliefs to researchers.

Traditional and customary cultural practices and beliefs have been defined as "those beliefs, customs, and practices of a living community of people that have been passed down through generations, usually orally or through practice" (Parker and King 1998:1; PHRI 1999:1). Traditional and customary cultural practices and beliefs contribute to the maintenance of a community's cultural identity and demonstrate historical continuity through the present. This is demonstrated through actual practice or through historical documentation of a practice or belief, including both written and oral historical sources (Parker and King 1998:1; PHRI 1999:2).

Contemporary cultural practices and beliefs have been defined as "those current practices and beliefs for which no clear specific basis in traditional culture can be clearly established or demonstrated – for example, the conducting of ritual ceremonies at sites or features for which no such prior traditional use and associated beliefs can be demonstrated. In some cases, however, "it may be possible to demonstrate the reasonable evolutionary development of a contemporary practice from an earlier traditional practice" (PHRI 1999:3).

2.3.3.1 Religious Beliefs and Practices

At the time of Contact, Hawaiian cultural and religious practices were inseparably intertwined as were many other activities. When describing the organization, structure and lifeways of traditional societies, it is important to remember that the terms used today, such as religion, economics and politics, are modern analytical constructs.

Ranging from Euro-American explorers and missionaries journal accounts to early native Hawaiian historians like David Malo, Kepelino, and S.M. Kamakau, and to later 19th and 20th century ethnologists, there is rich documentation of religious ceremonial and ritual life throughout the islands (Valeri 1985:37-44). Indeed, prior to and following significant undertakings, such as battles, dance, voyaging, the cultivation and harvesting of crops and fish, apprenticeship training, and the manufacture of tools or structures, etc., rites marked by offerings or sacrifices occurred. Propitiatory offerings were made to *`aumakua*, or family gods, and *akua* to avert disasters, like famines, volcanic eruptions and disease, or to ensure the coming of rain, success in crop fertility and fish harvest bounties, or victory in battle.

Following European contact, increasing numbers of Hawaiians converted to Christianity, while restrictions were placed upon traditional religious observances. As a result, traditional oral histories and written documentation of historic religious practices and any associated beliefs on Mauna Kea remain virtually non-existent. Because Ka`ahumanu abolished the *kapu* system in 1819 and imposed restrictions on certain traditional Hawaiian religious practices in the post-Contact period (Kamakau 1961:307, 322), in all likelihood, the voices of those practitioners were silenced, or perhaps simply muted, with traditional knowledge being passed on covertly. It is possible that close proximity to missionary settlements and Christian-converted chiefs may have, to a greater degree, influenced decline in traditional religious practice. In areas further removed from Christian centers, where new religious teachings had less appeal, traditional religious practices may have continued (Barrere et al. 1980:34).

Aside from Ka`ahumanu's restrictions, it has also been suggested that it may be culturally inappropriate for practitioners to speak aloud of their ceremonial or ritual practices and beliefs. As Jess Hannah points out when asked about the presence of *heiau* or burials upon Mauna Kea, "those days…if they know about them…they don't talk about `em. Even Alex [Bell], he knew 'em all, they had something here and there, but they would never pin 'em down. You couldn't pin point it. Something about how they were brought up or raised, it was bad luck or hard luck to talk" (Maly and Maly 2006:A-437, 438). Likewise, when Johnny Ah San was asked about burial locations on Mauna Kea, he revealed that "you take those Hawaiians, they were superstitious, and they hardly want to talk about that" (Maly 1999:A-75).

Nevertheless, modern-day oral history interviewees explain their knowledge, as well as an unfortunate lack thereof, concerning the presence of and meaning of *ahu* and burials in the summit region. And cultural practitioners also describe their knowledge of and beliefs surrounding the following contemporary religious practices - *kūahu* (family shrine) erection, the scattering of cremation remains, *piko* deposition in Wai`au, pilgrimage, offerings, and prayer.

2.3.3.2 Construction of Ahu and Kūahu

Although the archaeologically-documented presence of *ahu* and *kūahu* within the summit region of Mauna Kea indicates religious observances of various kinds in the Hawaiian past, no knowledge regarding the traditional practices and beliefs associated with these structures exists today. In the early post-Contact period, the existence of *ahu* on Mauna Kea are reported – however, information is unavailable concerning their traditional function, be it ritual, ceremonial, or otherwise. In the 1880s – 1890s, two surveyors, J.S. Emerson and E.D. Baldwin, independently denoted various *ahu* located upon *pu`u* in the lowlands surrounding Mauna Kea and the presence of "a pile of stones on the highest point of Mauna Kea" (Maly and Maly 2005:494-502, 505).

It is of interest that the word *kūahu*, a more obscure and presumably older term for one kind of Hawaiian shrine (the *ko`a* or fisherman's shrine is another), does not appear in any of the early accounts. By the post-contact era it appears that *kūahu* was no longer in common use, as opposed to *ahu*, a word with many meanings. Morphologically, *ahu* are a pile or mound of stones, yet in the functional sense, *ahu* may have served historically as altars or shrines, or as markers signifying burial locales, *ahupua`a* boundaries, or trail routes. When Thomas Thrum visited Haleakala on Maui in the 1920s, he reports that *ahu* functioned as trail and way marks, memorials of traveling parties, land boundaries, burial markers, or tributes to deities (Thrum 1921:259). While Emerson and Baldwin certainly confirm the presence of *ahu* as they are defined morphologically, the surveyors do not specifically speak to the functional meanings of the *ahu* on Mauna Kea.

Likewise, oral history interviewees reveal that they have heard of or have seen the presence of *ahu* on the summit plateau and on the Mauna Kea summit (Orr 2004:47; Maly 1999:A-134, -372; Maly and Maly 2006:A-183, -335, -349, -565). Yet, little information is available about the particularities of traditional religious observances practiced in association with the *ahu*. Libert Landgraf states that he had "no idea whether they were trail markers or a grave site or something else" (Orr 2004:47). Pualani Kanaka`ole Kanahele discloses that she does not know if *ahu* "represent these *ahupua`a* markers…or whether they are actually *kūahu* (altar) or *ahu* for different families that lived in that mountainous area…or if it had to do with *konohiki* (land overseers) that were in charge of a particular *ahupua`a* and so this family went there to mark the upper regions…they could also be new ones" (Maly 1999:A-372). On the other hand, Kealoha Piscotta offers up the following explanation of the significance of *ahu* – "some of the shrines mark the birth stars of certain *ali`i*…and also birth and death" (Orr 2004:47).

Piscotta is the only cultural practitioner to describe a contemporary attempt to maintain a *kūahu* (family shrine) on Mauna Kea, which was undermined by repeated destruction and removal of the shrine. It is significant to note that in 1870 Kamakau wrote that "it was not right to trespass on someone else's altar" (Kamakau 1964:96). This statement is the only indication of a traditional cultural practice that regulated people's access to *kūahu* and *ahu*. Piscotta explains that she erected the *ahu*, which consists of a stone from her family, on Mauna Kea because as an employee of one of the observatories, “I thought I would put it where I’m going all the time. And also it was very beautiful and I was always attracted to that place. I prayed at that place all the time” (Orr 2004:52). Piscotta’s contemporary cultural practice of erecting *kūahu* represents continuity of a traditional practice, except that she imported her upright stone rather than selecting a local stone.

In 1998 the Royal Order of Kamehameha I erected a *lele* (altar) on the summit. In the last decade the *lele* has been extensively modified. Several years ago it was dismantled and then rebuilt in a new form. Figure 2.14 illustrates how the *lele* looked in 1999 and 2005.

2.3.3.3 *Piko* Beliefs and Practices

The cultural weight that Mauna Kea carries within the Hawaiian community is also evident in the phrase, “*piko kaulana o ka `āina*,” which translates as “the famous summit of the land” and is used as a term of endearment (Maly 1999:A-3). However, the phrase also expresses the belief that the mountain is a *piko* (the navel, the umbilical cord) of the island and for this reason it is sacred (Maly 1999:D-20). In this context, the significance of the cultural practice of transporting and depositing a baby’s *piko* on Mauna Kea may be better understood. Pualani Kanaka`ole Kanahele explains the symbolic importance of this practice, saying that:

> the *piko* is that part of the child that connected the child back to the past. Connected the child back to the mama. And the mama’s *piko* is connected back to her mama and so on. So it takes it back, not only to the *wā kahiko* [ancient times], but all the way back to Kumu Lipo…So it’s not only the *piko*, but it is the extension of the whole family that is taken and put up in a particular place, that again connects to the whole family line. And it not only gives *mana* or life to that *piko* and that child, but life again to the whole family (Maly 1999:A-376).

Other Native Hawaiian cultural practitioners illustrate that for some families the practice of *piko* deposition on Mauna Kea is a long-standing traditional cultural practice. In 1956, Kaleohano Kalihi revealed that his grandfather had taken a gourd container “the *piko* of Mauna Kea. The place of the *punawai* [spring]…” which had been filled with 40 *piko* from “all of the people that had been born into this family” (Maly 1999:A-1). Kahili also mentioned that until he took the *piko* to Lake Waiau, his grandfather had “taken care of” those *piko*. Another practitioner, Elizabeth ‘Tita’ Lindsey Kimura, describes being a *piko* caretaker for her family – “I still have some of her *piko* that she [her mother] collected. Not collected, but when she goes to my sisters that have babies and the *piko hā`ule* [a *piko* that has fallen off], she’d pick it up and bring it home. …yes, I have it in the *`ōmole* [bottle]…And I’m waiting for somebody to go up to Mauna Kea with it” (Maly and Maly 2006:A-217). One of Kimura’s relatives, Irene Loeyland Lindsey-Fergerstrom, also confirms that she took her children’s *piko* and the *piko* of her one of her relatives up to Mauna Kea (Maly 1999:390).

These cultural practitioners also provide insight into the proper means of placing the *piko*. Irene Loeyland Lindsey-Fergerstrom recalls that “we put the *piko* in a little cotton and put ‘em in a bottle. And sometimes it’s hard to come out, so *kūkū* [grandmother] Laika said all you do is take the cover off and put it on the ground and it

Taken in 1999

Taken in 2005

Figure 2.14. Photographs Showing *Lele* (altar) on the Summit Erected by the Royal Order of Kamehameha.

will just deteriorate" (Maly 1999:A-392). Also, when Lindsey-Fergerstrom took *piko* to Mauna Kea, her husband "dug a little hole and put the *piko* in…the summit" (Maly 1999:A-391). Elizabeth 'Tita' Lindsey Kimura relates that her mother "was very particular…you don't just *hana kapulu* [to act carelessly or slovenly]…you got to treat it with respect" (Maly and Maly 2006:A-217). Kimura also says that the reason for taking the *piko* up to Mauna Kea is that the mountains is "neat" and "clean," practitioners "don't want any *kapulu*…in the discarding of the *piko*" (Maly and Maly 2006:A-217). It is clear that maintaining cleanliness and purity is an important component in this cultural practice. Kealoha Piscotta explains that in light of some practitioners belief that Lake Wai`au has become polluted, she fears that "people won't put the *piko* of the baby in there it it's polluted" (Orr 2004:45).

There were many reasons for hiding the *piko* of newborn babies. One was to ensure a long life. Another was to avoid the person from growing up as an irresponsible adult. There is a well known Hawaiian proverb concerning *piko--He piko pau `iole* which translates as "*an umbilical cord taken by a rat*." Pukui interpreted the proverb to mean:

> A chronic thief. The umbilical cords of infants were taken to special places where the cords of other family members were kept for many generations. If a rat took a cord before it was hidden away safely, the child became a thief (Pukui 1983:96).

2.3.3.4 Burial

Today, numerous oral history interviewees reveal that they have knowledge of burials located at a number of *pu`u* dotting Mauna Kea's western and eastern slopes, including Ahumoa, Kemole, Papalekoki, Mākanaka, Kihe, Kanakaleonui, Kaupō, and Pu`u O`o (Maly 1999:A-22, -48, -75, -165, -250, -279, -351, -395, -397).

Some cultural practitioners explain practices that relate to ancient family burials atop the mountain. Alexander Kanani`alika Lancaster reveals that he and his family members went up to Mauna Kea "for ceremonial. They go up there bless the whole mountain for all our ancestors who's buried up there…the old folks always said, 'Our family is up there'" (Maly 1999:240). As no documentation exists on traditional cultural practices relating to ancient Mauna Kea burials, it is unknown whether blessing ceremonies would be considered a traditional cultural practice or a contemporary cultural practice.

Other cultural practitioners reveal that they have participated in the practice of scattering the cremated remains of loved ones from atop Mauna Kea. It is noteworthy that cremation was not a common practice in traditional Hawaiian culture, and when it was done it was a punishment and meant to defile the dead person. Writing in the 1830s, native Hawaiian historian David Malo stated that "the punishment inflicted on those who violated the tabu of the chiefs was to be burned with fire until their bodies were reduced to ashes" and that cremation was practiced on "the body of anyone who had made himself an outlaw beyond the protection of the tabu" (Malo 1951:57, 20). In recent years, noted Native Hawaiian historian and ethnologist Mary Kawena Pukui explains why cremation was a defilement – "if the bones were destroyed, the spirit would never be able to join its *`aumakua*" (Pukui et al. 1972:109).

The cultural practitioners who express participation in cremation-related cultural practices on Mauna Kea include Toshi Imoto, Tita Elizabeth Kauikeōlani Ruddle-Spielman, and Kealoha Piscotta. Imoto explained that in 1954, he and six others ascended to Mauna Kea's summit, where *paniolo* Eben Low's ashes were scattered from an *ahu*, which is described as an old survey marker. It is also noteworthy that at the time Low's ashes were scattered, a commemorative cement plaque was placed at Lake Waiau in Low's honor (Maly 1999:25-26). Ruddle-Spielman, who happens to be the granddaughter of Eben Low, explained that in 1969, she and her family members scattered her parents' cremation ashes from the Mauna Kea summit (Maly 1999:273-274). Kealoha Piscotta also revealed that she brought her aunties' ashes to Mauna Kea (Orr 2004:52). Finally, Theodore "Teddy" Bell says that he wants his ashes to be scattered from the mountain (Maly and Maly 2006:A-293).

Undoubtedly, the scattering of cremation ashes today is a contemporary cultural practice that has taken the place of traditional interment practices. But debate ensues over whether this practice has evolved from traditional practices and beliefs or whether it is a new practice based on modern customs and beliefs. Pualani Kanaka`ole Kanahele explains that while the scattering of cremation remains on Mauna Kea may be viewed by some as non-traditional, she counters that notion saying: "it may not be the *iwi* [bones] itself, but the ashes are the essence of what is left of the *iwi*. It doesn't matter, it's going back" (Maly 1999:A-377). On the contrary, in 1970, a woman identified solely as Kolokea C. testified before the Hawaiian Culture Committee of the Queen Liliuokalani Children's Center that when her brother died, she intended to have his body cremated. However, she was told by her 73-year old great-great-grandaunt that "cremation was *puhi i ka iwi* [bone burning]" and that cremation was an expressly prohibited by Kolokea's great-great-grandfather. This auntie recommended burial in the ground or at sea instead, as with a cremation "the body will be without peace." In the end, Kolokea C. decided to bury her brother (Pukui et al. 1972:106-107). Ms. Kanahele explains that cremation is an evolutionary development of a contemporary practice from an earlier traditional practice, whereas Kolokea C. concluded that cremation was non-traditional in learning of the traditional prohibitions of this practice.

2.3.3.5 The Spiritual Resonance of Mauna Kea: Modern Pilgrimages to Chant, Pray, and Make Material Offerings

In public testimony before the Mauna Kea Advisory Committee, Ed Stevens ascribed Mauna Kea's spiritual significance to the fact that it is the highest point in Polynesia. Stevens states the mountain is significant "because it was considered to be the gateway to heaven. When the ancient *kāula* (priests, prophets) made their treks to the summit, it was to be nearest to *akua* where prayers could be offered in the highest reverence" (Maly 1999:C-10).

Instances of the cultural importance of Mauna Kea are related in several pilgrimages made to the mountain by royalty to partake in ceremonial practices in the post-Contact period. During the reign of Kamehameha I, fearing dissension amongst some of his chiefs, in the company of Kekuhaupi`o, the king is reported to have traveled to Mauna Kea to make a ceremonial offering close to Lake Waiau (Desha 2000:94 in Maly and Maly 2005:50). In 1881 or 1882, Queen Emma ascended Mauna Kea and at Lake Waiau, she swam across the lake, riding on the back of Waiaulima (de Silva and de Silva 2006 in McCoy and Nees 2008; Maly and Maly 2005:158; Maly 1999:A-4, -5, -387). Queen Emma's swim across Waiau was a cleansing ceremony initiated in an effort to prove her genealogical connection to Wākea and Papa (Kanahele and Kanahele 1997:9 in Maly 1999:D-21).

In addition, some oral history interviewees reveal seeing offerings left on Mauna Kea in recent times. Libert Landgraf recalls seeing *pu`olo* (offerings) left at Lake Waiau and on the summit of Mauna Kea, which he describes as "a gift or something wrapped in *ti* leaves. My feeling of that is it has cultural, I don't want to go out on a limb and say religious, but it has a significant cultural significance…someone is taking a gift or presentation to a particular area" (Orr 2004:51). Other interviewees, including Rally Greenwell, Hisao Kimura, Coco Vredenburg-Hind, and Daniel Kaniho Sr., testify that they either saw or had heard that `*opihi* shells were present in the Mauna Kea adze quarry (Maly and Maly 2006:A-37, -215; Maly 1999:A-118, -260). Archaeologists theorize that because these `*opihi* shells are too few to be interpreted as the remains of food consumption activities; it is more likely that they were offerings to the *akua* (McCoy 1990:108).

Other oral history interviewees demonstrate the spiritual resonances of Mauna Kea in the following statements:

> Libert Landgraf – "I looked at sites, the area, as the church. …In this instance maybe the summit of Mauna Kea represents to us what the church is, and the individual sites or the individual platforms is the altar" (Orr 2004:49).
>
> Kealoha Piscotta – "This is a really hard issue for Hawaiian people, because Hawaiian people have really no temples. [They're] in the state or national parks....So Mauna Kea represents one of the last kind of places where the practice can continue. …But for Mauna Kea, it's not a temple built by man. It's built by Akua…" (Orr 2004:49).
>
> Pualani Kanaka`ole Kanahele – "If you want to reach *mana*, that [the summit] is where you go" (Maly 1999:A:372).
>
> Pualani Kanaka`ole Kanahele – "Mauna Kea was always *kūpuna* [an elder, ancestor] to use. …And there was no wanting to go on top. You know, just to know that they were there…was just satisfying to us. And so it was kind of a hallowed place that you know it is there, and you don't need to go there. You don't need to bother it. …And it was always reassuring because it was the foundation for our island" (Maly 1999:A:366).
>
> Florence La`i-ke-aloha-o-Kamāmalu 'Coco' Vredenburg-Hind oral history – "I don't think I could live anywhere else. I feel like it's right, I belong to the dirt, the soil….It just like they protect all of us. These mountains protect us" (Maly 1999: A-117, 120).
>
> Alexander Kanani`alika Lancaster – "My grandmother…she said, 'When you go up there, you going feel the spirit.' And you do feel the spirit" (Maly 1999:A:234).
>
> Tita Elizabeth Kauikeōlani Ruddle-Speilman – "Yes the *mana* is there. There is no question" (Maly 1999: A-286).

Clearly, these statements demonstrate that Mauna Kea continues to be viewed as a realm of great spiritual and sacred importance, a belief rooted in Hawaiian tradition.

2.3.3.6 Collection of Water for Healing

Little documentation exists that Hawaiians sought to collect water or snow in ancient times, yet Lloyd Case says that "they went there because that mountain has the power to heal and it still does…I've heard of the old ones getting water from Waiau to use for healing…" (Maly 1999:A-353). Presently, cultural practitioners engage water and snow collection for ceremonial/medicinal purposes. Regarding the waters on the mountain, Anita Leilani Kamaka`ala Lancaster and Alexander Kanani`alika Lancaster explain that their family uses the "sacred water" of Waiau for baptisms (Maly 1999:A:246). And Kealoha Piscotta states that "its for medicine…all of these waters" (Orr 2004:45). However, concern surrounding the purity of Lake Waiau is also a factor influencing the contemporary practices of Lake Waiau water collection and snow collection on Mauna Kea. Some cultural practitioners believe that effluent from the observatories enters the aquifer and has caused the green coloration of Lake Waiau's water. Although scientific studies disprove the theory that effluent has in fact leached into the aquifer, Kealoha Piscotta states that "we are not really trusting to take the water for the medicine anymore" (Orr 2004:45). Piscotta states that because she is unsure about the purity of the Waiau waters, she gathers snow instead. In her words, "the snow along this ridge in here and by the lake, is what I was told is the snow to collect. It's powerful snow…" (Orr 2004:51).

2.3.3.7 Adze Manufacture

The manufacture of stone adzes made from discarded preforms left by ancient Hawaiian adze makers or from unmodified pieces of raw material in the Mauna Kea Adze Quarry is a practice occurring today, about which relatively little is known, however. One reason is that the collection of material from the quarry, a large part of which is located in the NAR, is not a permitted activity under the NAR rules. The collection and use of material from the quarry thus tends to be clandestine.

Cultural practitioners also have different beliefs concerning the appropriateness of using material from the quarry for adze manufacture and whether this activity should be taking place at all. For instance, Lloyd Case does not believe adze collection should take place whatsoever. Case states:

> I think that what ever is there should stay there. Because not only would it be a resource that people can go and see, what the old Hawaiians did and how things were. But if you take everything off of that mountain, and people keep taking things, you have nothing to show for our past (Maly 1999:A-352).

On the other hand, Hannah Springer believes that if it can be demonstrated that the quarries lack potential for archaeological analysis, adze quarrying could be permitted. She expresses that she does not know how access could or should be regulated, but expects that if it were stipulated that practice be done in a traditional manner, not many individuals would engage in quarrying. Springer says:

> Should there be fresh mining? I don't know if there's information that can still be extracted from the fragments that remain from past work done there. If already there has been tremendous removal of material, how valid is the data that remains? What sort of picture would we get from analysis of it? I cannot answer that. If it has relatively low value maybe we would want people to continue to mine an already tapped source. Hundred and eighty degrees away from that, I can't imagine how many people would make the effort if they had to go *kālai* [carve or cut] the *pōhaku* [stone]. So that might be self regulation, right there. To identify and designate an area where people could go. And again I don't know how you determine who's authentic to go up there (Maly 1999:A-310).

Pualani Kanaka`ole Kanahele believes that adze quarrying should be permitted, but only if those quarrying can demonstrate a genealogical tradition of adze quarrying. She says:

> I have two *mana`o* [opinion, thought] for that. One is, an old site should be approached...it depends on what you are taking it for. I can only say, 'Yes, take it if I see that you bring down the *ko`i* [adze] and you use it for something.' It has to be functional for you, and not just a show piece or something that you want to use commercially. …So I am thinking that if you would go to an old place to mine the *ko`i*, then you need to show some kind of genealogy where your *kūpuna* also had that kind of function. So if your *kūpuna* were some kind of *kālai ki`i* [carvers

> of images] or *kālai wa`a* [canoe makers] or had some kind of function with the *ko`i*, if you have that…Because then it would make us stronger to know that you still have that and that you still continue this in some form. …So it's not like saying, 'Oh you cannot, first you have to show us your genealogy.' No. 'Show us what your genealogy is because that makes you stronger, that makes us stronger, that brings *mana* to the place.' That it is still being continued by the *mo`opuna kuakāhi*, *kualua*, *kuakolu* [the great; great great great; and great great great grandchildren] of this *kūpuna* (Maly 1999:A-373-374).

Modern-day adze collection and quarrying can be considered a traditional cultural practice that has been modified to include the use of contemporary methods and tools (such as steel rock hammers).

2.3.3.8 Navigation/Orienteering

Kepā Maly notes in his collection of archival documentation on traditional practices that no specific references to *kilo hōkū* (observing and discerning the nature of the stars) upon Mauna Kea are present (Maly and Maly 2005:95). Maly speculates it is likely that *kilo hōkū* was practiced upon the mountain, as the gods and deities associated with the mountain are also embodied in the heavens, but such accounts are absent from the historical literature (Maly and Maly 2005:95). Libert Landgraf also says that he has "no personal knowledge of it," but he suspects "that it probably was a very good observation [point]" (Orr 2004:55). Lloyd Case says that he believes a platform, which he believes to have been a "navigational *heiau*" was present on the Mauna Kea summit. He states that "before the observatories were there, they had one when all the stones were piled up, kind of similar to some of the *heiau* at Mahukona" (Maly 1999:A-349).

In contrast to Maly's statement that there is an absence of evidence of traditional Hawaiian astronomical observations, cultural practitioner Kealoha Piscotta believes that "the lake [Wai`au] is like the navigation gourd," a concept which she learned from her auntie (Orr 2004:45). According to Piscotta, her auntie also instructed her to go to the lake and when she did, Kealoha says "I could see clearly why she wanted to look into the lake. Because when you look into the lake, the whole heavens are reflected in it and it's just like the gourd that they carry on the canoe with the water and the *ane ane*" (Orr 2004:45).

Piscotta states that *mo`olelo* passed down from her auntie describe solstice alignments with Mauna Kea, thus she believes that the solstices were marked from the Mauna Kea summit. Piscotta emphasizes that she does not doubt the validity of *mo`olelo*, but she is interested in understanding how the solstice alignments work. Thus, she has concerns that the view plane from Mauna Kea has been diminished and obstructed by the leveling of *pu`u* and the erection of observatory domes (Orr 2004:54-55). Piscotta reveals the importance of the solstice alignments by stating that "if you do not measure the solstice and the equinox, you cannot keep track of the sacred time. And if you don't know what year you're at, you don't know part of the *wā* or the epic period you're in, so you don't know where you are in the prophesy either" (Orr 2004:58-59). It is noteworthy that not only is Piscotta interested in validating traditional Hawaiian astronomy techniques, she also holds a degree in physics and has worked as a telescope systems specialist at a Mauna Kea observatory.

On a similar note, Tita Elizabeth Kauikeōlani Ruddle-Spielman conveys the significance of the Mauna Kea view plane, but as a landscape viewed from the sea. She says:

> It was so important when we used to go fishing with uncle Francis, I used to go with him. From Keawaiki. When we started out, he'd say 'Now watch the *pu`u* on the mountain.' And we'd go out, and that was my job to watch the *pu`u* as we went along. And as soon as a cloud came down to that certain *pu`u* we'd turn around and go right home again, because he knew that the ocean would change. It was anywhere that we went, whether we were going towards Kona or coming this side towards Kohala. He said 'You watch that *pu`u* and as soon as you see the clouds hug it, or heading towards it, let me know, because we are turning around and going home.' And he never failed. ….No, it was on the side, the slopes [not the *pu`u* near the summit, but on the slopes]. But he knew, and sure enough, by the time we got home, that wind would change, but we had gotten home safely. ...that is very important, this whole idea of line of sight, cultural landscape. So not only is it important close up on top, but as viewed from afar (Maly 1999:A-282).

2.3.3.9 Hunting

There is no evidence that hunting in the summit region was a traditional cultural practice. Available information indicates that it was not until the late 19th century and throughout the 20th century, following the introduction of numerous non-native ungulate species such as bullock (cattle), goats, and sheep that hunting for subsistence and for sport began on Mauna Kea. Following the Māhele, livestock was deemed the property of the King and the government, although private parties could apply for license to own and brand livestock (Maly and Maly 2005:270). Interestingly, government correspondence dating from 1850-1856 shows that illegal hunting activity by individuals was becoming problematic (Maly and Maly 2005:270-273).

In 1861, a legal dispute over hunting rights led to the decision that no hunting activities could take place on Mauna Kea, except for individuals who acquired leasehold interests in the mountain lands or who gained special permission to hunt (Maly and Maly 2005:274-277). In the years that the forested slopes of Mauna Kea were controlled by cattle ranching operations, Jess Hannah contends that one benefit of being employed as a ranch hand lay in one's ability to practice subsistence hunting. He says, "If you go hunting that was the main benefit because guys could go hunt pig, sheep, and all that. You could always eat" (Maly and Maly 2006:A-428). Dave Woodside, a former government naturalist, concurs and explains that it was only after the World War II era that public hunting on Mauna Kea lands was permitted. This managed hunting policy was developed in part because non-native goats and sheep were adversely impacting the forests and in part because individuals interested in sport and subsistence hunting organized to gain the right to hunt (Maly and Maly 2006:A-323-326). Indeed, Lloyd Case explains the importance of subsistence hunting to many ranch families, "a lot of my brothers and the old timers like David Hogan Kauwē, when they went out hunting, it was basically a hunt where each family took home so much of the meat so that everybody had meat" (Maly 1999:A-345).

Based on all available evidence, subsistence hunting on Mauna Kea is a contemporary cultural practice that has evolved from non-Hawaiian traditions.

3.0 PREVIOUS ARCHAEOLOGICAL RESEARCH AND CULTURAL RESOURCE MANAGEMENT STUDIES IN ALPINE AND SUB-ALPINE ZONES ON MAUNA KEA

A number of research and cultural resource management (CRM) studies have been undertaken in the alpine and sub-alpine zones of Mauna Kea. The two zones essentially correspond to the ecosystems above and below tree line, which varies between roughly 9,200 and 9,500 ft amsl. The majority of the studies have been CRM projects conducted in areas managed by UH for astronomical research. The CRM studies that have been conducted for the UH management areas include:

1) archaeological surveys and mitigation projects;

2) traditional cultural property assessments;

3) cultural impact assessments;

4) preparation of a burial treatment plan; and

5) preservation and cultural resource management plans.

CRM studies have also been undertaken west of Pōhakuloa Gulch at Hopukani, Waihu, and Liloe Springs.

In contrast to the long history of geological research on Mauna Kea, the only area that has been the subject of problem-oriented archaeological research is the Mauna Kea Adze Quarry Complex which encompasses parts of the NAR, the Science Reserve, and the Mauna Kea Forest Reserve in the vicinity of Hopukani, Waihu and Liloe Springs and elsewhere on the south flank of the mountain. The overview of previous work that follows is organized primarily by State agency administrative units and, in the case of the UH management areas, sub-units. In some cases there is an overlap between two or more administrative units. There are also a couple of studies that covered a larger area of the mountain, including one traditional cultural property assessment and two preservation/management plans covering all three UH management areas. These are discussed separately.

The history of archaeological investigations in each of the primary administrative units and management areas are described below. Figure 3.1 is an index map showing the series of maps for each of the administrative units that follow (Figures 3.2-3.5).

3.1 MAUNA KEA SCIENCE RESERVE

The first systematic archaeological investigations in the Mauna Kea Science Reserve were carried out in 1975-76 in the context of a National Science Foundation funded research project on the Mauna Kea Adze Quarry (McCoy 1977, 1990; Cleghorn 1982; Allen 1981; Williams 1989) (see Figure 3.2; Table 3-1). The results of this project are discussed in Section 5.

On June 2, 1981 the Bishop Museum conducted an archaeological reconnaissance survey of five locations on the north slope of the mountain that were under consideration as sites for the proposed Kitt Peak National Observatory data-collecting stations. Each of the alternative facility sites (see Figure 3.3) which were only generally located on a map, was inspected and found to be devoid of historic sites (McCoy 1981).

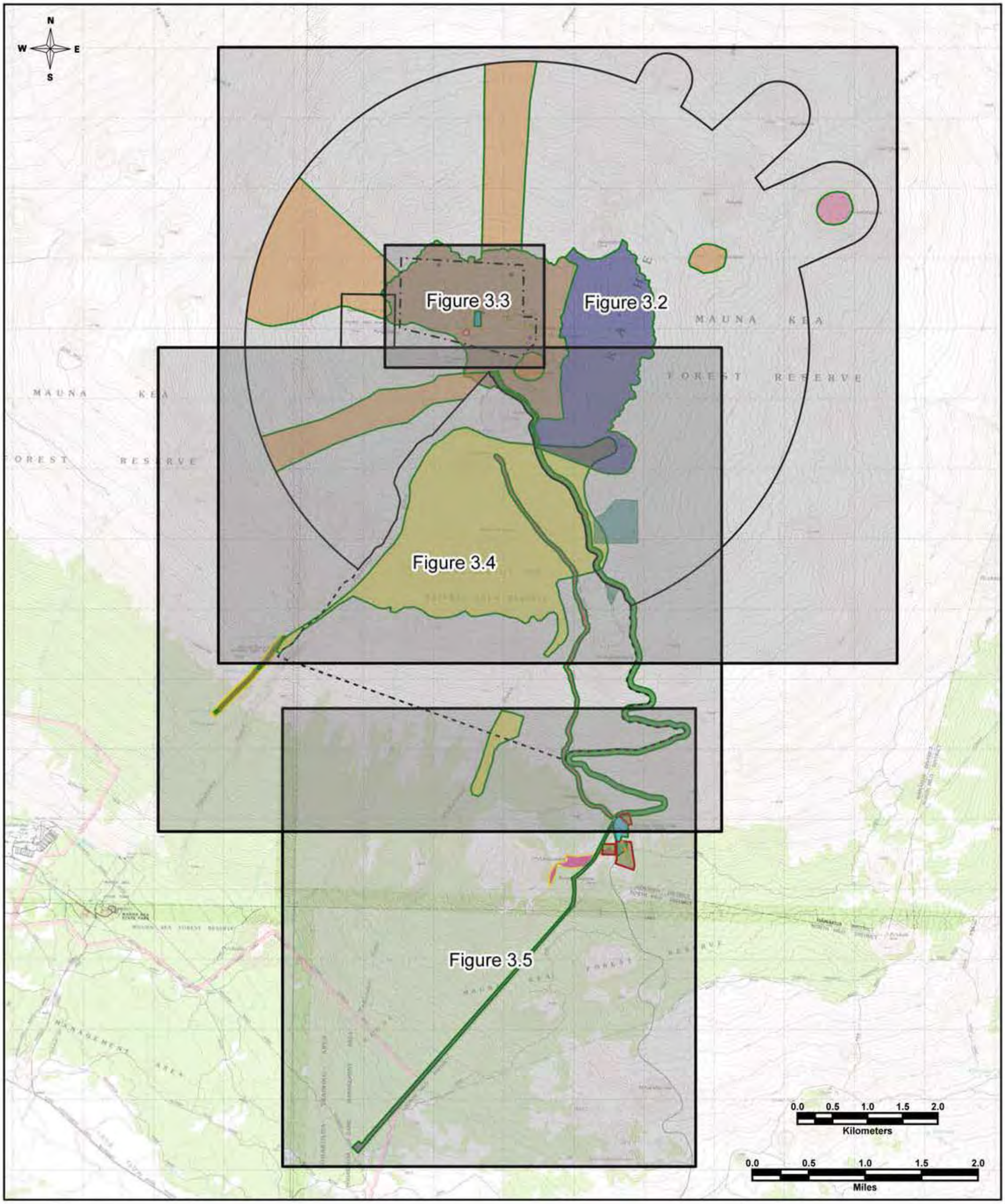


Figure 3.1 Index of Maps Showing the Location of the Previous Archaeological Investigations in the Alpine and Sub-Alpine Zones on the South Flank of Mauna Kea.

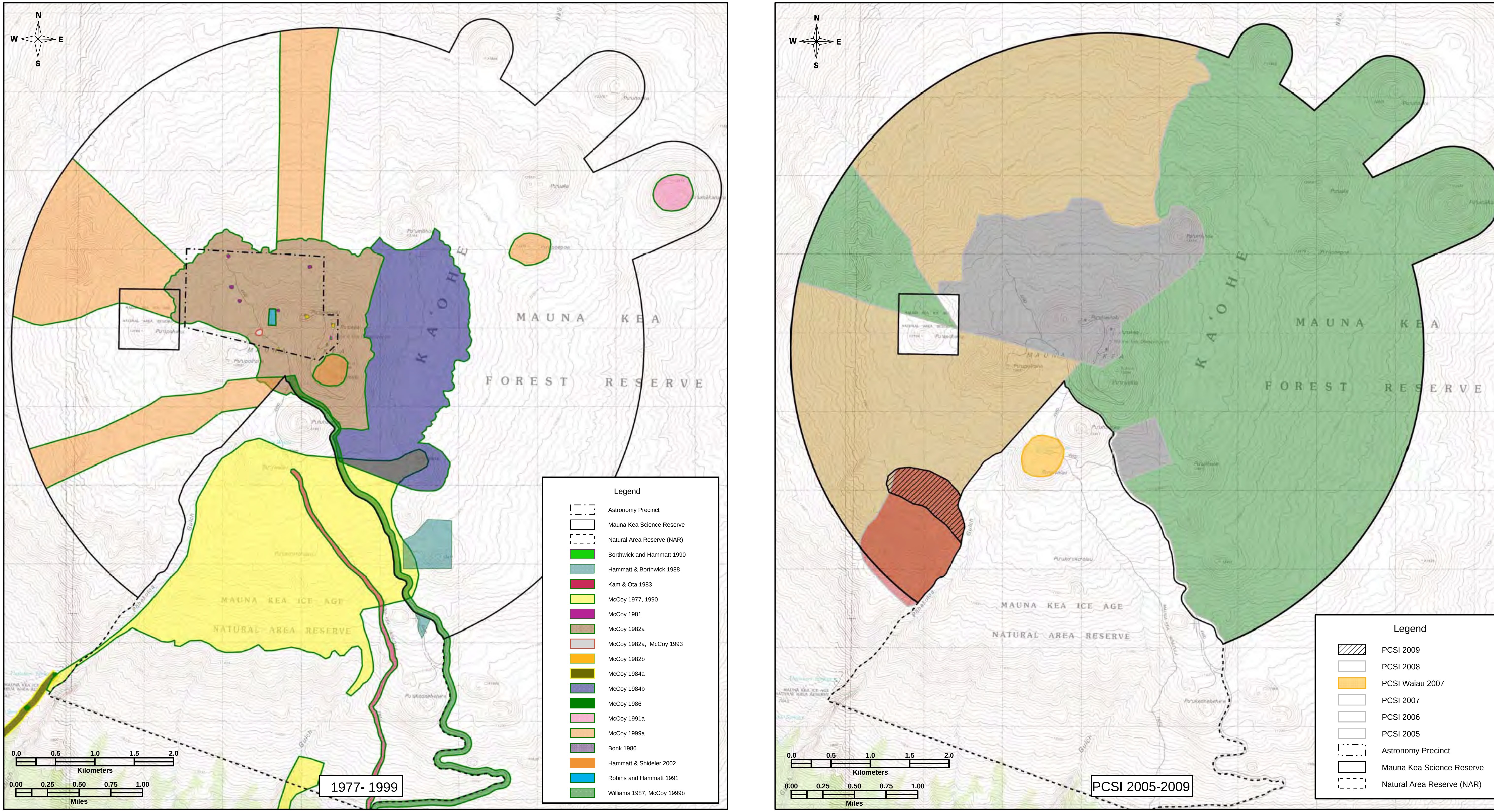


Figure 3.2. Locations of Previous Archaeological Surveys in the Mauna Kea Science Reserve and the Mauna Kea Ice Age Natural Area Reserve.

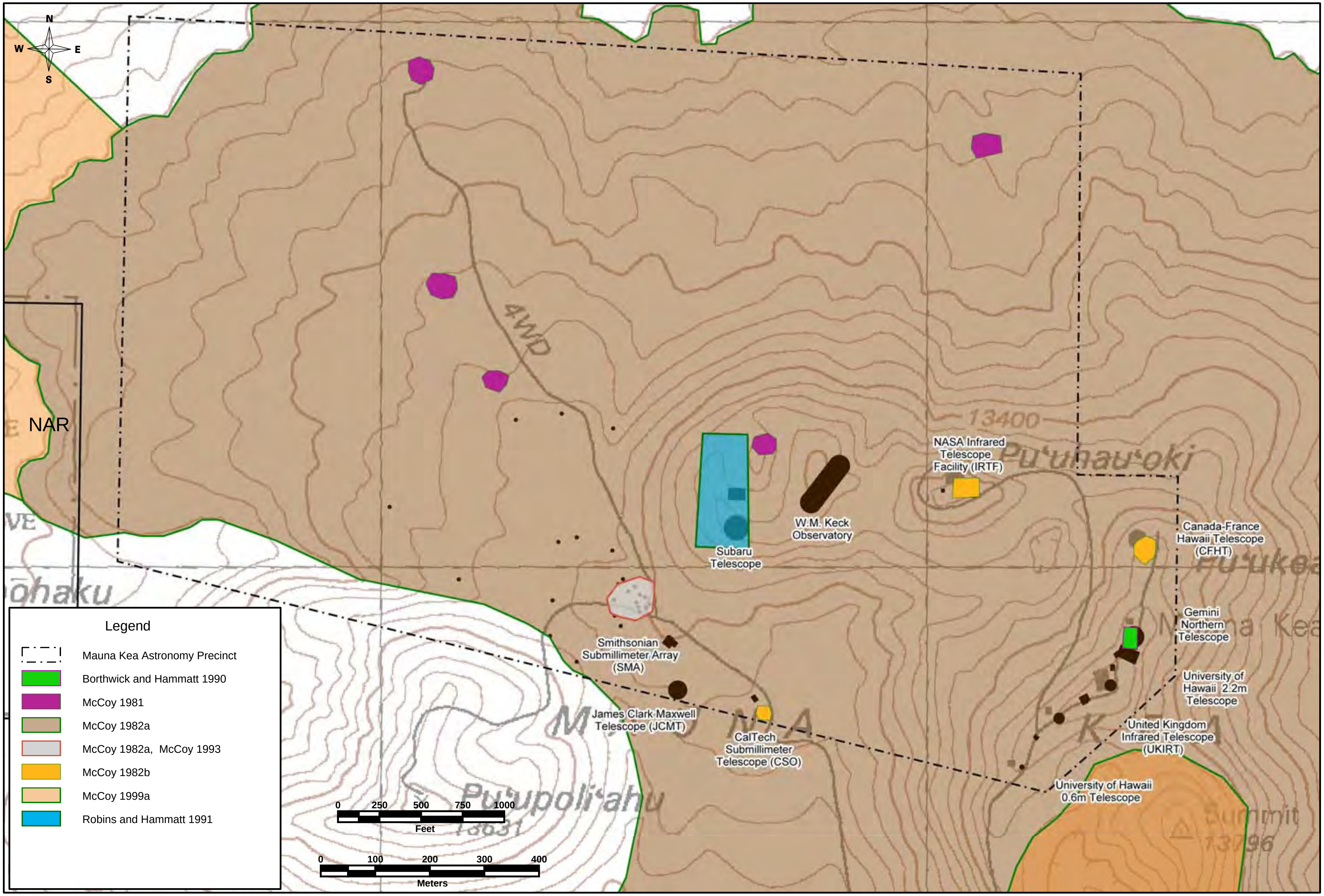


Figure 3.3 Locations of Previous Archaeological Surveys of Observatories, Telescopes and Arrays in the Astronomy Precinct Portion of the Science Reserve.

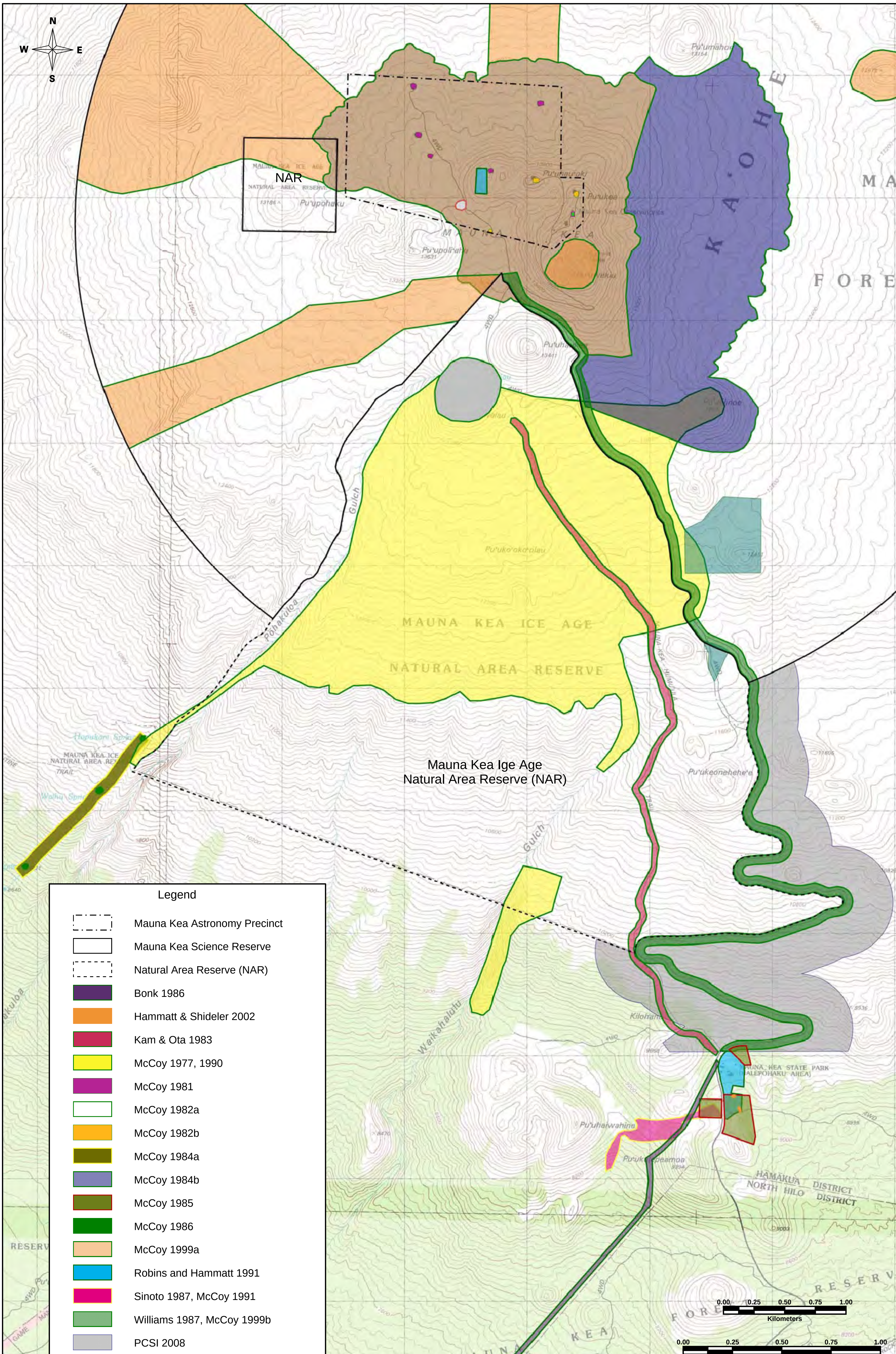


Figure 3.4 Locations of Previous Archaeological Research and Data Recovery Projects in the Natural Area Reserve, along the Mauna Kea Observatories Access Road and in the Hopukani, Waihu, and Liloe Springs Area.

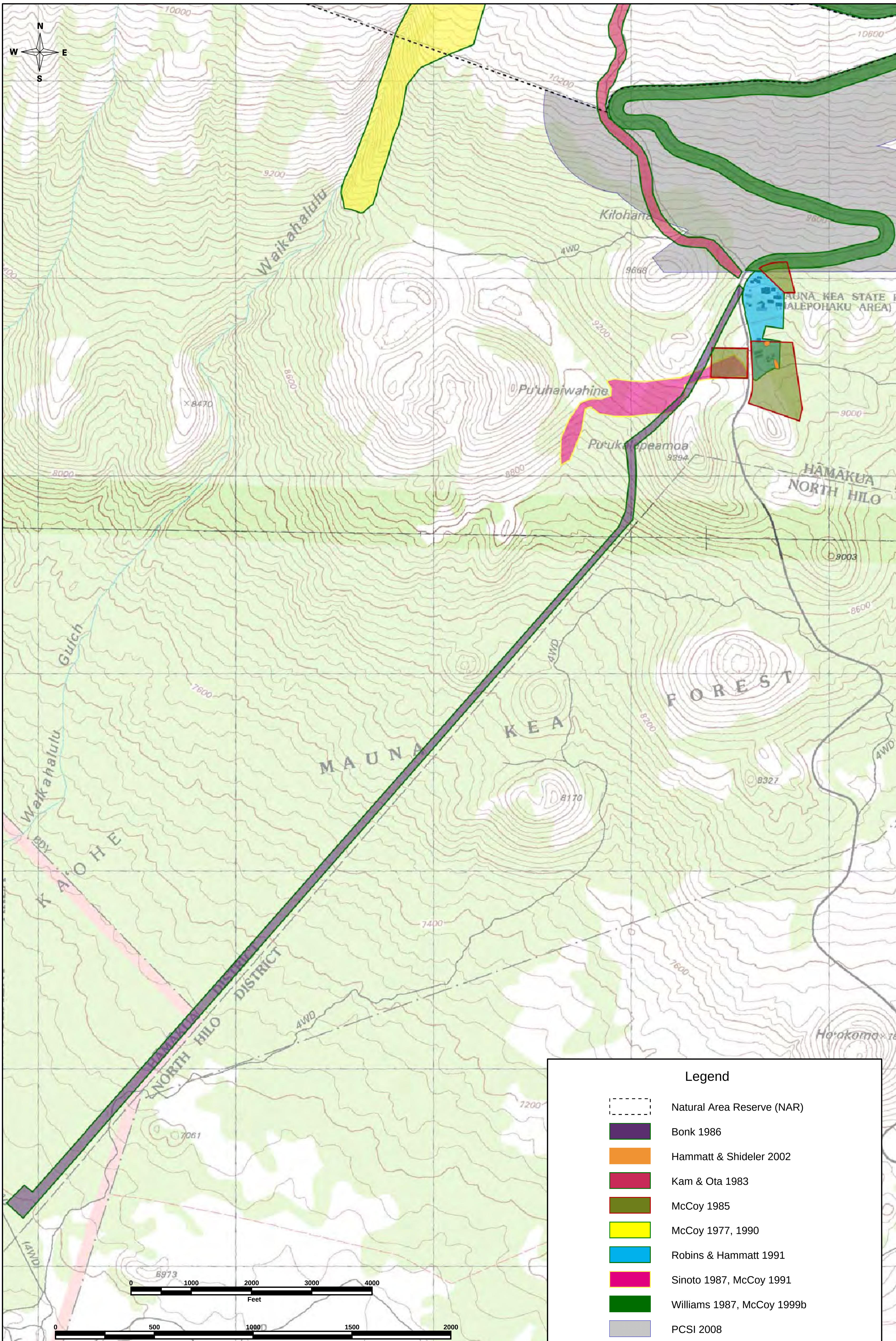


Figure 3.5 Locations of Previous Archaeological Surveys and Data Recovery Projects in the Hale Pōhaku Area.

Table 3.1. Summary of Previous Archaeological Surveys in the Mauna Kea Science Reserve Between 1975 and 1999

Year	Project	Survey Type	New Sites	Reference
1975-76	NSF Research Project on the Mauna Kea Adze Quarry	Reconnaissance and inventory	3	McCoy 1976, 1977; Cleghorn 1982
1981	Kitt Peak National Observatory	Reconnaissance	0	McCoy 1981
1982	Hawaii Institute for Astronomy	Reconnaissance	21	McCoy 1982a and McEldowney 1982
1982	Caltech Telescope	Reconnaissance	0	McCoy 1982b
1983	Mauna Kea Observatory Power Line	Reconnaissance	0	Kam and Ota 1983
1984	NSF Grant-in-Aid Survey	Reconnaissance	19	McCoy 1984a
1987	Summit Road Improvement	Reconnaissance	0	Williams 1987; McCoy 1999a
1988	VLBA Telescope	Reconnaissance	2**	Hammatt and Borthwick 1990
1990	Subaru Telescope	Reconnaissance	0	Robins and Hammatt 1990
1990	Gemini Telescope	Reconnaissance	0	Borthwick and Hammatt 1990
1991	Pu`u Mākanaka	Reconnaissance	1	McCoy 1999a
1995	SHPD site relocation and GPS recording	Reconnaissance	17	McCoy 1999a
1997	SHPD transect survey	Reconnaissance	31	McCoy 1999a
1999	SHPD survey of Pu'u Wekiu	Reconnaissance	1	McCoy 1999a

Note: Three previously identified sites (16183, 11076 and 11078) were deleted from the inventory during the work undertaken by the SHPD in 1995. A reassessment of Site 16183, recorded in 1982 as an open-air shelter with modern rubbish on the floor (McCoy 1982), convinced us that the walls are also modern. Site 11076 had been previously recorded in 1975 and 11078, a rockshelter, showed no evidence of modification or use. The number of sites found in the 1997 survey include two that are just outside the Science Reserve boundaries. These were left out of the count used in McCoy (1999a), which referred to a total of 93 sites.

The first major survey in the Science Reserve was conducted by the Bishop Museum over 5 1/2 days between July 12 and 17, 1982 for the Hawaii Institute for Astronomy (IfA) and encompassed roughly 1,000 acres of land on the summit and northern slope of the mountain, down to the ca. 13,000-ft elevation (see Figure 3.1). Few, if any, archaeological sites were predicted to occur within the boundaries of the project area, given the high altitude location and presumed absence of exploitable resources, including adze-quality stone, which was believed to be restricted to the south slope of the mountain. A total of 22 sites were recorded in this survey (McCoy 1982a). For field purposes, all but one site, an open-air shelter, were classified as "shrines," earlier defined by Buck (1957:527) as "a convenient term to designate a simple altar without a prepared court." The open-air shelter, which contained modern debris, was later deleted from the historic places inventory because of the belief that it is a modern feature. The number of historic properties found in the 1982 survey has thus been changed to 21.

The 1982 project also included ethnographically-oriented archival research on a variety of topics, such as land use patterns, place names, and practices in the summit region of Mauna Kea (McEldowney 1982). A survey of the Caltech Telescope site was conducted at the same time as the larger survey. No sites were found within the proposed project area, but two sites were found in close proximity (McCoy 1982b).

In 1983 SHPD conducted a reconnaissance survey of a proposed underground power line from Hale Pōhaku to the summit (see Figure 3.5). The survey, which did not identified any historic properties, was undertaken before the final alignment had been determined, however.

Archaeological survey of the Science Reserve was resumed in 1984 by the Bishop Museum with the support of a National Historic Preservation Grant-in-Aid. The 1984 survey (see Figure 3.2), which was carried out over a period of 6 days between July 23 and 28, was aimed at completing an inventory of archaeological remains on the east-southeast flank of the mountain adjoining the proposed northern boundary of the Mauna Kea Adze Quarry (McCoy 1978). The survey strategy and methodology were the same as those employed in the 1982 fieldwork. A total of 20 new, dispersed and aggregated sites was recorded in the survey (McCoy 1984b), which covered ca. 1,000 acres on the eastern slope of the mountain. Time did not permit survey of the upper slopes and summit of Pu`u Māhoe as originally planned.

In 1988 Cultural Surveys Hawaii, Inc. conducted a reconnaissance survey of two areas that were being considered as alternative sites for the National Radio Astronomy Observatory (now called the Very Long Base Array). No archaeological sites were found in the survey of the first area, an area of some 15 acres located between the 11,560 and 11,840 ft elevations near the junction of the summit road and a utility road (Hammatt and Borthwick 1990:1). Four archaeological sites were recorded in the survey of the second alternative site, an area of some 100 acres located on the east side of the summit road at the 12,100 to 12,225 ft elevations. Three of the sites (11076, 11077, and 11079) were interpreted as possible shrines; the fourth site (11078) is a small rockshelter (Hammatt and Borthwick 1990:21). Sites 11076 and 11078 were subsequently deleted from the inventory. Site 11076 had been previously recorded as part of Site 16204 (McCoy 1999a) and Site 11078 showed no evidence of human modification or use.

Two archaeological surveys were undertaken in the Science Reserve in 1990, both by Cultural Surveys Hawaii, Inc. The first involved a resurvey of a portion of Pu`u Hau Oki for the proposed Japan National Large Telescope (JNLT-- later renamed the Subaru Telescope) (see Figure 3.3). No sites were found in this survey, which covered an area of 5.1 acres (Robins and Hammatt 1990). The second survey was done for the proposed Galileo Telescope (later renamed the Gemini Telescope) (see Figure 3.3). Two alternative sites were inspected, both of them located on what the authors called the “summit ridge” (Borthwick and Hammatt 1990). No sites were found in either area.

In 1991 an unofficial one-day reconnaissance of the top of Pu`u Mākanaka was undertaken by Holly McEldowney and Marc Smith (SHPD) and Patrick McCoy (Mountain Archaeology Research Corp.) to relocate previously reported burials (see Figure 3.2). The survey, which was interrupted by bad weather, found a number of burials, none of which were mapped, however (McCoy 1991 field notes) a single state site number (50-10-23-16248) was assigned to the burials on the *pu`u* at that time.

As part of their Section 106 compliance, the Smithsonian Institution Astrophysical Observatory (SMA) contracted Mountain Archaeology Research Corp. in December 1992 to relocate two previously recorded sites in the general vicinity of one of the pads (see Figure 3.3). The two sites (50-10-23-16164 and 16165), which were found in the 1982 survey and described as shrines (see discussion of site types below) were found to be located well outside of the observatory footprint. Flagging of the two sites was recommended as a precautionary measure (McCoy 1993).

In 1995 SHPD with financial support from IfA, initiated a project designed to result in a historic preservation management plan for the Science Reserve. The first task, which was begun in 1995, involved the relocation and GPS locational mapping of the sites recorded in the 1982 and 1984 surveys (see Figure 3.2). In the course of the fieldwork 17 new sites were found and recorded (McCoy 1999a).

In 1997 SHPD undertook a reconnaissance survey of five previously unsurveyed areas aimed at obtaining a better idea of site distribution patterns for both management and research purposes. The 1997 survey area included three transects on the north, northwest and southwest slopes of the mountain from the summit area to the lower boundary of the Science Reserve at the ca. 12,000 ft elevation and two other areas—Pu`u Poepoe and a small piece of land located near the Science Reserve boundary downslope of the CalTech observatory (see Figure 3.2). A total of 31 new sites, including two located just below the Science Reserve boundary (21436 and 21437), were found in the 1997 project, which was conducted over a period of 6 days (McCoy 1999a).

The 1997 survey also began the process of recording what were initially referred to as “locations” but are now being termed “find spots”--a general term referring to man-made remains that are either obviously modern features (e.g., camp sites with tin cans, pieces of glass and other modern material culture items), or features that cannot be classified with any level of confidence as historic sites because of their uncertain age and function (e.g., a pile of stones on a boulder).

In summary, archaeological surveys undertaken between 1975 and 1999, the last year archaeological surveys were conducted in the Science Reserve prior to the current project, identified a total of 95 sites (McCoy 1975, 1977, 1982a, 1982b, 1984a, 1990, 1999a; Hammatt and Borthwick, 1990) in an area encompassing some 3,711 acres, which represents roughly 33% of the 11,288 acre Science Reserve (Table 3.2; see Figure 3-2). With the exception of a survey undertaken as part of a research project on the Mauna Kea Adze Quarry Complex, all of these surveys were reconnaissance level studies, which by definition are limited in terms of coverage and completeness. The list of previously identified sites is presented in Appendix A.

Five of the 95 sites are of unknown function. The other 90 sites include: (1) 77 shrines; (2) 1 isolated adze quarry-workshop; (3) 1 adze manufacturing workshops; (3) 1 positively identified burial site and 4 possible burial sites with an unknown number of interments at each site, and (4) 5 cairns that appear to be markers built either by surveyors or visitors to commemorate a visit (Appendix A).

Of the original 95 sites identified in the Science Reserve, 77 or 81% were classified as shrines. An additional 8 shrines are associated with adze manufacturing by-products, one each on Sites 11079, 16203, and 21211 and five on Site 16204. These four sites have been previously interpreted as a different kind of workshop, but the functions are not readily clear. The total number of shrines recorded in the Science Reserve through 1999 is thus 85. The locations of the 95 sites are shown on Figure 3.6.

An archaeological inventory survey of the 11,288-acre Mauna Kea Science Reserve was undertaken by PCSI over a period of 20 weeks between 2005 and 2009, under contract to OMKM (McCoy and Nees 2010). The survey followed on earlier archaeological reconnaissance surveys of selected areas of the Science Reserve that had identified 95 sites between 1975 and 1999.

Table 3.2. Historic Property Types Recorded in the Science Reserve between 1975 and 1999

Site Type	Number	Percent Total
Shrines	77	81.05
Isolated Adze Quarry-Workshop	1	1.05
Workshop	1	1.05
Adze Quarry Ritual Complex	1	1.05
Burials and Possible Burials	5	5.26
Stone Markers/Memorials	5	5.26
Unknown Function	5	5.26
TOTAL	**95**	**100%**

Note: The number of sites recorded between 1975 and 1999 was previously reported as 93 (McCoy 1999a). Two sites (21436 and 21437) located just below the Science Reserve boundary that were recorded in 1997 were omitted. They are included as part of the inventory because of their proximity to the boundary.

The primary objective of the inventory survey was to identify, record, and evaluate the significance of all of the historic properties in the Science Reserve, and to make recommendations regarding their preservation and continued protection. The survey was viewed as the initial step in developing a CRMP.

A total of 263 sites were identified in the survey, including the 95 previously recorded sites and two traditional cultural properties (Kūkahau`ula and Pu`u Līlīnoe) that were given SIHP site designations by SHPD in 1999. Shrines are the most common site type in the Science Reserve, but the relative number of sites has little meaning because of differential site complexity. The next most common site type is a complex of adze quarries/workshops found in the Pōhakuloa Gulch area. This site complex is part of the larger Mauna Kea Adze Quarry Complex, which was placed on the National Register of Historic Places in 1962 as a National Historic Landmark. The Mauna Kea Adze Quarry Complex consists of: (1) the quarry proper, which is defined as the source areas of tool-quality basalt, and (2) diverse activity remains located outside of the quarry proper as just defined, but an integral part of the quarry industry because of the activities that took place. These include isolated adze manufacturing by-products (e.g., cores, flakes), hammerstones and unfinished adzes in various stages of completion; shrines with associated lithic scatters of uncertain function and/or offerings; a ritual complex and two possible burials with lithic artifacts that suggest the possibility of adze maker interments. Burials and possible burials are another fairly common site type, but they are localized to just a few places. The remainder of the historic property inventory is represented by small numbers of diverse site types, such as markers/memorials, temporary shelters, one and possibly two of the camps occupied by the 1926 USGS survey party, and an isolated horseshoe located along what is believed to have been the `Umi Koa Trail. The function of a few sites could not be determined,

The survey included test excavations at two sites and probes at several overhangs to determine the presence/absence of buried cultural deposits. A single radiocarbon date of AD 1420-1480 was obtained on a piece of wood charcoal from a thin cultural layer in a rockshelter located in the Pōhakuloa Gulch area. This is currently the only dated site in the Science Reserve other than some of the historic sites.

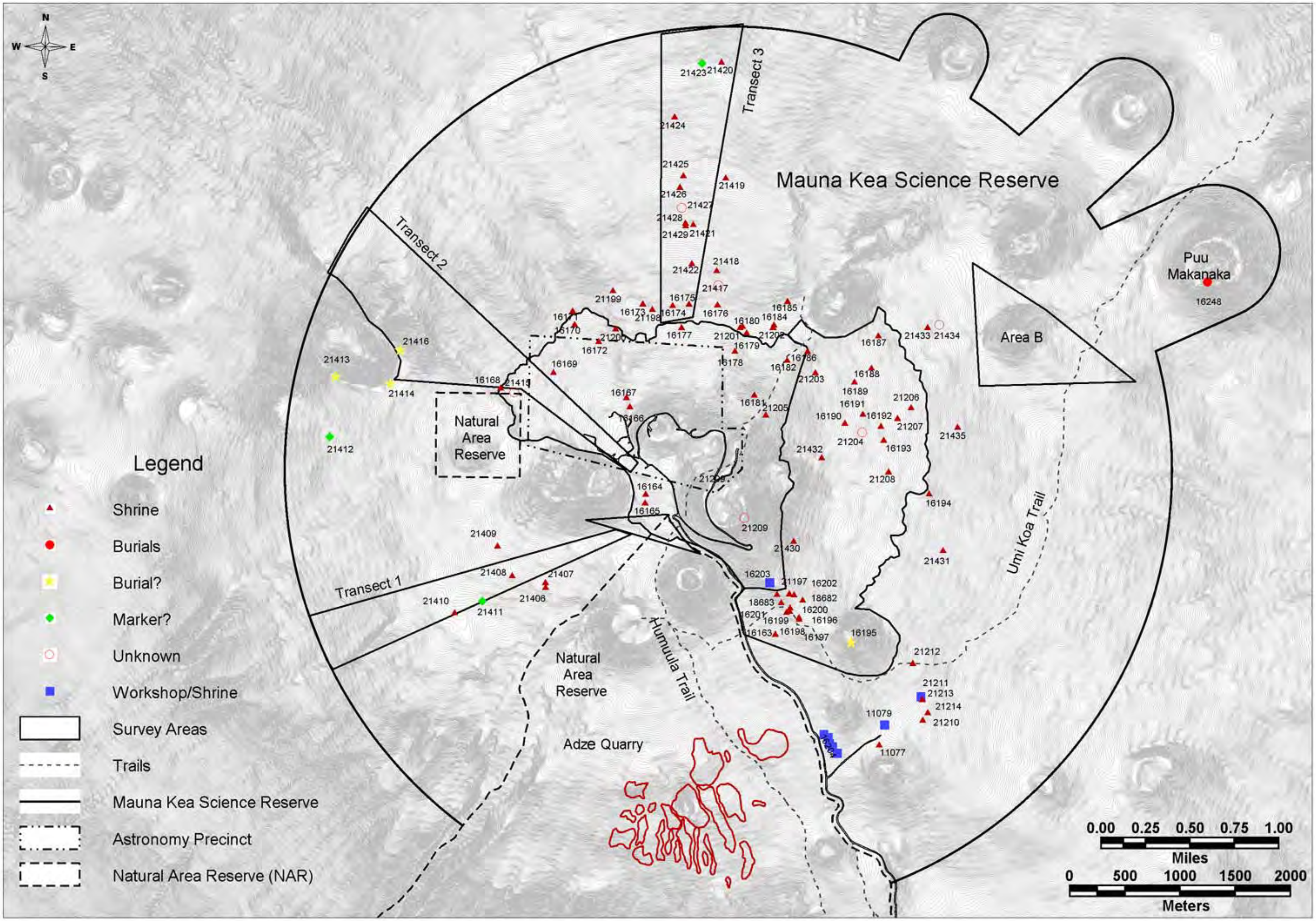


Figure 3.6 Location of Historic Properties and Other Cultural Resources Identified in the Science Reserve Between 1975 and 1999.

Table 3.3 summarizes the number and variety of historic property types found in the 2005-2009 survey (McCoy and Nees 2010). The inventory includes two previously identified traditional cultural properties, and 261 examples of what are commonly called archaeological sites. Shrines are the most common functional site type. The next most common category are sites located in the Mauna Kea Adze Quarry Complex which consists of: (1) the quarry proper, which is defined as the source areas of tool-quality basalt, and (2) diverse activity remains located outside of the quarry proper as just defined, but which are directly linked to the quarry because of the presence of adze manufacturing by-products (e.g., cores, flakes), hammerstones and unfinished adzes in various stages of completion. Burials and possible burials are another fairly common site type. Two possible burial sites have associated lithic scatters comprised of adze manufacturing by-products that suggest the possibility of adze maker interments. They are included in the list of sites that make up the Mauna Kea Adze Quarry Complex. The remainder of the historic property inventory is represented by small numbers of diverse site types.

Table 3.3. Historic Property Types Recorded in the Science Reserve Between 2005 and 2009

Functional Site Type	Number	Percent Total (%)
Traditional Cultural Properties	2	0.76
Shrines	141	53.61
Mauna Kea Adze Quarry Complex Sites	67	25.47
Burials and Possible Burials	29	11.03
Stone Markers/Memorials	15	5.70
Temporary Shelters	3	1.14
Historic Campsites	2	0.76
Historic Transportation Route	1	0.38
Unknown Function	3	1.14
TOTAL	**263**	**99.99**

3.2 HALE PŌHAKU AREA

The second area that is managed by UH is a 19.3-acre site at Hale Pōhaku (Conservation District Use Permit No. HA-1819, Tax Map Key 4-4-15:12) encompassing the Onizuka Center for International Astronomy (OCIA), the Visitor Information Station, and an old construction laborer camp. Some of the cabins in the old camp are now used by the OMKM rangers; others are available for rent by the public for short-term use.

A number of archaeological investigations have been conducted at Hale Pōhaku, both in and outside of the 19.3-acre parcel (Table 3.4; see Figure 3.5), beginning with a one-day reconnaissance survey by the Bishop Museum in 1979 for the Hale Pohaku Mid-Level Complex Development Plan. No sites were found at that time (McCoy 1979).

Table 3.4. Previous Archaeological Investigations in the Hale Pōhaku Area.

Year	Project	Investigation	Reference
1979	Hale Pōhaku Mid-Level Facilities Complex Development Plan	Reconnaissance survey	McCoy 1979
1984-85	Supplemental EIS for Construction Laborer Camp	Reconnaissance survey	McCoy 1985b
1986	HELCO transmission line and substation	Reconnaissance survey	Bonk 1986
1987	HELCO transmission line and substation	Reconnaissance survey	Sinoto 1987
1987	HELCO substation and surrounding area	Data recovery	McCoy 1991
1990	Japan National Large Telescope Dormitories	Reconnaissance Survey	Robins and Hammatt 1990
1993	Japan National Large Telescope Dormitories	Data Recovery	Hammatt and Shideler 2002
2005	Septic Tank Excavations	Monitoring	McCoy 2005

Three more surveys were conducted by the Bishop Museum between July 1984 and June 1985 as part of the preparation of a supplemental Environmental Impact Statement (EIS) for a permit to build a new construction laborer camp (McCoy 1985b). Two shrines and five lithic scatters comprised of adze manufacturing by-products and octopus sinker manufacturing by-products were recorded in the surveys, which encompassed roughly 40 acres on the west and east sides of the Mauna Kea Observatory Access Road between the ca. 9,080 and 9,200 ft elevations. The lithic scatters and shrines, one of which has octopus manufacturing by-products on it that have been interpreted as offerings, were designated the Pu`u Kalepeamoa Site (Bernice P. Bishop Museum (BBPM) site number 50-Ha-G28-87) after the name of one of the large cinder cones at Hale Pōhaku (McCoy 1985b). This cone, through which the summit access road passes, is the source of the stone (primarily dunite and gabbro) used in the manufacture of the sinkers. The two shrines and some of the lithic scatters found in the 1984-85 work are located outside of the Mid-Level facility parcel, as are some other 9 recorded lithic scatters found in later work (see Figure 3.5). SHPD arbitrarily assigned SIHP numbers to the two shrines and 12 lithic scatters (Cordy 1994) and to the site complex as a whole (16244) which corresponds to the BPBM site number. The Bishop Museum designations and corresponding SIHP numbers are presented in Table 3.5.

In early 1986 the late William Bonk of UH Hilo conducted a reconnaissance survey of a proposed new Hawaiian Electric Company (HELCO) transmission line and substation located at Hale Pōhaku. No historic sites were found in the survey which extended from an existing 69 KV powerline north of the Saddle Road and west of the Mauna Kea Access Road, (Bonk 1986) to the substation location at Hale Pōhaku. The alignment that Bonk surveyed, however, was different from the final alignment (see Figure 3.5).

The subsequent discovery of lithic artifacts in the vicinity of the HELCO substation led to a data recovery project that involved additional survey and surface collections at 11 different lithic scatters and limited test excavations of two of the scatters (Sinoto 1987; McCoy 1991; Figure 3.7). A total of 2,364 artifacts and 129 faunal remains were collected. In addition to the debris related to adze and octopus sinker manufacture some 20 special purpose bird cooking stones called *pohaku `eho* were found. Three radiocarbon dates from charcoal recovered in fire pits indicate that the site, which has been interpreted as a temporary camp occupied on the ascent to and descent from the Mauna Kea Adze Quarry, is of late pre-contact age (ca. AD 1600-1700).

Table 3.5 Historic Properties Located in the Hale Pōhaku **Area (Site 50-10-23-16244)**

State Site No.	BPBM Site No. 50-Ha-G28-87-	Description	Functional Interpretation
9074		Stone cabin	Rest house built in 1936
9075		Stone cabin	Rest house built in 1939
9076		Stone building	Comfort station built in 1950
10310	Locality 1	Lithic scatter	Adze and octopus sinker manufacturing workshop
10311	Locality 2	Lithic scatter	Adze and octopus sinker manufacturing workshop
10312	Localities 3 and 4	Lithic scatter	Adze and octopus sinker manufacturing workshop
10313	Shrine 1	3-5 uprights and octopus manufacture offerings	Octopus sinker manufacturing ritual
10314	Locality 5	Lithic scatter	Adze and octopus sinker manufacturing workshop
10315	Shrine 2	1 upright	Ritual
10316	Locality 6	Lithic scatter	Adze and octopus sinker manufacturing workshop
10317	Locality 7	Lithic scatter and firepit	Possible temporary camp and adze and octopus sinker manufacturing workshop
10318	Locality 9	Lithic scatter	Adze and octopus sinker manufacturing workshop
10319	Locality 10	Lithic scatter	Octopus sinker manufacturing workshop
10320	Locality 8	Lithic scatter and firepit	Temporary camp and adze and octopus sinker manufacturing workshop
10321	Locality 11	Lithic scatter	Adze and octopus sinker manufacturing workshop
10322	Locality 12	Lithic scatter	Octopus sinker manufacturing workshop
10323	Locality 4	Lithic scatter	Adze and octopus sinker manufacturing workshop
16245	Locality 13	Lithic scatter	Adze and octopus manufacturing workshop
16246	Locality 14	Lithic scatter	Adze and octopus manufacturing workshop

**The State site numbers were arbitrarily assigned by Cordy (1994:Table 28) before the 1991 site report was submitted to SHPD. Cordy assigned numbers to each of the 14 remains identified in the survey and also gave a number (50-10-23-16244) to the whole site complex (BPBM Site No. 50-Ha-G28-87), which was called the Pu`u Kalepeamoa Site by McCoy (1985b, 1991)

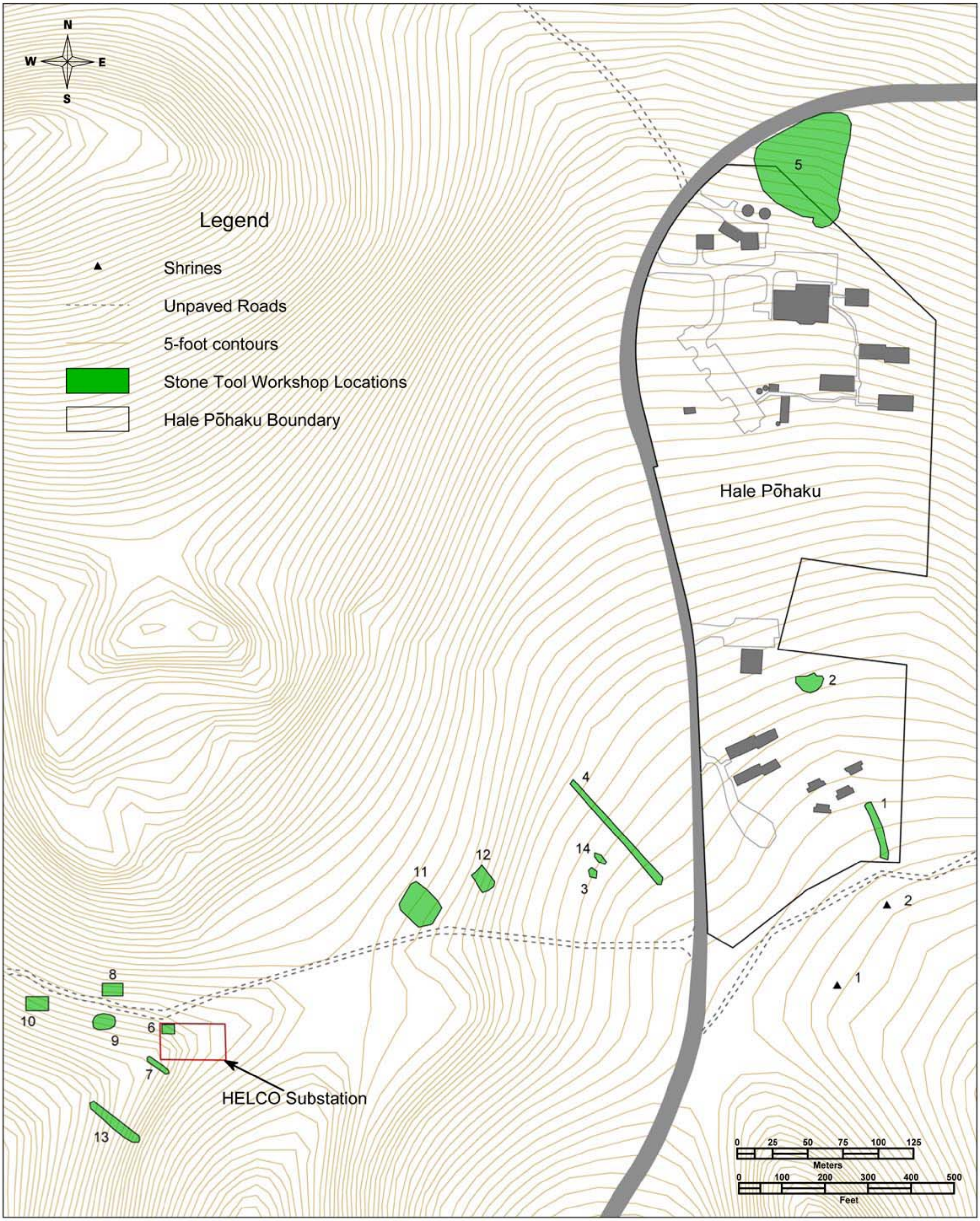


Figure 3.7 Location of Historic Properties in the Pu`u Kalepeamoa Site Complex (Site 16244).

Cultural Surveys Hawaii conducted another reconnaissance survey at Hale Pohaku on August 9, 1990. The survey, which was done in conjunction with the construction of dormitories for the JNLT (later renamed the Subaru Telescope), covered a portion of the area surveyed by the Bishop Museum in 1985. The survey, which relocated two lithic scatters, recommended data recovery investigations prior to construction of the dormitories (Robins and Hammatt 1990). The data recovery work was conducted October 19-20, 1993 by Cultural Surveys Hawaii. Two radiocarbon dates were obtained that support the idea of a late prehistoric camp site (Hammatt and Shideler 2002).

Archaeological monitoring of four septic tank excavations was conducted in March 2005 by PCSI. No cultural remains were found in any of the excavations except for buried modern utility lines. The monitoring report noted that while all of the known surface features in the lease area have undergone data recovery and no longer exist, there is a possibility that buried cultural deposits might exist in some undisturbed areas (McCoy 2005).

In 2010 PCSI conducted an historic resources inventory of two stone rest houses that were built by the CCC in 1936 and 1939 and a comfort station constructed in 1950 (Park and Pamerleau-Walden 2010, Table 3.5). The three buildings, which are called the Halepohaku Rest Camp in the inventory, were assigned SIHP numbers 50-10-23-9074 (rest house 1), 50-10-23-9075 (rest house 2), and 50-10-23-9076 (comfort station). The three sites, like the Pre-contact sites investigated earlier are all part of Site 50-10-23-16244 (Cordy 1994).

3.3 MAUNA KEA ACCESS ROAD

The third UH management area is the summit access road from the OCIA at Hale Pōhaku to the Science Reserve boundary at the approximately 12,000-foot elevation. This includes a corridor approximately 400 yards wide on either side of the road, except for sections that fall within the boundaries of the NAR (see Figure 1.2).

In 1987 the Bishop Museum was contracted by the Facilities Planning and Development Office of UH to undertake an archaeological reconnaissance survey of the Mauna Kea Observatories Access Road above Hale Pōhaku, the former cement batch plant located in the NAR, and a stockpile area as part of the planning process for road improvements and new parking areas (see Figure 3.4). The survey covered a 100-foot wide corridor on both sides of the road. A post-field letter report dated July 7, 1987 (Williams 1987) indicates that no new sites were found during the road survey and the resurvey of the batch plant and stockpile area. New data on Site 16204 (see description below), located in close proximity to the road, was obtained during the project (McCoy 1999b). A final report on the road survey was never prepared by the Museum.

An inventory survey of the road easement was undertaken by PCSI in 2009 for the OMKM (McCoy et al. 2010). The survey identified one previously recorded site (50-10-23-10314) and three new sites (50-10-23-27867, 27868, and 27869). The previously recorded site is a lithic scatter comprised of the by-products of adze manufacture and octopus lure sinker manufacture. The site, which is interpreted as a workshop, is part of the larger Pu`u Kalepeamoa Site Complex (Site 50-10-23-16244) that has been interpreted as a logistical support camp occupied on the ascent and descent from the Mauna Kea Adze Quarry Complex (Site 50-10-23-4136). The three new sites are inferred to be possible burials based on their location, architectural characteristics of the structural remains, size and morphological similarity to known and suspected burial features in the higher elevation areas on Mauna Kea (McCoy et al. 2010). Table 3.6 summarizes the sites found in the road easement.

Table 3.6 Historic Properties Recorded in the Road Easement Survey Area

Site No.	Site Type	Site Function
50-10-23-10314	Lithic Scatter	Adze Manufacturing
50-10-23-27867	Mounds	Possible Burial, Stone Marker/Memorial
50-10-23-27868	Mound	Possible Burial, Stone Marker/Memorial
50-10-23-27869	Mounds	Possible Burial, Stone Marker/Memorial

3.4 MAUNA KEA ICE NATURAL AREA RESERVE (NAR)

As noted above, the NAR was created in 1981. The NAR consists of two separate parcels, a 3750.0 -acre pie-shaped parcel (TMK: (3) 4-4-15:10) that encompasses most of the Mauna Kea Adze Quarry and Lake Waiau, and a 143.5-acre parcel (TMK: (3) 4-4-15:11) surrounding Pu`u Pōhaku, where fossil ice has been found (see Figure 3.4). Table 3.7 presents a list of previous archaeological investigations conducted within the NAR since 1935.

Table 3.7. Summary of Previous Archaeological Research and Cultural Resource Management Projects in the Natural Area Reserve

Year	Project	Study	Reference
1935	Hawaiian Academy of Science Expedition	Reconnaissance	Wentworth et al. nd
1937	Independent Research on Mauna Kea Adze Quarry	Reconnaissance	Emory 1938
1956	Independent Research on Mauna Kea Adze Quarry	Mapping and Description of a rockshelter	Y. Sinoto field notes
1971	Geo-Archaeological Research on Mauna Kea Adze Quarry	Test Excavation of Site 50-Ha-G28-6	Barrera field notes
1975-76	NSF Research Project on the Mauna Kea Adze Quarry	Reconnaissance and inventory survey	McCoy 1977, 1978, 1990; Cleghorn 1982; Allen 1981; Williams 1989)
1984	Bishop Museum Survey	Reconnaissance of Lake Waiau and Pu`u Hau Kea	Carter and Peterson field notes
1997	SHPD Survey	Reconnaissance of Lake Waiau	SHPD field notes
2007	PCSI Survey	Inventory Survey of Lake Waiau Area	McCoy and Nees 2009

Several 19th century expeditions to the summit region spent some time passing through what is now the NAR and occasionally stopping at one well known locality named Keanakako`i, or Keanakākoʻi, which translates literally as “cave of the adze,” appeared for many years on USGS quadrangle maps and according to some is the traditional name for what has become to be called the Mauna Kea Adze Quarry Complex, although another similar name, Kaluakako`i also appears in the literature (Maly and Maly 2005:279). The existence of the adze quarry was reported in the first recorded European ascent of Mauna Kea by Joseph Goodrich in 1823. Short accounts of the quarry complex appear in the records of other late 19th century and early 20th century expeditions to the mountain. One of the most informative is the account of W.D. Alexander's party, in 1892. About half an hour after leaving Lake Waiau, on the descent back to base camp, the party came to what they called the "axe-makers" cave called Keanakāko`i:

> This is situated about a mile south of Waiau, and a hundred yards west of the trail, in a ledge of that hard, fine-grained kind of rock, which ancient Hawaiians preferred for their stone implements. Here we saw the small cave in which the axe-makers lodged, their fire place, and remains of the shell fish they ate. In front of it is an immense heap of stone flakes and chips some 60 feet across and 20 or 30 feet high. Near by several hundred unfinished axes are piled up just as they were left by the manufacturers, when the arrival of foreign ships and the introduction of iron tools had ruined their trade…It was here that the late Dr. Hillebrand found a curious idol, which is still in the possession of his family (Maly and Maly 2005:189).

One of the earliest and most interesting descriptions of the adze quarries on Mauna Kea was made by William Brigham in his treatise *Stone Implements and Stone Work of the Ancient Hawaiians*.

His description, which contains several factual errors, was nonetheless the first to acknowledge the quarry as the most important of all those known at the time:

> Let us climb to the workshop of the adze maker. All these were in high places, and one on Mauna Kea, Hawaii, was nearly 12,900 ft. above the sea. As good clinkstone was not found in many places the known quarries hardly exceeded half-a-dozen. On Hawaii was the most important of all, that on Mauna Kea, where the workmen could only work in favorable seasons for the snow frequently covered the quarry, but from the immense quantity of fragments and chips the work must have extended over many generations; so far as known, this was the earliest quarry exploited, and it is puzzling how the place was discovered when we consider the aversion the Hawaiians had to even visiting those high, bleak and desert regions, the supposed abode of spirits not always friendly. It is possible that the tradition which speaks of the survivor of the deluge of Kahinalii grounding on Mauna Kea and following the receding waters to the lower levels, discovering the koi pohaku on the way, may point to the considerable antiquity of adze-making in this place, but I am inclined to believe that all traditions of the Hawaiian deluge date after the coming of the Spanish discoverers. It has always seemed strange that the axe-makers did not bring the raw material down to their homes and work it up in comfort instead of freezing in their kapa garments at this great altitude. It may be that the mystery of the place and its very solitude kept the trade in few hands and so enhanced the value of a tool that so many must have (Brigham 1902:75-76).

Of particular interest is Brigham's reference to the aversion of Hawaiians to high desolate places and the discomfort of working under less than favorable conditions; the possible link between environmental conditions and the labor component of the production process, and the probable influence this had on the value of a tool that as he so neatly put it *"so many must have*."

Robert Aitken, a member of the 1935 Hawaiian Academy of Science Expedition, made some general observations about the quarry which are summarized in the unpublished manuscript of the expedition (Wentworth et al. n.d.). In 1937 Bishop

Museum archaeologist Kenneth Emory visited the quarry over a three day period. He photographed and briefly described some of the shrines and rockshelters in the Humu`ula Trail and Pu`u Ko`oko`olau sector of the quarry complex. On file in the Bishop Museum is a USGS map on which Hebert Gregory had plotted what he believed to the lower limit of glaciation and the directions of glacial advances from the summit area. Emory used Gregory's map to plot the locations of the shrines and rockshelters he visited, which numbered six in total. A popular account of Emory's visit appeared in *Paradise of the Pacific* (Emory 1938:21-22).

Dr. Yosihiko Sinoto sketched and described one rockshelter in 1956. In 1971, the late William Barrera partially excavated a 50 cm square test pit in the floor of a rockshelter that was subsequently recorded as Bishop Museum Site 50-Ha-G28-6-R1 (SIHP Site 50-10-23-16209). The excavation was undertaken in conjunction with geological and soil studies by Drs. Stephan Porter and Fiorenzo Ugolini of the University of Washington. No report was ever prepared on the excavations (McCoy 1977:223-224).

The first major archaeological investigations of the adze quarry were conducted over a 7-month period in the summers of 1975-76. The 1975-76 project, which did not cover the whole of the quarry, identified 37 sites, two of which are located in the Science Reserve. The sites included 263 workshops comprised of 1566 "chipping stations" with 182 open-air enclosures; 39 rockshelters (this includes what were originally called overhang shelters); 40 shrines; 2 rock art localities and 1 basaltic glass source and workshop.

The Mauna Kea Adze Quarry Complex, one of the most significant historic sites in the Hawaiian Islands, was placed on the National register of Historic Places in 1962 as a National Historic Landmark (NHL). The boundaries of NHL have yet to be officially established by the National Park Service. Boundary recommendations were made in 1978 following the research in the best known and most accessible part of the quarry in 1975-76 (McCoy 1978: Figure 2). On present evidence the quarry covers not only more area but also contains a larger volume of manufacturing by-products and related archaeological remains than all of the other known adze quarries in the Hawaiian Islands combined (McCoy 1977; McCoy and Gould 1977). Fieldwork west of Pōhakuloa Gulch, in 1984-85 and again in 2007, indicates that the quarry encompasses a larger area than what was reported earlier, at the conclusion of the first phase of research in 1975-76 (McCoy 1977; McCoy and Gould 1977). Most of the quarry complex is located in the NAR, but some sites are located in the Science Reserve. Quarry and workshop sites have also been found on Mauna Kea Forest Reserve lands.

A reconnaissance survey of the Lake Waiau area was conducted in 1976 during the second field season of the Mauna Kea Adze Quarry research project (McCoy 1977, 1978). Little time was devoted to the survey of the lake area after finding that there was no tool-quality basalt in the immediate environs. No artifacts linking the lake to the adze quarry were found in the survey, but the lake was included in the proposed boundaries of the Mauna Kea Adze Quarry National Historic Landmark based on the assumption that not only was the lake a part of the "effective environment" used and possibly modified by Hawaiian adze makers, but because of the potential of the lake to aid in the interpretation of paleoenvironmental changes through the study of fossil pollens contained in the lake sediments (McCoy 1978:17-18). In addition, it was assumed that the location of the lake, just below the summit of the mountain, held special cultural significance for the adze makers and other Hawaiians. One site, a cluster of cairns located above the northwestern side of the lake, was recorded and assigned a site number in 1976 (BPBM Site No. 50-Ha-G28-36). The site marks the northwest corner of the proposed NHL boundary (McCoy 1978: Figure 2).

A sketch map showing cultural features at the lake and on the rim of Pu`u Hau Kea was made on July 28, 1984 at the end of the reconnaissance survey of ca. 1,000 acres of land on the east slope (McCoy 1984b). A number of features were noted on the rim of the Pu`u Waiau and below, along the margins of the lake. Two possible cairns were noted in a quick reconnaissance around the rim of Pu`u Haukea (Carter and Peterson, unpublished field notes).

Prior to an archaeological inventory survey conducted in 2007 (see below) only one site at Lake Waiau had been given a SIHP number. A cluster of five cairns and two uprights was assigned BPBM number 50-Ha-G28-36 in 1976 for the purpose of marking one corner of the recommended boundaries for the Mauna Kea Adze Quarry National Historic Landmark (McCoy 1978: Figure 2). The site was later given a SIHP number (50-10-23-16232) by Cordy during the writing of his *Regional Synthesis of the Hamakua District* (Cordy 1994).

While a number of other features were observed in 1976, 1984 and at other times, it was not until 1997 that a conscientious effort was made to begin recording all of the sites and features at the lake. The survey initiated by SHPD in 1997 was constrained by time, with the result that many sites and features were left unrecorded. The quality of much of the data that were collected was, moreover, not up to inventory survey standards. In view of the obvious need for a more comprehensive survey no SIHP numbers were assigned to the remains recorded in 1997.

Material support for the theory that the lake was frequented by the adze makers was found in the 1997 survey. A flake, presumed to be a waste flake from the adze quarry based on its texture and color, was found near the outlet to lake. While there is no way of knowing when the flake was introduced, it is not part of any modern construction and was in fact found in close proximity to a petroglyph, the first recorded at the lake.

PCSI conducted an archaeological inventory survey of Lake Waiau, located at the 13,020 ft elevation in the Mauna Kea Ice Age Natural Area Reserve, over a 6-day period in July 2007. The survey followed on earlier archaeological reconnaissance surveys in 1976, 1984, and 1997 that had identified a number of features in the immediate environs of the lake. A total of 21 sites comprised of 99 features were found in the survey area which covered approximately 43 acres (McCoy and Nees 2009).

The features recorded during the 2007 survey include possible burials; cairns that may have functioned as survey markers, boundary markers or trail markers; shrines and possible shrines; one trail segment; petroglyphs; lithic scatters related to adze manufacture; a cemented stone pedestal for survey equipment from an 1892 expedition; an historic dump and stone markers or memorials, including the remnants of a memorial plaque to a local cowboy. A number of features that had never been seen before because they are normally covered by water were found in the lakebed which was at a low stand in 2007. Most of these features, which are morphologically similar to previously identified structural remains on the rims of a number of cinder cones in the Mauna Kea summit region, are interpreted as possible burials.

If the remains are in fact burials, it indicates a much more diverse set of mortuary practices than what was previously known at the lake. It mirrors the on-going cultural practice of placing umbilical cords (*piko)* in the lake and on the land. The lithic scatters, which consist of primarily flakes but in one area also include an adze preform and a hammerstone, confirm a long suspected use of the lake by Hawaiian adze makers working in the Mauna Kea Adze Quarry Complex as not only as a probable source of freshwater but for other activities as well.

While none of the 21 sites have been dated, the presence of adze manufacturing by-products suggests that the cultural chronology of Lake Waiau began sometime in the pre-contact era. Continuity in the use of the lake from pre-contact times to the present is evidenced in the remains left by early scientific expeditions, modern altars (*lele*) and less formal rock piles. Remains that are either modern or cannot be classified with any level of confidence as historic sites because of their uncertain age, such as many of the rock piles, were recorded as “find spots,” following a practice begun by the SHPD during a reconnaissance survey of selected areas of the Science Reserve in 1997. A total of 63 find spots were recorded in the project area (McCoy and Nees 2009).

3.5 Hopukani, Waihu, and Liloe Springs

The first published reference to the existence of archaeological sites in the Pōhakuloa Gulch area is contained in a report by Wentworth and Powers (1943) who made the following observations during the course of their geological investigations in 1939:

> One section of the valley is isolated by the steep walls of thick lava flows, above and below which are stone walls built many years ago as a trap in which to impound wild cattle that frequented the spring area. The last of the wild cattle have been killed, but a few skulls were to be seen in 1939.
>
> In the area to the east and up the slope from the springs are numerous small heaps of pre-European stone adz workings. Certain lava caves contain evidence of habitation, suggesting that the springs were frequented by adz workers. The latter not only secured adz material from lava flows in places but carried on a surprising amount of casual prospecting on dense basalt boulders included in the moraines and outwash strewn several thousand feet down the mountain (Wentworth and Powers 1943:544).

In a later report on this area, Richardson and Woodside (1954:326-7) noted the presence of dark-rumped petrel (*Pterodroma phaeopygia)* bones and artifacts in a site they named Hopukane Shelter Cave, located at the ca. 10,000 ft elevation. This must be one of the habitation caves seen by Wentworth and Powers in 1939. It appears, more precisely, to be site 50-Ha-G28-34 (renamed Hopukani Rockshelter) based on information obtained from Woodside (personal communication).

The first systematic archaeological investigations in the Pōhakuloa Gulch area were undertaken in 1976, during the second field season of the Mauna Kea Adze Quarry Project (Table 3.5; see Figure 3.4). A reconnaissance survey of the Pōhakuloa Gulch area, between Lake Waiau and Mauna Kea State Park, was conducted over a two-day period (August 14-15, 1976). Five sites were recorded in this survey (unpublished field notes). Two of these sites (50-Ha-G28-34 and 35) are located along or in close proximity to the PTA waterline. The proposed western boundary of the NHL (McCoy 1978: Fig. 2) was established on the basis of the findings made during this survey.

In 1984 six archaeological sites and a number of find spots were identified in a reconnaissance survey of the PTA waterline catchments and pipeline at Hopukani, Waihu, and Liloe springs, located between the ca. 10,400 and 8,640 ft elevations in the western sector of the Mauna Kea Adze Quarry Complex (McCoy 1984a). The 1984 reconnaissance survey consisted of an intensive survey within a 100 meter radius of each spring and a walk-through survey of the intervening areas, covering approximately 50 meters on either side of the pipeline. The survey area encompassed approximately 16 hectares (McCoy 1984a:3). Five adze manufacturing sites and one historic corral were identified in the survey, which confirmed expectations of a significantly larger number and variety of sites in this part of the quarry complex, which includes sites located above and below modern treeline at the ca. 9,500 ft elevation. Indications of even more sites to the west of the major Pōhakuloa Gulch drainage area suggest the probability of a future boundary amendment and need to reassess what has been implicitly regarded as a fringe or marginal area of the larger quarry complex.

A data recovery project was undertaken in 1985 to mitigate the possible adverse effects of proposed repairs to the pipeline on the sites identified in 1984 (Table 3.8). Test excavations of a small overhang shelter at Hopukani Spring (10,400 ft) revealed a small assemblage of waste flakes, hearths and faunal remains suggestive of a temporary, short-term occupation. A much larger and more diversified collection of lithic artifacts and organic materials was recovered in the survey and test excavations of Hopukani Rockshelter (10,160 ft), the only previously known base camp in this region of the quarry. Investigations of the isolated site in the subalpine forest at Liloe Spring (8,921 ft) resulted in the definition of site boundaries and acquisition of data pointing to the existence of an open camp site at this lower elevation locality.

Table 3.8. Summary of Previous Cultural Resource Management Projects in the Hopukani, Waihu, and Liloe Springs Area

Year	Project	Study	Location	Reference
1984	PTA Waterline Improvement	Reconnaissance	Hopukani, Waihu, and Liloe Springs	McCoy 1984a
1985	PTA Waterline Improvement	Data Recovery	Hopukani and Liloe Springs	McCoy 1986

The chronology for this area of the quarry, based on a total of eight radiocarbon dates for the three excavated sites, spans a period of some 700-800 years beginning ca. AD 1000 and terminating some time prior to 1800. Some preliminary ideas regarding the significance of adze manufacturing sites and other sites located in the two major drainages on the south slope of the mountain were presented in a 1984 report:

> The sites located in the mid-elevation reaches of the Pohakuloa and Waikahalulu Gulch drainage systems are of particular importance with regard to questions relating to ascent routes, resource ownership, and general relationships to the main quarry area at the 12,200 to 12,400 ft. elevations. Material recovered in the excavations of Waikahalulu Rockshelter (Site 50-Ha-G28-11-R1) at the ca. 10,000 ft. elevation on the gulch of the same name, suggest a strategically located mid-elevation base camp on a southerly ascent route to the primary sources of raw material further up the mountain. Both this site and Hopukani Rockshelter (50-Ha-G28-34) are located just above present treeline in close proximity to freshwater springs, thus providing ready access to water, firewood, and other forest products, including birds, of which there are a number of species in the Waikahalulu camp site (McCoy 1983). The final provisioning of some task groups of adze makers residing in the rockshelters at higher elevations probably took place at these two intermediate camp sites and possibly much of the cooking of foods such as taro and yams as well, although there is as yet no direct

> archaeological evidence for these activities. There is the added implication, again admittedly speculative, that these upper montane forest base camps were occupied by family groups, including women, engaged in a variety of activities directly related to adze production and, perhaps, other unrelated economic pursuits as well (e.g., feather, fiber and wood crafts).
>
> Equally significant from an historical perspective on later land-use and socio-economic patterns are the walls and corral that functioned as a wild cattle trap. This site reflects a socially, and environmentally critical period in the early post-contact era of Hawaiian-European relations in Hawaii and the Mauna Kea-Waimea-Kawaihae areas in particular (McCoy 1984a:26-27).

3.6 Radiocarbon Chronology for Previously Excavated Sites in the Alpine and Sub-alpine Zones

A suite of 23 radiocarbon dates from eight excavated sites (Figure 3.8; Table 3.9) indicate that the adze quarry industry spanned a period of some 700 years between ca. AD 1100 and 1800. A lower limiting date of perhaps AD 800-1000 seems likely based on the interpretation of stratigraphic evidence from several of the excavated rockshelters. The basal layer of Ko`oko`olau Rockshelter No. 1, for example, is undated and where test excavations have been undertaken exterior of the dripline there is an indication of earlier activity. With regard to an upper limiting or terminal date, there is archaeological as well as ethnohistoric evidence (McEldowney 1982:7) suggesting that the quarry may have been abandoned prior to or just following first known European contact in 1778 (see Section 7 for further discussion of the chronology of adze.

The 840 +/- 60 Before Present (BP) date (Beta-15644) for the occupation of the Hopukani Spring Overhang Shelter is somewhat older than expected, but not out of line with the early dates for `Ua`u Rockshelter and Ko`oko`olau Rockshelter No. 1 in the main quarry (see Figure 3.8; see Table 3.6). The date is associated with a temporary occupation and, thus, should not be interpreted as marking the beginning of intensified adze manufacture at this locality, or even this region of the quarry. On present evidence the chronology of long-term, repeated exploitation of the drift deposits on and below the Makanaka and Waihu glacial moraines is believed to have begun ca. AD 1300. Terminal dates are not available for Hopukani Rockshelter, but the cultural sequence almost certainly ends prior to 1800. The 500 +/- 90 BP date (Beta-15649) for the Liloe Spring Site is consistent with the Hopukani Rockshelter dates, thus suggesting broad contemporaneity of adze manufacturing locales in the subalpine forest and the larger, more visible ones above treeline. This interpretation is consistent with the chronological relationships of lower and higher elevation sites elsewhere in the quarry.

On present evidence, which is limited to five dates from very limited testing, the Pu'u Kalepeamoa site is a late prehistoric and possibly even protohistoric age site (see Figure 3.8; see Table 3.6). It appears to be one of the latest sites in the quarry sequence, which spans a period of approximately 700 years between ca. AD 1100 and 1800. Given that all but one of the dates are consistently late, there does not appear to an "old wood problem" (Schiffer 1987:309-312; cf. also Gould 1990:19-21). The one anomalous date (Beta-71138) is organic sediment (Hammatt and Shideler 2002).

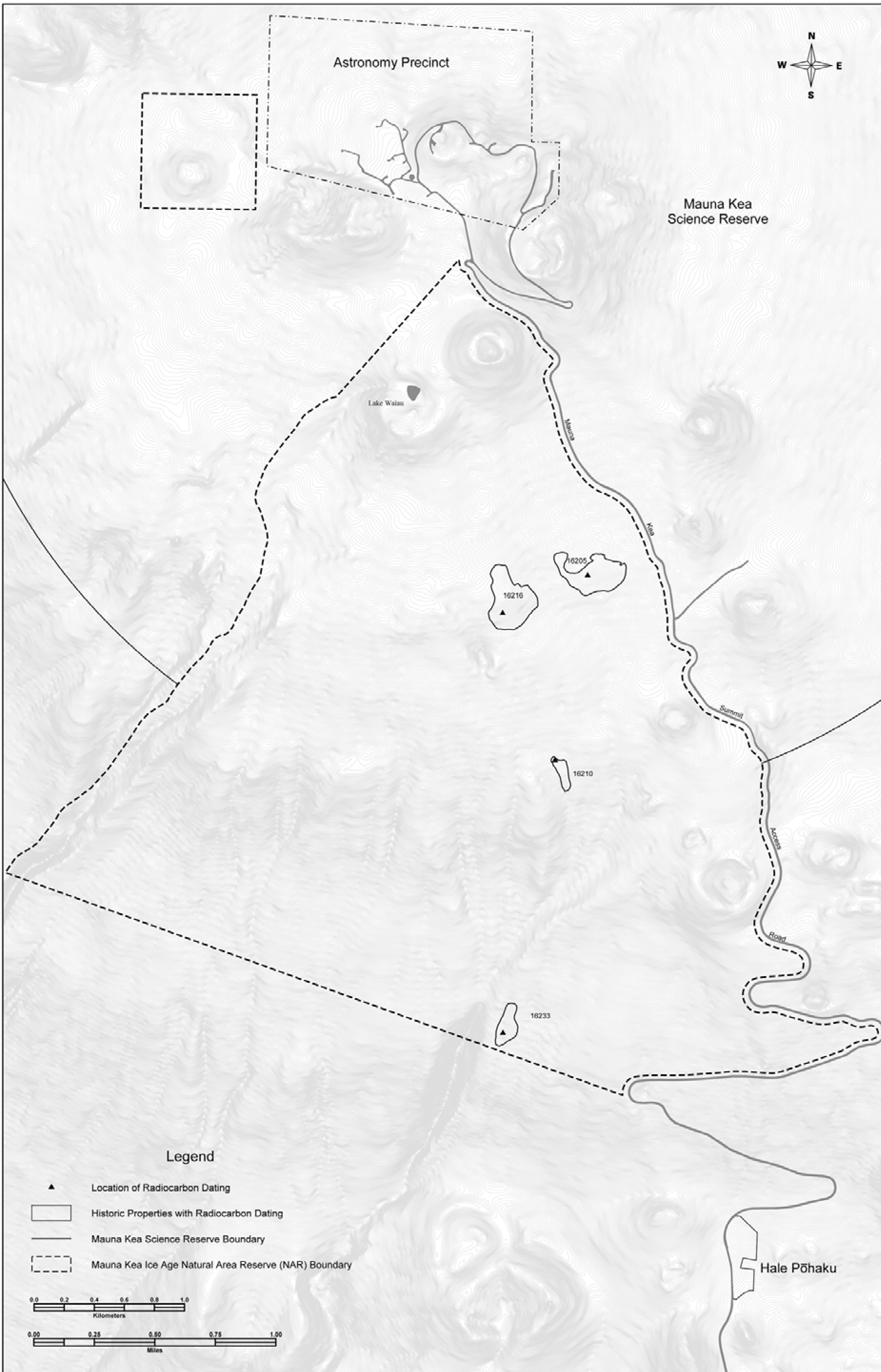


Figure 3.8 Location of Radiocarbon Dated Sites in the NAR.

Table 3.9 Radiocarbon Age Determinations for Previously Excavated Sites in the Alpine and Sub-alpine Zones on Mauna Kea

Zone	Elevation (meters)	Site	Provenience[1]	HRC No.[2]	Lab No.	Uncorrected Age[3]		Corrected Age (AD)[4]
						BP	AD	
1	3,780	Ko'oko'olau Rockshelter No. 1	B2 IV F1*	279	I-9128	355 ± 80	1595 ± 80	1400-1660
			B3 VI F3*	311	I-9743	470±75	1480±75	1350-1495
			B3-B4 VIII F4*	312	I-9744	775±80	1175±80	1045-1340
	3,727	'Ua'u Rockshelter	C5 II F2*	267	I-9070	190±80	1760±80	1490-1950
			B5 IV F3*	263	I-9069	490±80	1460±80	1315-1520
			G5 VI/3 **	275	I-9071	425±80	1525±80	1340-1465
			E5 VIII**	277	I-9072	355±165	1595±165	1335-1950
			E5 VIII F15**	299	I-9929	655±80	1295±80	1225-1415
2	3,475	Ahinahina Rockshelter	C3 II F2*	300	I-9741	345±75	1605±75	1420-1650
			surface*	340	W-4539	<200[5]		
3	3,170	Hopukani Rockshelter No. 2	7C-8C II F1*	828	Beta-15644	840±60	1110±60	1050-1265
	3,100	Hopukani Rockshelter No. 1	M24 II/III*	862	Beta-15647	290±80	1660±80	1415-1950
			M24 V F5*	869	Beta-15648	250±70	1700±70	1495-1800
			M28 II F1**	836	Beta-15645	810±60	1140±60	1065-1285
			M28 III F2b**	842-843	Beta-16400	520±60	1430±60	1330-1430
			M28 IV**	845	Beta-16401	520±60	1430±60	1330-1430
			M28 V F3**	853-857	Beta-15646	470±60	1480±60	1350-1495
	3,050	Waikahalulu Rockshelter	C4 III F1*	304	I-9742	430±75	1520±75	1400-1515
			D4 V F3**	307	W-4538	370±60	1580±60	1415-1640
	2,712	Liloe Spring Workshop		874	Beta-15649	500±90	1450±90	1310-1515
4	2,800	Pu'u Kalepeamoa	87-8 H8 II	979	Beta-23417	modern		
			87-8 H8 II	981	Beta-23418	250±70	1700±70	1495-1800
			87-7 II	1008	Beta-26377	130±50	1820±50	1650-1950
			10,310 II		Beta-71138	660 ± 60	1290±60	1260-1410
			10,311 II		Beta-71139	250 ± 60	1700±60	1510-1950

1 Square or excavation unit [e.g. B2], layer/level, [e.g. VI/3] feature no. [e.g. F1]; *=interior context [back of the dripline] **=exterior context [beyond the dripline]
2 HRC=Bishop Museum Hawaii Radiocarbon No.
3 see Section 6.2.1 for explanation of Zones; the uncorrected dates for sites in Zones 3 and 4 are C13 adjusted
4 based on Klein et al. (1982)
5 silversword; all other dates are on wood charcoal except for Beta-71138 which is organic sediment

A comparison of the available dates (see Table 3.6) indicates that the sites with the earliest and longest sequences are located along the escarpment in what I have elsewhere referred to as Zone 1 (McCoy 1990) and at Hopukani Spring in Zone 3. In sharp contrast to this pattern are the lowest elevation sites, the Pu`u Kalepeamoa site and the Saddle Road lava tube shelter, which appear to have been occupied for a brief period of time after ca. AD 1600-1700.

3.7 ASSESSMENTS AND MITIGATION PLANS

Cultural assessment studies have been undertaken for several recent projects. One is a traditional cultural property assessment and the other a cultural impact assessment, which is now required under Chapter 343 for Environmental Impact Statements. A draft Historic Preservation Plan (HPP) was developed for the UH Management Areas on Mauna Kea in 1999. The draft HPP was replaced by a CRMP in 2009.

3.7.1 Traditional Cultural Property Assessments

Traditional cultural properties are a type of historic property that was formally defined for the first time in 1998 by Patricia Parker and Thomas King, in National Register Bulletin 38 (*Guidelines for Evaluating and Documenting Traditional Cultural Properties*). TCP's, to use the commonly used acronym, were defined by Parker and King defined as follows:

> A traditional cultural property, then, can be defined generally as one that is eligible for inclusion in the National Register because of its association with cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community (Parker and King:1998:1).

Parker (1993) notes that an important difference between traditional cultural properties and other kinds of historic properties is that the significance of tcp's "cannot be determined solely by historians, ethnographers, ethnohistorians, ethnobotanists, and other professionals. The significance of traditional cultural properties must be determined by the community that values them" (Parker 1993:5). The Hawaiian oral traditions summarized in Section 2 testify to the importance of Mauna Kea and the summit in particular.

At the request of SHPD, Dr. Charles Langlas of UH Hilo conducted a TCP assessment of Mauna Kea in 1997 as part of the cultural resource management studies for the Hawaii Defense Access Road and Saddle Road Project. Langlas' work was undertaken in conjunction with a social impact assessment of the proposed road improvements on the *mamane-naio* forest (Kanahele and Kanahele 1997). The studies had two objectives: "(1) to evaluate the two areas as to their potential eligibility for the National Register of Historic Places, and (2) if eligible, determine the effect of the project and how to mitigate any adverse effect" (Langlas 1999:1). A letter written in March 1999 that accompanied the submittal of a supplement to the main study (Langlas et al. 1997), indicated that "the author intended to conclude that although the whole upper zone of Mauna Kea should be considered eligible as a traditional cultural property for the National Register of Historic Sites (as a historic district), he cannot recommend that the summit peak be considered eligible as a specific site, because he cannot make public the information he collected by Kupuna X" (Langlas 1999).

During the preparation of the Master Plan, in 1999-2000, SHPD designated three areas as TCP's because of their association with legendary figures and on-going cultural practices. Two of the TCPs, which are described in Section 5, are located in the Science Reserve. These include the summit (Kūkahau`ula) and Pu`u Līlīnoe. The third is Lake Waiau, which is located just outside of the Science Reserve in the NAR.

Tom King, in the declaration he submitted as part of the contested case hearing for the Keck Outrigger project (King 2003), stated his opinion that the landscape on the upper slopes of Mauna Kea meets the eligibility criteria for inclusion in the National Register as a TCP (King 2003:6-7). There are other individuals who believe that all of the lands above the 6,000 ft elevation should be recognized as a TCP (NASA 2005:xv).

3.7.2 Cultural Impact Assessments

A cultural impact assessment study was undertaken by Paul H. Rosendahl, Ph.D. Inc. (PHRI) for the EIS for the Master Plan under HRS Chapter 343-Environmental Impact Statements and HAR Title 11, Chapter 200-Environmental Impact Statement Rules. Office of Environmental Quality Control (OEQC) guidelines were employed in the study, which was focused on determining what effects implementation of the Master Plan would have on Native Hawaiian cultural practices, features and beliefs. The primary sources of information used in the assessment were oral histories and consultations undertaken by Kepa Maly, who at the time was employed by PHRI. Another of Maly's reports was included in the Master Plan as Appendix I (Maly 1999).

The cultural impact assessment identified a number of traditional and customary practices, several potential traditional cultural properties and several kinds of contemporary cultural practices, some of which may represent continuity of older practices, but also including practices where "no clear specific basis in traditional culture can be clearly established or demonstrated" (PHRI 1999:Table 2, 40). The PHRI report summarized Native Hawaiian perspectives on the Master Plan, from which Maly presented six recommendations, and a concluding discussion of potential mitigation measures.

3.7.3 Preservation, Management, and Burial Treatment Plans

In 1999-2000 the State Historic Preservation Division of the Department of Land and Natural Resources began preparing a HPP for the UH Management Areas on Mauna Kea. A final HPP was never completed before the authors of the plan left SHPD, but parts of the HPP were included in the Mauna Kea Science Reserve Master Plan as appendices. These included "Mauna Kea Historic Preservation Plan Management Components" (Appendix F, SHPD 2000) and "Mauna Kea Science Reserve Archaeological Site Inventory: Formal, Functional, and Spatial Attributes" (Appendix K, McCoy 1999a).

The SHPD Plan identified all of the major activities and actions that could have a potential adverse effect on historic properties located in the state lands managed by UH and the means by which such effects could be mitigated to ensure the long-term protection of individual historic properties and the Mauna Kea Summit Region Historic District as a whole. It also summarized existing management policies, which included the NAR, and made a number of additional policy recommendations.

In 1999 the National Aeronautics and Space Administration (NASA) proposed the addition of four and possibly as many as six outrigger telescopes to the W.M. Keck Observatory. After consultation with SHPD, NASA determined that the proposed project, which was classified as an undertaking under Section 106 of the National

Historic Preservation Act would have an adverse effect on the summit, which had been recognized as a significant historic property. The finding of adverse effect prompted the development of a Memorandum of Agreement (MOA). One of the stipulations in the MOA was the need to develop, prior to construction, an Inadvertent Discovery of Human Remains and Archaeological Properties Monitoring Plan.

While NASA later withdrew the funding for the Outrigger Project, following legal challenges, the MOA (Appendix B) and the Burial Treatment Plan (Appendix C) included in the Final Environmental Impact Statement (FEIS) are important documents that could be used as models in the development of future construction monitoring plans and burial treatment plans.

A CRMP, based in large part on the earlier SHPD draft historic preservation plan, was prepared by PCSI to assist OMKM in fulfilling its primary mission, which is the protection, preservation, and enhancement of cultural and natural resources in the UH Management Areas on Mauna Kea (McCoy et al. 2010). The CRMP is one of four sub plans for the Mauna Kea Comprehensive Management Plan (CMP) which was approved by the BLNR on April 9, 2009.

4.0 ARCHAEOLOGICAL THEORY AND PRACTICE

Many archaeologists, including the authors of this report, have ambivalent feelings toward "archaeological theory," especially toward some of the grand theories with a capital "T" that derive from philosophy, such as the covering law model. For us, theory is not synonymous with the hypothetico-deductive system.

One of the problems with modern archaeological theory is that it has become increasingly "rarified and removed" (Hodder 2001:4). Another problem is the existence of competing and often conflicting theoretical paradigms which tend, moreover, to be abstract. Without any obvious or immediate relevance "Abstract theory for theory's sake becomes engaged in battles over opposing abstract assertions" (Hodder 2001:4). Some archaeologists even question the existence of archaeological theory. Johnson argues that *we are all theorists* (his emphasis), whether we admit to it or not, because anyone involved in the production of archaeological knowledge uses "theories, concepts, ideas, assumptions in their work" (Johnson 1999:6). Shanks and Tilley go even farther in concluding that "The facts of the case become facts only in relation to convictions, ideas and values" (Shanks and Tilley 1987:104).

Hodder, who is clearly opposed to abstract theory, has noted that "archaeological theory is always "of something" and the recognition of this "undermines claims for a universality and unity of archaeological theory" (Hodder 2001:5). Lacking a universal theoretical underpinning, there are many archaeologists who argue that we should forget about theory and just "get on the business with doing archaeology." For other archaeologists, including the senior author, this is unacceptable:

> Ignoring philosophical and theoretical concerns is no way out. Such an approach, urging us to simply press on with the study of data without worrying about the niceties of theory, presumably inviting us to respond directly to that data, assumes that the lack of any systematic approach or procedure is somehow a miraculous guarantee of objectivity. Such a common-sense approach systematically evades any confrontation with its own premises, safeguards any methodology which is currently available and, in this manner, produces the very opposite of objective problem-free research. Empirical research presented as the obvious stuff of common sense is never called upon to guarantee its consistency, silences, and contradictions and hence is entirely unsatisfactory (Shanks and Tilley 1987:33).

4.1 THE THEORY - DATA DIALECTIC

While there is certainly a place for theory, it is, of course, also possible to go into the field without any theoretical presuppositions and make useful observations that can contribute to new ideas and new theories. Indeed, many archaeological projects are "*data-led*" (Hodder 1999:51). One reason is that the kinds of sites under investigation constrain the types of questions that can be asked (Hodder 1999:51). In the case of archaeological surveys there are, moreover, several potential problems with a strict problem-oriented approach and rigid adherence to the deductive method:

> It may be recognized (Charles Redman, in discussion) that strict problem orientation may miss a great deal, and that simply being open to what may happen to turn up in an excavation is a quite legitimate research strategy. There is nothing wrong with sensitive exploration, being open to finding out (Shanks and Hodder 1995:16).

> The usual contemporary attempt to provide research with rigor, to conquer the difficulties inherent in the natural process of observation and conceptualization, is framed deductively. Studies, we are instructed, should begin and move forward with explicitly stated hypotheses that are continuously tested and refined. Such studies are always methodologically admirable, but they may easily become trivial if the initial hypothesis was incorrectly formed with relation to the objects selected for study. An equally important trouble with the general demand for deductive research is that the scholar might like to approach a new problem, and yet find himself without enough information to form a useful first hypothesis (Glassie 1975:14).

Without hypotheses to test it is necessary to use an inductive approach based on the search for meaningful patterns in the data that have been collected. More important is the need for a rigorous method of recording data (Glassie 1975:116). As Glassie has written, “It is no test of the scholar or his craft to invent a theory and pop bits of information into it” (Glassie 1975:13).

Whether a researcher starts with a theory or collection of raw data, to make any significant contribution to archaeological knowledge requires going back and forth between the two (Jones 2002:37). Shanks and Tilley (1987) and Hodder (1999) describe the tacking between data and theory as a dialectical process:

> Archaeological interpretations of the past are not secondary to the physical reality of the past, the objects in the archaeological record. Understanding the past is a dialectical process occasioned by continual adjustments of ideas, concepts and representations and is not something that could be fixed by a single method such as the hypothetico-deductive method (Shanks and Tilley 1987:108).

4.2 Theoretical Orientation

Philosophically, the senior author is a realist in the way it was defined by Hirst (1967) and summarized by Bunge: “Realism is the view that material objects exist externally to us and independently of our sense experience” (Hirst 1967). It is the epistemology that all of us adopt tacitly when not under the influence of narcotics or anti-scientific philosophies” (Bunge 1996:326). Trigger provided a short but useful contrast with an idealist and a positivist:

> An idealist epistemology generalizes the everyday processes by which human beings deal with each other; a positivist one generalizes the way in which humans cope with the natural world; and a realist one takes account of the selective processes acting on all forms of human behavior (Trigger 1998:9).

In contrast to idealism and positivism, realism is “anti-reductionist and embraces a view of science that takes account of the need for employing different modes of inquiry to study different kinds of phenomena” (Trigger 1998:6). The realist, in Trigger’s view, “believes that some imperceptible entities, either processes or phenomena that are presently unobservable, are appropriate objects for scientific investigation even if they can be known only conceptually” (Trigger 1998:6).

For a realist the “archaeological record is a product of human behavior that was shaped with varying degrees of directness by material constraints, as these were comprehended in terms of culturally conditioned understandings of reality” (Trigger 1998:12). Aronson et al. (1995:43) summarize a point of view that to them and many other people is obvious, that “nature is intransigent and unforgiving” and that “There are causal structures that exist independently of the theories and projects and beliefs of human kind, that are totally unaffected by the way we classify things” (Boyd 1990:183). We agree. As discussed in an earlier report on Mauna Kea (McCoy 1990:86), there is a need to recognize that there are different kinds of material realities, including some like climate, which "remains outside the direct or indirect sway of humankind, but never ceases to affect it" (Godelier 1986:4).

Rather than claiming that the environment is limiting we think it is preferable to follow Glassie in saying that "The physical environment constrains, but it does not direct. It provides the stage upon which cultural options are sorted out, rejected, accepted, and ordered into a particular cultural logic" (Glassie 1975:189; cf. Sahlins 1976 for a similar but even stronger statement, albeit a controversial one, regarding the autonomy of cultural logic). Hodder elaborates on the implications for archaeology:

> The causes of variability in the archaeological record are not cultural or natural. They are both. Many archaeologists would now accept that while the environment and material forces constrain human endeavour, the specific character of human behaviour is equally informed by cultural choice and human intention. This dialectical view has been arrived at from many directions (Hodder 1999:199).

The senior author also favors the interpretive as opposed to the evolutionary perspective as summarized by James Peacock in the following passage:

> The evolutionary perspective tends to an "objective" positivist stance. This is partly due to the large scale of the evolutionary perspective, so that life is viewed from afar in order to see the whole panorama. Accordingly, life is viewed, not engaged...If humans are seen as aspects of a process, they are seen as worked over by such massive mechanisms as natural selection, the process through which the survival of traits is determined by the environment. The subjective viewpoints are of little interest and, in fact, raise the spectre of what evolutionists term the "teleological fallacy" (the fallacy that subjective purposes affect the evolutionary process, which, instead, should be seen as governed by the law of natural selection regardless of any petty motives and purposes...). Given the irrelevance of the actor's viewpoint, humans are treated as part of nature and analyzed according to natural laws (Peacock 1986:98-99).

It is not that the evolutionary perspective is wrong, but that like all paradigms, including the ecological paradigm with which it is commonly linked in the New Archaeology, it is limited (Peacock 1986:96; Pauketat 2004). Trigger summarizes the major shortcomings of the evolutionist perspective in the context of the debate between the older “processual” and the newer “post-processual” archaeology:

> Yet, contrary to the predictions of processual archaeology, during the last fifteen years there has been a growing realization among archaeologists that there is more variation in the archaeological record, and hence in human behavior, than can be accounted for in terms of neo-evolutionism and ecological determinism. This calls into question the distinction that processual archaeologists drew between evolutionism and history, as well as their assertion that, because evolutionism is more generalizing, its study is superior to that of history, in the sense that all or most specific historical situations can be explained in terms of small number of evolutionary generalizations. Post-processualism denies that neo-evolutionary generalizations adequately account for specific situations (Trigger 1991:66-67).

In favoring the historical approach, the senior author differs from many Hawaiian archaeologists who interpret the archaeological record in primarily evolutionary terms as a series of unilinear transformations or stages of development from simple to complex. This approach, which is focused on the development of so-called “complex societies,” is typically presented in terms of periods or phases, such as the Colonization Period, Expansion Period, etc. (Kirch 1984, 1985; Hommon 1976,1986; Carson and Mintmier 2006). Even when stage sequence terminology is not used, there is the implicit assumption of a developmental sequence of increasing complexity that is, moreover, taken to be universal, and, thus, true for Hawaiian prehistory in general. The senior author agrees with Barrett who has argued that archaeologists should view material culture as a medium of social practice rather than “an external trace or record of a type of society" (Barrett 1994:35), such as a tribe or chiefdom (see also Pauketat 2007). In the general failure to acknowledge that humans adapt to the world not as it really is, but rather in terms of how they perceive it to be based on ideas and beliefs, many Hawaiian archaeologists continue to interpret the archaeological record in narrow materialist terms that are both limited and limiting. There seems to be little appreciation of the well known fact that “activity that seems merely practical turns out to have deep cultural groundings” (Peacock 1986:17).

The senior author holds to the view that archaeology is an interpretive social science and that the “archaeological record” must be understood in both materialist (ecosystem) and idealist terms (the conviction that ideas, beliefs, values, motives, intentions, etc. are of paramount importance in human life). As remarked on elsewhere (McCoy 1991:25), humans, unlike other animals, do not simply adapt to the constraints of the external world (see also Johnson 1999:100); they also make their world--physically, by changing or altering it, and symbolically, by imposing a structure based on beliefs and values. This point of view is today becoming better known as “practice theory.” Pauketat, citing Bordieu (1977) and Giddens (1979), has defined practice theory as “…a theory of the continuous and historically contingent enactments or embodiments of people’s ethos, attitudes, agendas, and dispositions” (Pauketat 2000:115). Sahlins’ writings on how the ideology of a people is changed in practice has been summarized by Hodder:

> In Hawaii, Sahlins recognises sets of preconceptions and ideas which are part of action. For example, *mana* is a creative force that renders visible the invisible, that gives meaning to goodness and godliness. The divine *mana* of chiefs is manifest in their brilliance, their shining, like the sun. On the daily level, such notions orientate actions, as habitus, but they are changed in practice, in `structures of the conjuncture'. No-one can ever know exactly how a particular event or meeting will be played out in practice. The intended and unintended consequences of action lead to reformulation of the habitus and of the social structure (Hodder 1986:85).

Like other brands of archaeology, including what have been called “processual” and “post-processual” archaeologies, there is no consensus on what constitutes a proper field of study in the field of practice theory because of differences in definitions of key terms, such as agency and action (Dobres and Robb 2000; Clark 2000:97; Dornan 2002; Pauketat 2004). Pauketat has said that what he earlier called “historical processualism” (Pauketat 2001) “is not a rigidly structured or even internally coherent research program with a unified agenda” (Pauketat 2004:199). Johnson (2007) summarizes what is a core concept in views of agency and practice theory: “Practice, then insists that people’s actions are bound up with a “real world” but that this world is created by them; its elements are constituted through their subjective experience, their view of the world, not an explicit or implicit economic model imposed by a modern writer" (Johnson 2007:145).

Practice theory, which recognizes the centrality of human intentionality in social life (Ortner 2001:272), has been used previously in arguing that the Mauna Kea Adze Quarry represents something more important and meaningful than the adaptation to raw material scarcity (McCoy 1990:87). Rather, the quarry represents in the senior author's view a pre-eminent form of social action in the production of goods and reproduction of the social order, so that even though the primary activity was technological and economic, the underlying motives and intentions were in large part social and political, and encompassed societal as well as individual motives--the pursuit of personal careers (see Goldschmidt 1990) governed by the motivation to achieve a status, to seek prestige and honor (McCoy 1990:110; 1991:25).

In a paper written a number of years ago, the senior author concluded that work in the Mauna Kea Adze Complex was an integral part of the social construction of reality (McCoy 1990:114). The term "social construction" has become a common phrase in the writings of many social scientists. Some believe that everything, including nature, is socially constructed (see discussion in Johnson 1999:102). Ian Hacking (1999) has warned against the "strong view" of social construction (see also Weiner 2001). Hacking has written "Social construction has in many contexts been a truly liberating idea, but that which on first hearing has liberated some had made all too many others smug, comfortable, and trendy in ways that have become merely orthodox. The phrase has become a code" (Hacking 1999:vii). The senior author, taking heed of Hacking's critique, has adopted the "weak view" of "social construction."

5.0 SUMMARY OF INVESTIGATIONS

As noted in the Introduction (Section 1), Volume 1 of this report presents the results of three separate projects carried out intermittently between 1975-76 and 2007-09. In order to understand the history of archaeological investigations in the NAR, including the different approaches that have been used in site recording, the first part of this section of the report is focused on presenting:

(1) A recapitulation of archaeological investigations in the NAR;

(2) A discussion of key concepts and terms, such as site and feature, and the different approaches employed over time in the recording of archaeological sites in the NAR, and the Mauna Kea Adze Quarry Complex in particular; and

(3) A synthesis of the findings of each of the three major field projects in 1975-76, 2007, and 2008-09.

The findings of the 1975-76 project are presented in Volume 2. The results of the 2007 survey of Lake Waiau have already been presented in a separate report (McCoy and Nees 2009), but in the interest of having all of the basic site data for the NAR in one report, the Lake Waiau site descriptions are repeated in Volume 3, along with those from the 2008-09 survey. Volume 4 presents supplemental site information and technical data..

5.1 Recapitulation of Archaeological Investigations in the NAR

To recapitulate the main points in Section 3, Kenneth Emory was the first archaeologist to examine archaeological sites in the NAR, in 1937. Emory's work was limited to just two days during which time he photographed and briefly described some of the most visible remains, primarily shrines and debitage piles, in the general vicinity of Pu`u Ko`oko`olau (Emory 1937 unpublished field notes on file at the Bishop Museum). The first sustained archaeological investigations in the NAR, a research-oriented project on the Mauna Kea Adze Quarry Complex, did not take place until 1975-76, even though the National Park Service had placed the quarry on the National Register of Historic Places in 1962.

The 1975-76 project, which had limited funding, did not cover the whole of the quarry, which covers a much larger area than originally anticipated based on the initial reconnaissance survey conducted in 1975. Following the 1975-76 project, archaeological investigations in the summit region of Mauna Kea became focused on cultural resource management surveys in the Science Reserve in response to plans to build a number of new telescopes. Beginning in 1982 a series of archaeological reconnaissance surveys were carried out in the Science Reserve (see Table 3.1 for details). Between 2005 and 2009 PCSI conducted an archaeological inventory survey of the Science Reserve (McCoy and Nees 2010), which though separated by a modern political boundary from the NAR, has similar sites that part of a cultural landscape that in turn is part of a larger, more encompassing historic district.

With funding from the NAR program and additional assistance from the Office of Mauna Kea Management, archaeological investigations in the NAR resumed in 2007 with a survey of the Lake Waiau area. This was followed by a systematic survey of the remainder of the NAR in 2008-09 that is the primary focus of this report.

5.2 HISTORIC PROPERTY TYPES: FORMAL AND FUNCTIONAL CATEGORIES

The convention in Hawaiian archaeology today, due largely to the requirements set forth in Chapter 13-276 of the Hawaii Administrative Rules on archaeological inventory surveys, is to distinguish between formal and functional site "types." While sites and features can be easily described in terms of formal attributes, there is in reality no dichotomy between form and function, since function is inferred from form, as argued below for artifacts, but which applies to sites and features as well:

> It must at the same time be recognized that function is an inferential variable... that is, it is an inference made by the archaeologist himself, mostly on the basis of the observable form of the artifact. Consequently, there is no real dichotomy between functional and formal classification …functional classification merely involves the consideration of certain specific attributes of form and not others (Adams and Adams 1991:285).

Functional inferences in this report are based on the environmental and culture-historical context of the project area, formal attributes, locational context, and comparative ethnographic and archaeological data from Hawai`i and other areas of East Polynesia.

Because archaeology is fundamentally an interpretive practice, as argued in Section 4, and because the traces of past practices that archaeologists interpret are often fragmentary and incomplete, there is always an element of ambiguity or uncertainty in the inferences that are made, especially inferences of site function and age. This is especially true of piled and stacked rock features. The problem of determining the age and function of rock features, such as mounds and cairns, is common in Hawaiian archaeology (see Reinman and Pantaleo (1998) for a discussion of the problem in the Pohakuloa Training Area).

5.2.1 Formal Site and Feature Types in the Project Area

Like site and feature, there are no standard definitions of formal and functional types used by all Hawaiian archaeologists. Though not surprising, it obviously complicates, and in many instances makes impossible any kind of meaningful comparative analyses.

The following list represents the most commonly found formal site and feature types found in the summit region of Mauna Kea. Many of the terms have been used before in earlier reports (McCoy 1999a; McCoy and Nees 2009, 2010).

Ahu**.** According to Pukui and Elbert (1986:8) an *ahu* is a "heap, pile, collection, mass; altar, shrine, cairn; a traplike stone enclosure made by fishermen for fish to enter..." The various meanings, which include cairns and mounds, point to the problem of distinguishing these latter terms.

Cairn**.** Cairn is a widely used term, which is used to refer to a number of different kinds of stone constructions, however. Linda Hogan, a Native American, has noted that "In its usual, restricted sense, cairn refers only to the (most often) conical pile of stones used to mark boundaries; turning points along routes of travel; caches of food, water, and equipment; areas of danger; sacred sites; and places of private or personal importance" (Hogan 2006:58). In previous archaeological surveys on Mauna Kea cairn has been used to refer to a pile or heap of stones of generally circular to oval shape at the base; there are two varieties in the summit region of Mauna Kea--loosely constructed pyramidal forms with no facings that tend to be of nearly equal in diameter and height, and well-constructed cylindrical piles with facings. The distinction between cairn and mound (see below) is not always easily made, especially in the case of a tumbled cairn which can look like a mound or a simple rock pile.

Cave, Overhang, and Rockshelter. As used in this report and previous reports on the Mauna Kea Adze Quarry Complex, there are no caves utilized by humans in the Science Reserve and the NAR. A cave is distinguished from an overhang by a depth (measured from the dripline to the back of the opening) that is greater than the breadth or width of the opening. The areas utilized by Hawaiians for shelter in the summit region are overhangs at the edge of lava flows. These have been called rockshelters, though the term overhang has also been used.

In the original classification of activity remains a distinction was made between rockshelters and what were called "overhang shelters" based on differences in surface characteristics of the interior floor area. Rockshelters were characterized as overhangs with a variety of charcoal, bone and shell residues indicating their use as camps. "Overhang shelters" were characterized as lacking midden deposits and containing only small quantities of adze manufacturing debitage (McCoy 1977:229). Most of these “shelters” were presumed to have been used for the storage of food, firewood and other bulky items, although some may have also been used as daytime work areas where one and possibly two persons could get out of the wind and build a small fire in the recess, if necessary.

A test excavation of an "overhang shelter" at Hopukani Spring in 1985 (see Figure 3.8 for location) revealed a buried occupation layer with a fire hearth, faunal remains and flake debitage (McCoy 1986). As a result, a decision was made to combine all natural shelters into one category and to call them Rockshelters instead of continuing the earlier practice of trying to make a distinction based on surface evidence alone. The excavated overhang, originally called the Hopukani Spring Overhang Shelter (Site 16239) was renamed Hopukani Rockshelter No. 2 (McCoy 1990). This does not mean that all of the rockshelters in the NAR or elsewhere in the summit region of Mauna Kea were inhabited. Many are simply too small for even one human to occupy. As noted above, it is highly probable that the smaller rockshelters were used as storage areas.

Lithic Scatter. Lithic scatter is a generic term for all of the stone tool residues found at a given locality; these may include tools or implements, unfinished tools, manufacturing waste and hammerstones or some combination of all of these. Lithic scatters represent activity areas where one or more of the following activities may have taken place: tool manufacture, tool use, tool discard.

Prior to the 1980s and an increasing interest in stone tool manufacture, lithic scatter was a rarely used term in Hawaiian archaeology. Indeed, it was not employed in the earlier work in the Mauna Kea Adze Quarry Complex, in 1975-76 (McCoy 1977; Cleghorn 1982) for reasons discussed above. The term lithic scatter does not appear in the literature on the Mauna Kea Adze Quarry Complex until a later date. It was first used and defined in the report on the Pu`u Kalepeamoa Site (McCoy 1991) and later, in a paper on Site 16204 (McCoy 1999b). The lithic debris found at both of these sites differ in important ways from what is typically found in the quarry proper, where manufacture is the only one of the three activities (tool manufacture, tool use, tool discard or some combination of the three) is indicated, with a couple of rare exceptions (e.g., a modified or utilized flake is present, indicating a second function). At the Pu`u Kalepeamoa Site there is evidence of two artifact manufacturing technologies (adzes and octopus lure sinkers), tool use and tool discard (McCoy 1991). At Site 16204, a ritual complex, there are a small number of adze rejects, flakes, and hammerstones. The assemblage was described as a lithic scatter instead of a workshop because:

> This term [*workshop*], though rarely defined in the literature, normally implies in the case of reduction technologies, such as stone tool manufacture, a coherent structure amongst the various by-products of work [cores, waste flakes, rejected tools, etc.] that constitute this category of archaeological remains (McCoy 1999b:25).

Lithic scatter is a more appropriate field designation to use in situations, such as: (1) Site 16204, where the relationship between the various by-products and their behavioral meaning is unclear or ambiguous, and (2) the Pu`u Kalepeamoa Site Complex (16244), where there is evidence of multiple reduction technologies and, thus, different kinds of debitage (McCoy 1991).

In the case of the quarry proper, the alternative would be to describe every single concentration of adze manufacturing debris as a lithic scatter and then explain in every single case why the debris is believed to represent an adze manufacturing workshop. This approach would not only be inefficient, it would also perpetuate the long held, mistaken belief that description and interpretation are separate acts.

Lithic scatter is used in the present report as a blanket term to refer to the isolated artifacts found outside of the quarry proper, where their occurrence and function are ambiguous.

***Flake Scatter*.** The term flake scatter, which occasionally appears in the field notes and site descriptions in Vol. 2 and Vol. 3, is used interchangeably with lithic scatter. In some contexts it refers to a lithic scatter comprised of just flakes. In other situations it is a more generic term, equivalent in terms of its generality to lithic scatter.

***Chipping Station*.** In the 1975-76 research on the Mauna Kea Adze Quarry Complex, the term “chipping station” was used in reference to small, physically discrete features within a larger workshop (McCoy 1990:96). The term, which appears in some of the site descriptions in Volume 2, refers to a physically discrete workshop area often times characterized by small flakes that would appear to represent what are often called “finishing flakes.”

***Mound*.** A pile or heap of stones that is more irregular in construction and form than a cairn; the linear variety has sloping sides and a generally irregular upper surface.

***Pavement*.** A roughly flat to level surface of placed stones that may vary considerably in size, form and compaction; a term commonly applied to the upper surfaces of platforms and terraces; pavements can occur by themselves as either sites or features of sites.

***Platform*.** Commonly defined in Hawaiian archaeology as a free-standing stone structure two or more courses high and with faced sides; the fill can be made up of stone and/or soil; usually rectangular or square in shape; the term has been applied more loosely in previous reports on the archaeology of the Mauna Kea summit region as any kind of constructed foundation on which upright stones were placed; this more generic definition is also used in this report.

***Terrace*.** A structure similar to a platform, except that one side is not free-standing, but rather abuts a slope or rock outcrop; like a platform, the fill can be made up of stone and/or soil.

***Upright*.** An archaeological term for what are inferred to be god stones that the Hawaiians called *`eho* or *pōhaku `eho*; this same term was also used for stone boundary markers and bird cooking stones (cf. Pukui and Elbert 1971; Buck 1957; Emory 1938; McCoy 1991); because they were set on end (the long axis of the stone is vertical) they are called "uprights."

***Structural remains*.** A general term that refers to what is sometimes called the "built environment" and includes shrines, cairns, and the semi-enclosed structures interpreted as temporary shelters.

***Wall*.** A free-standing linear arrangement of stones that is longer than it is wide and at least two stones high; the sides and top are normally level in contrast to linear mounds.

5.2.2 Functional Site and Feature Types in the Project Area

Definitions of the functional site and feature types found in the project area are presented below. Functional inferences are based on a number of factors, including morphology, construction style and materials, locational context and comparison with similar remains of known function. The confidence level in assigning functions to many of the sites and component features varies.

***Burial*.** A deliberate or intentional interment of human remains. No human remains were observed in the project area so that all of the remains thought to be burials have been called **Possible Burials** following the practice established in previous surveys in the Mauna Kea summit region.

***Camp*.** A temporary habitation distinguished from permanent habitation sites by less diverse artifact and faunal assemblages and oftentimes, locational context. Camps can take many different forms and have a variety of functions (e.g., support or logistical camps, and base camps).

***Ceremonial and Ritual*.** Hawaiian archaeologists, like many archaeologists and even anthropologists, tend to use ritual and ceremony interchangeably. While ceremony is sometimes linked to the secular, in common usage ceremony and ritual overlap. The distinction between the two is thus problematic (Alexander 1987:179).

For Victor Turner, ritual is different from ceremony because ritual transforms social structure (Turner 1982:80-84; Alexander 1987:179). Ceremony is defined by some as having a legitimating function. According to Grimes, "ceremony consists of power negotiations in ritual form" (Grimes 1982:224; Alexander 1987:180). Grimes further notes that "Ceremonial gestures are bids for authority, prestige, recognition, and control" (Grimes 1982:224; Alexander 1987:180). Rituals and ceremonies, however they are defined, share one thing in common. As Peacock has noted:

> Ceremonies and rituals, myths and legends—all are "thick" with meaning; they distill into form a plethora of values, ideas, and experiences. Encounters with such forms is [sic] inevitably confusing, but the confusing richness of meaning leads to deeper understanding, provided we sort out the patterns and principles behind the meaning. This effort is what we call interpretation (Peacock 1986:71).

The late Catherine Bell suggested that we abandon the concept of ritual as a natural category of human practice with a single set of defining features and think instead in terms of "ritualization," defined by her as follows:

> I will use the term 'ritualization' to draw attention to the way in which certain social actions strategically distinguish themselves in relation to other actions. In

> a very preliminary sense, ritualization is a way of acting that is designed and orchestrated to distinguish and privilege what is being done in comparison to other, usually more quotidian, activities. As such, ritualization is a matter of various culturally specific strategies for setting some activities off from others, for creating and privileging a qualitative distinction between the 'sacred' and the 'profane,' and for ascribing such distinctions to realities thought to transcend the powers of human actors (Bell 1992:74).
>
> Hence, ritual acts must be understood within a semantic framework whereby the significance of an action is dependent upon its place and relationship within a context of all other ways of acting: what it echoes, what it inverts, what it alludes to, what it denies (Bell 1992:220).

To illustrate the contrast between routine activity and ritualization, Bell describes how a Christian eucharistic meal is distinguished from a regular meal by the “type of larger family gathering around the table to the distinctive periodicity of the meal and the insufficiency of the food for physical nourishment” (Bell 1992:90). She goes on to note that the two forms of action play off one another and, thus, define each other. This leads to the important conclusion that the Christian mass is not a model for a normal meal, but rather a strategic version of one. It indicates, moreover, that "what is ritual is always contingent, provisional, and defined by difference” (Bell 1992:91). Bell’s concept, which should appeal to archaeologists because it is set forth in a framework of practical activity, has been previously employed in the analysis and interpretation of a site (50-10-23-16204) situated on the eastern fringes of the Mauna Kea Adze Quarry in the Science Reserve (McCoy 1999b).

***Dump*.** An area set aside for the discard of tin cans and other refuse was found at Lake Waiau. The site, which has not been excavated, is definitely more than 50 years old and may in fact contain artifacts from some of the earliest modern scientific expeditions to Mauna Kea.

***Open-air Shelter*.** Different terminologies have been employed to describe a class of structural remains in the adze quarry The more general term *open-air enclosure* appears in the 1975 field notes in contrast to the somewhat more specific functional label *open-air shelter* that was used to encompass these and other similar structures in the initial site classification scheme that was developed for the quarry as a whole (McCoy 1977, 1978). A closer examination of the original site records prior to the 1987 fieldwork at Site 16204, a ritual complex that is part of the quarry complex, but located in the Science Reserve (McCoy 1999a) indicated that there was yet another problem in the failure to distinguish free-standing (i.e., "open-air") structures from walls attached to bedrock exposures where there is a sufficiently deep recess to warrant classification as an *overhang shelter*. The free-standing category is itself variable in terms of whether the structure is attached or unattached to bedrock so that what exists in fact is a continuum of enclosure "types" defined in terms of the extent to which there is a naturally occurring wall and/or roof. While it is useful to make such distinctions for the purpose of determining formal-functional relationships and their possible chronological significance, it is also necessary to describe the general characteristics of these remains which explain why we have resorted to simply calling them “enclosures.”

There are two varieties of walled "enclosures" in the quarry that have been classified as open-air shelters. The simplest form is a low windbreak wall. The second variety is a full enclosure. Both varieties are found singly on workshops and aggregated into clusters where they are associated with shrines in what appear to be religious compounds. Nearly 200 of these structural remains were recorded in the 1975-76 fieldwork.

Petroglyphs. The most common form of rock art, petroglyphs are made by one of several techniques, including pecking, abrading, incising, and other techniques. The petroglyphs in the NAR are anthropomorphic figures.

Pictographs. Sometimes referred to as “rock paintings,” these are quite rare in Hawai`i.

Rock Art**.** A general term for either or both traditional forms of artistic expression on rock surfaces called petroglyphs and pictographs.

Stone Marker/Memorial**.** A general term applied to cairns, mounds, or piles of rocks believed to have been built by either Hawaiians during the pre-contact period to mark a trail or land boundaries; or modern-day surveyors, or visitors to commemorate the ascent of a cinder cone or another destination, such as Lake Waiau; in some cases it is possible to be more specific and describe a marker or memorial as having a ceremonial or ritual function (see definitions of those terms above).

Shrine**.** In common usage a place of worship; the distinction, if one existed in the Hawaiian past, between shrines and temples (*heiau*) is not altogether clear. The present study uses shrine as a generic label for all sites with at least one upright stone. The definition departs slightly from the one used by Sir Peter Buck, who defined a shrine as “a convenient term to designate a simple altar without a prepared court. They were made by individuals or small family groups who conducted a short ritual which required no priest” (Buck 1957:527-528). A small number of shrines have prepared courts and some of these are sufficiently complex to infer that a priesthood may have been involved in their construction and use.

One of the clearest signs that adze manufacture in the quarry was, like Hawaiian canoe manufacture, "an affair of religion" (Malo 1951:126), is the presence of numerous shrines. All of the structures in the quarry that can be classified with confidence as shrines have one or more upright stones which Emory (1938:22) argued are stone gods (*`eho*) based on the name and comparative ethnographic data from Eastern Polynesia. There is a wide range of variability in the number of uprights as well as the manner in which they are arranged. As discussed in Section 6 of this report, the vast majority of shrines are conspicuously sighted in the landscape on workshops and above the entrances to rockshelters. A smaller number are found in isolated contexts. The surfaces of many shrines mimic workshops in the presence of a variety of adze manufacturing by-products which are interpreted as offerings to the gods (McCoy and Gould 1977; McCoy 1981).

Temporary Habitation. On current evidence all of the habitation sites found in the NAR are natural overhangs and rockshelters occupied by the adze makers while working in the quarry. There is no evidence of free-standing walled enclosures that might have been built for the purpose of short-term or temporary habitation, except for what have been called ***open-air shelters*** (see above) that were not utilized, however, as night-time sleeping and eating areas. Most, if perhaps not all, of the overhangs and rockshelters that were inhabited have an enclosing wall below the dripline. Access to the interior was through a narrow crawlway in the wall, which would have functioned to retard wind and maintain the heat from fires burning in the interior living space.

Trail. A segment of the Humu`ula Trail, which is shown on maps as earlier as 1892, is located in the NAR. The course of the trail is marked by cairns and metal poles.

Another trail, possibly associated with the Humu`ula Trail, was found above Lake Waiau. Unlike the Humu`ula Trail, it has a prepared surface.

***Unknown Function*.** This term is used to refer to remains where the function cannot be determined on available evidence.

***Water Catchment* and Conveyance.** In the mid-reaches of Waikahau`ula Gulch there are the remains of a camp associated with an effort to tap into a spring and transport water through a pipe. The pipeline, which rests on the surface, was never completed. It appears to have been destined to fill a basin or some kind of catchment in the vicinity of Hale Pohaku, although this is not entirely clear.

***Workshop*.** In sites, such as adze quarries the term workshop is the functional equivalent of a lithic scatter that contains material evidence of tool manufacture and/or use; though rarely defined in the literature, this term normally implies in the case of reduction technologies, such as stone tool manufacture, a coherent structure amongst the various by-products of work [cores, waste flakes, rejected tools, etc.] that constitute this category of archaeological remains. Like quarry, this term or one with the same meaning, such as "working areas," is rarely defined in the literature. Torrence, for example, noted that in her work on the island of Melos, "Well-delimited regions on the density maps can be translated into 'working areas' in behavioral terms, with the density of the surface obsidian as a rough quantitative measure of the amount of use of each location…" (Torrence 1984:51-52).

***Quarry* and *Workshop*.** The archaeological literature evinces a considerable amount of confusion surrounding these terms, particularly the word quarry, which to many people is synonymous with the word mine, where material is excavated and removed from beneath the surface. In many instances the meaning of the term is simply taken for granted (for an exception cf. Kahn et al. 2009) and not defined (e.g., Leach and Witter 1990; Weisler 1990; Torrence 1990). Torrence is one of the few archaeologists to distinguish between quarries and mines:

> In Europe, *quarries*-which can be defined as open sites where material was procured directly from outcrops located on the surface or from relatively shallow pits or trenches-have received much less attention that *mines*-sites where impressive shafts up to ten meters deep were sunk into order to obtain high quality surface rocks (Torrence 1986:164-165).

The most common and easiest method of obtaining raw material is to simply collect it from the surface (loose cobbles and boulders) or to extract it from lava flows or embedded boulders (boulder outcrops). The places where such activity has taken place, where there is a raw material source, are defined quarries. The physically discrete areas within quarries are workshops, but workshops are also commonly found some distance from the *quarry proper* (the source) which means that the raw material and/or incipient tools have been purposively transported and the work resumed in a new location.

***Quarry/Workshop*.** This is a term that appears rather frequently in the archaeological literature (e.g., Leach 1984; Torrence 1990:62). In a discussion of the quarry/workshop distinction at the Pu`u Moiwi adze quarry on Kaho`olawe, it was noted that the number of adze manufacturing sites and features identified in the 1976-1980 survey of the island could not be determined because *quarry* and *workshop* were lumped together in a single class of site--*quarry/workshop*--characterized by the presence of boulders or outcrops.

At first glance there is nothing wrong with this definition and in fact it is a good definition of a *quarry* as: (1) comprised of *workshops* and (2) coterminous with the raw material source. The problem is that the confounding of quarry and workshop excludes concentrations of adze manufacturing debris where there is no evidence of a raw material source (McCoy et al. 1993).

There is considerable variability in the size of individual workshops defined in terms of the area and volume of debitage. Assemblage variability is also evident in both the number of manufacturing stages that are represented and their position in the sequence [e.g., early or late stages].

Quarry Complex**.** As used in this and other reports (e.g., McCoy and Nees 2009), a term that encompasses the quarry proper (see below) and functionally related sites located outside of the sources of toolstone, that contain evidence of adze manufacture or the activities related to adze manufacture, such as shrines with offerings of flakes, preforms or other artifacts whose origin is the quarry proper.

Quarry Proper**.** This term is synonymous with the areal extent of naturally occurring toolstone sources. It differs from the quarry complex, which includes the quarry proper and sites located outside of the geological sources of toolstone.

5.3 The 1975-76 Mauna Kea Adze Quarry Project

Prior to 1975 the Mauna Kea Adze Quarry was for all practical purposes archaeological *terra incognita*, even though the quarry had been placed on the National Register of Historic Places 13 years earlier, in 1962, as a National Historic Landmark. The National Park Service, which did not carry out any fieldwork prior to the nomination, placed it on the National Register simply because of its widely acknowledged significance amongst local archaeologists. As a result, the nomination did not contain any substantive data on the quarry or boundaries.

Four months of fieldwork was conducted in 1975 with funding from the National Science Foundation (Grant BNS75-13421). The 1975 fieldwork revealed a quarry complex of much greater magnitude and internal complexity than originally expected. Additional funds were secured for a second season of fieldwork from NSF (Grant BNS76-15763) and the Charles and Anna Cooke Foundation. Three months of fieldwork was conducted in 1976. Figure 5.1 shows the 1975-76 study area.

5.3.1 Research Objectives

The 1975-76 project marked a major departure from the traditional focus in Polynesian adze studies, which up until that time were for the most part focused on developing typologies of finished specimens in museum collections (e.g., Brigham 1902; Emory 1968; Duff 1956; 1959; 1968). Adzes were typically classified on the basis of distinctions in adze form and cross section (e.g., Buck 1927, 1944; Skinner 1923, 1928; Emory 1924, 1928b; Metraux 1940; Park 1989). By 1930 four of the most active researchers in Polynesian ethnology and archaeology had developed a guideline to standardize terminology in the description of adze attributes (Buck et al. 1930). Continued studies by archaeologists of museum collections and some excavated specimens of known provenience resulted in more refined classifications (e.g., Duff 1950, 1956). A major classificatory scheme, still widely cited and used by many in slightly modified form, appeared in 1959 (Duff 1959). Duff's and the other major adze studies that followed (e.g., Figueroa and Sanchez 1965; Emory 1968) were undertaken primarily for the purpose of determining cultural-historical relationships between island groups in terms of the time and direction of migrations from primary dispersal center.

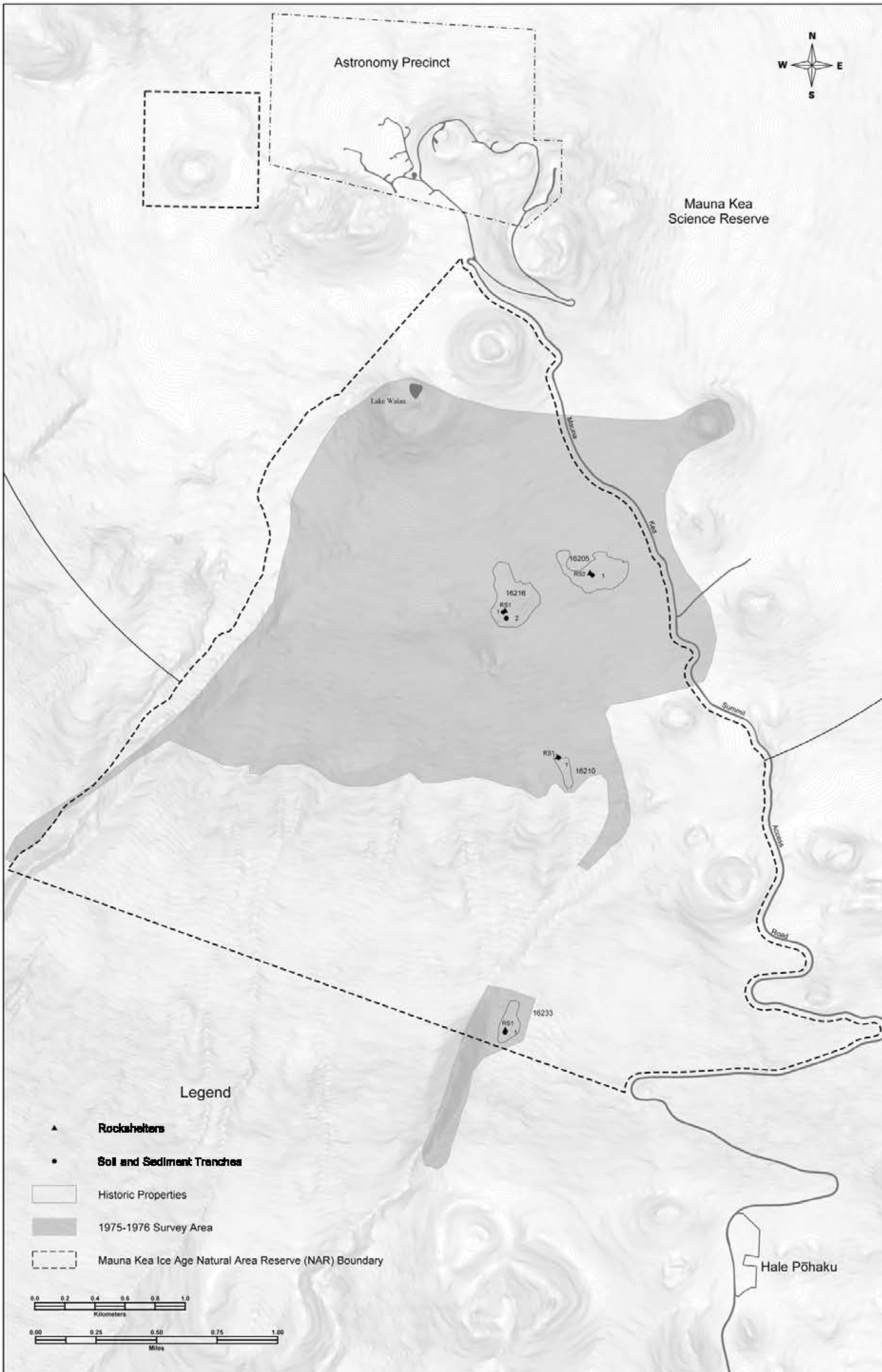


Figure 5.1. 1975-1976 Project Area Showing Extent of the Survey and Locations of Excavations.

While the full potential of museum studies of polished adzes remains to be realized for most areas of Polynesia, knowing where and how adze blades were manufactured has its own potential to contribute to a number of related research problems and to complement the knowledge gained from examining finished tools. Following arguments put forward by Crabtree (1972) and others, the 1975-76 project was based on the commonsense notion that the technological stages in stone adze manufacture cannot be fully known from the study of the finished product since the final steps in the manufacturing process (grinding and polishing) partially obscure or sometimes completely obliterate traces of the earlier stages of work.

The primary research objectives of the 1975-76 Mauna Kea Adze Quarry Project, as originally conceived, were to:

1) Develop a technological model of adze manufacture based on a characterization of techniques, stages, and activity pattern variability within and between sites in the quarry complex

2) Provide new data on chronological changes in Hawaiian adze types or the lack of it, and

3) Determine the relationship of this particular quarry industry to other forms of economic specialization and the development of socio-political complexity (McCoy 1976, 1986:7).

5.3.2 Site, Component, and Feature Definitions and Applications in the 1975-76 Project and Later Surveys

Site, one of the key terms of archaeology, is also one of the most troublesome and difficult to define. This may explain in part why the State administrative rule that governs archaeological inventory surveys in Hawai`i (HAR 13-276) does not define *site* and the other commonly used term in site descriptions, *feature*, nor does it even require definitions of these terms in archaeological inventory survey reports. Site and feature are, of course, archaeological constructs, and as remarked on elsewhere (McCoy and Nees 2010), no universally accepted definitions of site and feature exist in Hawaiian archaeology and it is unlikely that any ever will because of the architectural complexities of the archaeological landscape in many areas of the Hawaiian Islands, and the different theoretical perspectives that archaeologists hold on how the archaeological landscape should be observed and recorded.

An informal review of the literature on Hawaiian archaeology indicates that *site* and *feature* are rarely defined in inventory survey reports, especially those written in the last decade or so. Our impression is that there was more concern with site and feature definitions in the 1970s and 1980s than today (e.g. Kirch 1985:38-39). Rob Hommon is one of the few Hawaiian archaeologists to have offered a definition of site and feature:

> An *archaeological site* is a location with evidence of human activity in the past and consists of either a single feature or a complex of features. An *archaeological feature* is a spatially limited cluster of evidence of past human activities whose boundaries are determined by the extent of the evidence and/or by the boundaries of the artificial structure or natural land-form that contains it. An *archaeological complex* is a site composed of two or more features that appear to be related in some archaeologically significant way (Hommon 1980:37).

Though Hommon's definitions of site and feature were never widely employed, perhaps because the distinguishing criteria are somewhat vague, he at least realized the importance of site and feature definitions, even though they might be to a large extent arbitrary and idiosyncratic.

During the 1975-76 research on the Mauna Kea Adze Quarry Complex a working definition of "site" evolved that was believed appropriate to the type of site under investigation and the local context:

> A site is defined as a local of basalt procurement used for adze manufacture and includes any other activities performed in the immediate locale, such as habitation or shrine worship. The spatial limits of sites are variable according to the extent of usable basalt and, therefore, were set arbitrarily as the margins of natural topographic features—rock out-crops or ridges and glacial outwash plains (McCoy 1977:229).

Phrased somewhat differently, a *site* was defined as a topographically discrete constellation of what were presumed to be functionally integrated *activity remains*, such as rockshelters, overhang shelters, workshops, shrines and locales with rock art (McCoy 1977; Cleghorn 1982). Each class of activity remains, which were interpreted as the result of groups of adze makers living and working in the quarry, was considered a *site component* and numbered sequentially within a site (e.g., Site 14, Rockshelter 1; Site 14, Shrine 1; Site 3, Shrine 1). Physically discrete portions of the larger, more complex activity remains were assigned f*eature* designations (e.g., Site 14, Workshop 15, Feature 2). In the case of the workshops, many of the features correspond to what are often called "chipping stations," where one or perhaps two individuals were engaged in adze manufacture (Figure 5.2).

Like the term assemblage, *component* can have different meanings in archaeology. In the older cultural-historical approach that characterized American archaeology for so long, and still does to a certain extent, the artifact assemblages that were part of a single period of occupation were called by some a "component." This was particularly true of the Midwestern Taxonomic Method of McKern. Components were viewed as part of a larger taxonomic scheme that also included phases and patterns (Trigger 2007:283). Component seems a more appropriate term in the case of sites with stratified deposits. In Hawai`i, where stratified sites with layers believed to represent more than one period of occupation are on the whole uncommon, the term component appears to be rarely, if ever, used.

Even rarer still is the use of the term component to refer to the parts of a site. In the 1975-76 project sites were defined as comprised of one or more components that were viewed as functionally integrated activity remains, such as habitation rockshelters and workshops. The assumption, of course, was that these remains were not only spatially related but were also contemporaneous, or in use at the same time. In short, the quarry landscape was viewed as comprised of, for example, a habitation component represented by a rockshelter, a ritual component represented by a shrine, and work locales represented by workshops of different kinds (e.g., those associated with the initial process of extracting toolstone and reducing it to a roughed out adze that might be taken elsewhere to be finished).

Figure 5.2. Site 16218, Workshop 13, Feature 11 "Chipping Station"

Some archaeologists probably would have assigned either site numbers or feature numbers to each formal category (e.g., lithic scatter, rock overhang, upright stones). While some of these may have been grouped during the analysis of the field data, in order to talk about site structure it would have become necessary, for example, to describe Site X (an overhang) as possibly related to Site Y (an upright stone) and Site Z (a lithic scatter). If feature designations had been used for rockshelters, shrines, and other remains, this would have inevitably resulted in having to talk about features within features, which is cumbersome, to say the least, especially given the large numbers recorded in the quarry complex. The 1975-76 survey dispensed with this methodology because of the confidence that an upright or group of uprights were a shrine and the obvious fact that shrines, as places where rituals were conducted, were an integral part of the adze manufacturing process and thus not a separate site. The same logic applied to the use of the term workshop instead of lithic scatter given the context and experience of senior staff in recognizing the debitage, unfinished adzes and hammerstones as a workshop area.

In our view site and feature definitions for so-called "special purpose" sites, such as stone tool quarries, and especially those located in a locally unique natural and cultural environment like that found in the Mauna Kea summit region, need to be developed in the field and modified as seen fit, instead of trying to pigeonhole every find into a single, predetermined set of definitions. Isolated artifacts or small concentrations of artifacts constitute another class of remains that defy any simple approach to assigning site numbers.

There are a number of differing perspectives amongst archaeologists on both how and why isolated finds, such as those found in the Science Reserve and the NAR, should be treated and managed. Burtchard et al. (1994) present an interesting discussion of sites and isolated finds in a report on the John Day Fossil Beds National Monument in Oregon:

> Sites are distinguished from isolated finds on the basis of artifact density. As identified here, prehistoric archaeological *sites* contain multiple chipped stone flakes and fragments with or without stone tools. Presence of lithic debitage suggests some form of direct or sustained use of the locality. Increasing density and/or duration of use is roughly reflected by increasing artifact density and variety. *Isolated finds* typically are individual tools without evidence of associated use of the immediate area. Isolated artifacts generally are assumed to be spent shots or tools lost in more generalized use of the landscape. It is important to note that the distinction is arbitrary. All localities are archaeological sites of value for understanding human land-use processes. They are separated here to ease management efforts and to distinguish between direct versus generalized use of the landscape. All known sites and isolated finds are treated in similar fashion in dealing with larger land-use issues (Burtchard et al. 1994:6, footnote 5).

In the end, Burtchard and his colleagues recognized isolated artifacts as a site type, but did not assign each find a state site number (Burtchard et al. 1994: Table 1.1). This is the procedure that is used by the SHPO in Oregon where an "isolated find" is defined as "one (1) to nine (9) artifacts discovered in a location that appears to reflect a single event, loci, or activity" (www.gov/OPRD/HCD/ARCH/docs/Isolated_Finds rtf).

The importance given to isolated finds in Oregon is justified as follows:

> Isolate finds are considered important data to be recorded and should not be ignored. By recording these different levels of activity, archaeologists are gathering data about relative land use. The presence of isolates in "siteless" areas describes a form of low-level resource exploitation that would otherwise be missing from the archaeological record. The types of artifacts found as isolates are also important. They tell a story about the range of low-density activities and allow theory construction concerning seasonal rounds and resource exploitation.

The reference to seasonal rounds in the above quote obviously has limited applicability in Hawai`i, but the general idea of low intensity resource exploitation and activities that leave little evidence to become part of the archaeological record are reasons enough to expect the occurrence of small artifact assemblages meeting the criteria of "isolates" as opposed to sites as generally conceived.

The National Park Service is another agency that has placed an emphasis on the importance of recording isolated Early American or Paleoindian artifacts:

> Because documenting isolated finds is so critical for research purposes, they are here viewed as a specific Paleoindian property type. It is also strongly recommended that all isolated finds of Late Pleistocene age should be formally recorded in state site files, as either sites or in a special isolated find category, and that they should receive the same level of written documentation as true sites (National Park Service Archaeology Program, The Earliest Americans Theme Study).

5.3.3 Survey Methods, Recording Procedures, and Record Keeping

The survey methods have been briefly described in several places (e.g., McCoy 1976, 1977; Cleghorn 1982; Williams 1989). The start of fieldwork, in 1975, began with a reconnaissance survey of a large area that included a portion of the Science Reserve (see Figure 5.1), followed by an attempt to systematically record the sites and component parts found in the initial survey. After a couple of false starts, including one aborted attempt to utilize a grid system, the survey shifted to an initial concern with trying to establish site boundaries. This involved more intensive surveys of the major site areas identified in the reconnaissance survey. Begun in 1975, the survey continued until the end of the 1976 field season.

Three of the largest and most complex sites in the quarry (BPBM Sites 50-Ha-G28-14, 15, and 16; SIHP numbers 50-10-23-16216, 16217, and 16218), defined in terms of the number and type of activity remains or components, were mapped with a transit and/or plane table and alidade. The use of such instruments is time consuming and could not be employed for all of the sites found. These other sites were mapped with a tape and compass.

The site recording procedures employed in the 1975-76 survey focused on producing narrative descriptions and artifact inventories. The site recording process did not utilize forms, but was guided instead by a list of variables and attributes that are presented in full in Volume 4, Appendix A.

Because of the large quantity of descriptive data and collections that began to accumulate fairly soon after the survey began, an effort was made to maintain inventory lists of artifacts and to catalog as many artifacts as possible in the field. In the second field season, an old wooden cabin located adjacent to a wooden water tank at Hale Pohaku, was used as a field laboratory. With the aid of a generator it was possible to type field descriptions and make clean copies of field maps. Crew members took turns working in the lab.

5.3.4 Survey Findings

A total of 38 sites were identified in the 1975-76 survey, which extended, however, beyond what would later become the eastern and southern boundaries of the NAR (Figure 5.3). Eight of the 38 sites are located outside of the NAR as noted in Table 5.1.

Three of the 38 sites (16163, 16204, and 16195) are located in the Science Reserve (McCoy and Nees 2010). A reconnaissance survey undertaken in 1975 to determine the boundaries of the quarry complex found one site just inside the Science Reserve boundaries on the eastern side of the summit road, between the ca. 12,250 and 12,300 ft elevations (see Figure 3.2). The site (BPBM Site No. 50-Ha-G28-1; State Site No. 50-10-23-16204) as defined at the time, using the site definition criteria employed in the quarry project, consists of five shrines, 25 open-air enclosures (shelters) and a diffuse lithic scatter of adze manufacturing by-products (McCoy 1977, 1999b). Two other sites were found in the Science Reserve in the 1976 field season, which involved more intensive survey and site recording. One site (BPBM Site No. 50-Ha-G28-38; State Site No. 50-10-23-16163) is a shrine with a diffuse scatter of flakes located on a ridgetop at the ca. 12,880 ft elevation. The second site (BPBM Site No. 50-Ha-G28-76; State Site No. 50-10-23-16195) are the remains of two stone mounds on the rim of Pu`u Līlīnoe. These would appear to be the remnants of the burial interment features noted by W.D. Alexander’s survey party in 1892 (Alexander 1892) discussed in Section 2.

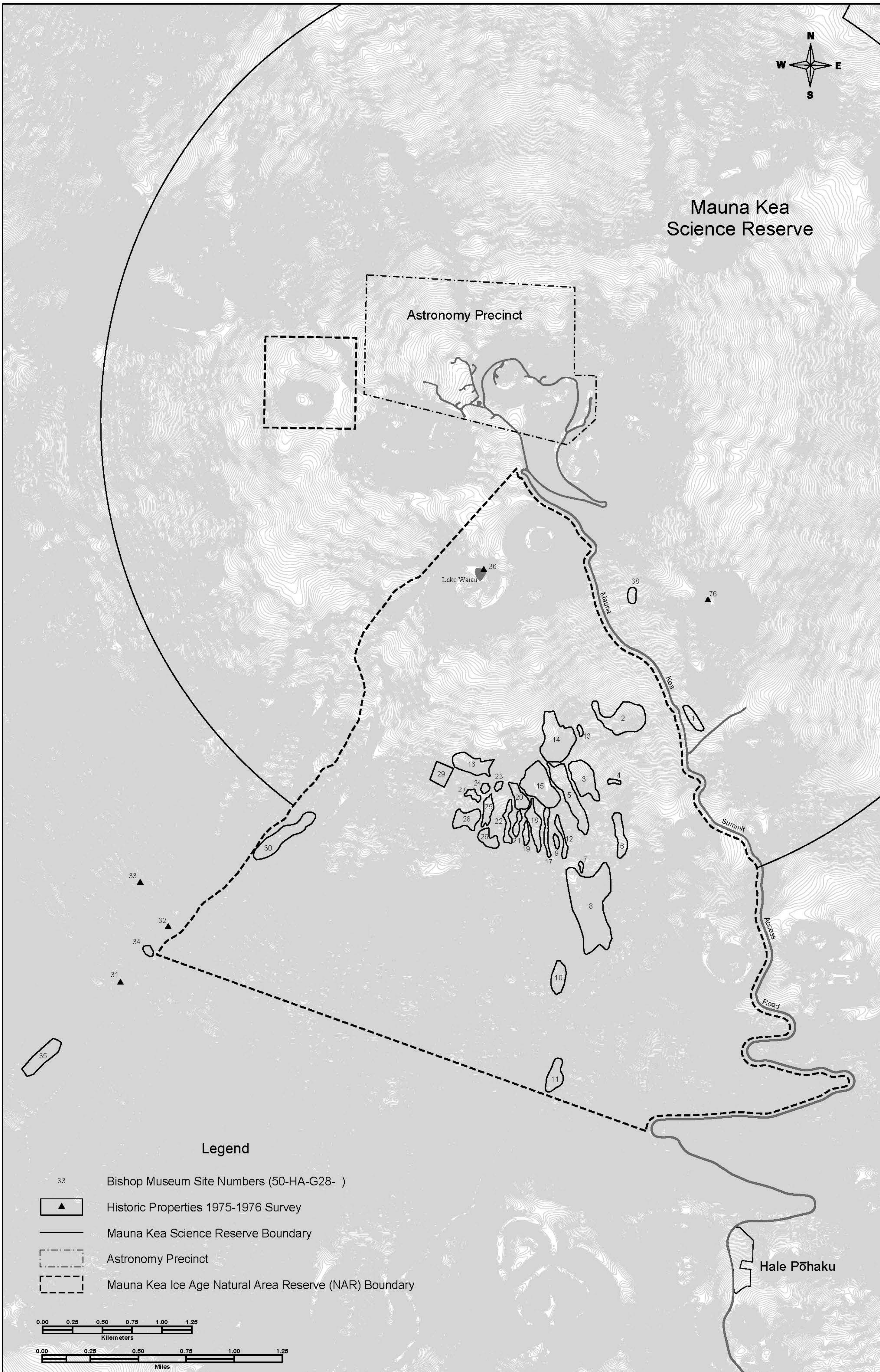


Figure 5.3. Locations of Historic Properties Identified in the 1975-1976 Survey.

Table 5.1 Sites and Constituent Site Components Identified in the 1975-76 Project.

Site Number		***Component***								
State Site Number	BPBM Site Number G28-	Adze Manufacturing Workshop	Basaltic Glass Source/Workshop	Rockshelter	Overhang Shelter	Open-Air Shelter	Shrines	Rock Art	Possible Burial	Total Components
16195	76								1	1
16204	1					25	4			29
16205	2	20		6	16	7	2	-		51
16206	3	24		1	1	1	3	-		30
16207	4	2		-	-	-	1	-		3
16208	5	28		-	-	2	1	-		31
16209	6	3		1	2	-	2	-		8
16210	7	4		1	-	-	-	-		5
16211	8	7		-	-	-	-	-		7
16212	9	3		-	1	-	-	-		4
16213	10	3		-	-	-	-	-		3
16233	11	4		1	-	-	2**	-		7**
16214	12	5		-	-	-	-	-		5
16215	13	4		-	-	-	1	-		5
16216	14	62	1	6	5	-	5	2		81
16217	15	16		-	-	-	6	1		23
16218	16	16		-	-	-	5	1*		22*
16219	17	2		-	-	-	-	-		2
16220	18	6		-	-	-	-	-		6
16211	19	4		-	-	-	-	-		4
16222	20	7		-	-	-	-	-		7
16223	21	3		-	-	-	-	-		3
16224	22	3		-	-	-	-	-		3
16225	23	1		-	-	-	-	-		1
16226	24	2		-	-	2	3	-		7
16227	25	4		-	-	-	-	-		4
16228	26	3		-	-	-	-	-		3
16229	27	4		-	-	-	-	-		4
16230	28	5		-	-	-	-	-		5
16231	29	10		-	-	-	2	-		12
16234	30	4		-	1	-	1	-		6
16235	31	1		-	-	-	-	-		1
16236	32	1		-	-	-	-	-		1
16237	33	1		-	-	2	-	-		3
16238	34	1		1	-	-	-	-		2

Table 5.1 Sites and Constituent Site Components Identified in the 1975-76 Project.

Site Number		***Component***								
State Site Number	BPBM Site Number G28-	Adze Manufacturing Workshop	Basaltic Glass Source/Workshop	Rockshelter	Overhang Shelter	Open-Air Shelter	Shrines	Rock Art	Possible Burial	Total Components
16240	35	1		-	-	-	-	-		1
16232	36						1			1
16163	38	-		-	-	-	1	-		1
TOTALS		**264**	**1**	**17**	**26**	**14**	**36****	**4***	**0**	**361**

In the Statewide Inventory of Historic Places 50=State of Hawaii; 10=Island of Hawai'i; 23=Mauna Kea Quadrangle, and the last digit the site specific number, which is sequential for each island.
* a single panel of petroglyphs at Site 16218 and a boulder with names and the date 1906 at Site 16216 were inadvertently left off the summary table; the 1975-76 survey thus recorded four locales with rock art on three sites.
** initially recorded as 2 cairns; a re-evaluation of these during the 2008-2009 survey indicated that they are not shrines; thus the number of shrines recorded in 1975-76 is 39.
Red—sites located outside of the NAR;

Five of the 38 sites (16235-16338 and 16240) recorded in the 1975-76 project are adze manufacturing sites located in the Mauna Kea Forest Reserve. They were found during a reconnaissance survey of the Pohakuloa Gulch area, from Lake Waiau to the lower terminus of the gulch near Mauna Kea State Park, in 1976. Site 16238, which was subsequently excavated in 1985, was given the name Hopukani Rockshelter. A test excavation was also made in 1985 at Site 16240, located at Liloe Springs. As noted in Section 3, the proposed western boundary of the Mauna Kea Adze Quarry Complex NHL was established on the basis of the findings made during this survey (McCoy 1978, Figure 2).

Of the 38 sites recorded in 1975-76, 30 fall within the boundaries of the NAR (Table 5.1, Figure 5.3). The sites, as originally described, include 264 workshops comprised of 1,566 "chipping stations" with 14 open-air enclosures; 17 rockshelters; 26 overhang shelters; 36 shrines; 3 rock art localities and one basaltic glass source and workshop (McCoy 1978:Table 1; Cleghorn 1982: Table 2.1). The site survey data collected in 1975-76 are summarized in a series of tables in Volume 4, Appendix A.

5.3.5 Surface Collections

An important part of the 1975-76 project was making collections of surface artifacts from a variety of different contexts and over a large area in order to document the range and possible inter-site variability in adze manufacture, and to aid in the development of a management plan. Systematic surface collection was undertaken on a total of seven sites in 1975 and included both workshops and shrines (Appendix B).

Sampling design varied according to a range of specific objectives. Controlled collection was aimed at defining surface patterning of adze manufacturing activities and shrine use. Random collections of adzes and hammerstones were made at 31 workshops for the purpose of establishing the degree of inter-site and intra-site variability in such attributes as size and cross-section.

This same underlying philosophy and collection procedure was employed in sampling the surface of four large debitage piles. Two of the samples were collected as part of the excavations of `Ua`u and Ko`oko`olau Rockshelters (Sites 16205, Rockshelter 2 and 16216, Rockshelter 1; Figure 5.4). Another collection was made on the debitage mound at Site 16205, Rockshelter 6, which is commonly known as Keanakako`i. In this random sampling, collecting was governed largely by the desirability of obtaining a representative sample of all adze forms and size ranges because of the location of this locality on the Humu`ula Trail and evidence of past and ongoing vandalism. There was an inherent tendency, however, in both examples of random sampling to collect only the more finished and complete forms, exhibiting all primary adze characteristics. A 6-square meter area in front of the entrance to Ko`oko`olau Rockshelter No. 1 (Site 16216) was intensively sampled (including adze fragments) by 1-meter squares. More than 200 adzes were collected, with a much greater number a short distance away on the top and side of the debitage mound.

This same rigorous quantitative collecting technique extended to two workshops at Site 16205 and four workshops on Site 16208 (Cleghorn 1982, 1986). Small workshop size, clearly defined boundaries and evidence of minimal movement by natural agencies were the main criteria of selection. Five of the six workshops are what have been termed single layer deposits, characterized by not more than two to three flakes on top of one another (Figure 5.5). Volume of material is thus not comparatively great, and the presence of generally less than three or four cores and/or preforms makes them attractive for study. Increased possibility of core reconstruction and elucidation of flake removal sequences, for example, exists in contrast to the virtually impossible conditions of massive and obviously mixed debitage pile accumulations. A 1-meter area of a multi-layered workshop at Site 16205 was quantitatively sampled (Figure 5.6).

5.3.6 Summary of Excavations

Several different kinds of excavations were conducted in the 1975-76 project. The primary emphasis was on the test excavation of rockshelters from different sectors of the quarry (see Figures 3.8 and 5.1). In 1976 a test pit was excavated at one of the primary sources of volcanic or basaltic glass that had been found in the survey. Trenches were also excavated across several gelifluction lobes containing flakes and other artifacts.

5.3.6.1 Rockshelters

An important part of the 1975-76 project was the excavation of selected rockshelters aimed at recovering:

(1) Datable material for developing a quarry chronology;

(2) Faunal and floral remains to interpret dietary patterns; and

(3) Material culture items (e.g., sleeping mats, clothing and footwear), utilized by the adze makers during their stay in the quarry.

Figure 5.4 Site 16216 (50-Ha-G28-14), Artifact Collection Area Outside of Ko`oko`olau Rockshelter No. 1

Figure 5.5. Site 16208 (50-Ha-G28-5), Workshop 1, Feature 18.

Figure 5.6. Site 16205 (50-Ha-G28-2) Workshop 2.

Though the rockshelters in the quarry are small by comparison to many rockshelters and caves elsewhere in Hawai`i and other parts of the world, complete excavation was viewed as not only impractical in terms of time and money, but more importantly, ill-advised given the state of lithic studies and archaeological field methods in general. We adhered to the basic philosophy that it is best to leave deposits for future study.

Four habitation rockshelters were excavated in 1975-76 (Table 5.2; see Figure 5.1). Various factors, discussed in more detail in Volume 2, were involved in the selection of these particular rockshelters, which were given names following a common practice in North American archaeology. One factor was the decision to obtain sample data from different parts of the quarry, and more specifically, different raw material sources from the primary source along an escarpment at the 12,000 ± ft elevation, and what were considered secondary sources in glacial drift deposits at lower elevations. These different sources of toolstone are discussed in Section 6 of this report in terms of zones and patches.

Table 5.2. Excavated Rockshelter Characteristics.

Zone	Rockshelter Name	Elevation (feet above mean sea level [ft amsl])	Enclosing Wall +/-	Roof-top Shrine +/-	Interior Floor Area (m^2)	Excavated Area (m^2)
1	Ko`oko`olau 1	12,398	+	+	8	4.0
	`Ua`u	12,202	+	+	21	6.0
2	`Ahinahina	11,398	+	-	17	1.0
3	Waikahalulu	10,168	-	-	23	2.0

The first excavation was conducted in 1975 at `Ua`u Rockshelter, partly due to the fact that it is near the summit road and thus more susceptible to vandalism (Figure 5.7). The selection of what was called Ko`oko`olau Rockshelter No. 1 after the name of the nearby cinder cone, was based on the fact that it contained an undisturbed deposit of well-preserved organic matter in one corner of the interior living area. In addition, it was anticipated that the excavation would probably yield some earlier dates because of the size of the associated debitage pile (Figure 5.8). The other two rockshelters, `Ahinahina and Waikahalulu (Figures 5.9 and 5.10), were excavated in 1976.

The same basic excavation procedures were used at all four rockshelters. The rockshelters were mapped and a longitudinal profile was drawn from the rear of the living area to the toe of the debitage mound fronting each rockshelter. The interiors and entrances were gridded into $1m^2$ squares, and a surface collection made prior to excavation. Excavation was done by natural stratigraphic layers and in the case of thicker layers, arbitrary levels. Excavated material was sifted through 1/8“ wire-mesh screens, and all lithics and faunal remains were collected. In the case of `Ua`u Rockshelter, the $1m^2$ squares were subdivided into four 25 cm quadrants to maintain even more horizontal control. Flakes were catalogued by lots, specific to each provenience (square, layer and level) bagged in the field (sorted vs. unsorted) dictated by volume of smaller flakes mixed with other rock, primarily red scoria.

At the beginning of the excavations, everything that passed through the 1/8” screens was saved. The large volume of debitage collected in 1975 forced a change in collection strategy. While all of the non-lithic remains continued to be collected, only half or 50% of the debitage was collected for future analysis. The retention of a large volume of flake debitage was founded on the belief of Cowgill (1964:472-473) and others that it is better to save more in the early stages of a study.

5.3.6.2 Basaltic Glass Quarry Excavation

Dr. Stephen Porter, who conducted geological investigations on Mauna Kea in the 1970s, found several places along the base of the large escarpment on the east side of Pu`u Ko`oko`olau (Figure 5.11) with small exposures of volcanic or basaltic glass:

> At places along the flow margin, where subsequent erosion has been minimal, chilled glassy surfaces, commonly palagonitized, are found…Glassy palagonitized surfaces were found in situ in a few places, but the frontal margin has been extensively and repeatedly quarried and abraded by ice so little of the original cooling surface remains (Porter 1979:1034).

A $1m^2$ test excavation at this locale in 1976 yielded evidence of a small workshop in the presence of a number of cores and flakes, which were also recovered from two `Ua`u and Ko`oko`olau Rockshelter No. 1. The quantity of cores and flakes at the workshop, which is a part of Site 16216, suggests the possibility of export, even though the material is of generally poor quality. An analysis of some of the artifact data is presented in Section 6.

5.3.6.3 Soil and Sediment Trench Excavations

The relationship between gelifluction movement, characteristic of periglacial conditions, and the transport of debitage from workshops in lobes was briefly explored in 1976, with the assistance of Dr. Fiorenzo Ugolini. This work, which was not part of the original research design, developed following the 1975 rockshelter excavations which identified buried soils in the stratigraphic sections of `Ua`u and Ko`oko`olau Rockshelter

Figure 5.7. Site 16205 `Ua`u Rockshelter and Shrine 2 Located above.

Figure 5.8. Debitage Pile Outside of Ko'oko'olau Rockshelter No. 1 (Site 16216).

Entrance to Rockshelter. View to North

Debitage Pile outside Rockshelter. View to North

Figure 5.9. Site 16210 `Ahinahina Rockshelter.

Figure 5.10 Site 16233 Waikahalulu Rockshelter. View to North.

Figure 5.11 Site 16216 Oblique Aerial View Showing Location of Basaltic Glass Source Below the Large Debitage Pile at Ko`oko`olau Rockshelter No. 1.

No. 1. The lack of funding limited the amount of fieldwork and laboratory analyses. Insufficient funds prevent a full report on this work, which though preliminary, has demonstrated the potential for more such work in the quarry to contribute to an understanding of paleoenvironmental conditions throughout the Holocene in the summit region and the effect of gelifluction on the quarry landscape. One of the gelifluction lobe excavations is briefly described below. The locations of the excavations are shown in Figure 5.1.

Part of a large surface area of gelifluction lobs and terraces at the 12,000 ft elevation at Site 16216 was mapped and a trench cut transversely through the end of one lobe. The trench was located on a lobe, 1.45 meters from the V-shaped terminus, which extends upslope c. 40 meters to the point of origin at the base of a rock face that is also the location of a workshop. The trench, 2 meters long and 50 cm wide, was excavated in natural layers. Excavated material was passed through a 1/8" wire mesh screen and catalogued by 50 cm squares and layer. The excavation was terminated 1 meter below ground surface on top of what appears to be a boulder talus. A buried soil, exhibiting a weathering profile, was found on top of this lower stratigraphic unit. Above that was a uniform sequence of well-sorted to moderately well-sorted, alternating coarse and fine-grained sediments c. 75 cm thick (Figure 5.12). Lithic material was found throughout these gelifluction layers. A notable decrease in the quantity of flakes and flake size was found toward the bottom of the excavation.

5.3.7 Summary of Post-Fieldwork Analyses, Experiments, and Management Recommendation

Some of the massive amount of data collected in the 1975-76 project have been analyzed, but a considerable amount of analysis still remains to be done these many years later. This report is one more contribution to that effort, which has included two master theses (Allen 1981; Williams 1989) and one doctoral dissertation (Cleghorn 1982) and a number of published and unpublished papers and reports (Allen 1984; Cleghorn 1986; Cleghorn et al. 1985; McCoy 1976, 1977, 1978, 1984a, 1985b, 1986, 1990, 1991, 1999b; McCoy and Gould 1977; McCoy and Nees 2010 and McCoy et al. 2009). The most substantive contributions to date include studies of:

(1) Economic and non-economic plant remains from four rockshelter excavations (Allen 1981, 1984);

(2) The adze manufacturing technology (Cleghorn 1982, 1986; Williams 1989);

(3) Subsistence patterns (Allen 1981, McCoy 1990);

(4) Ritual practices (McCoy 1991,1999b);

(5) Chronology (McCoy 1977, 1990, 1991; McCoy et al. 2009).

Several of the participants in the 1975-76 fieldwork, wrote papers for classes offered by Dr. Richard Gould, who also participated in the fieldwork and assisted in so many other ways, including the preparation of the first National Science Foundation grant proposal. The student papers include one by the senior author's wife, Judy McCoy, on the shrines of the adze quarry, another by Beverly Maekawa on Site 16216, Shrine 4; a paper by Paul Cleghorn on the first of a series of replicative experiments; and another by Warren Osako on hammerstones.

Figure 5.12. Photograph of Site 16216 Gelifluction Lobe Trench Stratigraphy.

An integral part of the 1975-76 research was lithic experimentation, an approach that at that time was becoming increasingly popular in the field of lithic studies. The experiments, which started with informal attempts in the field, were not conducted for the personal satisfaction gained in successfully replicating an adze or simply gaining a familiarization with the raw material in terms of its physical properties and constraints. The experiments were aimed instead at obtaining data on fracture mechanics and the strategies and techniques used in making a rough adze blade that could be used to develop a model of adze manufacture against which the artifact assemblages from the quarry could be compared. Controlled experimentation was one focus of Cleghorn's doctoral dissertation (1982).

Preliminary management recommendations were made in a summary report prepared in 1978 (McCoy 1978). The report contained a recommended boundary for the Mauna Kea Adze Quarry National Historic Landmark. Though the National Park Service began the process of preparing an official nomination form, including a boundary determination, the NHL still does not have official or statutorily recognized boundaries.

5.4 The 2007 Lake Waiau Survey

An archaeological inventory survey of a 43.29-acre area surrounding Lake Waiau, located at the 13,020 ft elevation near the upper end of the NAR (Figure 5.13), was undertaken over a 6-day period in July 2007. The survey followed on earlier archaeological reconnaissance surveys in 1976, 1984, and 1997 that had identified a number of features in the immediate environs of the lake.

The survey of this one small area (1.14% of the NAR land area) presented its own site and feature definition problems because of the environmental setting and discovery of archaeological remains in the lakebed, which was exposed to an unusually degree because of a drought, though not as low as would be seen in the following couple of years (Figure 5.14) (McCoy and Nees 2009). Many individual architectural remains (called features) were grouped as sites, not only because of their proximity, but because of their inferred common function and assumed relative age. Because the lake became a popular destination in post-Contact times, more historic features and sites were found, compared to the Science Reserve, for example.

5.4.1 Findings

The 2007 survey identified a total of 21 sites, including Site 16232, that had been recorded in 1976, and 20 new sites (Tables 5.3 and 5.4). The new sites incorporate the cultural remains that were identified in the 1997 SHPD reconnaissance survey (McCoy and Nees 2009). Site locations are shown in Figure 5.2. No excavations were conducted in the 2007 survey. A total of five surface artifacts were collected, including three basalt flakes for EDXRF geochemical characterization (McCoy and Nees 2009).

In addition to the 21 sites, the 2007 survey recorded a total of 63 find spots, defined as a kind of cultural resource, such as a pile of stones, of uncertain function and age, but most probably less than 50 years old.

5.4.2 Interpretive Summary

The features recorded in the 2007 survey of the Lake Waiau area include possible burials; cairns that may have functioned as survey markers, boundary markers or trail markers; shrines and possible shrines; one trail segment; petroglyphs; lithic scatters related to adze manufacture; a cemented stone pedestal for survey equipment from an 1892 expedition; an historic dump and stone markers or memorials, including the remnants of a memorial plaque to a local cowboy (Table 5.3). A number of features that had never been seen before because they are normally covered by water were found in the lakebed which was at a low stand in 2007, but not as low as what would be observed in the following couple of years. Most of these features, which are morphologically similar to previously identified structural remains on the rims of a number of cinder cones in the Mauna Kea summit region, are interpreted as possible burials.

There are three multi-functional sites at Lake Waiau with a total of 29 features whose function could not be determined (Table 5.4). A large number of these features, 23 of which were recorded at Site 26129, are stone mounds and rock piles, which is one of the most common formal feature types found in the project area. It illustrates the difficulty in determining the use and meaning of one of the simplest kinds of features, in

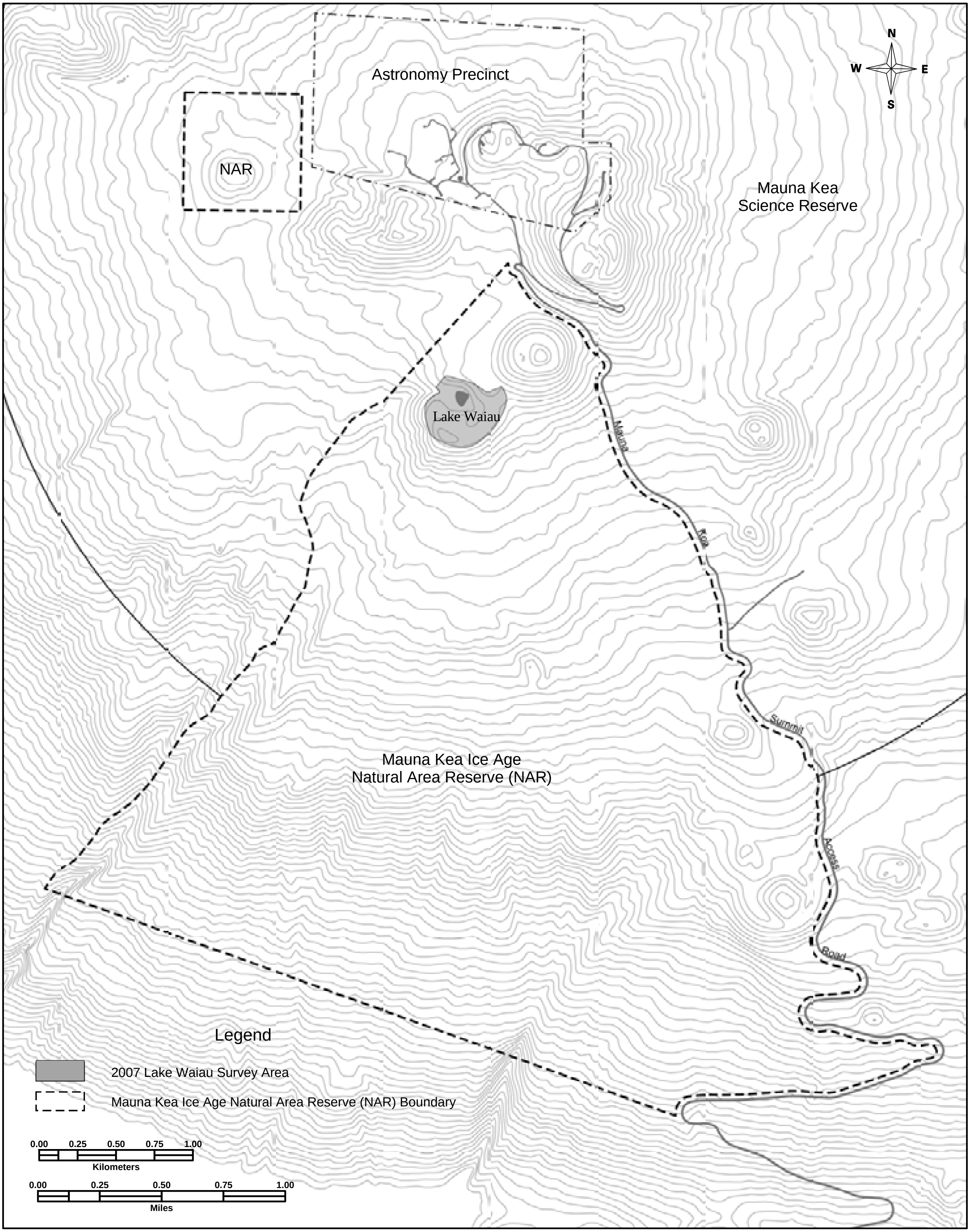


Figure 5.13. 2007 Lake Waiau Project Area.

Taken 7_15_11

Taken 10_28_11

Figure 5.14. Two Photographs Showing Lake Waiau Water Levels Over a 3 Month Period in 2011.

Table 5.3 List of Sites Recorded in the 2007 Archaeological Inventory Survey of Lake Waiau.

Hawaii Island No. 50-10-23-	Temporary Field No.	Formal Site Type	Probable Site Function	No. Features
16232	-	Cairns	Shrine**	4
26123	PM2007.09	Trail, cairns, and basalt flake scatters	Transportation and adze manufacture	7
26124	MS-1	Cairns	Markers/Memorials	2
26125	MS-3 and 4	Rock piles	Possible Burials	2
26126	RN2007.01 and PM2007.02	Rock piles, alignments, pavements	Unknown, possible burials	10
26127	RN2007.02	Enclosure	Historic trash dump	1
26128	PMLW.01	Cemented rock pillar	Pendulum stand	1
26129	RN2007.03 PM2007.03-5, E5, 6, 12	Rock piles, pavements, petroglyph and lithic artifacts	Unknown, possible burials, rock art, adze manufacture	42
26130	RN2007.04	Petroglyph	Rock art	1
26131	RN2007.24	Boulder	Memorial Plaque	1
26132	RN2007.05 (E-11)	Rock alignments	Possible Burials	1
26133	E-10	Cairn	Marker	1
26134	E-1 through E-8	Rock piles, pavements	16 Possible Burials and 1 possible shrine**	17
26135	RN2007.07	Lithic scatter	Adze manufacture	1
26136	PM2007.06	Rock pile	Marker	1
26137	RN2007.08	Rock pile	Marker	1
26138	RN2007.09	Mound	Possible Shrine	1
26139	PM2007.07	Alignment	Possible Shrine	1
26140	PM2007.08	Mound and wall	Marker and temporary shelter	2
26141	RN2007.10	Mound	Possible Shrine	1
26142	RN2007.12	Lithic scatter	Adze manufacture	1

** The probable functions of Sites 16232 and 26134 have been slightly modified since the 2009 inventory survey report on Lake Waiau was written

Table 5.4 Feature Type Frequencies in the Sites at Lake Waiau.

State Site number 50-10-23-	Feature Type									Number of Features (Totals)
	Possible burial	Shrine	Possible shrine	Marker/ memorial	Rock art	Adze "workshop"	Trail	Historic dump	Unknown function	
16232		1	3							4
26123				5		1	1			7
26124				2						2
26125	2									2
26126	6								4	10
26127								1		1
26128				1						1
26129	18			1					23	42
26130					1					1
26131				1						1
26132	2									2
26133				1						1
26134	13		1	1					2	17
26135						1				1
26136				1						1
26137				1						1
26138			1							1
26139			1							1
26140				2						2
26141			1	1						1
26142						1				1
TOTALS	**41**	**1**	**6**	**17**	**1**	**3**	**1**	**1**	**29**	**100**

part because such features continue to be made today. The large number of features of unknown function is a significant difference from what was found in the survey of the Mauna Kea Science Reserve, and other areas of the NAR, most notably the Mauna Kea Adze Quarry Complex.

5.5 THE 2008-2009 NAR SURVEY

An archaeological inventory survey of the remaining portions of the NAR (TMK: (3) 4-4-015: 10, 11) was undertaken by PCSI over a period of 10 weeks in 2008 and 2009. The primary objective of the survey was to identify, record, and evaluate the significance of all of the historic properties in the NAR, and to make recommendations regarding their preservation and continued protection. The survey was viewed as the logical first step in developing a cultural resources management plan (CRMP).

5.5.1 Project Objectives

In addition to fulfilling SHPD requirements for archaeological inventory surveys, which are *minimal* requirements (HAR 13-276), the survey had other more specific objectives. Based on the senior author's conviction that archaeological surveys should do more, when possible, than simply meet regulatory requirements, an effort was made to collect data amenable to new and different kinds of analyses and the formulation of propositions and hypotheses. As mentioned above, more attention was given in the project to recording shrine and artifact attributes and making representative collections artifacts for sourcing and technological analyses.

The 2008-2009 survey continued the practice, begun by former State Historic Preservation Division staff in 1997, of recording man-made remains that are either obviously modern or cannot be classified with any level of confidence as historic properties or sites because of their uncertain age and/or function (e.g., one stone or several stones on top of a boulder).

5.5.2 Pre-Fieldwork Tasks

Prior to the start of fieldwork in 2008 a number of oversized maps and stratigraphic profiles from the 1975-76 project were digitally scanned and converted to electronic files. The scanning was done with the assistance of Bill Godby, employed at the time as a staff archaeologist at the Pohakuloa Training Area.

The 1976-76 project amassed a large amount of data that had only been partially processed and analyzed. One of the major tasks and objectives of the 2008-2009 project was to integrate, to the extent that time and funding allowed, the data from the earlier work into the final archaeological inventory survey report on the NAR. In 2008 PCSI obtained a temporary loan from Bishop Museum to copy the 1975-76 field notes and maps, typed site and feature descriptions, and artifact catalogs. Typed descriptions of sites and features and excavation records were transferred to electronic format using Optical Character Recognition Software and then manually proofed to ensure 100% accuracy.

5.5.3 Data Requirements

The definition of what constitutes an adequate database to achieve the objectives of most archaeological projects, including site surveys, is never a simple, straightforward matter. Much of the time the issue is simply ignored. The assumption is that there is a consensus amongst archaeologists on what is important to record and what is not. Charles Redman has referred to the minimal information necessary to characterize a site as "baseline information," which in his view is different from the information necessary to address a research problem:

> ...much of the fieldwork we do is designed to collect a common body of information that characterizes the site. I will refer to this as *baseline* information. Baseline information is the minimal set of information that most archaeologists agree must be retrieved from an excavation or survey (Redman 1987:257-258).
>
> Realistically, there are two genres of minimal data requirements with which one must be concerned: those that provide adequate baseline information, and those that solve the specific problems one has chosen to investigate (Redman 1987:259).

What Redman and many other archaeologists fail to recognize is that “baseline information” is theory dependent:

> Now, as all archaeologists know, or should know, there are a multitude of possible competing descriptions of an artifact, an assemblage, or any set of remains encountered in the archaeological record. The choice involved in the description of these remains is related to the theories used to understand them (Shanks and Tilley 1987:109).

If a person believes, for example, that nature is not real, but rather a socially constructed category or analytical construct, then the observations she or he will make will be different from those who hold to the view that humans adapt to a world not entirely of their own making. Lewontin describes how theories, or what he calls organizational metaphors, affect the kinds of observations that are made:

> The metaphor of construction replacing the metaphor of adaptation would completely change the problematic and the nature of evidence because many of the problems are the provision of the evidence of adaptation, looking for ways to show that an adaptation has occurred. But if we deny in the first place that an adaptation has occurred and change the metaphor to one of construction, how organisms have constructed the world in which we live, then we look for totally different kinds of observations (Lewontin 1994a:506).

The “archaeological record” itself oftentimes determines what are appropriate baseline data. The kinds of baseline data that are useful for characterizing quarry sites, for example, are quite different from those needed to present a description of a simple shrine. Simply put, different kinds of sites require different baseline data.

5.5.4 Survey Methodology and Field Techniques

In the field of archaeology generally, and in Hawaiian archaeology in particular, there is evidence that archaeological field methods tend on the whole to be taken for granted. The unstated assumption is that the observations made in the field do not differ from one archaeologist to another and that “standard archaeological recording procedures” are universal and known to every archaeologist. This is obviously not the case as a review of the literature would demonstrate. There is always an element of subjectivity, combined with objectivity, in field methods and, as discussed above, the process of defining on the ground the boundaries of sites in a large quarry like that on Mauna Kea.

The problems with doing archaeology without reflecting on field techniques and methods are highlighted in this statement made by Bradley:

> The practice of archaeology is not as objective as fieldworkers would like to believe; nor is it as subjective as theorists often suppose. Its procedures employ a mixture of objectivity and subjectivity…The observations made in the field depend on a whole series of assumptions that are not discussed because they are taken for granted. It is only when those ideas are challenged that archaeologists can recognize their own vulnerability. All their primary observations are influenced by their knowledge and experience, but what they accept as knowledge, and what they think of as relevant experience, will change when the assumptions behind them are questioned. The methods used in the field constrain the interpretations formed at the time, and those techniques may not be the best ones for investigating different problems (Bradley 1998:3).

The techniques employed during the survey were on the whole rather uniform, with the exception of the adze quarry (discussed below in site recording procedures). Based on the results of the earlier surveys, ridge tops and other areas of high relief were the focal points of the most intensive search for sites, since this is where the vast majority of sites had been found. Apart from this fact, the tops of lava ridges and lava domes also provide excellent vantage points from which to scan the terrain below with the eye or binoculars. It is important to note in this regard that “archaeological visibility” in the summit region, indeed on the whole top of the mountain above the tree line, is exceptionally good. Areas of low relief, such as the glacial drift deposits and moraines, can be scanned very quickly to determine the presence/absence of historic sites.

While the survey methods employed in earlier projects had proven to be generally successful, the current survey also employed the use of systematic transects, following either a set azimuth or more often, topographic features (ridge tops), to ensure that the coverage was as complete as possible. The spacing of individuals within transects varied and was determined by the kinds of landforms present in a given area. In open areas with no rock outcrops, individual crew members were more widely spaced, whereas areas of relief required closer spacing.

The perennial problem of what to call a site or historic property and how to establish site boundaries was exacerbated in the 2008-2009 survey area because of large areas of glacial drift and moraines containing tool-quality basalt boulders and cobbles that were used by Hawaiians in the manufacture of adzes. Adze manufacturing by-products (cores and flakes), hammerstones and unfinished adze blades are scattered over vast areas of the glaciated landscape. The scatters vary widely in size and density of artifacts.

Previously used site definitions had to be modified and new categories added to the list of cultural remains found in the quarry. The classification employed in the 2008 survey included: (1) archaeological sites with more or less clear boundaries; (2) artifact scatters, which are more dispersed and lack clear-cut boundaries, and (3) isolated artifacts.

The surveys conducted in 2008-2009 utilized the same general site designation scheme as the 1975-76 project, with several exceptions:

1) A decision was made to dispense with workshop feature designations and to number all workshops consecutively from 1 - # within a site.

2) Diffuse debitage scatters, some of which occupy the spaces between sites and thus complicate the determination of site boundaries, were identified in the field, plotted on a map and described as *“flake scatters*.”

3) Isolated lithic artifacts and scatters located outside of the geologic source areas of tool-quality basalt were given site designations for reasons discussed below

As in the previous projects, site boundaries were established based on topographic location, spatial discreteness and clustering, inferred functional differences and obvious differences in age. This does not mean that a site had but one function. On the contrary, some sites include remains with multiple inferred functions. The underlying assumption, of course, is that the material remains are contemporaneous. The function of a number of features and sites, as might be expected, is either simply unknown, or the level of confidence is such that a site is classified, for example, as a possible burial or possible shrine.

Just as with the 2007 survey of the Lake Waiau area, no excavations were conducted in the 2008-2009 survey. This included possible burial features. Beginning with the 1982 reconnaissance survey in the Science Reserve (McCoy 1982; McEldowney 1982) the practice in all subsequent archaeological surveys in the Science Reserve and NAR has been to not test possible burial features to determine the presence/absence of human remains. This same practice was adhered to in the current project out of respect and because the sites are being preserved. One result of this decision is that many structural features believed to be burials are classified in this report as "possible burials" because no human remains were observed at the time the site was recorded.

5.5.4.1 Description and Interpretation and the Importance of Context

Description can no longer be regarded as a totally objective and purely methodological undertaking. In deciding what is important to record and why it is clear that description is an interpretive act. Peacock (1986) notes how description is not only inseparable from interpretation, but how interpretation is also theory-laden:

> The impossibility of making a carbon copy of reality and therefore the necessity of interpreting even as one describes is true in all sciences. One definition of the fact captures this point: A fact is a percept viewed through a frame of reference. The observer-describer brings to his object of observation his own theories and questions as well as implicit biases and attitudes, and these set a framework for his perceptions (Peacock 1986:66-67).

Hodder notes how description and interpretation are both subject to being contested:

> Descriptions seem obvious and undisputed. Interpretations involve the selection of information according to certain criteria, and they involve judgments that can be contested by others. However, all description involves selecting and ordering information (Hodder 1999:67).
>
> All description involves an interpretive component. But equally, all interpretation involves trying to link sense to data. Interpretation is always interpretation of something. Thus it is always partially a description (Hodder 1999:67).

The philosopher Richard Shusterman elaborates on the questionable distinction between describing and interpreting and notes that the distinction can only be relative:

> First of all, we must remember that every description of a work of art involves an interpretation of it, since it involves a selection of what to describe, what aspects of the work are important as to be worth describing. No description describes everything, egalitarianly reflecting all that can said truly about a work. But what more acutely undermines the idea of any firm and distinct distinction between descriptive truth (presenting the work's core of incontrovertible properties) and interpretive elaboration is that what is taken as descriptively true (the so-called hard fact on which interpretation is based) will often shamelessly depend on which interpretation of the work we come to adopt...More generally, we can be led from what we originally see as simple facts about the work to reach an

> interpretation of the work which dislodges or recasts the facts by showing the work in such a way that the original descriptions no longer ring true or adequate (Shusterman 1992:71).
>
> Thus, any distinction between describing and interpreting (as between understanding and interpreting) can only be relative and formal. It must be a pragmatic, shifting, heuristic distinction, not an unchanging one which would provide a firm and incorruptible core of determinate truth for simple and final description. In other words, it is not that we all agree how to describe the facts and differ only in what interpretations we elaborate from them. It is rather that the descriptive facts are simply whatever we all strongly agree upon, while interpretations are simply what commands less consensus and displays (and tolerates) wider divergence (Shusterman 1992:71-72).

Archaeological interpretations are not only theory-laden, they are also heavily dependent on context (Hodder 1987; Papaconstantinou 2006). Glassie has written that "To explain the object the analyst needs to know something of its meaning, and to know its meaning he needs some understanding of its context" (Glassie 1975:116). Richard Gould argues that “Anthropology’s greatest and most lasting contribution to the social sciences lies in its recognition that context [interrelated conditions in which something exists or occurs] is everything in explaining variability and change in human behavior,” and that “when disagreements arise in archaeological interpretation, they usually spring from different assumptions about what constitutes the relevant context: Not all archaeologists can agree on what contextual variables to control for, with the result that there may be widely divergent explanations for the same archaeological assemblages” (Gould 1990:5).

There are, of course, many different kinds of context, such as the culture-historic context of the project area described in Section 2. There is also the environmental context, which can be broken down into a number of specific contexts, such as the physiographic or geomorphological context.

5.5.5 Site Recording Methods and Procedures

GPS readings were taken at all sites. In the case of the sites recorded in 1975-76, the readings were limited to previously identified shrines, selected rockshelters and workshops, and, of course, newly found workshops. The primary purpose of taking readings on already recorded features was to aid in georeferencing points on an orthophoto site location map produced at the end of the 1975-76 project. The boundaries of some sites changed as a result of this process.

Digital photographs were taken of all sites. The general location and direction of each photograph was marked on site maps to serve as photographic reference points. The purpose in establishing such points is to provide future land managers and researchers with a guide for taking new photographs from the same places on a site to assist in the monitoring of changes in site condition. The large number of workshops in the quarry precluded taking a photograph of every one.

In an effort to use a more rigid approach to field recording along the lines recommended by Glassie (see Section 4), a number of new field forms were prepared during the course of the survey. These included a new site and feature form and forms for the recording of shrine attributes, adze quarry workshop characteristics, adze preforms, and hammerstones. A brief description of the attributes that were selected for characterizing each of the above is presented below in Section 5.5.5.1. An analysis of the attributes appears in Section 6 (Data Analyses and Results) of the report.

The magnitude of the gelifluction process in the quarry forced us to reconsider how to map and describe workshops. In the end a new descriptive category was adopted to deal with the problem of dispersed manufacturing by-products, primarily waste flakes, some of these areas, termed “flake scatters” cover large areas.

5.5.5.1 Primary Site Information

As described in Section 5.2, a site and feature recording form was developed at the beginning of the project for use in the field and for creating a site database. The form, which was based in part on an earlier form developed by SHPD in 1997, was aimed at ensuring that all of the normal site information (e.g., location, area or size, etc.) would be systematically recorded. Some minor revisions to the form were made during the course of the survey. The baseline site data that were recorded included:

***Site Number*:** Unfortunately, the sites recorded in the 1982 and 1984 surveys have several numbers---a Bishop Museum number and a State number that were assigned in the 1982 survey and used in the 1982 report, and another State number that was mistakenly assigned by Cordy in his synthesis of the Hāmākua District (Cordy 1994). Because Cordy’s publication has been widely circulated, a decision was made to use the number he assigned.

***State Site Number*:** The NAR is located in the USGS Mauna Kea Quadrangle which is identified in the Statewide Inventory of Historic Places by the prefix 50-10-23- where 50 stands for the State of Hawai`i; 10-the island of Hawai`i, and 23-the number assigned to the Mauna Kea Quad map.

***Bishop Museum Site Number*:** The Bishop Museum (BPBM) site numbers assigned in the earlier surveys (see **Section 3**) are all prefixed by 50 (Hawaii)-Ha (Hawaii Island)-G (Hāmākua District) and 28 (Ka`ohe Ahupua`a): example 50-Ha-G28-2.

***Temporary Field Number*:** The number assigned during fieldwork, prior to the assignment of a State number.

***GPS File Number*:** These are the field readings, which can be converted to either northing/easting, UTM, or Lat./Long.

***Elevation*:** The site elevations used in this report are based on the USGS quadrangle map plots that were determined using GPS field readings. The elevations for most all sites are believed to be accurate within 5 feet. A different set of elevations, sometimes nearly identical to those on the contour maps but often considerably higher, appear in the field records and in the GPS logs. In deciding to use the USGS map data as the standard for presenting elevation data, there is recognition of the fact that USGS contour maps may contain errors, especially in areas of high relief, and that the true elevations of the sites on Mauna Kea are essentially unknown or open to question.

***Formal Site Type*:** See definitions above in Section 5.2.1.

***Functional Site Type*:** See definitions above in Section 5.2.2.

***Feature Number*:** Feature numbers, when used, were numbered sequentially within a site.

***Site Dimensions*:** Most of the sites in the Science Reserve are not bounded or circumscribed by anything, such as a wall, thus making the determination of site size problematic; the dimensions presented in the site descriptions are the maximal area encompassed by a feature or set of features; they should not be interpreted as necessarily reflecting the area of a site or the boundary of the ritual activities performed, in the case of shrines.

5.5.6 Artifact Recording and Collection: Philosophy, Objectives, and Methods

We do not subscribe to the “no collection strategy” advocated by various public and private agencies (see comments in Butler 1979). Instead, we hold to the opposite view for several reasons. Most importantly, we think it is naive to think that the artifacts in areas with high surface visibility, such as the adze quarry complex on Mauna Kea, will always be there for study in the future (Butler 1979:796; Schaafsma 1989). At the same time we think that in the case of quarry sites, where there is an abundance of surface artifacts, we must also consider alternatives to collecting.

The recording of attribute data in the field is one alternative to collecting. The primary rationale for this particular kind of data collection approach, which was used in 1985 in the context of a data recovery project in the Hopukani and Liloe Springs area of the Mauna Kea Adze Quarry Complex (McCoy 1986) and at the Pu`u Moiwi Adze Quarry on Kaho`olawe (McCoy et al. 1993), is that it is a quick and efficient method of obtaining useful data for:

1) Recognizing general patterns, such as inter-site assemblage variability;

2) Making informed interpretations on reduction strategies; and

3) Developing hypotheses for future work.

It is necessary to emphasize that this method is *not* a substitute for permanent collections. The great value of permanent collections, of course, is that they can be studied over and over from different perspectives and with new and different techniques.

5.5.6.1 Sampling Design and Recording Procedures

In the adze quarry, the primary objective was to make systematic and, to the extent possible, “representative” surface collections. Representative collections should be made using an appropriate sampling design of the kind suggested by Sullivan, who has useful things to say as well about the matter of redundancy in sites such as quarries:

> Not only must individual collections possess characteristics that make them useful for continuing research, the aggregate sample of the archeological record preserved in collections must allow continuing study of the broadest possible range of research problems (Sullivan 1992:4).
>
> While a certain level of redundancy in collected information is necessary for research purposes, excessive redundancy in collected materials may exist for some types of sites and projects. Sites with large and highly redundant sets of materials, e.g., quarry sites and brickyards, pose questions of trade-offs between large samples and costs of facility space...What constitutes a sufficient sample of material from these sites? Regional variation in the archeological record must be considered since redundancy at the regional level, e.g., regions with many quarry sites, may allow conservatism in sample size at the site level. Consideration of sample size and composition leads to a second key factor in ensuring a satisfactory database for future research--the overall representation of the archeological record in curated collections (Sullivan 1992:4).

The artifact recording and collecting "sampling design" was dictated in large part by time and personnel limitations. The selection criteria varied from site to site and were dependent in large part on assemblage size (i.e., the number of specimens of a class of artifacts). On sites with larger assemblages we were forced to reduce the sample size and make more choices in terms of what was either recorded or collected. In some cases we tended to pass over irregular-shaped, hard to classify specimens. Some of the collections consist of just "grab samples."

Two different methods were employed in mapping and collecting artifacts. In the adze quarry, artifact locations were plotted on a scaled map. Each class of artifacts was numbered consecutively 1 - # for each workshop. Measurements were made with tape measures and rounded off to the nearest millimeter.

A total of 76 artifacts, primarily adze preforms and hammerstones were collected in the survey.

5.5.7 Survey Limitations

Though the whole project area was surveyed, it is impossible to claim, as is the common practice in Hawaiian archaeological inventory surveys following on the minimal requirements set forth in HAR 276, that all historic properties were identified and recorded in the NAR. The authors, based on years of cumulative field experience on Mauna Kea, agree with Cowgill that it is a mistake to think that an archaeological survey, surface collection or excavation is ever "total" or complete in terms of, for example, identifying or recovering every single artifact (Cowgill 1986:378; 1989a; 1989b). Cowgill referred to one specific case to make his point:

> Plog et al. (1978) show that although the large and conspicuous sites may be reliably found in open landscapes, no surveys have yet reached the level of intensity at which a still more intensive survey fails to reveal additional inconspicuous but significant occurrences of archaeological data. In order to be able to even begin to compare the results of one survey with another, we must *routinely* describe the exact procedures used, and recognize that more intensive survey would always modify the picture (Cowgill 1986:379).

Cowgill's remarks hold especially true of stone tool quarries of the size and complexity as those found on Mauna Kea. While what is often called "archaeological visibility" is excellent because of the absence of a vegetative cover, the vast size of the project area, combined with a geomorphological regime dominated by slope movement, means that many inconspicuous artifacts (e.g., flakes and even adze preforms) may be alternately exposed and buried. So one survey may observe a small cluster of flakes while a survey of the same intensity conducted at different time would observe no artifacts on the same ground surface. There is, in effect, an inverse relationship between archeological visibility overall and the ability to see or observe small artifacts and even small sites, such as single uprights where the upright may have fallen onto a bedrock surface amongst a mass of other stones.

While the entire project area was covered, the intensity of coverage was not uniform. This is in part a result of the history of previous archaeological surveys in the NAR. The areas that have been surveyed most intensively are those that have been covered in more than one project. This would include portions of the 1975-76 project area which have been surveyed twice.

The one part of the landscape that was not systematically surveyed was the steep slopes of all of the cinder cones in the NAR, except for Ko`oko`olau which does not project much above the surrounding landscape. A systematic, intensive survey of all of the other cinder cones would have required a huge expenditure of time and effort. Such an effort would have resulted in extensive scarring of the slopes and the probable disturbance of large areas of *wekiu* bug habitat. In addition, while there is ethnographic evidence to suggest the possible existence of human skeletal remains in buried contexts on the lower flanks of cinder cones, the massive size of these landforms and the instability of their steep-sided slopes effectively precluded survey and subsurface testing as a means of determining the presence or absence of burials or any other possible subsurface features. The survey of cinder cones was limited to the rims and bases.

Another factor that posed a problem in conducting the survey were the effects of high altitude on the field crews. The project area is unlike any other in the Hawaiian Islands in terms of the kinds of physical and mental challenges it presents for fieldworkers. At elevations ranging from roughly 11,800 to over 13,000 ft a person will experience high altitude hypoxia, which is produced by the reduction in partial atmospheric pressure with increasing elevation. The effect is a significant decrease in aerobic working capacity (Grover 1974, 1979). In the project area, the aerobic working capacity varies between 82% and 77% of the value at sea level (Figure 5.15). Sudden changes in weather conditions also occur. Fog and other forms of ground condensation occur with some regularity, typically in the afternoon, and depending on the amount of moisture and temperature change can leave a person at risk of hypothermia. Dense fogs can also cause a person to become disoriented. In addition to the usual effects of high altitude on work performance, day-time temperatures on a number of days remained in the 30s and 40s. It is clear from our own field experiences that the old adage, “night is the winter of the tropics,” frequently applies to the day as well. Field conditions were made even more uncomfortable on many days because of high winds. Wind and cold presented problems in terms of mapping and writing field notes and may have contributed to more than the usual amount of mental errors that are virtually impossible to avoid at high elevations.

A different kind of limitation, which again applies to the current project area more so than any others in our experience, is the difficulty if not virtual impossibility, of designating sites and features on a consistent and non-arbitrary basis that we ourselves agree with completely. Over time it has become increasingly clear that what constitutes a site and a feature of a site, especially within the adze quarry, has no easy answer and will undoubtedly continue to be contested because of the essentially uncountable number of pieces of manufacturing waste spread out, albeit discontinuously, over such a vast area. In brief, the site concept does not work well in a quarry landscape like that found on Mauna Kea. A better approach is to use a more holistic landscape perspective.

5.5.8 Summary of Work

The 2008 fieldwork involved two 2-week long surveys (July 14-25 and August 4-15) by a crew of four PCSI archaeologists under the direction of the Principal Investigator, Dr. Patrick McCoy. The other crew members included Rich Nees (Field Director), Valerie Park, and Keola Nakamura.

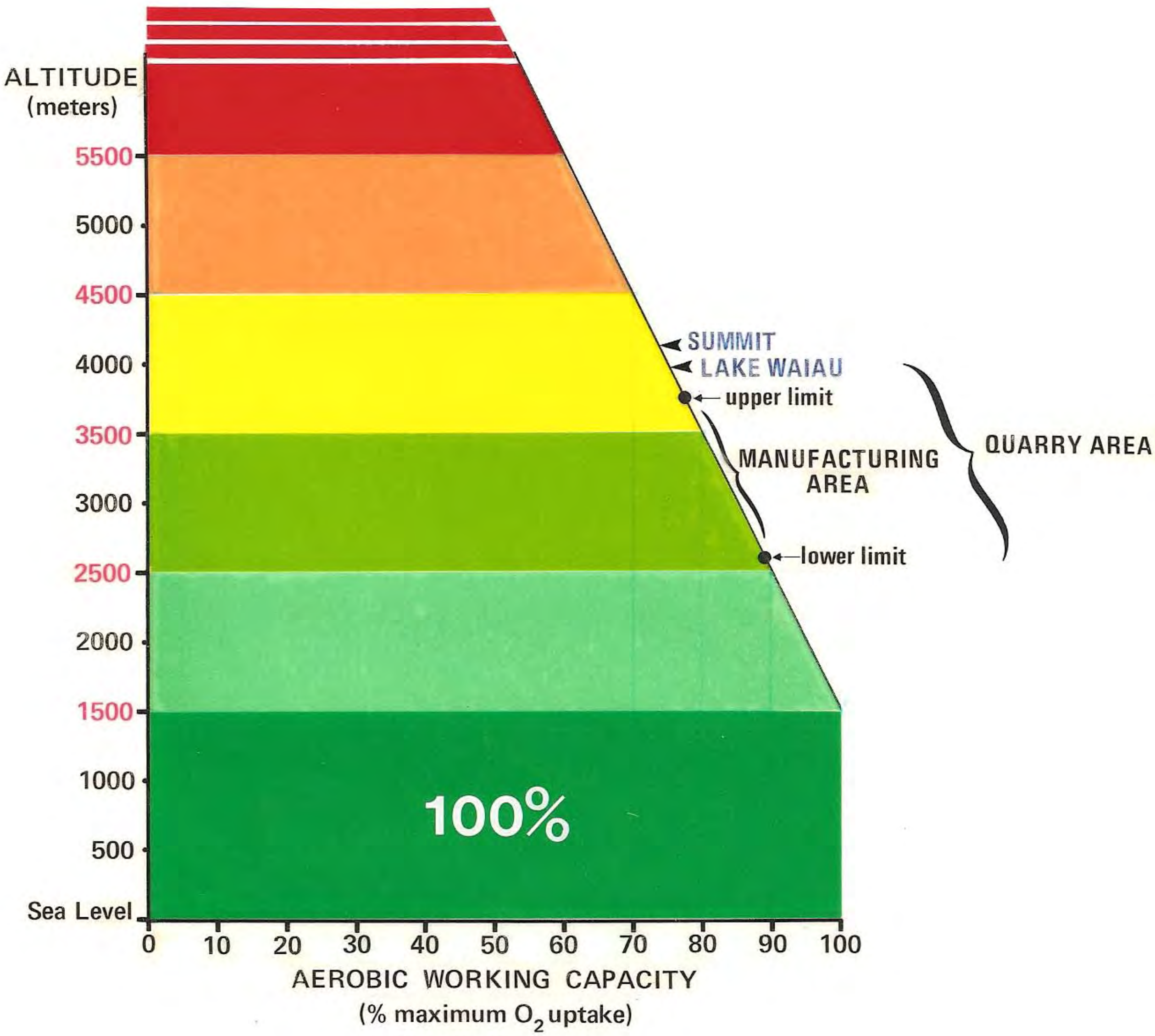


Figure 5.15. Reduction in Aerobic Working Capacity with Increase in Elevation.

The following tasks were completed in 2008:

1. Completion of the survey of the eastern margin of the NAR, between Waikahalulu Gulch and the Mauna Kea Observatories Access Road, from Pu`u Hau Kea to the lower boundary of the NAR at the roughly 10,200 ft elevation, except for a small sliver of land located along the road below Pu`u Keonehehee (Figure 5.16). The survey included mapping the course of the Humu`ula Trail and all of what are believed to be old trail markers (cairns or *ahu*) along the trail.
2. GPS mapping of selected workshops, shrines and rockshelters in the Mauna Kea Adze Quarry Complex. Two Army archaeologists from Pohakuloa Training Area (PTA), Bill Godby and James Head, assisted in the mapping which was focused on accurately locating previously identified site components for the purpose of geo-referencing site maps from the Bishop Museum investigations of the quarry complex in 1975-76. The mapping was done with Trimble GPS units provided by the archaeological crew from PTA.
3. Relocation and up-dating of the site records for 39 previously identified shrines in the adze quarry. Some of the shrines were re-mapped, in addition to filling out forms to ensure that the shrines in the NAR and in the Science Reserve were recorded to the same standard. Photographs were taken of all of the shrines.
4. Survey of a proposed 9-acre silversword propagation exclosure located on the lower NAR boundary, between Waikahalulu and Pohakuloa Gulches.

The remainder of Parcel 10 and Parcel 11 (Figure 5.16) were surveyed over a period of six weeks in 2009 under the direction of the Principal Investigator, Dr. Patrick McCoy. The other crew members included Rich Nees (Field Director), Keola Nakamura, Sara Collins, and Valerie Park.

No excavations were conducted in the 2008-2009 survey. A piece of branch coral from the surface of a newly recorded site was collected and subsequently dated (see Section 7). A small surface collection of 73 specimens was made at 13 sites (Appendix G; Figure 5.17). Of the collection a total of 25 specimens from six sites were sent for EDXRF Analysis (Appendix O; Figure 5.17).

5.5.9 Findings

The 2008-2009 inventory survey recorded a total of 55 new sites and added 278 components to the sites recorded in 1975-76. Table 5.5 presents the inferred function and a count for each site recorded in 2008-2009. Figure 5.18 (Fold Out found in the back of the report) shows the general distribution of historic properties, including those within the Science Reserve. Appendix C provides a detailed breakdown of sites, components and features within the NAR, including updates resulting from the 2008-2009 surveys. As expected, most of the sites found in the survey are adze manufacturing locales that are part of the Mauna Kea Adze Quarry Complex.

5.6 Synthesis of Site Data from the 1975-76, 2007 and 2008-2009 Projects

The total number of historic properties recorded in the NAR as of 2009 is 109. This number includes sites that are part of the Mauna Kea Adze Quarry Complex, and sites with no known or apparent relationship to the quarry (Table 5.6; Figure 5.18).

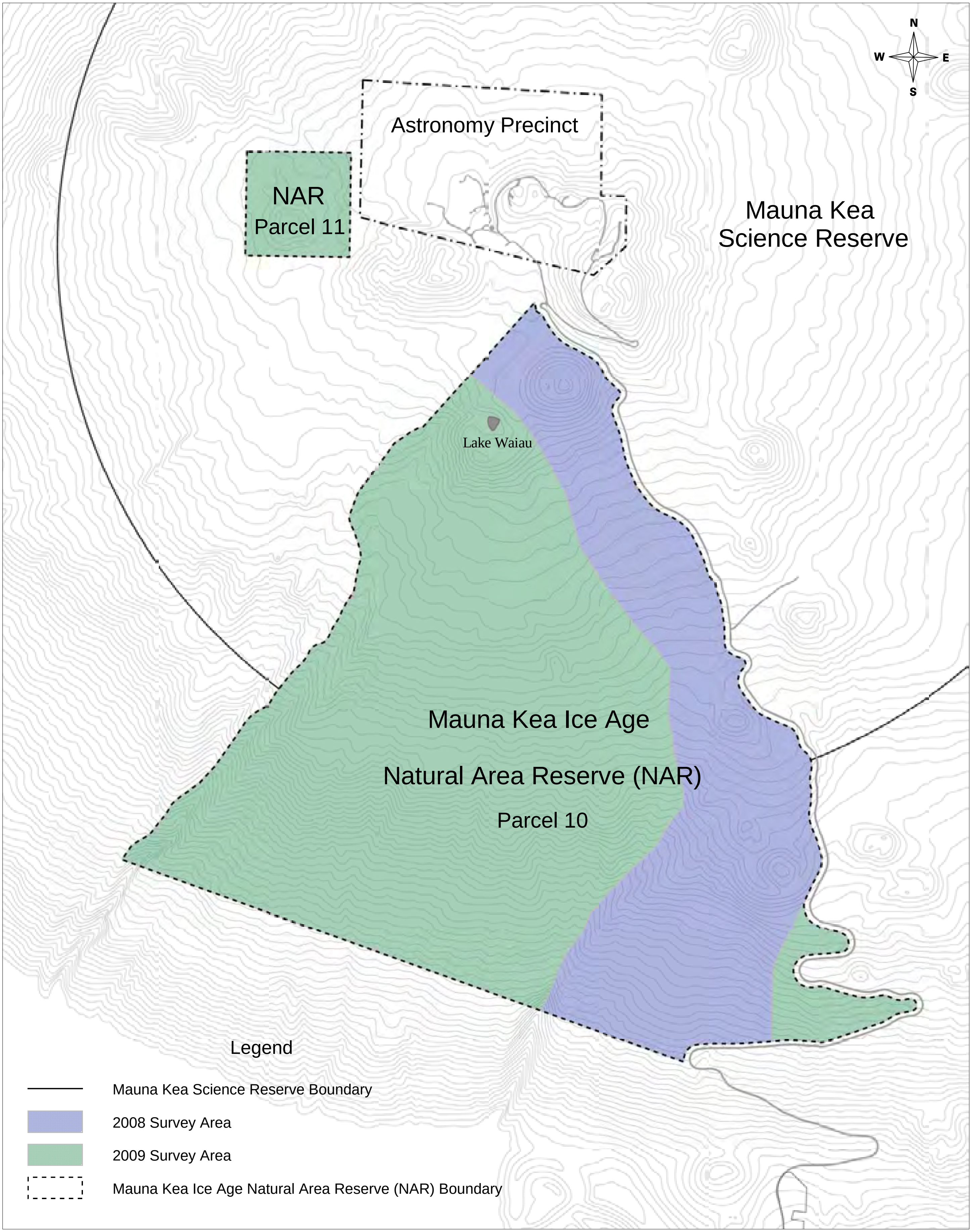


Figure 5.16. Mauna Kea Ice Age Natural Area Reserve Showing the Location of the 2008 and 2009 Survey Areas.

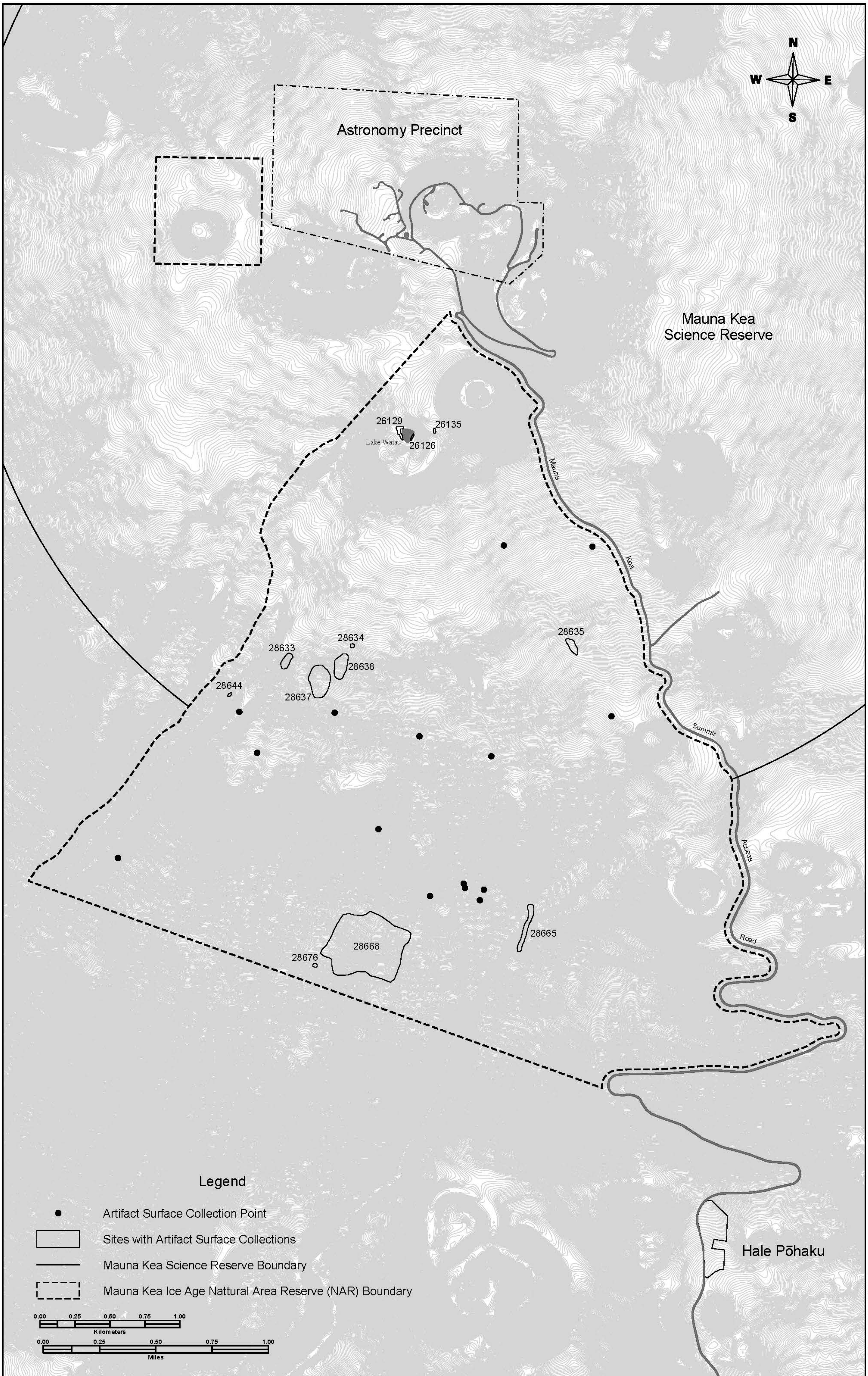


Figure 5.17 Map Showing Artifact Surface Collections.

Table 5.5. Summary of Sites Recorded During the 2008-2009 Survey.

State Site Number 50-10-23-	Temporary Number	Production Zone	Possible Burial	Possible shrine	Shrine	Marker	Adze workshop	Extraction pit or area	Temporary shelter	Artifact scatter	Isolated Artifact	Rock Art	Other	Total number of components	Comment
2008															
28635	PM2008-04	1					12	4			1			17	
28636	PM2008-06	2					1		1					2	
28639	PM2008-05	1					6	1		6	15			28	
28640	VP2008-05	2			1		1			3	5			10	
28666	PM2008-08	2					7			4	4			15	
28667	VP2008-07	Outside	1											1	
28672	VP2008-08	3			1									1	
28673	PM2008-10	3			1		1		1					3	
28674	PM2008-07	Outside				2								2	
28675	PM2008-11	3											1	1	rock wall
2009															
21196	N/A	Outside			1									1	
21453	N/A	Outside	2											2	
21454	N/A	Outside	2											2	
28623	Site A	Outside	4											4	
28624	Site B	Outside	1											1	
28625	Site C	Outside	3											3	
28626	Site D	Outside	3											3	
28627	Site E	Outside	2											2	
28628	Humu`ula Trail Site F	Outside				150								150	Humu`ula Trail
28629	RN2009-03	Outside			1									1	
28630	RN2009-01	Outside			4					1	1			6	

Table 5.5. Summary of Sites Recorded During the 2008-2009 Survey.

State Site Number 50-10-23-	Temporary Number	Production Zone	Possible Burial	Possible shrine	Shrine	Marker	Adze workshop	Extraction pit or area	Temporary shelter	Artifact scatter	Isolated Artifact	Rock Art	Other	Total number of components	Comment
28631	RN2009-02	Outside			1									1	
28632	Site J	Outside					2							2	
28633	RN2009-07	2					3			1	3			7	
28634	RN2009-06	1			2		5		1	1				9	rock wall
28637	RN2009-08	2					41	1	3	2	5			52	
28638	RN2009-09	1					22	1	5	6	9		4	47	three rocks walls, possible cupboard, two filled-in crevices
28641	KN2009-07	2					18	5	1	2				26	
28642	RN2009-13	2			1		12			15			2	30	two rock piles
28643	Site U	1					5			4				9	
28644	RN2009-12	1					3		1				3	7	two rock walls and terrace
28645	RN2009-16	1			1					1	1			3	
28646	KN2009-06	2			1									1	
28647	Site Y	2					56			35	8			99	
28648	Site Z	2					12			2	1			15	
28649	Site AA	2					14			1				15	
28650	Site BB	2					61			37	12			110	
28651	Site CC	2					4			1				5	
28652	Site DD	2					5							5	
28653	Site EE	2								1				1	
28654	Site FF	2					8			15	8			31	
28655	KN2009-15	3					13		1	14	11			39	

Table 5.5. Summary of Sites Recorded During the 2008-2009 Survey.

State Site Number 50-10-23-	Temporary Number	Production Zone	Possible Burial	Possible shrine	Shrine	Marker	Adze workshop	Extraction pit or area	Temporary shelter	Artifact scatter	Isolated Artifact	Rock Art	Other	Total number of components	Comment
28656	Site HH	2					8			2				10	
28657	Site II	2					6			4			1	11	rock wall
28658	RN2009-17	3							1	1				2	
28659	RN2009-18	3							1	1				2	
28660	KN2009-20	3					1		1					2	
28661	Site MM	3					4				2			6	
28662	Site NN	2					5							5	
28663	Site OO	2					7			1	1			9	
28664	Site PP	2					7			4	1			12	
28665	RN2009-26	2							2				3	5	Historic complex
28668	RN2009-22	3					32		1	64	9			106	
28669	KN2009-19	2			1		1			8			3	13	one prepared surface, a platform, and a rock wall
28670	KN2009-16	3					1		1					2	
28671	RN2009-24	3			1									1	
28676	KN2009-13	3				1	5		1				1	8	cupboard
4136	**PM2008-03**	**^**					**65**			**161**	**119**			**345**	
Totals			*18*	*0*	*17*	*153*	*454*	*12*	*19*	*397*	*215*	*0*	*24*	*1,308*	

^ = in all production zones

BOLD = estimated number

Figure 5.18

Over-sized Map Located in Pocket at the End of Volume 1

Table 5.6 Natural Area Reserve Historic Property Inventory.

FUNCTIONAL SITE TYPE	NUMBER	PERCENT TOTAL (%)
MAUNA KEA ADZE QUARRY COMPLEX SITES	**72**	**66.1**
Quarry Proper	69	95.8
Isolated Habitation Rockshelter	1	1.4
Isolated “Workshops”	2	2.8
NON-QUARRY SITES	**37**	**33.9**
Traditional Cultural Properties	1	0.9
Isolated Shrines and Possible Shrines	10	9.2
Possible burials	13	11.9
Stone markers/Memorials	8	7.3
Historic Dump	1	0.9
Historic Camp and Associated Water Catchment and Transport	2	1.8
Trails	1	0.9
Rock Art	1	0.9
TOTAL	**109**	**99.9%**

5.6.1 Mauna Kea Adze Quarry Complex Sites and Components

Of the 109 designated sites, 72 or 66.1% are part of the Mauna Kea Adze Quarry Complex, which as earlier described is comprised of two distinct but related parts:

(1) The ***quarry proper***, which is defined as the source areas of tool-quality basalt or toolstone, and

(2) Diverse activity remains, such as rockshelters and shrines, located ***outside of the quarry proper*** as just defined, but which are directly linked to the quarry because of the presence of adze manufacturing by-products (e.g., cores, flakes), hammerstones and unfinished adzes in various stages of completion.

The quarry complex is a discontiguous set of sites. Many are found within a single circumscribed space whose defining characteristic is the presence of readily accessible basalt toolstone. The smaller sub-set of sites that make up the quarry complex are places used by adze makers where the raw material used in manufacture was transported from a source area, or where artifacts were dropped or inadvertently lost in departing the quarry. Within each of the two areas, there are hundreds of small, isolated workshops, lithic scatters and isolated artifacts. These are classic examples of what were described above, in Section 5.3.2, as *isolates*. They have been treated in the same way as in other states, such as Oregon, except that in addition to locating them on a map and providing a brief description, they have been included as part of a site, in this case the quarry complex which is identified as Site 50-10-23-4136 (Cordy 1994).

The Mauna Kea Adze Quarry Complex, as defined above, consists of 69 sites in the quarry proper and three sites in areas where there is no source of toolstone. The sites located outside of the quarry proper include two lithic scatters at Lake Waiau that are described below as a different kind of “workshop,” and one habitation rockshelter and workshop locality situated along the lower part of the Humu`ula Trail, on the lower flank of the massive cinder cone called Pu`u Keonehehee.

5.6.1.1 Rockshelters (Temporary Habitation Shelters, Possible Storage Areas)

The evidence for "habitation" in the most general sense of the word is limited to rockshelters and possibly a small number of crude stone wall enclosures. A total of 48 rockshelters have been recorded in the NAR as of this time. Figure 5.19 shows the location of the rockshelters. Table 5.7 summarizes some of their more salient characteristics, such as the presence/absence of enclosing walls, estimated floor area, and the presence/absence of roof-top shrines.

With the possible exception of a walled enclosure at Site 16205, located along the newer alignment of the Humu`ula Trail below Keanakako`i, there is no evidence that any of the shelters were occupied over night. The age of this enclosure, which is unlike any other encountered in the NAR (Figure 5.20), could be either late prehistoric or historic in age. It is possible that the structure was built to accommodate horses or mules, or possibly even humans, during the trail work carried out by the CCC in the mid-1930s.

5.6.1.2 Site 4136 Isolated Workshops, Lithic Scatters, and Artifacts

A number of different kinds of isolated lithic artifacts, oftentimes referred to as *find spots* (e.g., McCoy 1984a), as opposed to the admittedly more idiosyncractic use of the term in the current survey, were found in different areas of NAR, including the 1975-76 project area. As explained earlier, all of these isolated finds have been grouped under Site 4136, which is the site number that was given to the "main quarry area" (Cordy 1994: Table 28) (Table 5.8).

Some of these isolated finds, most of which cover a small area and contain a small number of artifacts, have been previously discussed as a specialized kind of adze manufacturing "workshop" based on the presence of one or more of the following kinds of manufacturing byproducts---flakes, cores, adze preforms, and hammerstones (McCoy 1999a; McCoy and Nees 2009). Others may represent locations where an unfinished adze or several adzes and hammerstones, were lost in transport. In other instances, there is reason to suspect that additional artifacts are located in the immediate vicinity, but were not identified because of factors such as small size, poor lighting conditions, or because they are buried.

Four lithic scatters were found in the survey of Lake Waiau in 2007. Two were isolated enough that they were given site designations (26135 and 26142). The other two were found in association with other features. The one at Site 26123 was found along a newly discovered trail/road. On current evidence all three of these scatters are comprised solely of flakes. The stone artifacts found at Site 26129 are more varied. They consist of flakes, an adze preform and a discoidal hammerstone.

The presence of waste flakes or debitage, an adze preform and hammerstone at the lake indicate a direct link to the adze quarry, even though a geochemical analysis has not yet been conducted to confirm the quarry as the source area. In hand specimen the flakes have the same grain characteristics and color as those in the quarry. The same is true of the hammerstone which is the same scoriaceous basalt found in the quarry, where it, too, was quarried. One of the largest, most concentrated areas of quarry activity is centered around Pu`u Ko`oko`olau, which is one mile south of the lake.

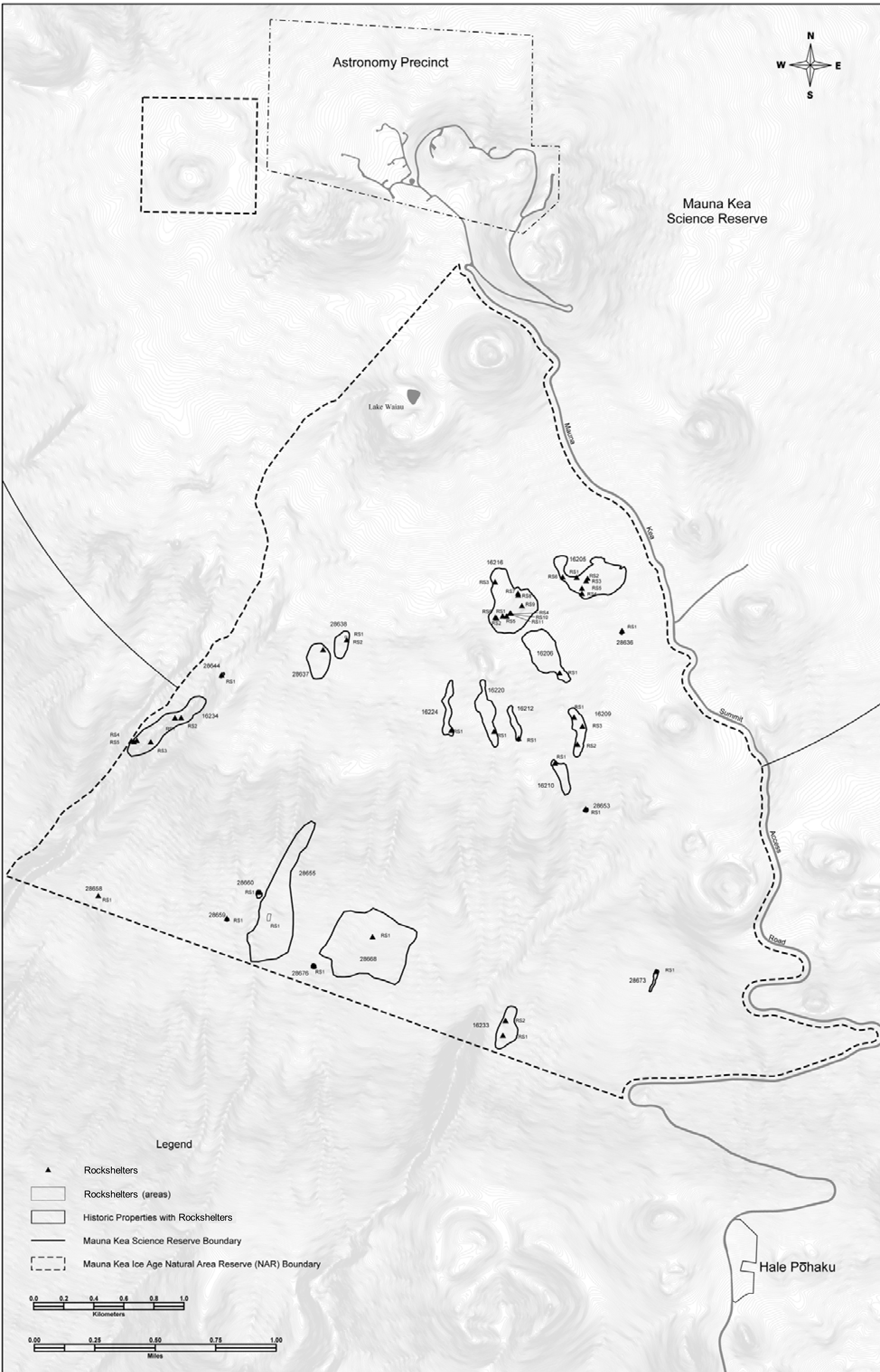


Figure 5.19. Locations of Rockshelters.

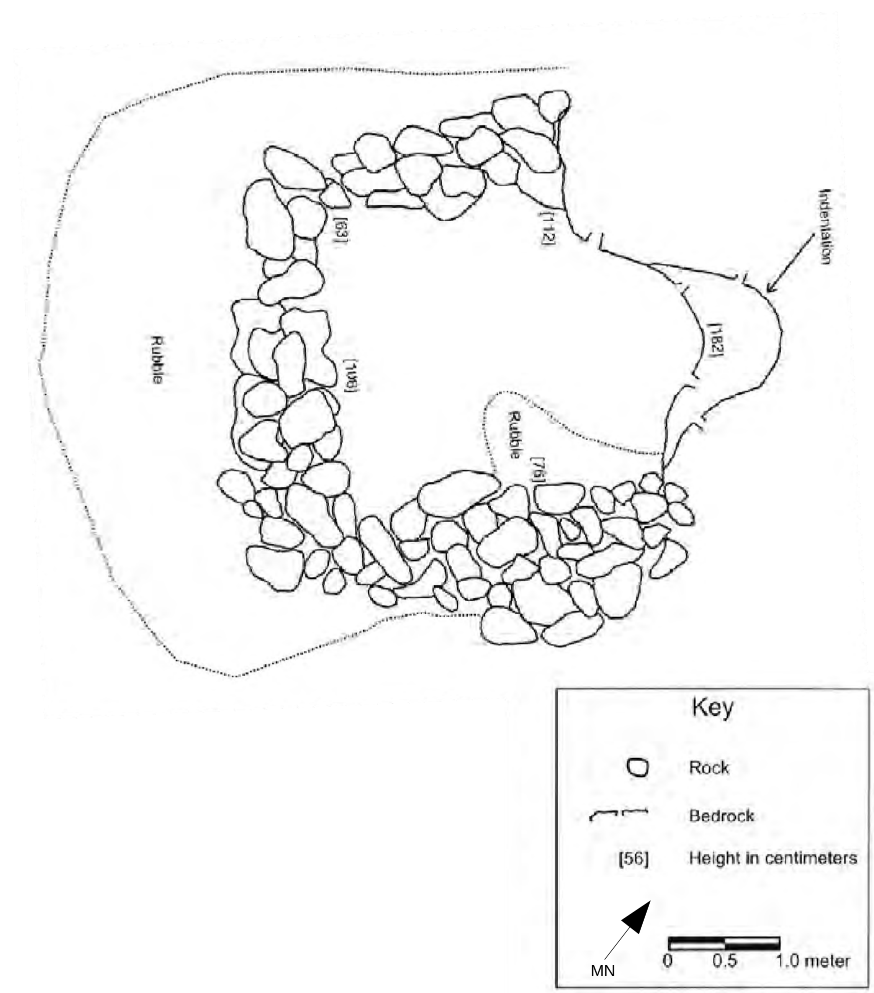


Figure 5.20. Photograph and Plan View of Possible Temporary Shelter at Site 16205 on the 1930s realignment of the Humu`ula Trail (below Keanakako`i [in the background]).

Table 5.7. Summary of Selected Quarry Complex Rockshelter Characteristics.

State Site Number 50-10-23-	BPBM 50-Ha-G28-	Zone	Elevation	Enclosing Wall (+/-)	Estimated Floor Area m^2	Roof-top Shrine (+/-)
16205	2-R1	1	12,202	+	3.7	+
16205	2-R2			+	21.0	+
16205	2-R3			+	12.0	-
16205	2-R4			+	15.0	-
16205	2-R5			+	10.5	-
16205	2-R6			+ -	(F1) 9.2 (F2) 4.0	+
16205	OS-1			-	4.0	-
16205	OS-2			-	N/A	-
16205	OS-3			+	N/A	-
16205	OS-4			+	3.5	-
16205	OS-5			+	2.8	-
16205	OS-6			+	14.0	-
16205	OS-7			+	3.7	-
16205	OS-8			+	3.8	-
16205	OS-9			+	12.0	-
16205	OS-10			+	22.0	-
16205	OS-11			+	18.0	-
16205	OS-12			+	3.5	-
16205	OS-13			+	2.5	-
16205	OS-14			-	N/A	-
16205	OS-15			+	N/A	-
16205	OS-16			+	N/A	-
16206	3-R1	1	16,226	-	2.5	-
16206	6-OS-1			+	6.0	-
16209	6-R1	2	11,949	-	3.0	+
16209	6-RS2			-	21.0	-
16209	6-RS3			-	21.0	-
16209	6-R2				15.0	-
16210	7-R1	2	11,398	+	17.0	-
16212	9-OS-1	1	12,001	+	N/A	-
16233	11-R1	3	10.337	-	23.0	-

Table 5.7. Summary of Selected Quarry Complex Rockshelter Characteristics.

State Site Number 50-10-23-	BPBM 50-Ha-G28-	Zone	Elevation	Enclosing Wall (+/-)	Estimated Floor Area m^2	Roof-top Shrine (+/-)
16216	14-R1	1	12,398	+	8.0	+
16216	14-R2			+	11.0	-
16216	14-R3			+	11.0	+
16216	14-R4			+	16.0	-
16216	14-R5			+	8.0	-
16216	14-R6			+	15.0	-
16216	14-OS-1			+	N/A	-
16216	14-OS-2			-	12.0	-
16216	14-OS-3			+	N/A	-
16216	14-OS-4			+	4.5	-
16216	14-OS-5			+	6.0	-
16220	18-OS-1	1	12,123	+	13.0	-
16234	30-OS-1	1	11,689	+	11.0	-
28634	RS1	1	12,355	-	2.4	-
28637	RS1	2	12,257	+	6.3	+
	RS2			-	11.9	-
	RS3			-	3.5	-

Table 5.8. Components Associated with Site 4136.

Component Type	Approximate Number	Percentage
Workshop	65	18.8
Flake Scatter	161	46.7
Isolated Artifacts	119	34.5
TOTAL	**345**	

What kind of relationship to the adze quarry is indicated in the four lithic scatters is difficult to ascertain with the limited data from the survey. As noted in the definition of formal terms, lithic scatters represent a kind of activity area where one or a combination of behavioral events may have taken place—stone tool manufacture, use, discard or a combination of all three activities. A quick inspection of the flakes at each locality found no evidence of use-wear, which means that the scatters are the result of either *in situ* manufacture, a ritualized form of discard, or a combination of both of these. There are several characteristics of the scatters at Sites 26123, 26135, and 26142 that bear on the question of what they might represent. One caveat applies to the assemblage characteristics listed below. It is possible that additional and other adze manufacturing by-products could be found in the future because of the geomorphic contexts in which the scatters are located. The flake scatters at Sites 26123 and 26135 are located on gelifluction lobes, while the scatter at Site 26142 is in a cinder matrix. Because of the active geomorphic contexts in which they are found, some flakes and other artifacts may at different times be either buried or exposed on the surface. This phenomenon has been noticed previously at Site 11079, located in the Science Reserve, where adze preforms have at one time been found in full view on the surface and at other times partially to almost completely buried.

1. On current evidence all three assemblages consist of waste flakes and nothing more;
2. All three assemblages contain a small number of flakes (less than 25);
3. The flakes in all three assemblages are of quite uniform length (10 cm or smaller);
4. On current evidence all of the flakes lack cortex, thus indicating the high probability of a later stage in the manufacturing process;
5. Most, if not all, of the flakes that were examined were whole rather than broken;
6. There was no evidence of small (<5 cm) non-diagnostic (broken) flakes or shatter at any of the scatters.

There are several possible interpretations of the flake scatters at Sites 26123, 26125, and 26142:

1. the flake scatters mark the locations of small workshops where only one or perhaps two stages of adze manufacture took place;
2. the flake scatters are specialized “workshops” where a small number of flakes were removed as a symbolic act as part of a ritual practice;
3. the flake scatters represent selected pieces of debitage that were carried from the quarry and offered to the gods of the lake, thus representing a different kind of ritual

Hypotheses 2 and 3 are similar in that both involve symbolic acts with similar intentions. They are virtually impossible to test, however. Hypothesis 1 would require a technological analysis of each assemblage to reconstruct the reduction sequence and determine how many stages of manufacture are represented. On current evidence it is a highly unlikely scenario because of the assemblage characteristics. These characteristics, considered singly and as a whole, are unusual compared to the debitage found on chipping stations in the quarry, where regardless of the size of the blank (either a core or flake) the number and types of flakes removed in the reduction process are more varied. Paul Cleghorn’s replicative experiments, using raw material from the quarry, confirmed this (Cleghorn 1982). For example, the manufacturing process typically produces large and small flakes and shatter throughout the reduction sequence. The number of flakes produced in making an adze perform varies enormously (Cleghorn 1982), but a workshop with only 20 or so flakes, all or the majority of them without cortex and of fairly uniform size, is not something that has been observed in the quarry or in replicative experiments.

The lithic scatters at Lake Waiau are not unique in terms of their location outside of the known raw material source areas on Mauna Kea and the small size of the assemblages. There are 17 sites in the Science Reserve that have been tentatively classified as adze manufacturing "workshops" based on the presence of one or more of the following kinds of artifacts---flakes, cores, unfinished adzes, and hammerstones. These are "workshops" of a different kind than those found in the adze quarry, however. First, there is no naturally occurring source of raw material of the same quality as that found in the adze quarry in the environs of these sites. With one or two possible exceptions, there is little question that the artifacts in these sites were transported from the quarry, even though a geochemical analysis has not yet been conducted to confirm this. Second, there appears to be a considerable amount of inter-site variability in the number or frequency of different artifact classes found on these sites, unlike the usual workshop. In some cases there seems to be a disproportionate number of unfinished adzes compared to the number of flakes, thus pointing to the high probability that some of the adzes were flaked elsewhere and/or transported to these localities at a later stage in the manufacturing process. At other sites the predominant artifact type is flakes. These characteristics, combined with the small size of most of the artifact assemblages, indicate that these were not ordinary workshops. Indeed, the evidence for *in situ* manufacture, as opposed to a place where offerings were made, is in many instances ambiguous. The unusual characteristics of all four assemblages suggest they are the result of what can be called "symbolic manufacture."

The lithic scatter at Site 26129 is unlike the other three scatters not only because it contains an adze preform and a hammerstone, but because of its location in the midst of a number of features on the northwestern edge of the lake just above the outlet. It may be significant that the hammerstone was found concealed beneath a rock in a mound. This suggests that there may be more concealed artifacts in the area, which may have been a place where adze makers may have assembled and performed rituals. Ethnographic data indicates that amongst groups of craft specialists, one of them assumed the temporary role of a "priest" in conducting ritual activities. According to Irving Goldman (1970:223), "Kahuna, a title for both professional priests and craftsmen, implied in both fields a ritual office. The crafts kahuna was its religious leader." The proximity to the possible burials at Site 26129 leads to the intriguing possibility that some of them may contain the remains of famous adze makers who had achieved a very high status during their lifetimes.

If adze manufacture did take place at Lake Waiau and the other isolated sites, it would appear to have been an essentially symbolic act as argued in the case of Site 16204, the ritual complex that is part of the quarry complex (McCoy 1999a). It is important to note that symbolic acts can be both expressive and instrumental:

> But as well as expressing something, symbolic activity often (though not always) has an instrumental aspect. People who carry out institutionalized symbolic procedures or rites usually believe that by doing so they are either producing some desired state of affairs or preventing some undesired one (Beattie 1964:202).

Though not common, the location of isolated lithic scatters and artifacts, some associated with shrines, are potentially one of the most important findings of the 2005-2009 survey. Their possible significance is discussed in Section 7.

The four lithic assemblages assume another kind of importance in archaeological practice. They demonstrate that “work” is a far broader, more elusive phenomenon than is generally recognized, thus pointing to the need to continue developing appropriate theory/methods for interpreting the residues of work, such as adze manufacture.

5.6.1.1 Shrines

Kenneth Emory, who was the first one to describe the shrines on Mauna Kea and note their East Polynesian affinities, made the following comments about the shrines he saw in the adze quarry in 1937:

> The adze makers, clinging to the ancient form of shrine at which to approach their patron gods, have preserved a most important link with their ancestral home. Each upright stone at a shrine probably stood for a separate god. The Hawaiian dictionary describes *'eho* as "a collection of stone gods" and this is the term which the Tuamotuans, the neighbors of the Tahitians, used to designate the alignment of upright stones on the low and narrow platform at their maraes, or sacred places (Emory 1938:22).

Various classifications of shrines have been proposed. Gilbert McAllister (1933a:15), for example, divided shrines into three groups: fishing, family, and road shrines. Buck thought it useful, however, to divide McAllister’s family shrines into household and occupational shrines. Buck described occupational shrines as follows:

> Malo (1951, p. 81) writes that “each man workshipped the *akua* that presided over the occupation or profession he followed...” Thus what may be termed occupational shrines were built to the presiding gods in convenient places, and cultivators, woodsmen, fowlers, and others recited their rituals and laid their offerings upon their particular shrine before engaging in their work. There was nothing to distinguish this form of shrine from others, except, perhaps, the locations of the sites, which were away from the beaches and could not be readily confounded with the shrines of fishermen (Buck 1957:529).

On current evidence there are at the minimum two functional classes of shrines on Mauna Kea: (1) occupational specialist shrines related to adze manufacture, and (2) all the others, which on current evidence appear to be “non-occupational. Morphologically, there is nothing to distinguish these two classes, each of which exhibits considerable variability in groundplan, number of uprights, etc. The Mauna Kea shrines are in this regard no different from Hawaiian shrines in general. According to Buck, “Shrines varied considerably in construction, and similar forms were distinguished merely by their function. All shrines came under the general term of kuahu, except the fishermen’s shrine which received the specific term of ko`a” (Buck 1957:528).

A total of 58 shrines have been recorded in the NAR section of the Mauna Kea Adze Quarry Complex. The shrines, which are analyzed in Section 6, were found in direct association with workshops and rockshelters (above the entryways), and in seemingly isolated locations as well (Table 5.9). An example of a shrine associated with a workshop and with offerings on the surface around the uprights is shown in Figure 5.21. This shrine, like some others in the quarry, has been altered since it was first mapped and described in 1975 (Figure 5.21).

Table 5.9. Summary of Major Shrine Variables and Attributes in the Adze Quarry Complex.

State Site Number	BPBM Temp Site Number	Production Zone	Shrine Number	Number of Uprights Minimum	Number of Uprights Maximum	Locational Context	Artifact Assemblages (absence o /presence x)
16205	G28-2	1	1	6	7	Workshop	x
			2	8	8	Rockshelter 2	x
			3	1	1	Rockshelter 1	x
			4	2	2	Rockshelter 6	x
			5	1	1	Isolated	x
16206	G28-3	1	1	27	27	Isolated	x
			2	4	4	Workshop	x
			3	3	3	Workshop	x
16207	G28-4	1	1	1	1	Workshop	x
16208	G28-5	1	1	2	2	Workshop	x
16209	G28-6	2	1	2	6	Rockshelter 1	x
			2	3	4	Workshop	x
16215	G28-13	2	1	3	3	Workshop	x
16216	G28-14	1	1	4	6	Workshop	x
			2	1	6	Workshop	x
			3	4	4	Workshop	x
			4	2	2	Rockshelter 3	x
			5	3	3	Rockshelter 1	x
16217	G28-15	1	1	20*	20*	Workshop	x
			2	1	1	Workshop	x
			3	1	2	Workshop	x
			4	1	1	Workshop	o
			5	1	1	Workshop	o
			6	1	1	Workshop	o
16218	G28-16	1	1	14	18	Isolated	x
			2	2	3	Workshop	x
			3	3	3	Workshop	x
			4	3	3	Workshop	x
			5	1	2	Workshop	x
16219	G28-17	1	1	1	1	Workshop	o
16220	G28-18	1	1	1	1	Rockshelter 1	o
16222	G28-20	1	1	2	2	Workshop	x
16226	G28-24	1	1	1	3	Isolated	o
			2	1	2	Isolated	x
			3	1	1	Isolated	x
16229	G28-27	1	1	2	2	Workshop	x
16231	G28-29	1	1	1	1	Workshop	x
			3	1	1	Workshop	x

Table 5.9. Summary of Major Shrine Variables and Attributes in the Adze Quarry Complex.

State Site Number	BPBM Temp Site Number	Production Zone	Shrine Number	Number of Uprights Minimum	Maximum	Locational Context	Artifact Assemblages (absence o /presence x)
16234	G28-30	1	1	2	2	Isolated	o
			2	2	2	Isolated	o
28640		2	1	1	3	Workshop	x
28642		2	1	2	2	Workshop	x
28645		1	1	7	9	Isolated	x
28669		2	1	1	1	Workshop	o
28671		3	1	1	1	Isolated	x
28673		3	1	1	1	Rockshelter 1	x

5.6.1.2 Possible Burials with Associated Lithic Scatters

Two of the possible burials found in the NAR are located in the quarry proper at Sites 16205 and 16216 (Table 5.10). They are rectangular “platforms”, measuring between 6.0 and 7.0 meters long by 4.0 to 6.0 m wide with a average height of 0.8 m. They more closely resemble pavements rather than platforms, although slope wash may be covering more foundation stones and fill. The perimeters consist of larger sized stones in contrast to the interior surfaces (Figure 5.22). The middle tends to be lower than the sides. Morphologically, these features are similar to many of those found at Lake Waiau and to others located in the Science Reserve (McCoy and Nees 2010). Their locations suggest that they may contain the remains of adze makers.

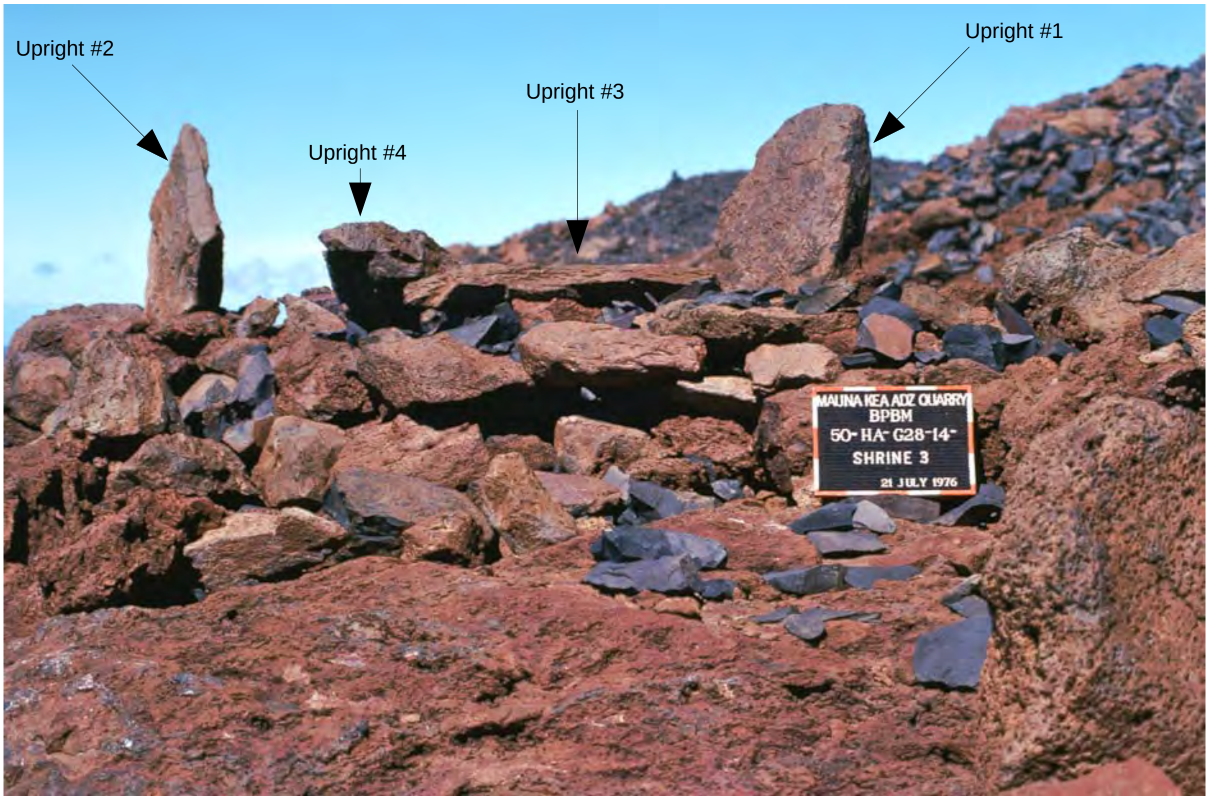
Table 5.10. Summary of Possible Burial Sites with Associated Lithic Scatters.

State Site Number 50-10-23-	Number of Features	Elevation (feet amsl)	Feature Type	Location
16205	1	12,260	pavement	Adze quarry
16216	1	12,283	pavement	Adze quarry

* USGS elevation

5.6.1.3 Rock Art

Petroglyphs and pictographs are found in the NAR, but are rare. The few examples appear localized to Lake Waiau (see discussion below) and the Pu`u Ko`oko`olau area of the adze quarry. In 1975-76 petroglyphs were found at Sites 16216 and 16218 and pictographs at Site 16217. The surveys conducted between 2007 and 2009 identified several more petroglyph sites. These include Feature 19 and 23 of Site 26129 and Site 26130 at Lake Waiau (McCoy and Nees 2009; Table 5.3 in this report), and a panel of two anthropomorphic figures located on Site 16216, Feature 9 (Figure 5.23). The latter was originally found by Rich Nees and Scott Williams in the early 1990s.

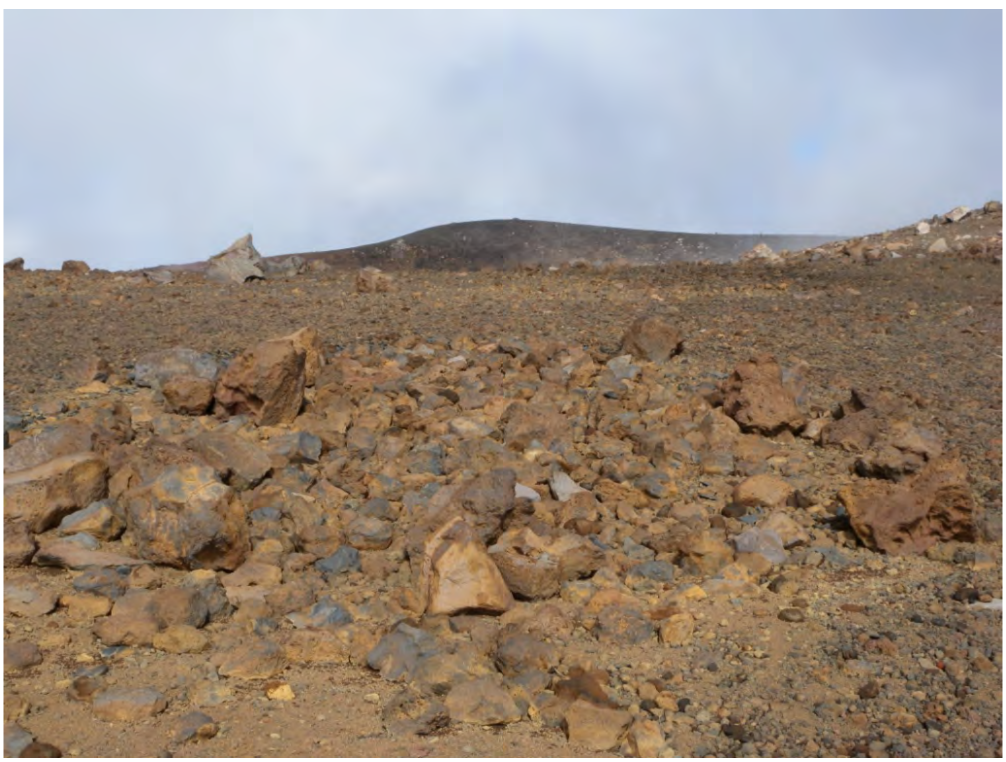


Photograph Taken in 1976 with Two Uprights Standing (Close Up)

Photograph Taken in 2008 with Four Uprights Standing

Figure 5.21. Site 16216, Shrine 3 in 1976 and 2008.

Site 16205



Site 16216 (close up)

Figure 5.22. Possible Burials at Sites 16205 and 16216.

Panel at Site 16216

Two Anthropomorphic Figures at Site 16216, Feature 9

Figure 5.23. Examples of Rock Art Found within the NAR.

The pictographs, all of which are a red pigment, include a shark and what appear to be other sea animals or creatures that may be depictions of *`aumakua*, a class of deities, some of whom are related to professional groups (Figures 5.24 and 5.25) (Valeri 1985:19-30). Another image, similar to one found at Kaupulehu in North Kona, may be a fish trap (Ed and Diane Stasack, personal communication).

The petroglyphs in the adze quarry are limited to just three panels, two at Site 16216 and one at Site 16218. At Site 16216 one is located above the entrance to Ko`oko`olau Rockshelter No. 1. It includes both traditional Hawaiian images of the anthropomorphic type and more modern "graffiti" in the form of initials The second panel, initially identified by Rich Nees and Scott Williams, consists of two anthropomorphic images. The panel at Site 16218 is currently the largest known rock art display in the Mauna Kea summit area in terms of the number of images.

In addition to traditional Hawaiian types of rock art, another type of rock art that occurs in the NAR is what would today be called "graffiti" but because it was done at an earlier time and does not compare to today's graffiti is different. The earliest known example of this found in the NAR is a date inscribed in a man-made structure at Lake Waiau. The date, 1892, appears at the base of what has been interpreted as the pendulum pier of the Pendulum Expedition of 1892 (McCoy and Nees 2009:5-21).

In an area of the adze quarry that became fairly well known by the early 20th century, is a boulder located at the bottom of a large extraction pit at Site 16216 with the names of several individuals, including Eben Low or "Rawhide Ben" as he was known to many. A photograph of Rawhide Ben standing beside a boulder with his name on it was published in a 1911 edition of *The Mid-Pacific Magazine* (Anonymous 1911:409).

The following information was recorded in the 1975-76 survey:

> At the bottom of the pit, on the north side, is a large boulder or outcrop exposure with several names and a date scratched on the cortex of the eastern side. The date reads April 10, 1905. The date may be associated with the name Henry P. Beckley which is just above. Over the date and name in larger letters is a faint name in 2 lines which looks like Wilbur Meyer. In the lower left hand corner of the rock as it appears looking from the E, there are a series of even fainter scratches. They include a second date of Aug. 21, 1906. To the right of the date are two readable names. Brother Low and E.P. Low.
>
> Above the upper name and also to the right are several more scratches which I cannot read. In the upper right hand corner are a series of faint numbers 19435. Probably the 4 and 9 were both attempts to make a good 9 as the 4-looking one is beneath the better done 9. Below the date is the name NAKAMA. There are other scratchings on the far right center which were not legible, unfortunately.

5.6.2 Non-Quarry Sites

Apart from the adze quarry complex, relatively few other kinds of sites have been found in the NAR, and most of these are represented by just one or a few examples (see Table 5.6). Possible burials are the most common type of site other than those found in the adze quarry complex. Isolated shrines and possible shrines are one other relatively common site type in the NAR. The remainder of the historic property inventory is represented by small numbers of diverse site types, which are briefly described below.

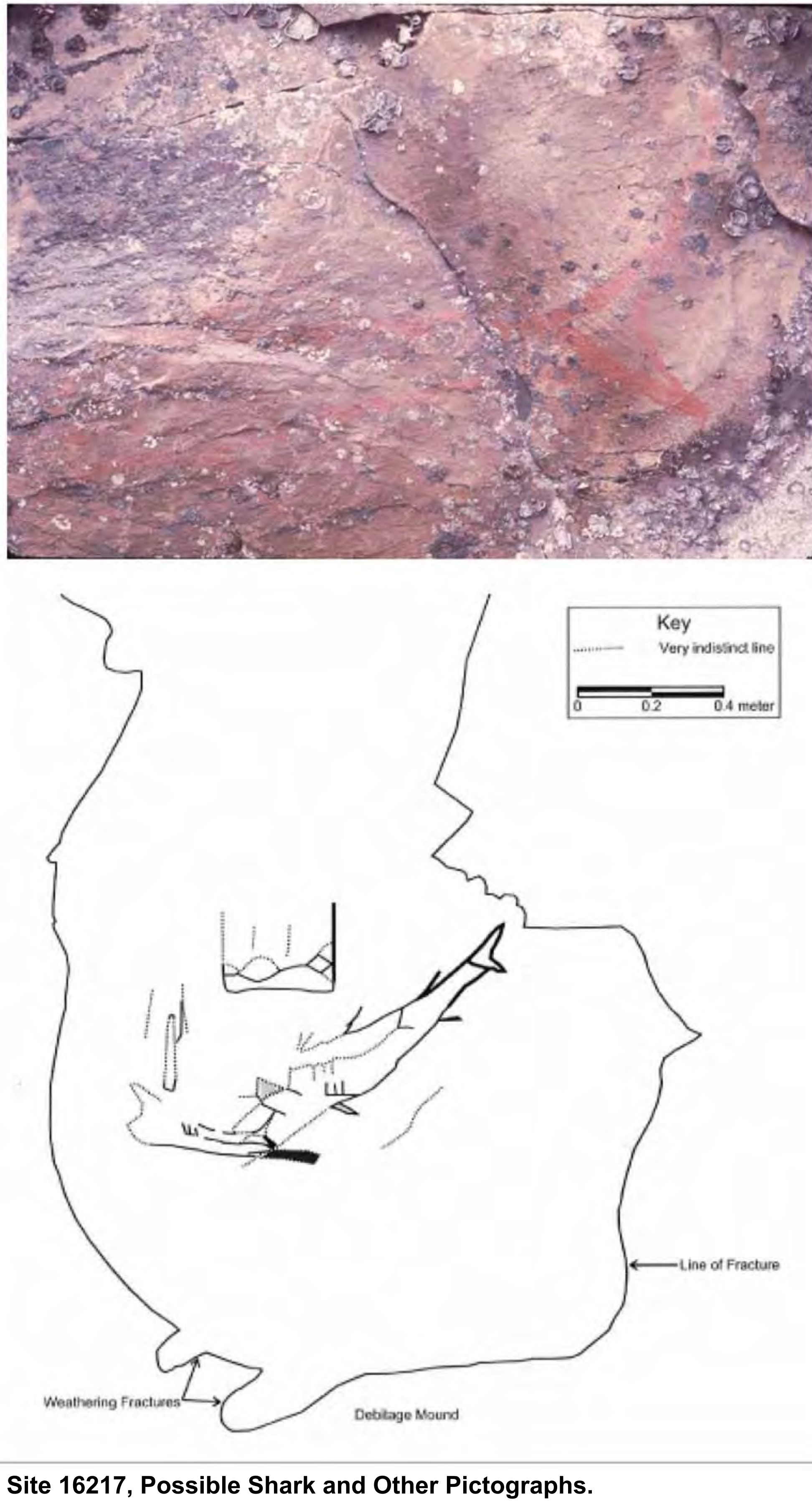


Figure 5.24. Site 16217, Possible Shark and Other Pictographs.

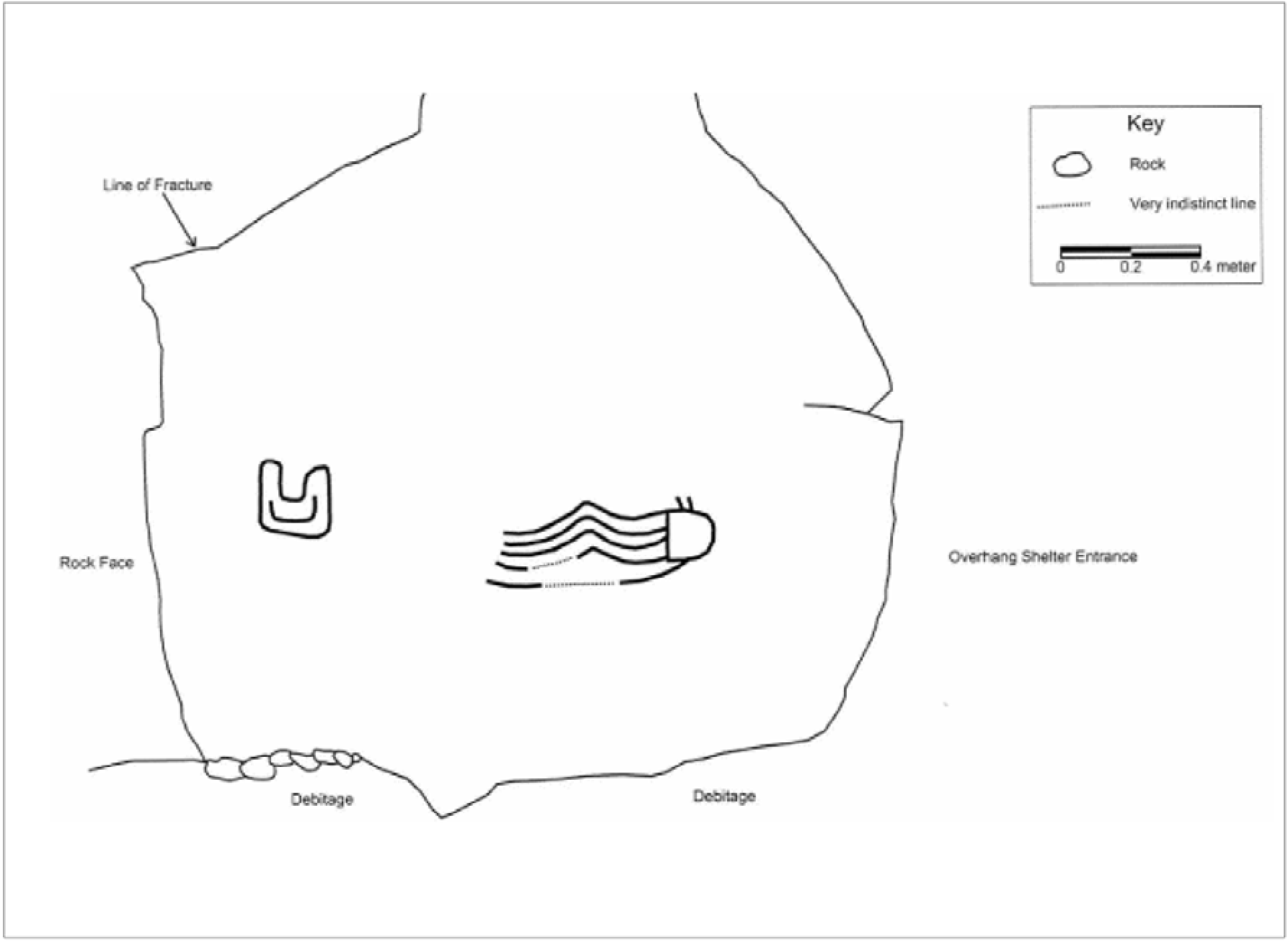


Figure 5.25 Drawings of Two Additional Pictographs at Site 16217.

5.6.2.1 Traditional Cultural Properties

As noted in Section 3, in 1999-2000 SHPD designated three areas on Mauna Kea as traditional cultural properties. Two of the three, Kūkahau`ula and Pu`u Līlīnoe are located in the Science Reserve. The third TCP, Pu`u Waiau, is located in the NAR (Figure 5.18).

Traditional cultural properties, like all historic properties, must have boundaries. As Parker notes, however, “Many, if not most, traditional cultural properties, were and are simply not meant to have lines drawn around them marking where they begin and where they end. Trying to do so can lead to some fairly bizarre and artificial constructs” (Parker 1993:4). Parker goes on to give a hypothetical example of a Native American vision quest site on a mountain top in terms of how the boundaries can be narrowly defined from one point of view and encompass a vast area from the perspective of potential effects on the property. She writes, “The boundaries of a mountain top on which religious practitioners seek visions could be drawn around the toes of a person sitting on it, but the area of potential effect could include everything within that person’s viewshed” (Parker 1993:4).

As explained in previous reports (McCoy et al. 2009; McCoy and Nees 2010), the boundaries of the three TCP’s on Mauna Kea were drawn based on geological boundaries of the cinder cones (Wolfe et al. 1997: Plate 2) and in the case of the summit a series of overlapping, contiguous cinder cones which include Pu`u Wekiu, Pu`u Kea, Pu`u Hau Oki and at least one other unnamed cone (see Figure 5.6). In the case of Kūkahau`ula, the boundaries are also based in part on the near total absence of archaeological sites on the summit. The summit thus stands out from the rest of the cultural landscape which is dotted with shrines and other cultural remains as summarized above.

5.6.2.2 Isolated Shrines and Possible Shrines

Five shrines with no lithic offerings and five other possible shrines were recorded in the NAR (Table 5.11), outside of the Mauna Kea Adze Quarry Complex, where there is a much larger number of shrines (see below). The latter are remains where some doubt exists about the presence of uprights because none were found in a standing position. It is possible that the construction of some shrines was never completed or the uprights were removed at a later date.

Three or four possible shrines were found at Lake Waiau. Three of the sites (26138, 26139 and 26141) are located near the edge of the escarpment on the north side of the lake. The other possible shrine is Feature 14 of Site 26134. Whether the large tabular slab ever rested on the surface of the feature prior to its recent placement there is unclear. There is no doubt, however, that the slab was transported to the rim of Pu`u Waiau from some other place as there are no such slabs on or near the cinder cone. What may have been uprights on each of the structures at the lake were found in a horizontal position, thus reducing the level of confidence in identifying them as shrine uprights. As a result, they have been characterized as possible uprights and the sites or feature, possible shrines.

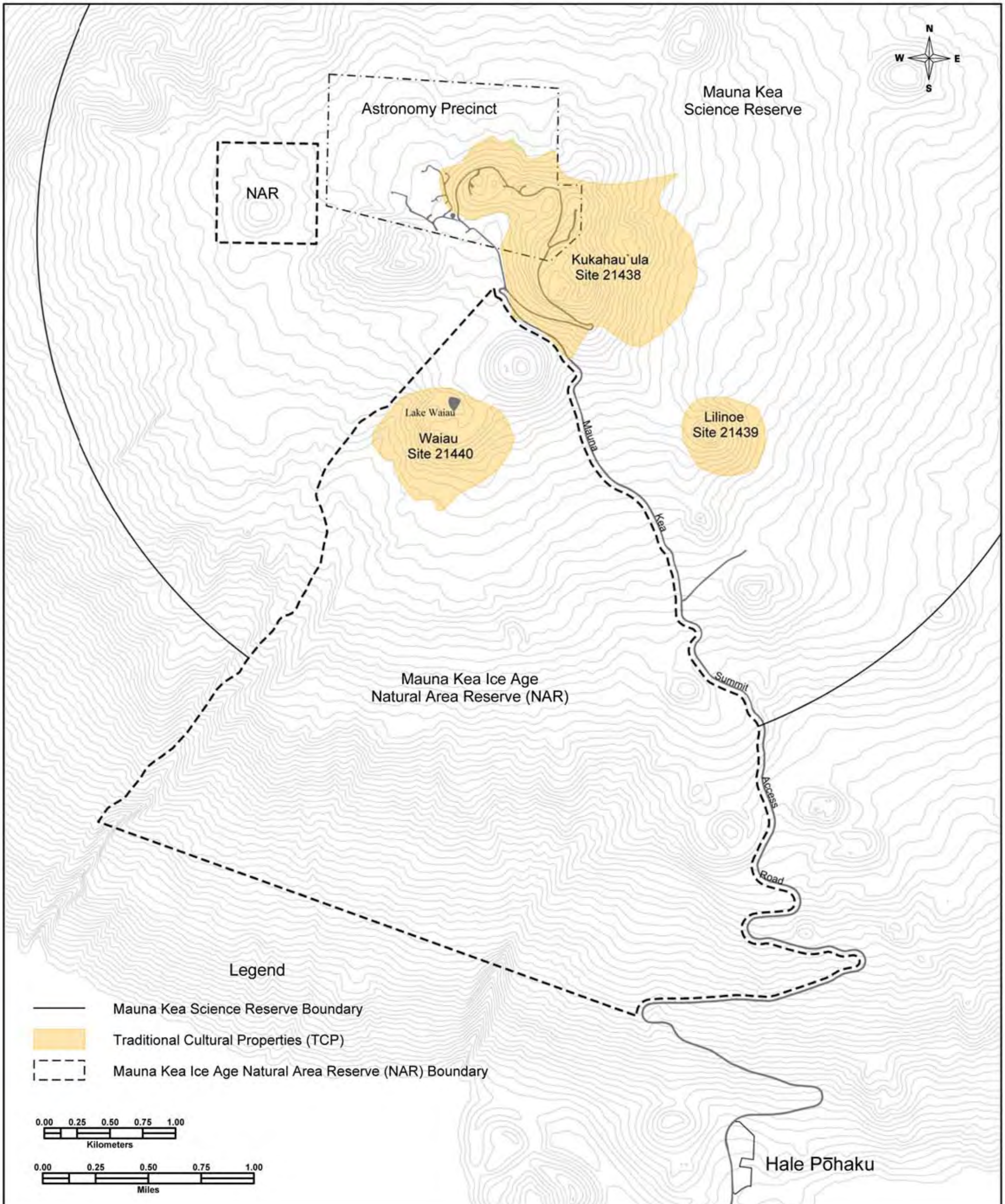


Figure 5.26 Location of SHPD Designated Traditional Cultural Properties (TCP) in the Mauna Kea Summit Region.

Table 5.11. Summary of Non-Quarry Related Shrines and Possible Shrines.

State Site Number 50-10-23-	Number of Features	GPS Elevation (ft. amsl)	Location	Description
16232	4	13,213	Pu`u Waiau	4 cairns with one standing upright
21196	1	12,554	Glacial Drift plain	Boulder shrine with 2 uprights
26138	1	13,212	Rim of Pu`u Waiau	Possible shrine on mound or collapsed platform
26139	1	13,212	Rim of Pu`u Waiau	Possible shrine with tabular basalt slab on an alignment or low platform
26141	1	13,210	Rim of Pu`u Waiau	Possible shrine on stone terrace
28629	1	12,465	Glacial moraine	Boulder shrine with 1 upright
28630	5	12,606	Glacial drift deposit	4 boulders with 1 upright on each
28631	1	12,528	Ridge crest (toe)	1 upright on bedrock
28646	1	11,679	Glacial moraine	1 upright on bedrock
28672	1	10,670	A`a ridge crest	1 to 2 uprights

5.6.2.3. Possible Burials

Prior to the initiation of the most recent surveys in the NAR, in 2007, the only possible burials that had been found were located at Lake Waiau. Unlike the Science Reserve where 29 sites with a total of 48 features were recorded as burials (defined as features with visible skeletal remains) or possible burials (McCoy and Nees 2010), there are no known confirmed burials in the NAR.

For the sites classified as possible burials there are compelling reasons, such as the topographic location and morphological characteristics of the structures, to believe that these sites are indeed burials, but because human remains were not seen at the time they were recorded they are classified as possible burials (Figure 5.27). In addition to Lake Waiau, where possible burial features were found on the rim of Pu`u Waiau, the margins of the lake, and the lakebed itself, possible burials were found at three other localities. These include Pu`u Hau Kea, Pu`u Ko`oko`olau (Table 5.12; Figure 5.28), and Pu`u Keonenehehe`e.

A total of 40 features interpreted as possible burials were found at five sites at Lake Waiau. None of the features are confirmed burials since no human remains were observed on the surface and no excavations were undertaken to aid in determining function. They are interpreted as burials based on their topographic location and morphology, which conform to known burial sites in the Science Reserve. The features interpreted as burials are located on the eastern and southern rim of Pu`u Waiau and on

Figure 5.27. Example of Possible Burial Located at Site 21454, on Pu`u Ko`oko`olau.

Table 5.12. Summary of Possible Burial Sites and Features.

State Site No. (50-10-23-)	Number of Features	Elevation (ft. amsl)	Burial Feature Types	Location
16205	1	12,330	mound	SE of Rockshelter 2
16216	1	12,430	mound	S of Workshop 10
21453	2	12,638	mounds	cinder cone rim
21454	2	12,538	mounds	cinder cone rim
26125	2	12,820	rock piles	Lake Waiau area
26126	6	13,111	pavements	Lake Waiau area
26129	18	13,115	1 platform, 1 mound, 1 alignment, 15 pavements	Lake Waiau area
26132	2	13,247	alignments	Lake Waiau area
26134	15	13,229	1 terrace, 1 mound/ terrace, 4 pavements, 9 mounds	Lake Waiau
28623	4	13,411	mounds	rim of Pu`u Haukea
28624	1	13,450	mound	rim of Pu`u Haukea

Table 5.12. Summary of Possible Burial Sites and Features.

State Site No. (50-10-23-)	Number of Features	Elevation (ft. amsl)	Burial Feature Types	Location
28625	3	13,447	mounds	rim of Pu`u Haukea
28626	3	13,449	mounds	rim of Pu`u Haukea
28627	2	13,449	mounds	rim of Pu`u Haukea
28667	1	11,529	mound	rim of Pu`u Keonehehe`e

the western and eastern margins of the lake. The sites on Pu`u Waiau are all located on the crest of the rim, except for Site 26125, which is on the outer eastern side of the rim, out of view of the lake. If the two features at Site 26125 are indeed burials, it may signal interments of people of a lower class or status than those buried on the rim, the margins of the lake and in the lake itself. This site may also be more recent. This would accord with the information obtained in the consultation with Kimo Pihana that protocols determined who could approach the lake and who could not and had to remain out of sight of the lake. If this is true, it would presumably represent a more recent practice on the assumption that in the past the only people allowed to approach the lake were high status individuals.

The possible burial features found in the lakebed are more uniform that those located on the shores of the lake and rim of Pu`u Waiau in terms of overall size, shape and the size of the stones used in the construction. The lake features are not only smaller than most of the other possible burials, but they are noticeably more uniform in both overall size and the size of the cobbles that were used in their construction. This suggests the possibility that the lake features contain the remains of just one or perhaps several individuals, in contrast to the larger pavement-like features above the west side of the lake that could conceivably contain the remains of several generations of an extended family.

Two of the 18 features at Site 26129 are of interest because of the presence in the center of the pavement of stones resembling shrine uprights. The features, 10 and 11, which are two of the largest, are located side by side above the lake. Each of the stones is a piece of tabular basalt that is uncommon in the environs of the lake. Both were found resting on the surface of the pavements. There was no indication, such as a depression or presence of what might be interpreted as bracing stones, that either one was ever set upright. Yet, they seem to have been intentionally placed based on their non-local origin and shape. It may be that they represent another form of god-stone like those found on shrines. They may have been a means for families to identify their own burial plots, especially as time passed and more and more interments were made at the lake. The stones would be a means of identifying a plot without drawing obvious attention to it.

There may have been other means of marking a burial interment used over a period of several generations or more. Another one of the large pavement-like features at Site 26129, Feature 32 has a large grey-colored tabular slab on one end. In terms of size and color it is quite distinctive. Feature 23 at Site 26129 had a petroglyph stone, also located in the approximate center. The petroglyph, which is difficult to decipher, may not have been finished. It may also be modern.

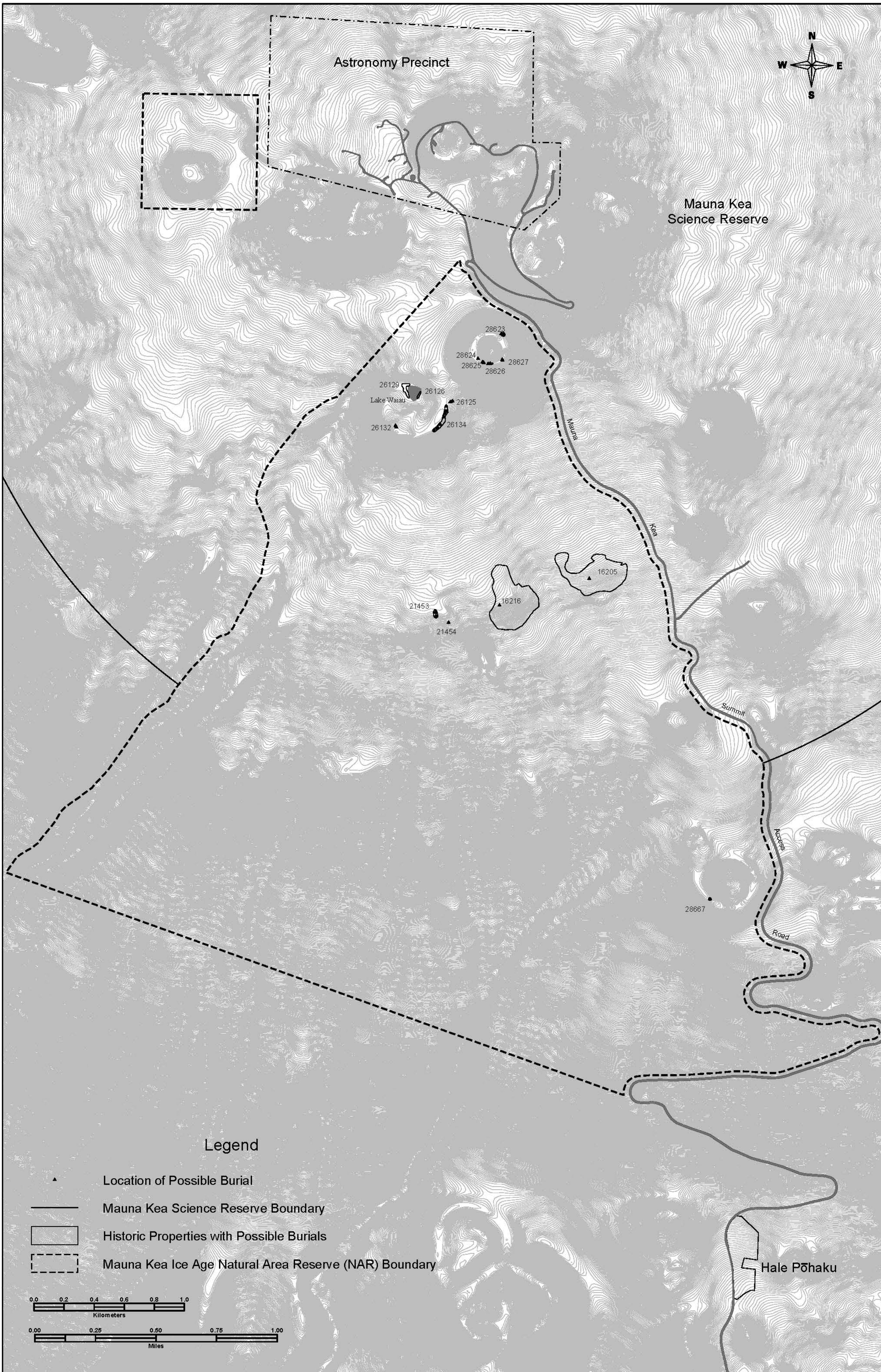


Figure 5.28. Locations of Possible Burials.

The evidence of what appear to be god-stones on burial features at the lake suggests that the large slab on Site 26134, Feature 14, which was on the ground in 1997, is a burial marker, rather than a shrine upright.

5.6.2.4 Stone Markers/Memorials

One of the more ambiguous classes of sites are piles or stacks of rocks believed to be a marker of some kind or a memorial to some person or event. In all but a couple of cases the actual function is unclear. Table 5.13 presents locational data and a brief description of each of the markers.

Some of the mounds and cairns found on the rim of Pu`u Waiau are probably markers or memorials of some sort, possibly erected by either surveyors or modern day visitors wishing to leave a memorial of their visit. Morphologically, all are quite unlike those which have been interpreted as burials. Some of the more elaborate examples, such as Site 26124, Feature 1 and Site 16232, Feature 1 are cylindrical in shape and faced. These two particular cairns and several others on the north side of the lake may have been boundary or *kapu* markers that warned people of what was ahead and inaccessible to those of lower rank.

Table 5.13. Summary of Markers and Memorial Sites.

State Site Number 50-10-23-	Number of Features	GPS Elevation (ft. amsl)	Location	Feature Type (Feature Number)
26124	2	12,910	NE rim of Pu`u Waiau	2 cairns (Features 1 and 2)
26128	1	13,028	East edge of Lake Waiau	1 marker dated 1892 (Feature 1)
26131	1	13,186	SE edge of Lake Waiau	1 destroyed marker
26133	1	13,252	South rim of Pu`u Waiau	1 cairn (Feature 1)
26136	1	13,240	NE side of Lake Waiau	1 cairn (Feature 1)
26137	1	13,234	North side of Lake Waiau	1 cairn (Features 1 and 2)
26140	2	13,181	North side of Lake Waiau	2 mounds (Features 1 and 2)
28674*	2	11,137	SE of Pu`u Keonehehe`e	2 cairns (Features 1 and 2) Queen Emma Shrine

* USGS elevation

The age of the numerous rock piles on Mauna Kea, including the current project area, is unknown. It is likely that they are of different ages. Some rock piles that could possibly be interpreted as markers have been built in modern times. Jerome Kilmartin, who was in charge of the topographic mapping of the Lake Waiau quadrangle [later changed to the Mauna Kea quadrangle] for the United States Geological Survey, in 1925, mentions building an *ahu* to retard the wind (Kilmartin 1974:15).

Of the sites whose function and age are known, there is the Pendulum Party" Instrument Pier constructed in 1892. This site is a monument to the work of the earliest Western surveys in the summit region of Mauna Kea. The cemented stone monument with the date 1892 inscribed on one side (Site 26128) is to our knowledge the only surviving evidence of the Pendulum Party, led by the government surveyor W.D. Alexander and the Coast and Geodetic Survey astronomer, E.D. Preston. The only other remains that might be associated with the Pendulum Party would be some of the rubbish in the historic dump (Site 26127).

The site of the Eben Low memorial plaque (Site 26131) is the only other site unequivocally associated with a known person or person. According to the descendants of Eben Low, the plaque was installed at the lake at the same time that his ashes were buried in an urn. Dating to 1954, this is the most recent historic site in the project area, although some of the rock mounds and piles could also date to this same time period.

While there are no dates for any of the cairns, we know from historic accounts that the Rev. Goodrich saw a cairn on the "summit" in 1823 (Goodrich 1826) and that later visitors also observed and built cairns (see Section 2). Jarves (1844:228) described the construction of a cairn to memorialize the ascent of the summit by his companions. It is possible that some of the simple stacked-stone constructions that have been interpreted as modern (see Section 2.4), may be memorials of the kind described by Thomas Thrum in Haleakalā:

> It was a recognized custom of Hawaiians to erect stone piles--pile is one meaning of the word ahu--as way marks, memorials of parties traveling or resting, division points of survey, and also guides to most accessible routes of travel. One such marks the safest of three ridges leading from the rim of the crater to the district of Nuu. That some ahu mark burial places is in accord with the present practice in certain districts of Maui and of Hawaii, and perhaps elsewhere. Most, if not all, of the ahus of three stones, one upon the other, are tributes to the deity of the locality and are designed by travelers to assure safety in their journey (Thrum 1921:259).

The number of markers could thus change with a closer analysis of the survey data.

The Alexander map of the summit plateau published in Preston (1895:602, Illustration 34) also shows the trail, which is labeled Trail to Kalaieha, cutting across the south and eastern slope of Keonehehee. This indicates that the Queen Emma memorial was southeast of the trail, contrary to Maly's interpretation (Maly and Maly 2005:Figures 8b and 8c) that it is located on the rim of Pu`u Ko`oko`olau, which is in the adze quarry and the middle, rather than edge of the summit plateau (see Figure 2.10). Preston mentions that there was more than one cairn:

> Some interesting pyramids of stones, built to commemorate Queen Emma's visit, were seen on the edge of the plateau, and at elevation of 12,000 feet was found Keanakakoi, a famous quarry opened by the natives many centuries ago for the manufacture of battle axes (Preston 1895:601).

Figure 5.29 is a photograph of what has been identified during the recent survey as the Queen Emma Shrine (Site 28674).

5.6.2.5 Historic Dump

Site 26127 is an historic dump located on the east/northeastern edge of Lake Waiau. The site consists of a roughly square enclosure located at the base of the north slope of Pu`u Waiau (Figure 5.30). It is constructed of piled and stacked cobbles and small boulders along the east, west, and south sides. The north side of the enclosure

Figure 5.29 Site 28674, Queen Emma Memorial. View to West.

Figure 5.30 Site 26127, Historic Dump at Lake Waiau. View to South.

abuts, and incorporates, the natural slope. The enclosure's exterior dimensions are approximately 2.8 m by 2.4 m with walls 0.7 m thick; the interior's dimensions are 1.8 m by 1.5 m. The maximum wall height occurs along the interior and is 0.7 m.

The interior of the enclosure is littered with rusted cans, broken glass bottles, wire, screen mesh, miscellaneous metal fragments, wood fragments, and shoe leather (see Figure 5.30). The age of the dump is unknown, but it may have been used over a period of time, perhaps beginning with the W.D. Alexander survey party in 1892. The 1925 USGS survey team may have left some of the rubbish. Most of the items may be associated with the 1935 Hawaiian Academy of Sciences Expedition. According to a staff member at the Visitor Information Center some of the trash within the enclosure was removed several years ago as part of a cleanup effort.

5.6.2.6 Historic Camp Site and Water Collection Site

The camp site, comprised of five components/features, is located on the east and west flanks of Waikahalulu Gulch at 10,841 ft amsl. The components consist of the remnants of a rectangular enclosure, a U-shaped enclosure, metal pipes and retaining walls, a wall segment, and what appears to be an area that was excavated. Associated with the site are numerous historic artifacts, some of which were collected for identification (see Appendix Q in Volume 4).

5.6.2.7 Trails

Three trail segments have been identified in the NAR. The best defined is the Humu`ula Trail which has already been discussed in Section 2. The old section of this trail, from just below Pu`u Keonehehee to Lake Waiau, has been obliterated and no longer exists. Based on the 1892 Alexander map, this section of the trail was located within or close to the modern roadway. The 2008-2009 survey recorded the alignment of this trail, from the southern boundary of the NAR to the uppermost preserved section on the outside rim of Lake Waiau (Figure 5.31). The alignment differs slightly from that shown on the 1930 Mauna Kea USGS Quadrangle map. The height and base diameter of the cairns located along the trail were also recorded and photographs taken of representative cairns (Figure 5.32). The cairns are of variable forms and sizes. The variability may be due to post-construction modifications and collapse.

A section of a prepared foot trail was found above Lake Waiau in 2007 (McCoy and Nees 2010:5-6, 58-to 5-9). The trail, which has a constructed surface of cobble and pebble sized rocks and cinder, is located alongside the modern jeep trail that used to lead from the summit access road to the lake, along the base of Pu`u Hau Kea before it was closed off by NARS. Five small cairns located along the trail and a basalt flake scatter in the same area was assigned Site number 50-10-23-26123. The age of this trail segment is unknown but it is unlikely to be coeval with the adze quarry. The prepared surface and cairns suggest a post-contact date. It appears that the jeep road not only removed a portion of this previously unknown trail, but what may have been an extension of the Humu`ula Trail that is illustrated on some modern maps as going from Lake Waiau to the summit.

The only direct and in our view unambiguous evidence of the Umi Koa Trail, which is shown on the 1892 Alexander map and other maps as terminating at Lake Waiau, is a single horseshoe that was assigned SIHP number 25800. The horseshoe was found in close proximity to the route shown on the USGS Mauna Kea Quadrangle maps (see Figure 2.13). We believe that this is not a case of mere coincidence. How long the trail was used to transport visitors from the Hāmākua Coast is unknown.

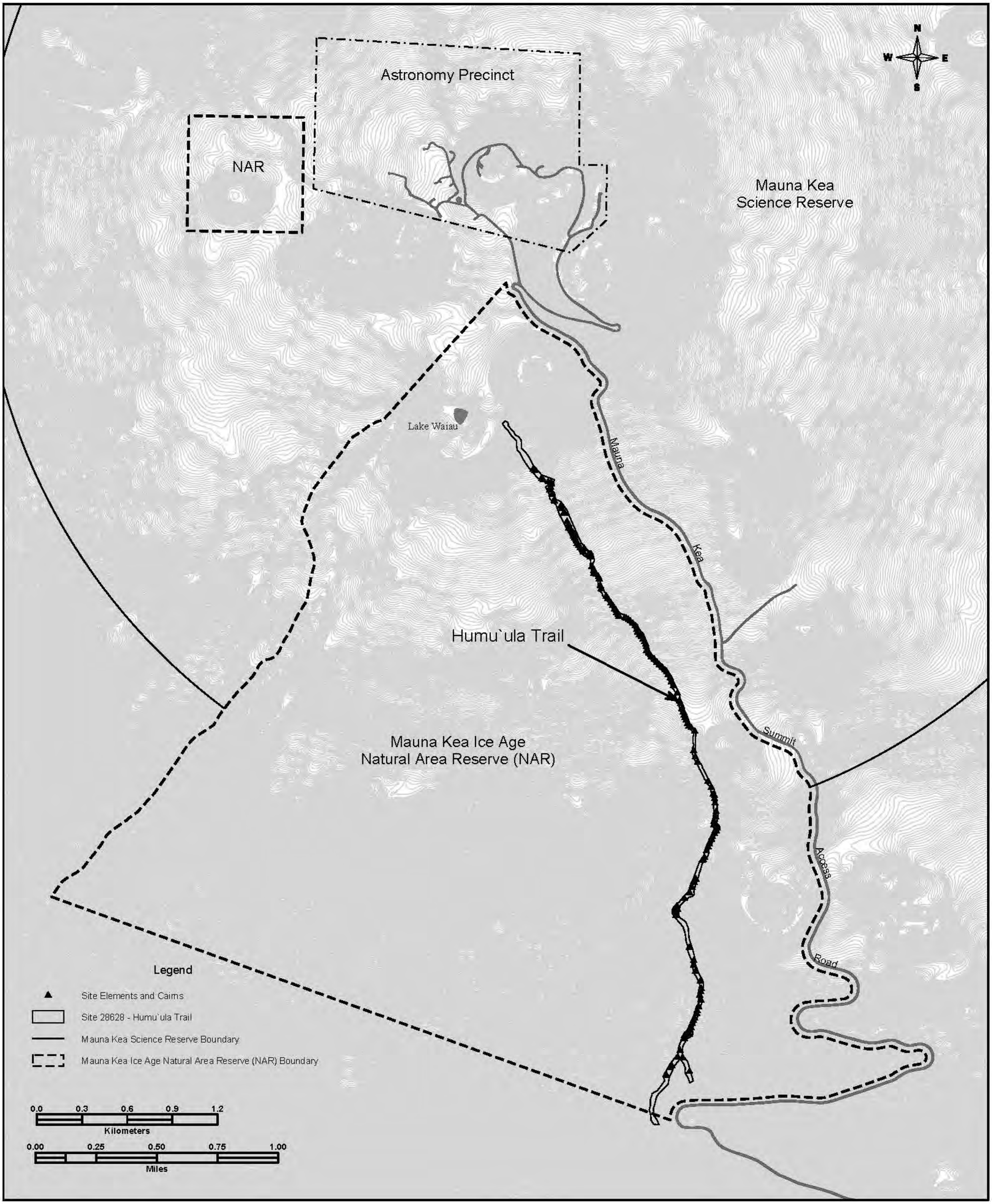
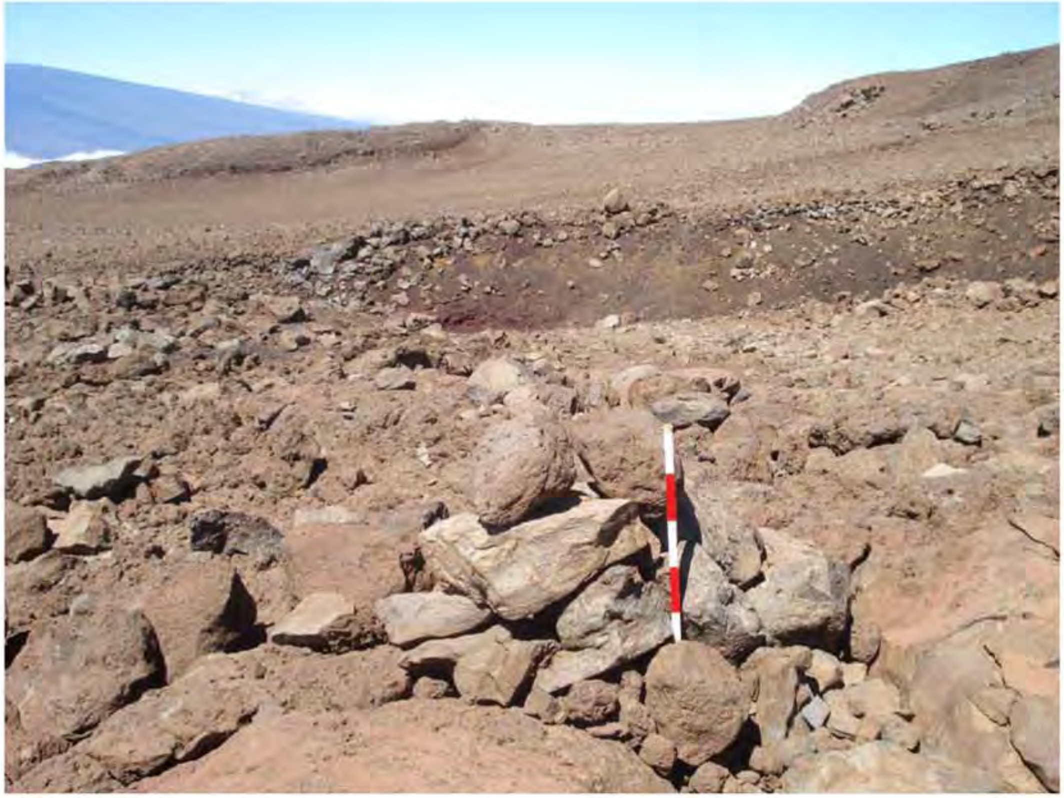


Figure 5.31. Site 28628 - Humu`ula Trail.


View to Southwest.


View to Northwest.

Figure 5.32. Site 28628, Examples of Cairns Along the Humu`ula Trail.

5.6.2.8 Rock Art

Petroglyphs have now been recorded at Lake Waiau and at three sites in the adze quarry. The Lake Waiau petroglyphs include one anthroporphic figure and one image that might be a horse.

5.6.3 Other Cultural Resources (Find Spots)

Cultural resources in the NAR include a large number of remains that at present cannot be classified as historic properties or sites, as normally defined in State and Federal laws, but which nevertheless need to be considered in developing appropriate management strategies which, according to Tom King (1998:235), need to consider all cultural resources. As noted above in the summary of previous archaeological work in the Science Reserve (Section 3.1), in 1997 SHPD instituted a process of recording what were initially referred to as “locations” but are now being termed “find spots,” although this term generally refers to isolated artifacts (cf. McCoy 1984a). “Find spots” are cultural resources that are either obviously modern features (e.g., camp sites with tin cans, pieces of glass and other modern material culture items), or features that cannot be classified with any level of confidence as historic sites because of their uncertain age and function (e.g., a pile of stones on a boulder).

Approximately 313 find spots were observed in the NAR (see Appendix E for descriptions and a representative sample of photographs). Their general locations are shown in Figure 5.33.

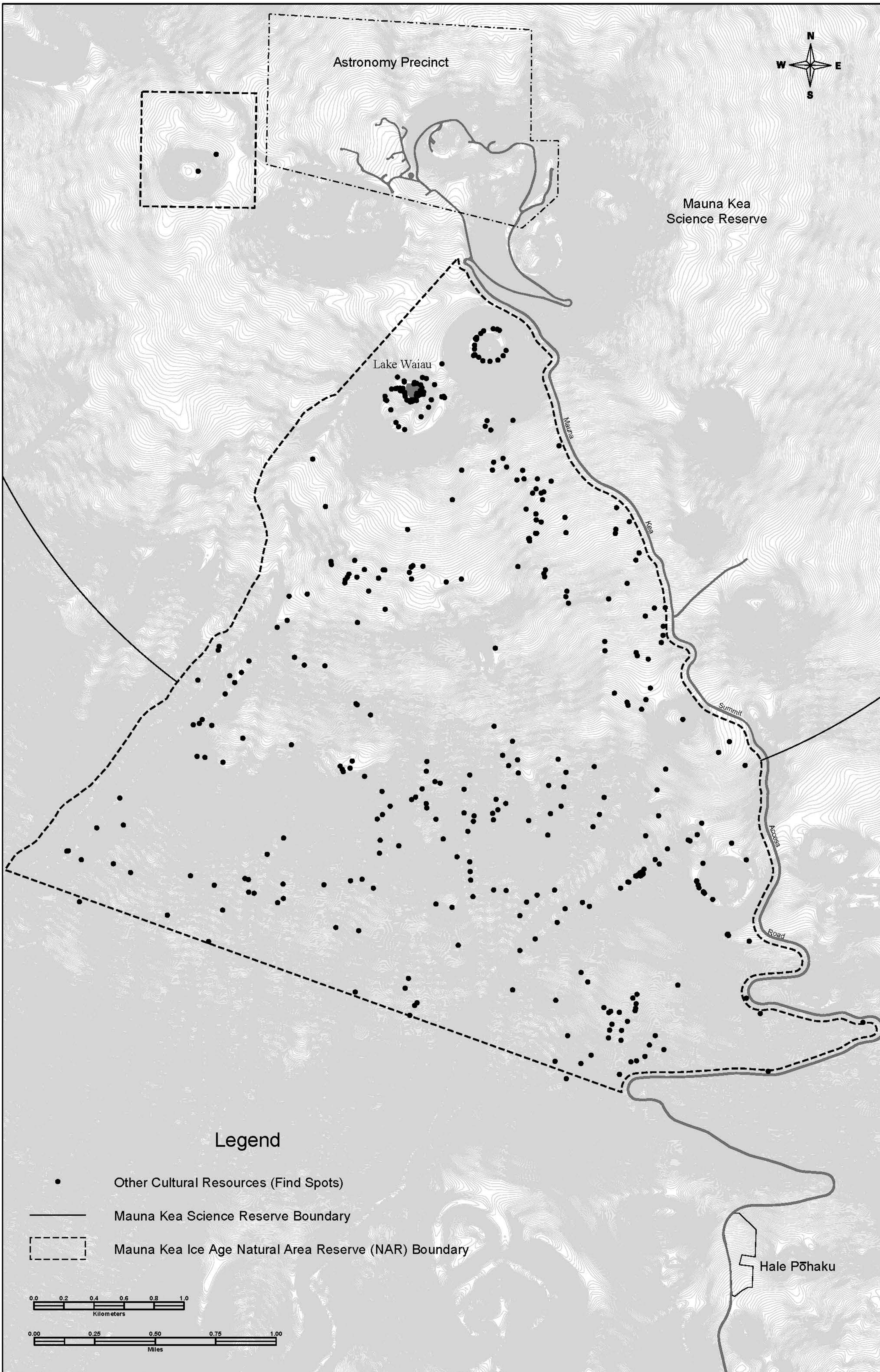


Figure 5.33. General Location of Other Cultural Resources (Find Spots) Identified in the NAR.

6.0 THE MAUNA KEA ADZE QUARRY COMPLEX: SELECTED DATA ANALYSES

One of the common criticisms of CRM archaeology is that because little attention tends to be given to methodological and theoretical matters (Watson 1991), it often amounts to little more than data aggregation, and as a result does not contribute significantly to the production of archaeological knowledge. As a generalization it may be true that while CRM-oriented compliance surveys and data recovery projects meet the Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation on data analysis, many do so only minimally. It is our impression, moreover, that the data are more commonly under-interpreted and not very often linked to sociocultural theory. In this regard, our view of the place of data analysis in the archaeological process follows Cowgill who has written:

> It is useful to think rather distinctly of three broad categories: archaeological observations, analytical methods, and sociocultural theory. Analytical methods provide the connections between observations and sociocultural theory (Cowgill 1986:369).

The quantity of raw data collected during the several archaeological projects in the NAR is immense. The analyses undertaken for this report are limited to the adze quarry because if for no other reason than it constitutes most of the cultural landscape of the NAR. The analyses that follow include:

(1) Geoarchaeological patterns and relationships, with a focus on production zones and patches, and the effects of post-depositional processes on the adze quarry landscape;

(2) Shrine attributes and the composition of artifact assemblages (offerings) associated with a sample of six shrines from different parts of the upper quarry area that were the focus of a preliminary study on shrine variability undertaken in the 1975-76 fieldwork;

(3) Adze preform and hammerstone assemblages from selected workshops and rockshelters and basaltic glass core and flake assemblages from the geological source and two rockshelters;

(4) Faunal and floral assemblages recovered in the four rockshelter excavations from 1975-76;

(5) EDXRF data from a small sample of 25 artifacts collected for geochemical characterization in the 2008-2009 project;

(6) Other artifact types found in the NAR besides the ubiquitous adze preforms and related artifacts, including manufacturing waste or debitage, and

(7) ^{230}Thorium dates for two shrines and one rockshelter

The first part of the shrine analysis mirrors a previous study of the shrines in the Mauna Kea Science Reserve (McCoy and Nees 2010). The artifact analyses are also similar to those in the archeological inventory survey on the Science Reserve, with an emphasis on inter-site variability in adze preform assemblages. The faunal and floral remains recovered in the 1975-76 rockshelter excavations have been only partially analyzed and reported prior to this time. Allen's (1981) analysis of the plant remains and artifacts made of vegetal materials is the most complete. The vertebrate and invertebrate faunal data were briefly summarized in 1990 based on the identifications that were available at the time (McCoy 1990:104-108).

6.1 Analytical Framework: Concepts and Terminology

Though workshops, shrines and habitation rockshelters, the primary components of the adze quarry sites found in the NAR, require a different analytical framework, the general approach that is being utilized is based on variables and attributes to identify variability and to develop typologies.

The focus on variables and attributes and the development of typologies is a common archaeological practice that is not without its problems, however, as described below. To paraphrase Laurent Stern, the general approach is based on the conviction that "we are not finding, stating or describing facts, we are making sense of attributes and actions" (Stern 1990:205-206).

6.1.1 Pattern Recognition and the Matter of Scale

Pattern-recognition, the first step in attempting to comprehend the "archaeological record," is heavily dependent on context. Richard Gould has emphasized how important it is to determine the broadest possible relevant context:

> Pattern recognition is an essential step in all archaeological analysis, but the problem we must deal with is really a kind of selective pattern recognition, with selection based on the prior expectations of the archaeologist rather than on an organized approach that considers the widest possible range of relevant context and seeks to control for contextual variables (Gould 1990:40).

Glassie notes that "Many possible patterns will appear, and the task becomes the separation of the "patterns" that are merely coincidences from those that might have been structures in the thought of the artifacts' makers" (Glassie 1975:116). In the syntheses that follow an effort has been made wherever possible to go beyond pattern recognition to a consideration of pattern-generation processes.

The fact that archaeological practice is by nature multi-scalar means that there is no single way of analyzing data. It is puzzling that Tilley, who otherwise believes in the need for different analytical approaches and theories (Tilley 1993), is not in favor of analyzing distribution maps, at least in the case of European megaliths:

> In an oblique manner, to use another visual metaphor, the point I am trying to make is that if we are to try and understand the relationship between megalith and landscape the focus of our attention must be on modes of visual perception and experience on the human scale. Little is to be gained from the analytical gaze at the distribution map in which megaliths are merely dots in an abstracted containing space (Tilley 1993:56).

While we agree that there is much to be gained from a phenomenological analysis based on perception (cf. McCoy 1999b), we also believe that there is a great deal to be gained in what Tilley somewhat contemptuously calls the "analytical gaze at the distribution map."

The approach to data analysis employed in this report recognizes the importance of scale and the need for multi-scale analyses as argued by Lock and Molyneaux:

> Scale is a slippery concept, one that is sometimes easy to define but often difficult to grasp. In the practice of archaeology, there is much equivocation about scale, as it is at the same time a concept, a lived experience and an analytical framework…In taking scale for granted, archaeologists rarely expose its complexities and therefore overlook its crucial role in the process of representing the past (Lock and Molyneaux 2006:1).

The Mauna Kea Adze Quarry Complex, which covers a vast area on the south flank of Mauna Kea, is not a monolithic whole, but is instead comprised of many different parts, sectors or places, which become evident only through analyses at different scales, however. The analyses that follow, though largely exploratory and thus incomplete, illustrate a number of different kinds of relationships and correlations. As discussed below, there are, for example, different production zones that correspond to differences in the form, abundance and accessibility of basalt toolstone.

6.1.2 Variables and Attributes

One of the problems in archaeological analysis is that variable and attribute definition and selection are still primarily ad hoc and intuitive. They should be theoretically justified (Hill and Evans 1972:251-252; Dunnell 1986:193). Redman provides one of the clearest statements on the importance of the attribute selection process in archaeological analysis and what it entails:

> *Attribute recognition and selection* is the most crucial step in the analysis of archeological material. It is at this juncture that the archeologist is required to incorporate all available knowledge of similar artifacts, previous classificatory systems, insights on the relevance of particular attributes, and initial observation of the patterning of potential attributes. Attribute recognition is not an automatic process, and the decisions made directly affect the outcome of any subsequent analysis (Redman 1978:163).

We use variable and attribute as defined by Adams and Adams:

> An attribute is a definable aspect of a particular variable; that is, one of the states that it can assume (Adams and Adams 1991:169).
>
> Variables might better be characterized as dimensions of variability. They designate properties that are manifest in one way or another in all of the types in a typology, but not always in the same way or to the same degree (Adams and Adams 1991:170).
>
> Attributes designate recognizably different measurements or aspects within the same field (or along the same dimension) of variability. They differ from variables in several important respects. In each type there can be only one attribute per variable (Adams and Adams 1991:172).

6.1.3 Taxonomy, Classification, and Typology

There is a vast literature on taxonomy, classification and typology in both the natural and social sciences, including archaeology. The late, eminent biologist Stephen Jay Gould noted that "Taxonomies are theories of knowledge, not objective pigeonholes, hatracks, or stamp albums with places preassigned" (Gould 2000:223). Gould recognized that taxonomies, though generally useful in giving order to a body of data, could also be wrong and potentially harmful in some instances. He wrote "A false taxonomy based on a bogus theory of knowledge can lead us badly astray" (Gould 2000:223).

There are significant differences in the way archaeological typologies are developed and used compared to the natural sciences. As Cowgill points out, the "one obvious difference in our data and those of biologists is that our categories are far more problematic" (Cowgill 1989b:132). Adams and Adams (1991) make an important point in emphasizing that classification is just a tool, which means that there is no right and wrong way to classify things, as also argued by Cowgill (1989b:132). Classifications, moreover, are not immutable (i.e., they may require revision):

> We encounter frequently the assertion that typologies should strive for maximum scientific "objectivity." This does not strike us as a relevant or even a meaningful consideration, applied to what are essentially tools of communication. Useful typologies require intersubjective agreement (consistency), which is not the same thing as objectivity (correctness). We will never know, in many cases, how closely our type concepts correspond to some external reality, but we can discover and measure how closely the concepts of one person correspond to those of another (cf. especially Fish 1978 and Ziman 1978) (Adams and Adams 1991:4).
>
> There is no right or wrong way to classify anything, but there are better and worse ways of achieving specific purposes, once we have decided what those purposes are. By better we mean not only more precise, but also more communicable and more affordable (Adams and Adams 1991:4-5).

Adams and Adams view typology as a particular kind of classification and describe what the process of developing types involves:

> Scientific literature often does not distinguish between classifications and typologies. To us, this distinction is crucial. In our usage, a typology is a particular kind of classification: one designed not merely for categorizing and labeling things, but for segregating them into discrete groups which correspond to our class categories and labels. This process of segregation we call sorting; the things that are classified and sorted we call entities; the categorical groupings into which they are sorted we call types (Adams and Adams 1991:47).
>
> A typology is a basic set of mutually exclusive categories, at the same level of abstraction, and a taxonomy is a clustering of basic types into large and more inclusive units, or taxa (Adams and Adams 1991:88).

The purpose of classification is not to just organize the data and make them amenable to comparison, but to make comparisons meaningful. What is meaningful is defined in terms of purpose. Adams and Adams (1991: Table 9) define basic, instrumental and multiple purposes. Within the basic purpose category there are three sub-categories--descriptive, comparative, and analytical, which is further subdivided into interpretive and historical. The descriptive function is simply one of economy or convenience. Classifications developed for comparative purposes would be useful at a larger scale of analysis, such as a region. According to Cowgill, whatever the objective, “The essential thing is that, for a given purpose, we must not lump in ways that obscure important differences and we must not split on the basis of differences that are irrelevant for that purpose” (Cowgill 1989b:132).

6.2 Georchaeological Patterns and Relationships

Site types and site location patterns in the Mauna Kea Summit Region exhibit a number of different geoarchaeological patterns and relationships. This is abundantly clear, as expected, in the case of the adze quarry, which only exists because of the presence of basalt toolstone for the manufacture of the traditional Hawaiian adze blade. Less obvious perhaps, but no less important, is the effect that post-depositional geomorphic processes have had and continue to have on the integrity of surface workshop deposits, for example.

6.2.1 Toolstone Sources: Production Zones and Patches

The most obvious "explanation" for the size of the Mauna Kea Adze Quarry Complex and chronology of long-term repeated use is the quantity and quality of the raw material or toolstone. The boundaries of the quarry as presently known coincide with the occurrence of fine-grain basalts that have at different times also been called hawaiite (e.g., Porter 1979c; Wolfe 1987). The basalts belong to the earliest stage of volcanism which Stearns and Macdonald (1946) called the Hāmākua Volcanic Series. Hawaiite, by contrast, is the dominant lithology in all of the younger andesitic lavas on Mauna Kea (Macdonald and Abbott 1970:142; Porter 1979c; Wolfe and Morris 1996; Wolfe et al. 1997; Sherrod et al. 2007) that were called the Laupāhoehoe Volcanic Series by Stearns and Macdonald (1946). Porter renamed these the Hāmākua Group and the Laupāhoehoe Group and noted the lithostratigraphic relationship between the volcanics and glacial drift deposits on Mauna Kea (Porter 1979a: Figure 2). The lithostratigraphic nomenclature for Mauna Kea has gone through several more revisions since the publication of Porter’s primary work in 1979. A major revision appeared in 1997 with the publication of the work of Wolfe and two colleagues (Wolfe et al. 1997). One of the major changes made by this group of geologists was the subdivision of the Laupahoehoe Volcanics into two groups, which were termed the older volcanic rocks member of Pleistocene age, and a younger volcanic rocks member of Holocene and Pleistocene age (Wolfe et al. 1997:Plate 2). A simplified version of the Wolfe et al. 1997 nomenclature is shown in Figure 6.1 (Dorn et al. 1991: Figure 3).

Toolstone is not found everywhere in the NAR. Indeed, much of the NAR is covered with cinder cones and what Wolfe earlier called felsic hawaiite flows (Wolfe 1987:30) but were subsequently described as hawaiite-mugearite flows belonging to the older Laupahoehoe Volcanics (Wolfe et al. 1997: Plate 2). Approximately 1,634.73 acres or 42% of the NAR is devoid of basalt toolstone (Figure 6.2).

Using the latest geologic maps (Wolfe et al. 1997: Plate 2; Dorn et al. 1991: Figure 3), areas with tool-quality basalt are restricted to roughly the southern two-thirds of the NAR, from Pu`u Ko`oko`olau to the southern boundary of the NAR, between Pohakuloa and Waikahalulu gulches. According to the mapping of Wolfe et al. 1997, the basalts are in the Liloe Spring Volcanic Member of the older Hāmākua Volcanics.

Figure 3 (right).
Stratigraphic terminology[34] and chronologic summary of the upper flanks of Mauna Kea.

Figure 4 (below).
Generalized geologic map of the summit and upper flanks of Mauna Kea.
MODIFIED FROM WOLFE ET AL.[34]

Volcanics	Member	Approximate age, ka based upon only K–Ar and ^{14}C ages (Wolfe et al.[34])	Approximate exposure ages, ka
LAUPAHOEHOE	younger volcanic rocks member	13–4	
LAUPAHOEHOE	Makanaka Glacial Member	40–13	40–13
LAUPAHOEHOE	older volcanic rocks member	65–14 (possibly as old as 100)	
HAMAKUA	Waihu Glacial Member	within interval from 150 to 70	60–70
HAMAKUA	Liloe Spring Volcanic member	within interval from 150 to 70	
HAMAKUA	Pohakuloa Glacial Member	within interval between 200–150 and 150–100	>135–163
HAMAKUA	Hopukani Springs Volcanic Member	within interval from 200 to 150	

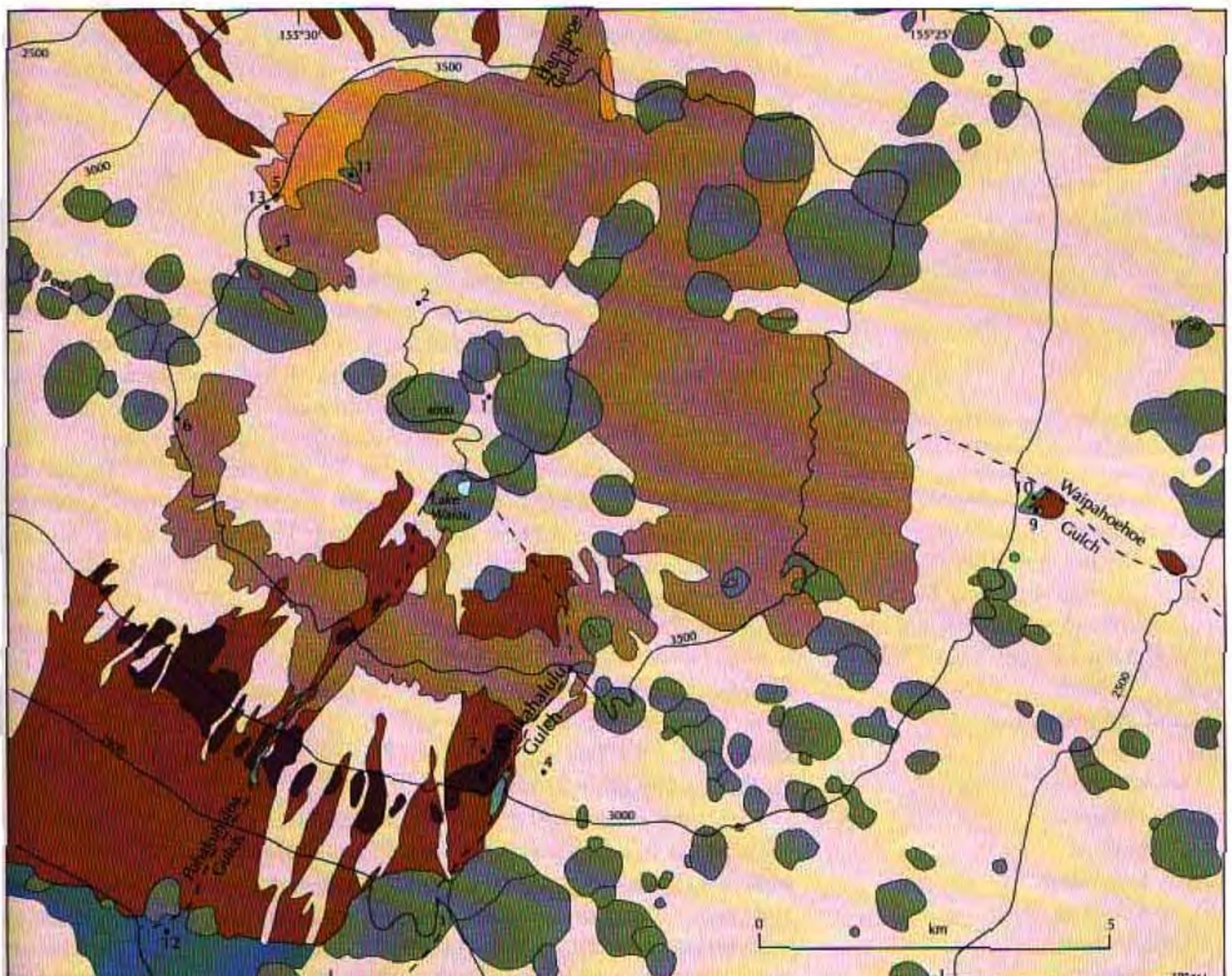
Alluvial Deposits
- Silt, sand, and gravel

Laupahoehoe Volcanics
- Lava flows, undivided
- Cinder cone

Makanaka Glacial Member
- Till
- Older till of north flank

Hamakua Volcanics
- Lava flows and cinder cones, undivided
- Till

Pohakuloa Glacial Member
- Till; mapunit locally includes underlying basalt



contour interval 500 m

Figure 6.1. Stratigraphic Terminology and Chronological Summary of the Geologic Formations on the Upper Flanks of Mauna Kea (after Dorn et al. 1991).

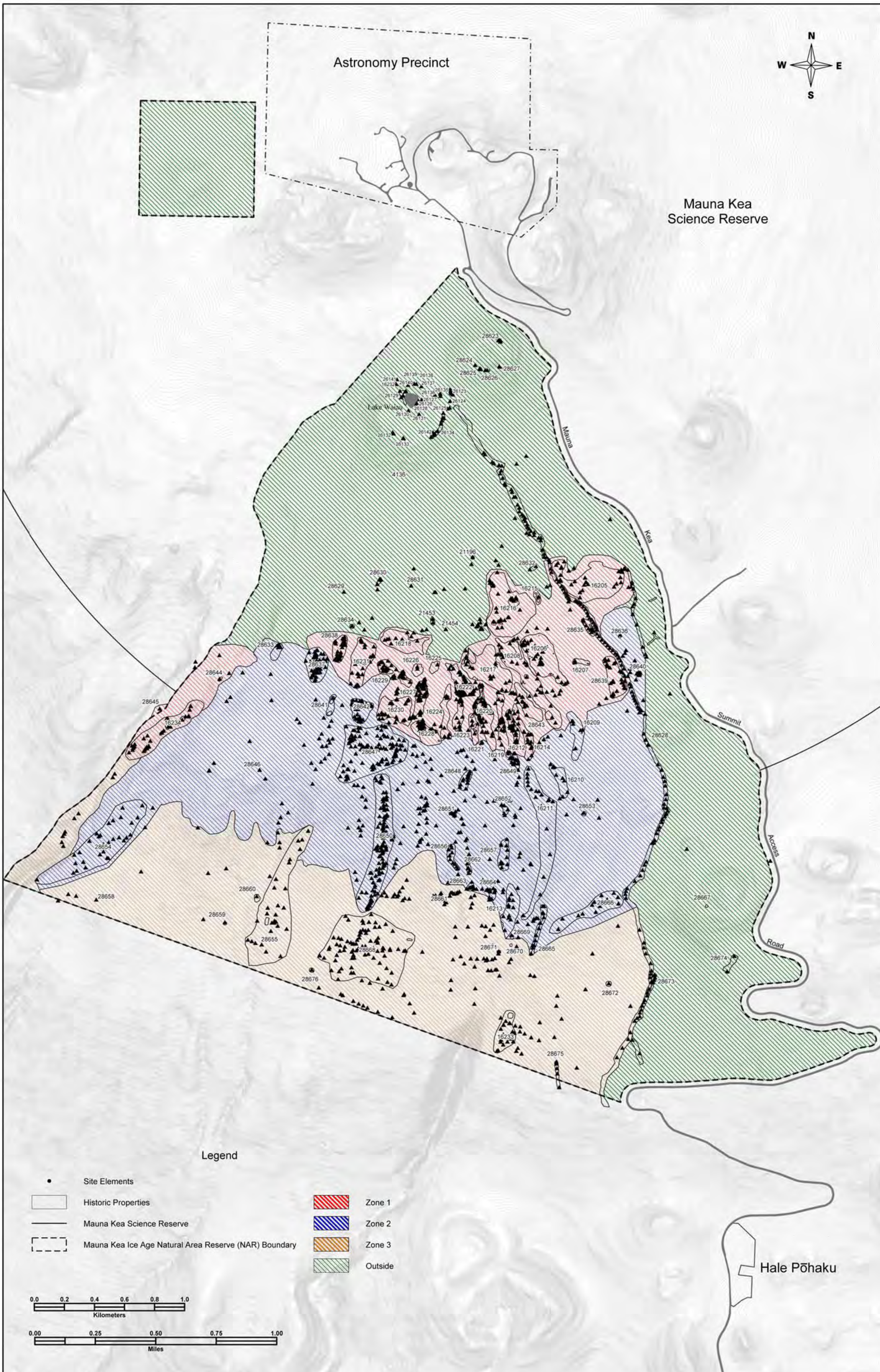


Figure 6.2 Toolstone Sources (Zones) and Non-Quarry Areas in the NAR.

One of the primary sources of basalt in the NAR is what Porter (1979c; 1987) believes to be the front margin of a subglacially erupted flow that forms an escarpment at the 3720 to 3780m elevation in the vicinity of Pu`u Ko`ko`olau. Porter has described this flow, which he called the Puu Waiau flow, as follows:

> Its downslope margin forms a discontinuous but abrupt cliff, locally embayed and commonly 15 to 25 m high (Fig. 15). The flow consists of a dark-gray dense nonporphyritic and nonvesicular hawaiite with well-developed intersecting joint planes that result in distinctive and rather symmetrical blocks of various sizes. The early Hawaiians quarried this flow extensively for adze blanks, because the dense aphanitic nature of the rock and its prominent jointing were ideally suited for their lithic industry (Fig. 4, loc. 10, Table 1).
>
> The large concentration of quarry sites along the steep flow margin suggests that the special properties of the rock that the Hawaiians found so desirable may be due, in part, to the unique eruptive conditions and cooling history of the flows (Porter 1979c:1034).
>
> The flow, which is very fine-grained and hard, fractures into slabs appropriate for such artifacts [adzes] and apparently was ideal for stone working. Its glassy groundmass contains randomly oriented microlites of plagioclase, rather than fully developed crystals, making the rock tougher than other flows and therefore easier to shape (Porter 1987:592).

Porter's interpretation of the escarpment as the terminus of a flow from Pu`u Waiau has been questioned by Wolfe and his colleagues (Wolfe 1987; Wolfe et al. 1997:52). The geology of Pu`u Ko`oko`olau and an associated pit crater (see Figure 6.1) were earlier described by Wolfe as follows:

> Puu Kookoolau is a hawaiite (table 1, anal. 13) cinder cone of the Laupahoehoe Volcanics. Its surface is littered by blocks of hawaiite and porphyritic basalt emplaced as ejecta in a late-stage explosive phase of the Kookoolau eruption. A still later, brief eruptive phase is represented by the mound of reddish brown scoria within the crater; no basalt ejecta mantle the scoria mound. Erractics of hawaiite from the Puu Waiau flow are scattered on both the cone and the scoria mound.
>
> Puu Kookoolau produced virtually no lava flow. Thus the outcrops immediately downhill from the cone represent the eroded upper surface of subglacial mafic hawaiite flows of early Wisconsin age. Ice-contact features such as mosaic jointing, spiracles of oxidized and brecciated rocks, and cavernous voids are common features of those outcrops.
>
> Prominent ridges of dense mafic hawaiite and scoria project westward and northeastward from beneath the Puu Kookoolau cinder cone. The occurrence of scoria and the linear-ridge form suggest that the ridges may be the remains of a fissure-vent system that supplied the mafic hawaiite flows to the south. Porter (1979a, 1979c) recognized ice-contact features in the rocks of these ridges and interpreted them to be of Waihu age, as I do. However, he concluded that the south-facing escarpment was the ice-contact terminus of a flow from Puu Waiau. In contrast, I interpret the escarpment and the low ridge that caps it as the northernmost and highest outcrops in this area of the distinctive mafic hawaiite that extends far down the mountain face from here. Younger, felsic hawaiite from Puu Waiau overlies the mafic hawaiite on the north flank of the ridge; in places, the younger hawaiite overflowed the ridge" (Wolfe 1987:30).

While the source and absolute age of the basalt lavas favored by Hawaiian adze makers may still be a matter of debate, it is clear that the adze quarry is not localized to the escarpment, contra the impression given in some of the geological literature (Porter 1979c, 1987:592 and Fig. 21.3) and even the archaeological literature (Streck 1992). Secondary sources of tool-quality basalt are found in other flows and in glacial drift deposits below the escarpment (McCoy 1985, 1986; Wolfe 1987). Gregory and Wentworth may have been among the first to comment on the presence of adze manufacturing debitage in the glacial drift deposits:

> A less abundant rock type is the finer-grained black adze rock of Keanakakoi (The-cave-of-the-adze) at 12,500 feet, used so extensively by the native Hawaiians in adze manufacture. Over much of the area of both Makanaka and earlier drift are strewn spalls from adze-chipping operations carried on by natives who found the dense black adze rock in blocks transported downslope. With the spalls are found distinctive vesicular, ball-shaped hammer stones (Gregory and Wentworth 1941:1206-1207).

The large area of the quarry is directly related to the spatial distribution of glacial drift deposits which include till and outwash deposits of different ages. The older drift, labeled the Waihu Glacial Member by Porter, is exposed mainly below the 3,350 m elevation. According to Porter's field mapping, the younger Makanaka Glacial Member is comprised of two bodies of drift, which as a whole is less indurated than the Waihu deposits (Porter 1987:588-589). All three drifts contain hawaiite or basalt clasts of predominantly sub-angular to sub-rounded shape.

As described in an earlier paper (McCoy 1990) significant variability exists within each of the two "sources" --lava flows and glacial deposits-- in terms of the quantity and density of "tool-quality material", defined here as the combination of major raw material properties: (1) grain-size or texture, (2) form (shape, sphericity, and rounding) and (3) size. What exists in fact are a large number of variable size "patches" (Winterhalder 1981:23) of toolstone unevenly distributed over a large area of the southwest flank of Mauna Kea. There are large "patches" which were called "production zones" in an earlier paper (McCoy 1990:93, 96). Three major zones (see Figure 6.2) are recognized in the present analysis, which formalizes the earlier description in terms of their actual location and areal extent (McCoy 1990). These zones, which have an element of verticality to them in terms of elevations, include in descending order of probable importance from the perspective of the quantity and quality of toolstone that was utilized:

Zone 1	The escarpment and related basalt flows of the Liloe Spring member of the Hamakua Volcanics (c. 422.98 acres)
Zone 2	A "middle-ground" of predominantly erosional Makanaka glacial till deposits and some bedrock exposures of toolstone (c. 1027.30 acres)
Zone 3	Lower elevation slopes discontinuously covered with Early and Late Makanaka and Waihu glacial moraine and outwash deposits and some volcanics (c. 848.55 acres)

Zones 1 and 2 extend from the roughly 12,400 ft elevation, which coincides with the physiographic feature called the escarpment in the geological and archeological literature, to the edge of the summit plateau at roughly the 12,000 ft elevation on average. Some of the flows in Zone 1 exhibit a pronounced flow structure, such as the flows around the pit crater directly below Pu`u Ko`oko`olau. Below the edge of the summit plateau is a broad expanse of Makanaka age glacial moraines and drift deposits that includes Porter' Early Makanaka and Late Makanaka end moraines. Zone 3 is intermediate area between the Makanaka and earlier Waihu end moraine belts. These pre-Makanaka age flows and landscape in the NAR was pretty much unknown archaeologically prior to the 2008-09 survey, except for a couple of reconnaissance surveys in the Waikahalulu and Pohakuloa gulch drainages in 1975-76 (see Section 2.1)

Archaeologically, Zone 1 is characterized by larger, more complex sites in terms of the number of functional components or activity areas and a longer chronology of repeated use over time. The sites in Zones 2 and 3 are on the whole smaller and contain fewer habitation rockshelters and workshops, which tend, moreover, to have comparatively little debitage. The primary production strategy in Zones 2 and 3 was based on the foraging of glacial drift deposits for tool-quality stone.

The three zones, which extend beyond the NAR on the west into the Science Reserve and adjacent Mauna Kea Forest Reserve lands, together constitute what we are calling the *"quarry proper."* Sites with adze manufacturing artifact assemblages or shrines with offerings of adze manufacturing byproducts such as flakes, located outside of the three zones, are part of what we are calling the *"quarry complex."*

6.2.2 The Effect of Post-Depositional Processes on the Quarry Landscape

The periglacial environment of the summit region is of major importance because of the dominance of frost-activated mass-movement slope processes (primarily gelifluction) and the effects these have on the spatial integrity of sites and quarry workshops in particular. The surface area of many workshops, for example, is in part a result of the downslope movement of flakes, cores, adze preforms and hammerstones. The problems created by the long-term, cumulative effects of post-depositional movement in determining workshop and site boundaries cannot be overemphasized, even in areas with a gentle slope (Figure 6.3). A salient characteristic of gelifluction is the abnormally low angle over which material is transported (Davies 1972:1). The extent or degree of disturbance, which includes both horizontal and vertical displacement of surface material (i.e., burial in the geological matrix of gelifluction lobes and terraces), cannot be accurately determined without excavation.

Post-depositional slopewash is clearly a major site formation process at many localities in the quarry complex, with differential mass-wasting providing the only ready explanation for the co-existence of lobes of relatively concentrated debitage and more diffuse lithic scatters covering large areas. The problem that diffuse lithic scatters, and flake scatters, in particular pose in the definition of site boundaries was recognized in work conducted in 1984-85 in the Hopukani, Waihu, and Liloe Springs area of what is considered to be a part of the Mauna Kea Adze Quarry Complex. The discussion that follows, taken directly from the 1986 report applies to most all of the lower elevation sites in the quarry complex, especially those in areas covered by glacial drift deposits.

Adze manufacturing debitage is scattered, albeit discontinuously and in varying densities, over virtually the entire Hopukani Spring area (McCoy 1986 Fig. 3), extending

Figure 6.3. Adze Manufacaturing Debitage Located in an Active Gelifluction Lobe.

well beyond the project boundaries in all directions. The broad areal extent and differential patterning (density) of these lithic scatters is clearly related to the distributional characteristics of the source material and post-depositional slope processes. There are two primary sources of raw material, an Early Makanaka and Late Makanaka end moraine located above the spring (Porter 1979:1043, Fig. 17). Hawaiite clasts are the predominant sediment in the stony ablation till and ice-contacted stratified drift that form these moraines (Porter 1979 map 3). These clasts, primarily subangular to subrounded cobbles and boulders, are by definition unevenly distributed given the geologic context in which they occur.

The objective of delineating the boundaries of spatially discrete workshops and individual chipping stations within larger workshop areas met with understandable difficulties and had to be abandoned in favor of a more generalized recording strategy. For immediate planning purposes, the only reaonable alternative was to attempt to isolate and demarcate on a map the locations of higher density scatters.

As previously noted, these scatters comprise only part of a much larger adze manufacturing locality with as yet undetermined boundaries. Under these circumstances the use of one or more than one site designation is obviously open to question. It could be argued, for example, as was originally done in the field, that the lithic scatters on opposite sides of the gulch constitute two separate sites. The gulch is indeed a convenient physiographic boundary marker, but it was found to contain debitage, thereby dissuading us to consider it an archaeologically meaningful boundary at the site level. I believe, however, that it serves a useful function in describing intra-site patterning and variability, and have proceeded to use the gulch as the dividing line between what is provisionally called Area 1 and Area 2 (Porter 1979: Fig. 3).

Apart from obvious size differences, all five of the "concentrated" lithic scatters defined in the present survey are similar in several important respects. They are all lobate-shaped configurations of disaggregated debitage lying parallel to the southerly declining slope on which they occur. The largest, which tend to be three to four times longer than they are wide, all originate on steeper slopes at higher elevations. The material comprising each of these lobes is not derived from a single eroded workshop, however, since it is neither continuously distributed nor uniformly size graded over the whole length of the slope. On present evidence each lobe is comprised of the by-products of many independent, small chipping stations which have been subjected to varying degrees of post-depositional erosion.

Much of the uncertainty that presently exists regarding the meaning of the artifacts on many sites, but ritual sites in particular, such as 16204 in the Science Reserve (McCoy 1999b; McCoy and Nees 2010), is due to the long-term, cumulative effects of post-depositional erosion. A salient characteristic of frost activated mass-movement in periglacial environments is the abnormally low angle over which material is transported (Davies 1972:1), so that even seemingly level surfaces, like the ridgetop, are affected. The actual extent or degree of disturbance, which includes both horizontal and vertical displacement (burial in the geological matrix of gelifluction lobes and terraces), is difficult to determine without excavation. It appears that the most common result on Site 16204 has been horizontal disaggregation rather than the creation of new surface patterns (Schiffer 1983:678) with the aggregation of transported material at the ramparts of gelifluction lobes or terraces.

The debitage on 16204 includes what appears to be an unusually large number of flakes with secondary edge damage (micro-flake scars) on the margins. Field observations of an admittedly small sample of flakes suggest natural causes rather than purposeful retouch. Some of this attrition may be due to downslope transport. An alternative explanation is trampling, by man and/or sheep and goats. Obviously none of these postulated agencies of edge damage formation are mutually exclusive which means that probably all of them have operated to some degree in the past as well as today.

In addition to natural processes there are also cultural processes that have contributed to changes in the surfaces of many workshops. Trampling is the most obvious example. It is highly likely that some of the flakes with "edge damage" found in the quarry are the result of human trampling (Flenniken and Haggarty 1979). In addition to the formation of what might appear to be flake tools, human trampling also resulted in the vertical displacement of flakes and other manufacturing by-products. Gould conducted an informal experiment in the 1975 season involving trampling. He was able to demonstrate that human impacts cause damage to flake edges. Feral animals walking across workshops and bedding down inside of rockshelters are another potential source of modified flakes, sometimes referred to as bovifacts (Knudson 1979: 280).

In some cases it is possible to distinguish the natural and the cultural without excavation (cf. Williams 1973; Tilley et al. 2000). For example, with experience it becomes possible to distinguish with some degree of confidence a gelifluction terrace, which occur in such numbers that they are essentially uncountable, from a man-made terrace of which there are relatively few in the summit region (see Figure 2.5). As discussed elsewhere (McCoy 1999b), while an understanding of natural site formation processes (Schiffer 1983, 1987) helps to understand some aspects of the archaeological record, it is by itself never adequate to fully comprehend the meaning of the artifact assemblages found on a gelifluction terrace, for example.

6.3 Shrine Attributes, Types, Spatial Distribution Patterns, Function, and Age

The quintessential characteristic of all of the sites on Mauna Kea that have been interpreted as shrines is the presence of one or more upright stones that the Hawaiians called *`eho* or *pohaku `eho*, which translates as "god-stone" (cf. Andrews 2003; Pukui and Elbert 1971; Buck 1957; Emory 1938). The conventional view of these and other kinds of Polynesian "god-stones" is that they were "places for the gods to inhabit," or "abodes of the gods," as opposed to icons or actual representations of the gods (Best 1976; Buck 1957; Handy 1927).

The uprights can be regarded as either a special kind of *sign* or *symbol* in the way these terms were defined by Langer:

> Symbols are not proxy for their objects, but are *vehicles for the conception of objects*. To conceive a thing or a situation is not the same thing as to "react toward it" overtly, or to be aware of its presence. In talking *about* things we have conceptions of them, not the things themselves; and *it is the conceptions, not the things, that symbols directly "mean."* Behavior toward conceptions is what words normally evoke; this is the typical process of thinking (Langer 1957:60-61).
>
> In short, images have all the characteristics of symbols. If they were weak sense-experiences, they would confuse the order of nature for us. Our salvation lies in that we do not normally take them for bona fide sensations, but attend to them only in their capacity of *meaning* things, being *images* of things--symbols whereby those things are conceived, remembered, considered, but not encountered (Langer 1957:144-145).

A number of shrines consist of just a single upright, while others are characterized by multiple uprights arranged in different patterns on a variety of different kinds of foundations (Figure 5.7). Kenneth Emory, who was the first one to describe the shrines on Mauna Kea and note their East Polynesian affinities, was of the opinion that the uprights represented or symbolized separate gods. Emory made the following comments about the shrines he saw in the adze quarry, during a brief reconnaissance of the main quarry area in 1937:

> The adze makers, clinging to the ancient form of shrine at which to approach their patron gods, have preserved a most important link with their ancestral home. Each upright stone at a shrine probably stood for a separate god. The Hawaiian dictionary describes *'eho* as "a collection of stone gods" and this is the term which the Tuamotuans, the neighbors of the Tahitians, used to designate the alignment of upright stones on the low and narrow platform at their maraes, or sacred places (Emory 1938:22).

On current evidence there are at the minimum two functional classes of shrines in the Science Reserve: (1) occupational specialist shrines related to adze manufacture, and (2) all the others, which on current evidence appear to be "non-occupational." Morphologically, there is nothing to distinguish these two classes, each of which exhibits considerable variability in groundplan, number of uprights, etc. The Mauna Kea shrines are in this regard no different from Hawaiian shrines in general. According to Buck, "Shrines varied considerably in construction, and similar forms were distinguished merely by their function" (Buck 1957:528).

For the so-called occupational shrines Buck added:

> Malo (1951, p. 81) writes that "each man worshipped the *akua* that presided over the occupation or profession he followed..." Thus what may be termed occupational shrines were built to the presiding gods in convenient places, and cultivators, woodsmen, fowlers, and others recited their rituals and laid their offerings upon their particular shrine before engaging in their work. There was nothing to distinguish this form of shrine from others, except, perhaps, the locations of the sites, which were away from the beaches and could not be readily confounded with the shrines of fishermen (Buck 1957:529).

The only thing that distinguishes the occupational shrines from all the others in the Science Reserve are lithic scatters found either on the shrine itself or in close enough proximity to be considered part of a single site. The artifacts found on shrines are interpreted as offerings, while those some distance may denote some other kind of ritual practice (McCoy 1999a).

The report on the 1982 archaeological survey of roughly 1,000 acres of land on the north flank of the mountain (McCoy 1982) followed Buck in referring to the architecturally simpler and generally smaller structures as shrines (*kuahu*), which Buck (1957:527) considered "a convenient term to designate a simple altar without a prepared court." Some of the larger, more complex structures, including those with courts, were called *marae*, following Emory, who had used this term to describe structures on the island of Necker that he believed bore close resemblances to the so-called "inland" type of Tahitian *marae* (Emory 1921, 1928, 1933, 1943, and 1970). Though some of the stone remains in the Hawaiian Islands, including those on Necker and Mauna Kea, do in fact appear to more closely resemble some of the simpler forms of *marae* in Tahiti and the Tuamotus than any known form of Hawaiian *heiau* (see discussion in Section 7) it is probably best to discontinue using the term *marae*, which has no cognate in the Hawaiian language.

The shrines in the Mauna Kea summit region have been previously described as including one or more of the following elements or "parts": (1) uprights, (2) pavements, and (3) courts. The idea of describing shrines as comprised of parts, instead of features, follows Emory (e.g., Emory 1947:10) who used this terminology in describing East Polynesian *marae* and the structures on Necker Island that he called marae (Emory 1928).

Significant variability exists in the presence/absence of pavements, courts, and artifacts, and in attributes such as, the number of uprights and manner in which they were set and arranged. Whether or not all of the observed variability can or should be subsumed by the term "shrine," as it is commonly understood, is a thorny issue that needs to be briefly addressed. If one accepts the distinction that Buck (1957) made between shrines and temples, then the sites with prepared courts should be called temples. This report uses the generic term "shrine" to describe all of the religious structures that exist in the summit region of Mauna Kea.

Some may object and argue that they should instead be called *heiau*, but a review of the literature indicates that there is no agreement on what that term included in the past and how it should be used today. According to Buck, "All shrines came under the general term of *kuahu*, except the fishermen's shrine which received the specific term of *ko`a"* (Buck 1957:528). As noted in Section 2, the term *kuahu* appears to be a more obscure and presumably older term that in modern times has been shortened to *ahu*.

The fact that there were names for different kinds of shrines suggests that shrines and heiau were different. Kamakau (1964:33) said that the *Pohaku o Kane* were family shrines and not a kind of *heiau*, whereas some archaeologists, such as Kirch (1985:260), hold to the view that the *Pohaku o Kane* was a *heiau*. Kolb presented an even broader definition of *heiau* based on the earlier definitions used by McAllister (1933:20) for sites on Oahu, and Bennett (1931:31) for sites on Kauai. They included natural rock outcrops, boulders and other unmodified places as examples of *heiau*. Kolb used this information to define sacred places: "Sacred places thus represent *heiau* possessing little, if any, structural modification" (Kolb 1991:109).

Based on the earlier, limited analyses of shrine uprights in previous surveys, the senior author's view is that we cannot even begin to try and understand the meaning and significance of the shrines on Mauna Kea without an analysis of upright shape and the variability in shape on sites with more than one upright. A major focus of the shrine recording process was the systematic recording of the dimensions and what we believe are the most important qualitative attributes of the uprights. Table 6.1 presents a summary of some of the major variables and attributes that are considered at the outset of the analysis. A table with all of the variables and attributes that were recorded is presented in Appendix E.

The analysis that follows has several objectives:

(1) Identifying and analyzing what we believe are the most important characteristics of the Mauna Kea shrines;

(2) Developing a shrine typology for descriptive and comparative purposes;

Table 6.1. Summary of Major Shrine Variables and Attributes in the Natural Area Reserve

						Number of Uprights		Foundation Type								
State Site Number	BPBM Temp Site Number	2008/2009 Temporary Number	Geological Zone	Shrine Number	Shrine Type	Minimum	Maximum	Bedrock	Boulder	Mound	Platform	Multiple	Pavement	Court	Topographic Setting	Orientation
16205	G28-2			1	2	6	7	x							Ridge Crest Flank	Perpendicular
				2	4	8	8			x					Ridge Crest Toe	Perpendicular
			1	3	1	1	1	x							Ridge Crest Summit	Perpendicular
				4	3	2	2						x		Ridge Flank	Indeterminate
		VP2008-01		5	1	1	1		x						Ridge Flank	Indeterminate
16206	G28-3			1	5	27	27	x					x	x	Ridge Crest Summit	Parallel
			1	2	4	4	4	x							Ridge Flank	Parallel
				3	4	3	3	x							Ridge Flank	Parallel
16207	G28-4		1	1	1	1	1				x				Ridge Crest Toe	Indeterminate
16208	G28-5		1	1	2	2	2			x					Ridge Crest Summit	Perpendicular
16209	G28-6		2	1	7	2	6	x					x		Ridge Crest Summit	Parallel
				2	2	3	4	x							Ridge Crest Toe	Parallel
16215	G28-13		2	1	2	3	3	x							Ridge Flank	Parallel
16216	G28-14			1	7	4	6		x						Ridge Crest Summit	Indeterminate
				2	2	1	6					**x**			Ridge Crest Summit	Parallel
			1	3	2	4	4				x				Ridge Crest Summit	Parallel
				4	2	2	2			x					Ridge Crest Toe	Indeterminate
				5	2	3	3			x					Ridge Flank	Parallel
16217	G28-15			1	2	20*	20*	x					x		Crater rim	Parallel
				2	1	1	1	x							Crater rim	Indeterminate
				3	7	1	2	x							Crater rim	Indeterminate
			1	4	1	1	1		x						Crater rim	Indeterminate
				5	1	1	1	x							Crater rim	Indeterminate
				6	1	1	1			x					Crater rim	Parallel
16218	G28-16			1	5	14	18	x						x	Ridge Crest Summit	Perpendicular
				2	2	2	3						x		Glacial Drift Deposits	Perpendicular
			1	3	2	3	3	x					x		Ridge Crest Mid	Parallel
				4	5	3	3				x				Ridge Crest Toe	Perpendicular
				5	2	1	2						x		Ridge Crest Summit	Perpendicular
16219	G28-17	2008G17-NF1	1	1	1	1	1		x						Ridge Crest Toe	Indeterminate

Table 6.1. Summary of Major Shrine Variables and Attributes in the Natural Area Reserve

						Number of Uprights		Foundation Type								
BPBM Temp Site Number	2008/2009 Temporary Number	Temporary Number	Geological Zone	Shrine Number	Shrine Type	Minimum	Maximum	Bedrock	Boulder	Mound	Platform	Multiple	Pavement	Court	Topographic Setting	Orientation
16220	G28-18	2008G18-NF1	1	1	1	1	1	x							Ridge Crest	Parallel
16222	G28-20	2008G20-NF1	1	1	2	2	2		x						Ridge Flank	Indeterminate
16226	G28-24		1	1	4	1	3	x							Ridge Crest Summit	Perpendicular
				2	2	1	2	x							Ridge Crest Summit	Perpendicular
				3	1	1	1			x					Ridge Crest Summit	Parallel
16229	G28-27	KN2009-02	1	1	1	2	2	x							Ridge Crest Summit	Perpendicular
16231	G28-29		1	1	1	1	1			x					Glacial Moraine	Indeterminate
		2008G29-NF1		3	1	1	1			x					Glacial Drift Deposits	Parallel
16232			Outside	1	7	2	4			x					Ridge Crest Toe	Indeterminate
16234	G28-30		1	1	2	2	2		x						Glacial Moraine	Indeterminate
		RN2009-10		2	2	2	2	x							Ridge Flank	Parallel
21196			Outside	1		2	2		x						Glacial Drift Deposits	Indeterminate
28629		RN2009-03	Outside	1	1	1	1		x						Glacial Drift Deposits	Indeterminate
28630		RN2009-01	Outside	1	7	1	1		x						Glacial Drift Deposits	Indeterminate
				2		1	1		x						Glacial Drift Deposits	Indeterminate
				3		1	1		x						Glacial Drift Deposits	Indeterminate
				4		1	1	x							Glacial Drift Deposits	Indeterminate
28631		RN2009-02	Outside	1	1	1	1	x							Ridge Crest Toe	Perpendicular
28634		RN2009-06	Outside	1	1	1	1	x							Ridge Crest Toe	Perpendicular
				2	1	1	1	x							Ridge Crest Toe	Indeterminate
28640		VP2008-05	2	1	4	1	3	x							Ridge Crest Mid	Perpendicular
28642		RN2009-13	2	1	2	2	2	x							Ridge Flank	Parallel
28645		RN2009-16	1	1	5	7	9					x		x	Ridge Crest Toe	Indeterminate
28646		KN2009-06	2	1	1	1	1		x						Glacial Drift Deposits	Indeterminate
28669		KN2009-19	2	1	1	1	1	x							Ridge Crest Mid	Perpendicular
28671		RN2009-24	3	1	1	1	1			x					Ridge Crest Mid	Indeterminate
28672		VP2008-08	3	1	7	1	2					x			Glacial Drift Deposits	Perpendicular
28673		PM2008-10	3	1	1	1	1			x					Glacial Drift Deposits	Indeterminate

* could contain more uprights but very difficult to determine what is an upright and what is construction material

(3) Examining the spatial distribution of the various attributes and shrine types and the types or styles of uprights found on the shrines in the NAR

The analyses are by no means definitive or exhaustive in the sense that they do present all that is potentially meaningful about the construction, use and meaning of the shrines. Some of the analyses are, moreover, exploratory.

6.3.1 Methodological Issues

In deciding which of any number of variables and attributes are important to record there is a clear need to consider both qualitative and quantitative attributes. Measurements, such as height, width and thickness, tend to be amongst the most commonly recorded attributes. On the whole little thought is given to the meaning of measurements, however:

> Generating measurements is not difficult; it is far more challenging to assign meaning to these measurements. But measurements themselves do not create meaning; meaning is imposed on the data and this necessitates establishing the context and the priority of questions at the outset. Because we have the ability to take measurements with nearly infinite detail and variety, we are forced to select those measurements that are more appropriate than others. This task *cannot* be separated from the selection and definition of problems (Moore and Keene 1983:16).

While measurements are important in characterizing, for example, the size of a shrine upright and thus making it possible to identify it in future monitoring projects, measurements may not necessarily be the most important attributes. The qualities of a thing, such as a shrine upright, may be more important than physical properties. Maurice Merleau-Ponty recognized long ago that "The qualities of a thing, its colour for example, or its hardness or weight, teach us much more about it than its geometrical properties" (Merleau-Ponty 1962:304). Tilley reiterates what Merleau-Ponty said and emphasizes the importance of taking a phenomenological point of view into consideration in deciding what are the most important variables:

> From an empiricist point of view, objects may be said to possess certain primary characteristics, those that can be measured, and certain secondary characteristics, such as colour or how a thing feels, which cannot. We obtain objective knowledge of the former, but only subjective and thus imprecise knowledge of the latter. From a phenomenological point of view, such a perspective has to be rejected. Just because we can measure the size of a stone does not imply that size is more important than texture or colour. The qualities of a thing, in fact, may tell us fare about it than any number of measurements of its geometrical properties that we might like to take (Tilley 2004:11).

For a variety of reasons, but most importantly, perception, a variable like shape is indeed difficult to record in a regular or systematic way. The approach we have used follows Tilley who describes the need, following Merleau-Ponty, to relate objects to the body:

> The size and shape of objects in a landscape appear to alter as we change our relationship to them. A large stone will appear to be small when seen from far away. As we look at the stone from different angles, its shape will change; so

> what is its true size and shape? And what size and shape of the stone are illusory? Merleau-Ponty's answer to this problem is to relate the stone to the body: the true size and shape of an object is when it is in reach (and can be measured) (Tilley 2004:11).

In terms of upright recording methodology the most important point made by Tilley is the statement that ***"the true size and shape of an object is when it is in reach (and can be measured)"*** (our emphasis). We are highlighting this statement because there are those who we know have found or would find the recording of upright shape problematical. The problem is the natural tendency to see changes in form based on different perspectives (e.g., from above and below or one side vs. another side), rather than from within a reach close enough to take measurements and record the form or shape of an upright. The same would hold true of any three dimensional object, artifact, building, etc. It is interesting to note how size (defined as height, width and thickness) tend to be regarded as unproblematical in contrast to a qualitative attribute, such as shape. The underlying assumption is that there are determinate sizes but not shapes, which raises the methodological issue of regularity and uniformity (see Cowgill 1989a, 1989b), in addition to the complicated matter of emic and etic types. It is interesting to note that similar concerns are rarely voiced regarding measurements, which would also vary with changes in distance and perspective.

In addition to recognizing how perception can affect observations there is also the matter of experience:

> In ordinary experience, the tendency of the person is to accumulate information randomly, incompletely, and then to order that information into conscious patterns that are specific, yet complicated and unwieldy. Normal perceptions are selectively small; normal concepts are large and weak. It is by constantly reexperiencing the same or similar things that a person's perceptions become adequate and his concepts become efficient, although these concepts remain unconscious and unarticulated (Glassie 1975:13).

Glassie's account of how perception can become more adequate over time, with an increase in experience, is a perfect description of the history of shrine upright recording procedures on Mauna Kea from the mid-1970s on. The recording of shrine upright attributes was initially limited to noting condition (whole or broken) and height, width and thickness measurements. Over time more attention was paid to the form of the uprights in terms of raw material properties (e.g., the recognition that most uprights are tabular and have cross-sections varying from square to triangular). By the time of the 1984 survey, on the east side of the Science Reserve, upright shape was a variable that was beginning to assume significance in the recognition that there were a limited number of recurring forms. The perception of shape was limited, however, to the top of the upright. The observation of pointed and flat-topped uprights led to the preliminary conclusion that the two forms might be symbolic markers of male and female gods (McCoy 1999a; 1999b).

6.3.2 The Component Parts of a Shrine

The shrines on Mauna Kea include one or more of the following elements or "parts": (1) uprights, (2) pavements, and (3) courts (Figure 6.4). Significant variability exists in the presence/absence of pavements, courts, and artifacts, and in attributes such as, the number of uprights and manner in which they were set and arranged. In

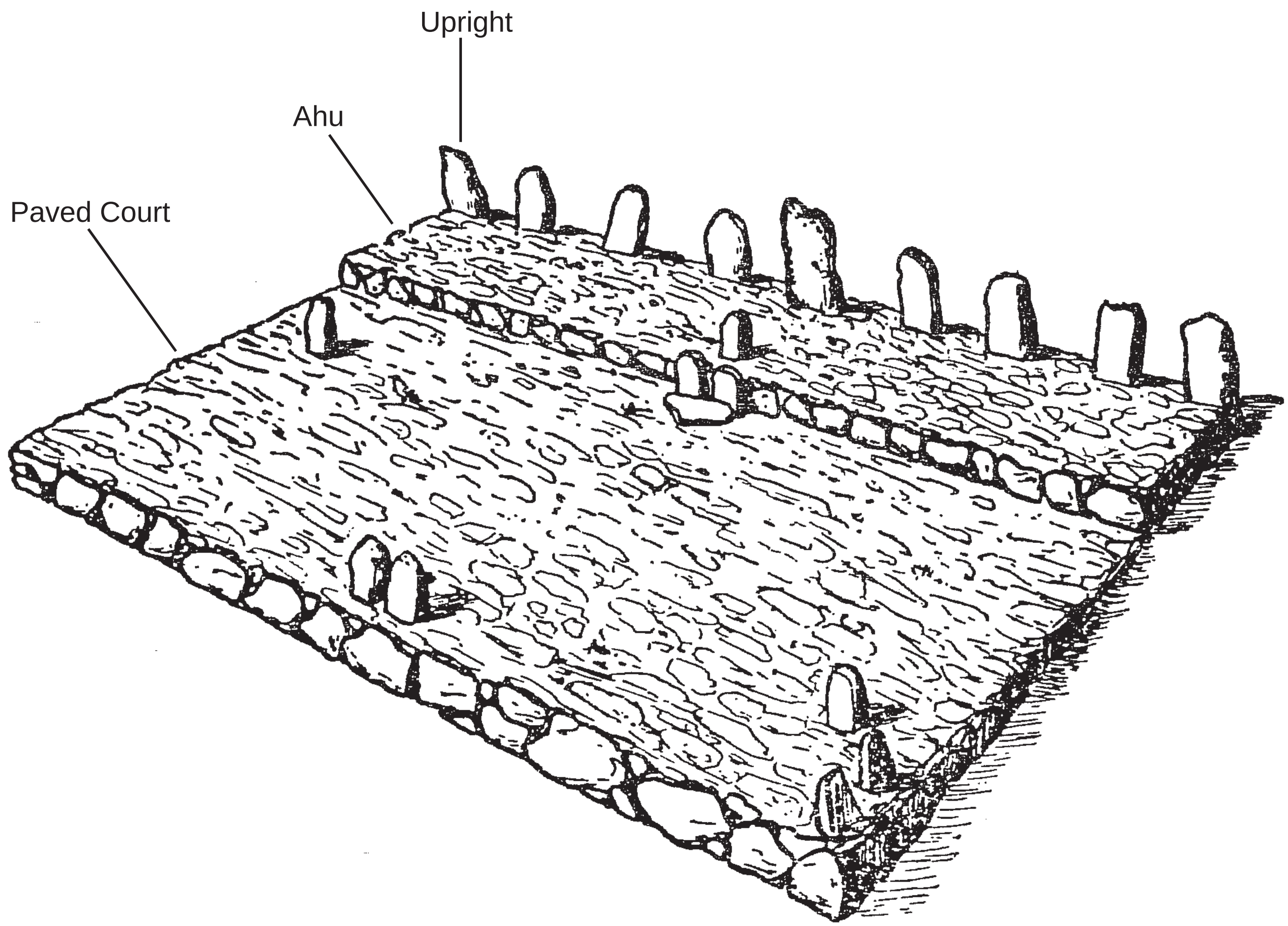


Figure 6.4. The Component Parts of Shrines and Related East Polynesian Religious Structures. (Modified from Emory 1928: Figure 13).

contrast to what Emory called the Necker *marae* and many other *marae* in Eastern Polynesia, few of the Mauna Kea shrines have a raised platform corresponding to what is in many island groups called the *ahu* (Emory 1943:13). The few shrines with defined courts in the Science Reserve are paved, but not clearly demarcated in the way illustrated for the Necker *marae* (Figure 6.5). The analyses that follow indicate significant variability in the presence/absence of pavements, courts, and artifacts, and in attributes such as, the number of uprights and manner in which they were set and arranged. The number of shrines used in the analyses is 58. This number represents all of the remains that were classified with a high degree of confidence as shrines, as opposed to other structural remains that have been called possible shrines.

6.3.3 Topographic Settings, Orientations, and Locational Contexts

The site location data obtained in earlier surveys showed that the vast majority of shrines are conspicuously sighted in the landscape, either on a ridge top, or at a break in the slope, which generally seems to correspond to either a lava flow margin or a change in the slope of a glacial moraine or glacial drift deposit (McCoy 1999a).

> A conspicuous feature of glacial erosion is the “whale-backed” smoothing (roche moutonne). Many of the ledges that extend radially down the slope of the dome (Pl. 1, fig. 2) have been eroded and smoothed on the top sides, with a stoss approach upslope and a plucked cliff or series of steps at the downslope end. In general, the roches moutonnes are long and narrow, with parallel sides and a straight rather than oval or domed longitudinal profile. The form of many, if not all of them, has been determined by the original lava flow. Commonly the irregularities of the lava flow are still in evidence, and in places the deeper pahoehoe wrinkles have not been completely removed. It appears that only a small amount of erosion and smoothing has sufficed to form rather characteristic glacial outlines and surfaces, owing to the similarity in direction of motion of the glacial ice and the lava flows (Gregory and Wentworth 1937:1733).

6.3.3.1 Topographic Settings

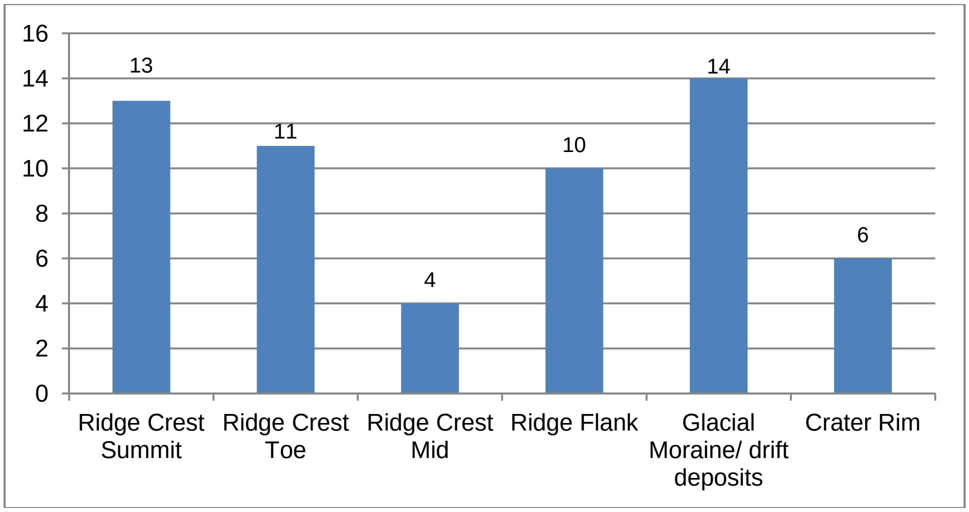
Sites were found in various topographic settings and on different landforms. In some cases more than one of the following categories might apply, such as a site located on the mid-elevation portion of a ridge, on top of which is a gelifluction lobe. A summary of the data is presented in Appendix F. The frequency distribution of the major topographic categories (1-5) is presented in Figure 6.5, which is based on a sample of 58 shrines.

(1) ***Ridge Crest* (Summit):** There are 13 shrines (22.41% of the total 58) in this category.

(2) ***Ridge Crest (Mid-Elevation)*:** There are 4 shrines (6.89% of the total) built on the top or crest of a ridge, but not at the highest point or summit.

(3) ***Ridge Crest* (Toe):** The toe of a ridge is the bottom end, where the ridge terminates and another landform begins. There are 11 shrines (18.96 % of the total) in this category.

(4) ***Ridge Flank*:** There are 10 shrines (17.24% of the total) located on the edge or flank of a ridge top.



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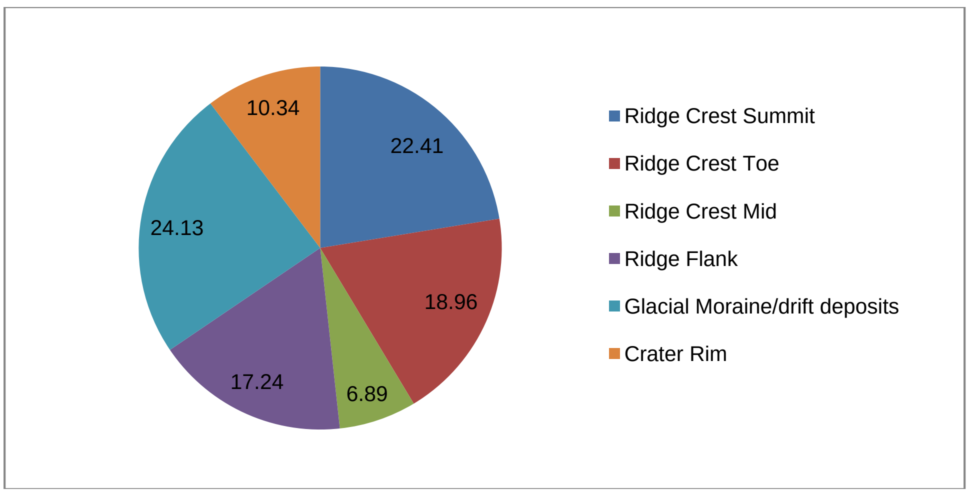


Figure 6.5. Frequency Distribution of Shrine Topographic Settings

(5) ***Glacial Moraine-Drift Deposits*:** With exception of large boulders, few shrines were found in the poorly sorted deposits that form glacial moraines and the more generic glacial drift deposits. There are 14 shrines (24.13% of the total) in this category, which is predictably widespread in the NAR given the broad extent of glacial deposits in the summit area.

(6) ***Crater Rim*:** This is another minor category, which applies only to Site 16217. This site, one of the largest in the quarry in terms of the number of workshops, is located on the rim and interior of a large pit-crater, one of only two found on Mauna Kea (Porter 1979c). Six shrines or 10.34% of the total were round on the rim of the pit crater below Pu`u Ko`oko`olau.

Though the majority (38 or 65.51%) of the shrines in the NAR are located somewhere on a ridge (the crest, flank, toe, etc.), very few are visible from any great distance. There are several reasons for this. One is the relatively small size of most uprights and the predominance of small shrines comprised of just one or a few uprights (see discussion of this variable below). Perspective is another factor, depending on the line of sight and approach taken to a shrine. The most visible shrines are those with rows of more than 4 or 5 uprights. Some shrines, especially those located at the toe of a ridge, are the least visible. So while a preference for highly visible locations is the norm from a statistical point of view, there are exceptions that may signal different beliefs or choices. It may be, too, that the location of shrines at the top (crest) and bottom (toe) of a ridge may have marked the boundaries of a patch or field of toolstone claimed by a group of adze makers.

The preference for prominent locations with commanding views of the landscape mirrors the pattern described by Gilbert McAllister (1933) and Buck (1957) for *heiau*:

> Heiaus were usually built on some commanding site, such as a hill top, the seaward end of a range, or a promontory of higher land which overlooked valleys, villages, or the sea. According to McAllister (1933a, p. 9) the orientation depended only upon the slope of the land. Heiaus face in all directions of the compass, the only generalization being that most of them face the sea (Buck 1957:516).

While *heiau* may be found on hilltops elsewhere, there are no positively identified shrines in the NAR located on top of a cinder cone. There is one possible example on Pu`u Waiau (McCoy and Nees 2009). Some could be found in the future, but on current evidence the tops of cinder cones were reserved for burial (see discussion of burial sites below).

McAllister and Buck were not the first to recognize the relationship between topographic location and site orientation in Hawaiian *heiau*. John Stokes came to similar conclusions even earlier, at the turn of the century. His observation about sites that seem to be oriented to cardinal points fits the Mauna Kea shrines perfectly:

> Orientation of the *heiau* platform was controlled by the situation. If situated on the shore, the temple lay parallel or at right angles to the immediate shoreline (not the overall lay of the coast). If slightly inland, the orientation would seem to depend primarily on the contour of the ground and secondarily on the lay of the coast; however, on the account of the form of the volcanic islands, either factor would seem to produce the same result. Farther inland, it would be only the contour of the ground which would be considered. I could find no evidence in the foundations of the orientation to cardinal points. It is true that some of them did lie almost true north-south or east-west, but this was because the situation required it (Stokes 1991:35-36).

In the 1982 survey on the north slope several shrines were described as oriented close to north-south and east-west (McCoy 1982a: Table 2.1). How significant this is cannot be determined at the present time.

6.3.4 Topographic Orientations

The orientation of shrines is potentially one of the most significant variables. For shrines located on ridges, the orientation was recorded as parallel, perpendicular or unknown. The raw data are presented in Appendix E and the frequency distributions in Figure 6.6.

(1) ***Parallel*:** This orientation means that the long axis of the shrine and the ridge on which they are located are the same. There are 17 sites (29.31% of the total) with this orientation.

(2) ***Perpendicular*:** 16 sites (27.58% of the total) where a row of uprights is oriented transverse to the long axis of a ridge.

(3) **Indeterminate:** The orientation of 25 of the 58 shrines or 43.10% of the total could not be determined for one reason or another. Many of these are single upright shrines, where orientation is either not evident or did not exist (see Figure 6.6).

The numerical frequency of shrines with either a parallel or perpendicular orientation is of some interest. Not only are they virtually the same, but they contrast significantly with the shrines in the Mauna Kea Science Reserve, where 44.06% have a parallel orientation and 25.98% a perpendicular orientation. The latter percentage is virtually the same as what is found in the NAR.

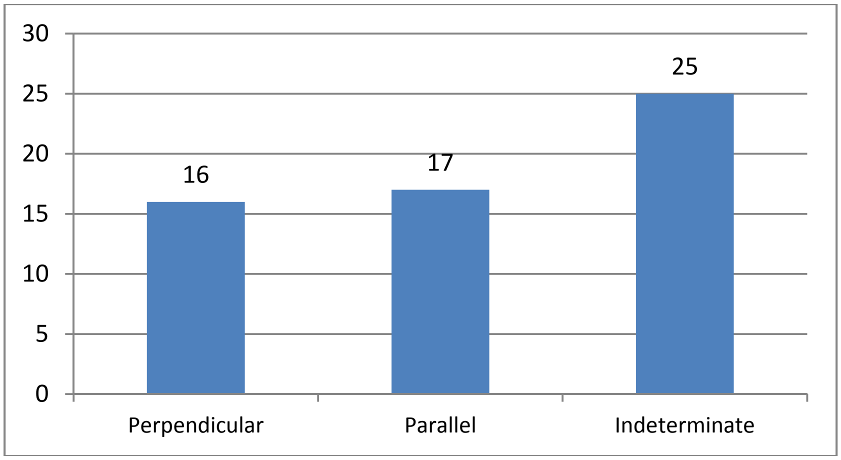
6.3.4.1 Locational Contexts or Associations

In addition to topographic setting, there is another kind of location, or more properly, association, that is of interest in terms of potential variability in shrine function and meaning. Unlike the vast majority of shrines in the Mauna Kea Science Reserve (McCoy and Nees 2010), many of those in the NAR are found in direct association with a workshop or a rockshelter in the adze quarry. Every rockshelter with an associated shrine also has a workshop area fronting the opening. The thing that sets these apart from the shrines found on workshops is that the shrine is located above the entryway where there are generally no workshops. Some shrines have no clear association with other remains. There are thus three different locational contexts:

(1) ***Workshops*:** This is the most common association, with 29 or 50% of the total, are shrines located within or near a workshop (less than 10 m distant).

(2) ***Rockshelters*:** The shrines associated with rockshelters are those located above the entryway. These have been previously described as “roof-top” shrines (McCoy 1990). The relative small number of shrines in this category (10 or 17.24% of the total) and their common association with one of the rockshelters with large debitage mounds that have been interpreted as base camps, initially suggested that the shrines marked the location of different groups of adze makers (McCoy 1990:110). While this interpretation still seems valid, not all of rockshelters with associated shrines have large debitage piles fronting the entrance.

(3) ***Isolates*:** There are a number of shrines (n=19 or 32.75% of the total) that have no obvious association, even though some are found within the adze quarry proper, or in relative close proximity to quarry sites. The function of these isolated shrines is thus less clear. They have been boundary markers or markers erected by people on their way towards the summit or Lake Waiau.



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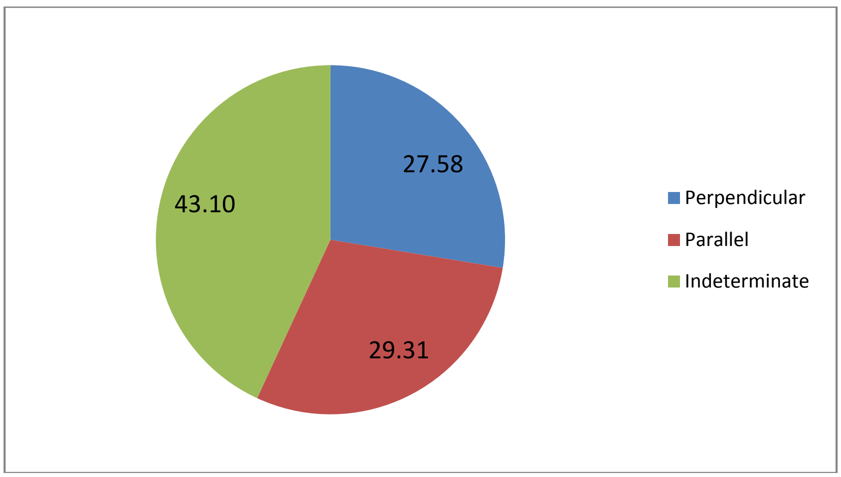
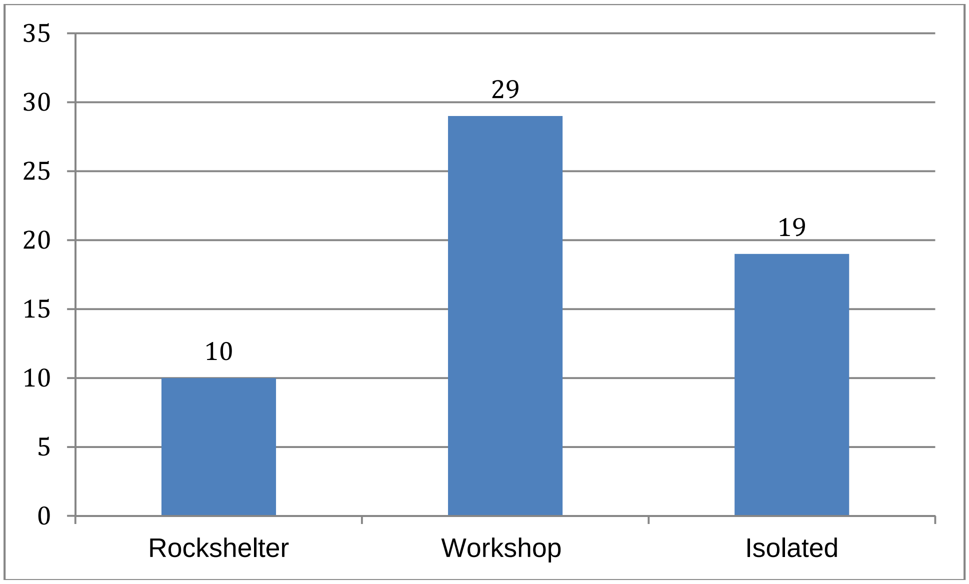


Figure 6.6. Frequency Distribution of Shrine Orientation.

The associations of all 58 known shrines in the NAR are summarized in Table 6.1. Figure 6.7 shows the numerical distribution of each of three types of associations and Figure 6.8 their geographical distribution. Shrines associated with workshops are the most common and widespread. The “roof-top” shrines found above the entryways to a number of rockshelters are more localized to the central part of the quarry complex where there is evidence of long-term adze manufacture. The isolated shrines, which represent one-third of the total, are more scattered, with some occurring in the quarry and some outside the quarry proper as defined in this report.

6.3.5 Architectural Elements

As might be expected based on the environmental context, little time appears to have been spent in assembling and arranging the materials needed to build a shrine, with the exception of the uprights which are not considered an architectural element, however. There are, however, different kinds of foundations. A small number of shrines have pavements and an area identified as a court.



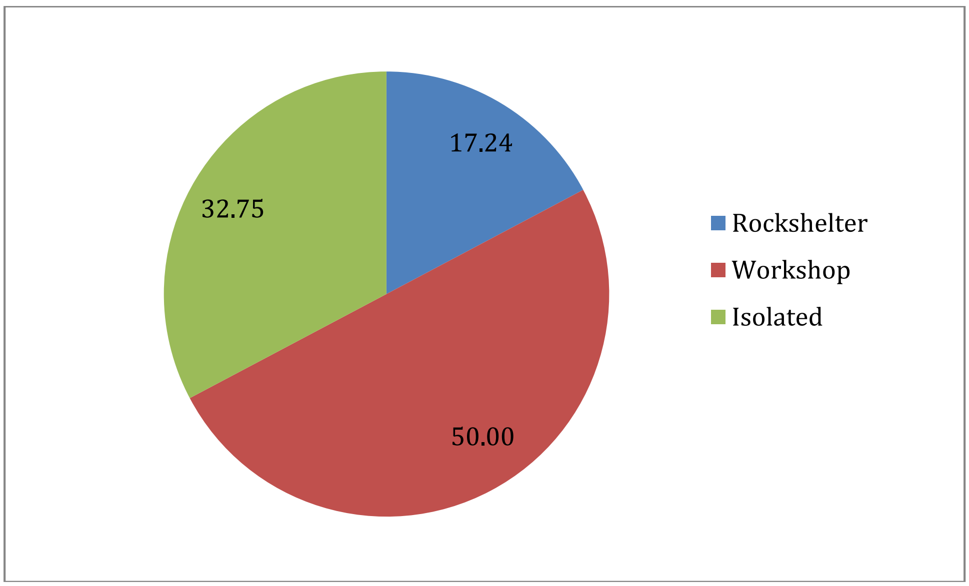


Figure 6.7. Frequency Distribution of Shrine Associations.

6.3.5.1 Settings or Foundations

The method or manner in which uprights were set varies considerably, sometimes even within the same site where, for example, some uprights may be found resting on bedrock and others on a platform. Five different kinds of settings or foundations were observed and recorded. They include both natural surfaces (bedrock and boulders) and constructed foundations (mounds, cairns and platforms). The general characteristics, frequency of occurrence, and spatial distribution patterns for each variety is briefly described below, along with the numbers for sites with multiple kinds of foundations (see Table 6.1; Figure 6.9).

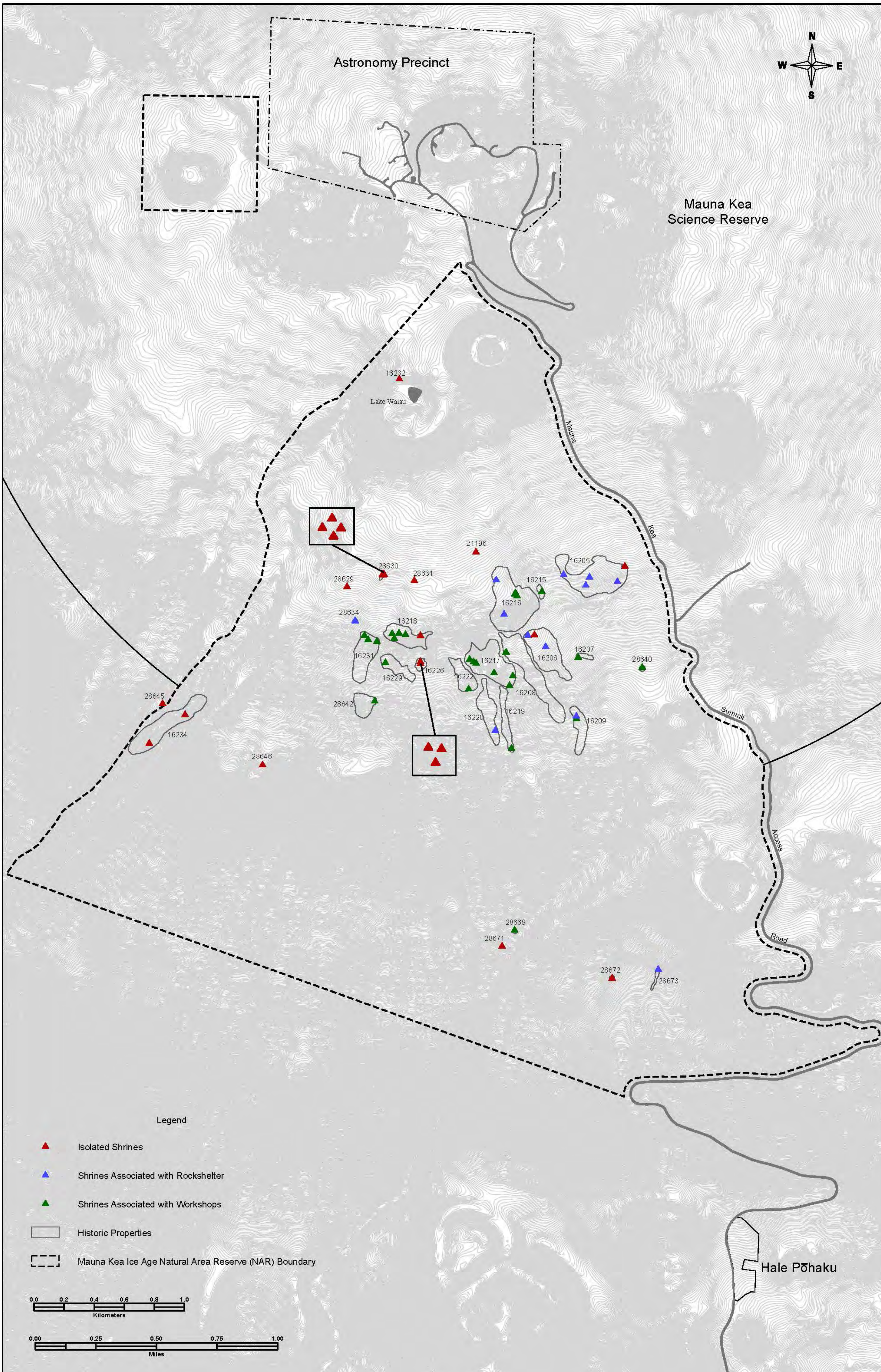
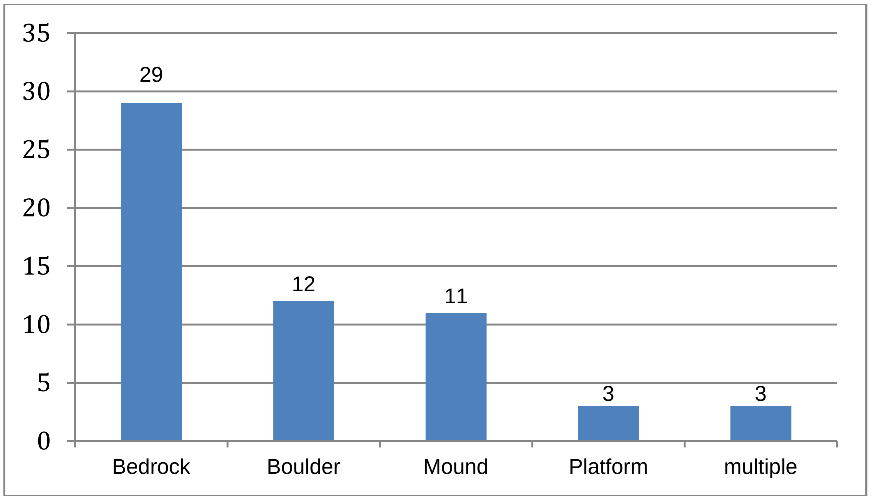


Figure 6.8. Locations of Isolated Shrines and Shrines Associated with Rockshelters and Workshops.



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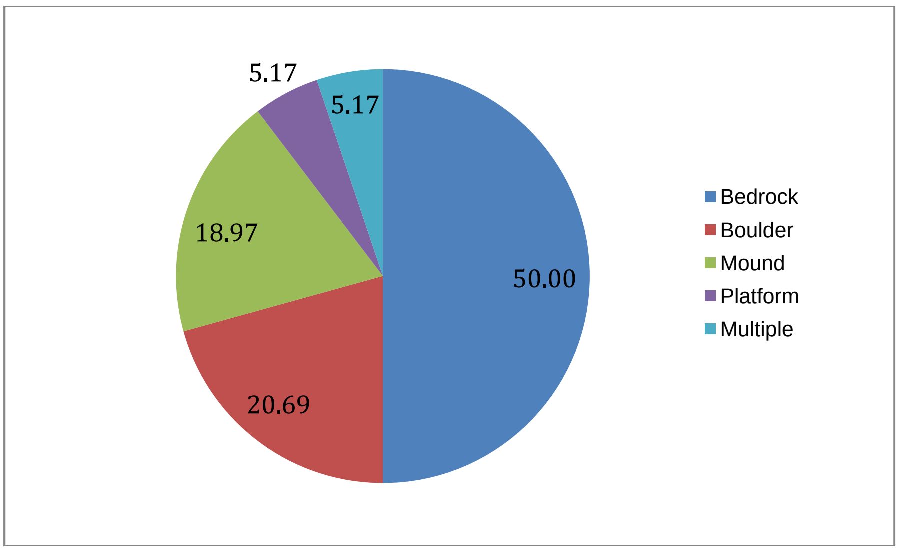


Figure 6.9. Frequency Distribution of the Varieties of Different Shrine Foundations

(1) ***Bedrock***: The most common method was to simply set the uprights on top of an outcrop and brace them with a few stones. In many instances the uprights were set into a crack in the bedrock. There are 29 sites (50.00% of the total) in this category, which is predictably widespread.

(2) ***Boulder***: The next most common method was to set the uprights on top of a boulder. In some instances the uprights were braced by other stones; in other cases it appears that an upright might have been set into a heap of stones. There are 12 shrines (20.69% of the total) where uprights were placed on top of a boulder. They constitute a distinctive class of remains that for comparative purposes are being called "boulder shrines." Their locations are shown in Figure 6.10. The vast majority (8 of the 12) occur in the quarry proper on seven sites, most of them in Zone 1. Two sites (21196 and 28630) with boulder shrines are located outside of the quarry complex.

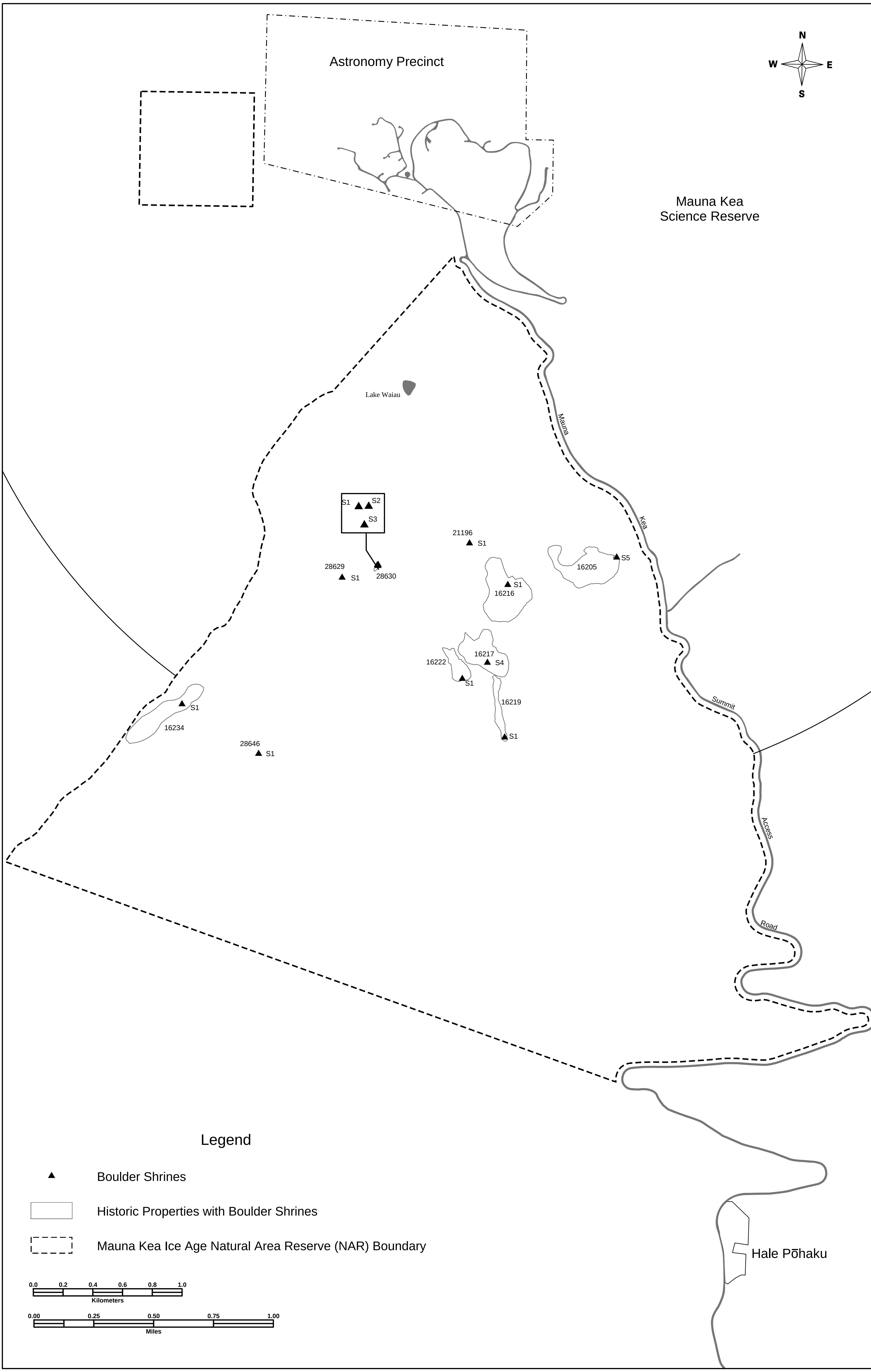


Figure 6.10. Locations of Boulder Shrines

(3) ***Mound*:** On 11 shrines (18.97% of the total) the uprights are set into a low rubble heap or pile of stones. In the case of some of the smaller heaps, which are low and circular to oval in shape, it may be that the mound was built up around the uprights. The larger mounds are linear and are found on sites with a larger number of uprights. They correspond in a general way to what would be called the *ahu* on East Polynesian *marae* (see Figure 6.1). Sites in this category occur over a large area on the north, east and south sides of the Science Reserve.

(4) ***Platform*:** There are three shrines (5.17% of the total) where a low, rectangular platform was constructed to seat one or more uprights. These are the closest thing to the *ahu* of East Polynesian *marae* (see Figure 6.4). The platforms are made of the same kinds of stones used in the mounds.

(5) **Multiple Settings:** Of the 58 shrines identified in the NAR three or 5.17% have more than one kind of foundation or base. In both cases (Sites 16216, Shrine 2 and 28645) there is a mound and bedrock.

6.3.5.2 Pavements

There are seven shrines with crude pavements comprised of one to two courses of irregular and poorly fitted stones (see Table 6.1). The upper surface of most of them also tends to be irregular, as does the shape or form of the pavement in plan view. The size (area) is likewise highly variable. The largest pavements are found on shrines with courts (e.g., Site 16206, Shrine 3), and indeed the pavement is commonly the best indicator of a court.

The small number of shrines with pavements (12.06% of the total) indicates that they were not a common feature. They are localized to Zone 1, which is where all of the larger (defined in terms of the number of uprights) and more complex shrines are found.

The function or uses of these pavements is unknown, but based on what is known about the function of stone pavements found on *heiau* it is reasonable to suggest that they were probably built as a place to lay offerings as indicated in this account by Buck:

> Stone pavements termed *kipapa* were laid in front of the images on the floor of the court...According to Malo (1951, p. 162), the temple offerings (*mohai)* were placed upon the offering pavements temporarily, until the priest was ready to go through the ceremony of presenting them to the gods. Some pavements were made in the space between two images for a similar purpose (Buck 1957:522).

6.3.5.3 Courts

It is the presence of one or more uprights on a flat area opposite a row of “altar” uprights that defines the court. None of the courts on the Mauna Kea shrines, which may have been called *kahua* like those on *heiau* (Buck 1957:516), are enclosed, but in several instances the court area is clearly demarcated by the local topography (lava flow margins or ledges). Some have pavements.

There are only three sites (5.17% of the total) with clearly demarcated courts (see Table 6.1), which as previously noted are oftentimes identified by the presence of a crude pavement to one side of a row of uprights. Not all of the sites with courts have pavements, however (see Table 6.1). In cases such as this, it is the presence of one or more uprights on a flat area opposite a row of “altar” uprights that defines the court. None of these courts, which may have been called *kahua* like those on *heiau* (Buck 1957:516), are enclosed, but in several instances the court area is clearly demarcated by the local topography (lava flow margins or ledges).

The location of the court at Site 16206, Shrine 3 and Site 16218, Shrine 1 indicates that the approach to the shrine was from the uphill side, so that the back of the celebrants would have been to the mountain. The orientation of these sites thus conforms to the way that lowland *heiau* are commonly oriented.

The three shrines with courts are structurally and visually among the most impressive religious structures in the summit region. If one accepts the distinction Buck made between shrines and temples, these shrines should be classified as small temples, that according to Buck would have been made by a family group or lesser chief (Buck 1957:516). Their location in a quarry constitutes a different kind of context, which suggests that they were used by groups of adze makers and possibly an adze makers' guild in the case of Site 16206, Shrine 1 (McCoy et al. 2009:455).

6.3.6 God-Stones (Uprights)

As noted in the general description of shrines in Section 5, there is good reason to believe on the basis of ethnographic analogy that each upright on a shrine stood for a separate god. Ethnographic information indicates that god-stones or uprights were a place for the gods to inhabit when they were needed. The literature on Hawaiian god-stones indicates the use of both natural and modified stones:

> Gods could be invoked in the abstract or they could be called to natural or fabricated objects, which in turn acquired power and served as suitable places into which the gods might be lured when next needed. These objects retained residual mana and power, which might be passed on from generation to generation (Kaeppler 1982:83).
>
> In stone sculpture production was limited, the workmanship was less expert than in wood carving, and no significant tradition seems to have been established as it was in the Marquesas, Easter, Society, and Austral Islands. However, stone representations of the great gods, particularly Kane, were very common. Most of these seem to have been natural stones selected for their odd shapes and at most only slightly carved or retouched (Cox and Davenport 1988:25).

If the uprights were not representations of the gods (i.e., images or icons), but merely places for the gods to be called to and inhabit on a temporary basis, and if a piece of unworked stone would suffice, the question arises, why bother recording upright shape? Wouldn't any stone do if the purpose was to simply provide a temporary abode for a god? The answer appears to be no.

While most of the uprights are “unworked” (i.e., they are naturally occurring forms), observations made during the earlier surveys showed that the procurement of slabs to be used as “god stones” was not arbitrary or random, that not just any slab was expediently picked up off the surface (McCoy 1999a). If it had been then the slabs used in shrine construction should be representative of the wide range of shapes and sizes found in the source areas. They are not as a walk through any of the several potential source areas demonstrates (Figure 6.11). To put a somewhat finer point on it, if there was no contemplation of the natural environment according to some conceptual scheme or belief system the uprights should exhibit no patterning in either size or shape and

Figure 6.11. Photographs Showing Examples of Upright Slab Source Areas.

should be undecipherable to everyone except for the agent that chose stones to be used as “an abode of the gods.”

The data demonstrate that the procurement process was deliberative and that the uprights have what can be called a “deliberative history”:

> We can mark, as part of the “deliberative history” of an object, the range of objects from which it was chosen, the properties of those objects that were contemplated, and the role these observations played in the eventual decision to use, or not use, them for a purpose (Dipert 1993:29).

> It is one of the severe difficulties in attributing a deliberative history to an artifact that we often have as evidence for this history only the physical, now easily observable, properties of the object. Only some few of the properties represent artifactual features, and then only under a description. Thus, although the designer of the Parthenon undoubtedly had some fairly definite intentions concerning the dimensions and other properties of the building, it would be incorrect (anachronistic) to describe the content of these intentions in terms of feet, meters, comparison of its dimensions with a building that the builder did not know, using special features of our Arabic base-10 number system, and so on (Dipert 1993:55).

6.3.6.1 Raw Material Sources and Physical Properties

While we know from historic accounts of at least one wooden image on Mauna Kea (Arning 1931), from a well known rockshelter called Keanakako`i, and several other locations where small wooden images may have existed at one time in the adze quarry, all of the shrine uprights found on Mauna Kea are stone. This may seem on the whole a rather unremarkable fact, especially given the remote location in a sometimes harsh environment, but there are other reasons why stone, rather, than wooden uprights, may have been preferred:

> By reason of its materially lasting qualities no doubt, stone was regarded throughout Polynesia as the most important agency that could be utilized as a medium and container of mana. This is evidenced in many of the religious customs. The most obvious examples of this usage are the carved and natural blocks of stone that served as embodiments for, or mediums of, rapport with patron deities, but other customs illustrate more definitely the native view of the value of stones as mediums of rapport, one is the ceremonial use of stone seats or back rests. This usage is based upon the principle of transference of sacredness through contact: the stone, upon which a man imbued with mana rested, and especially one so employed upon ceremonial occasions, became charged with the man’s divine power and would remain so until the tapu was released and the rapport broken between the object and the individual by one of the rites prescribed for the purpose. When a stone slab had served as a seat or back rest for chiefs or priests for generation after generation, it is evident that as it aged it would become more and more sacred and an ever more potent medium of rapport with the spirits of those who had passed on; it sacredness and its mana would be cumulative (Handy 1927:179-180).

The vast majority of uprights are naturally occurring, unaltered slabs of tabular rock of long-narrow shape that were universally set on end (i.e., the long axis of the stone is vertical). The lateral edges of a few of the slab uprights bear flake scars, but with a couple of isolated exceptions these appear to be generally of natural rather than human origin. The use of unmodified or minimally worked stones to represent gods appears to have been more common in Hawaii (Cox and Davenport 1988:25) than some other areas of East Polynesia where stone sculpture was more developed (e.g., Easter Island and the Marquesas). This could vary, though, as Buck noted in this description of Hawaiian stone gods:

> However, stone was used a good deal to represent family or craft gods (`*aumakua*). Some individuals were content to use pieces of unworked stone, whereas others made rough representations of the human figure. It should be remembered that it was not the workmanship but the prayers and offerings which gave a material object power (*mana*) and converted it into a god, no matter what the form (Buck 1957:495).

The origins of these slabs and their abundance in some places are noted in this description of the glaciated areas on Mauna Kea:

> Over the glaciated area of Mauna Kea the wedge-work of ice is conspicuous. The bed rock has been shattered, and spalls and slabs by thousands are strewn over the surface. In addition to the little-weathered, light gray fragments transported by glacial ice, large quantities of broken rock talus lie at the bases of cliff ledges, and, in many places stand in great stacks of flat or curved slabs only little removed from the bedrock itself. Some of the frost slabs are chunky or roughly columnar in form. Especially at the sides and downslope ends of thick lava flow or tube masses, the rock has spalled off in straight or slightly curved slabs, one to several inches thick and several square feet in area (Gregory and Wentworth 1937:1738).
>
> Not only are the ledges frost-riven, but many blocks of basalt in the ground moraines and in the talus of cones, some of them only a few inches in diameter, have been split neatly into thin slices which lie stacked near their place of origin. In some such rocks an original or developed fissile structure permitted easy splitting, but joint cracks and incipient fissures produced by moving glacial ice seems to have afforded the most suitable conditions. In general, the shapes and sizes of spalls appear to be due largely to the structures developed in the lava flows during cooling (Pl. 5, fig. 2) (Gregory and Wentworth 1937:1738-1739).

Raw Material Sources**:** Observations made during earlier surveys indicated that there are some sites where there is no source of tabular slabs in the immediate area, thus indicating that any slab uprights must have been collected elsewhere. An attempt was made for the first time during the current survey to systematically note the presence/ absence of a probable raw material source on or near a site, or the approximate distance to a source where none existed in the immediate site area. Figure 6.11 illustrates one of the major potential source areas on the south flank of the mountain and the multitudinous shapes of slabs found on the surface and along lava flow margins.

Raw Material Form**:** There are two general classes of uprights: (1) angular slabs and (2) rounded boulders of generally elongated form. The latter are uncommon, occurring on sites where slab material does not seem to have been readily available. The slabs, which are characterized as "tabular" in the attribute analysis, vary in thickness, although most are relatively thin.

> (1) **Tabular:** correspond to the slabs and spalls described by Gregory and Wentworth (see description of the environmental setting above); some slabs are more columnar and, thus, thicker.

(2) **Non-tabular:** more rounded and irregular in overall shape; not as common as the tabular variety.

6.3.6.2 Number, Condition, Position, and Location on the Structure

In some cases it is difficult to accurately determine the number of uprights on a shrine because of: (1) the effects of natural processes, such as erosion and perhaps wind shear, that have might have resulted in breakage and the displacement of the stone from its original position, or the deliberate displacement of uprights by humans, and (2) uncertainty regarding whether a particular stone had been utilized as an upright, a bracing stone or a paving stone. Given a situation such as this, where there are different degrees of confidence, a decision was made to present minimum and maximum numbers (see Table 6.1).

***Condition*:** The condition of the stones recorded as uprights was noted as either whole or broken.

(1) ***whole*:** complete

(2) ***broken*:** fragmentary

***Position*:** One would assume that an upright is a standing stone and that calling something a "fallen upright" would be an oxymoron. But to give just one example of why "fallen upright" is a useful, indeed necessary, term, one can think of a flagpole that has toppled over and observed lying flat on the ground. It is still a flagpole. As might be expected, uprights were found in a variety of different positions, ranging from fully erect, to partially erect and fallen. The reports on some of the earlier surveys (e.g., McCoy 1984b) used the term semi-erect, but because of the obvious subjectivity involved in making this finer distinction, the 2005-2009 survey used just two terms to characterize the position of uprights:

(1) ***erect*:** vertical or nearly vertical; in some of the earlier surveys a distinction was made between erect and semi-erect.

(2) ***fallen*:** horizontal position on bedrock or ground surface.

***Confidence Level*:** The decision to call a fallen stone an upright is not always easy or straightforward and thus involves an element of subjectivity. The decision, which can vary from one individual to another, is dependent in part on experience and such specific criteria as the form or shape of a stone and/or the presence of a depression that could be reasonably inferred to be the "seat" for an upright. The following confidence levels were established for use in the survey:

(1) ***excellent*:** applies to all standing uprights and fallen stones whose form and location on a site or feature of a site indicates a high degree of probability that the stone was set upright.

(2) ***good*:** fallen stones that can be regarded with a lower degree of confidence as uprights based on form and location on a site or feature of a site.

(3) ***fair*:** fallen stones of more problematical function; could correspond to what are being called "possible uprights."

(4) ***poor*:** fallen stones resembling one of the several different formal "types" of uprights; corresponds to what are being called "possible uprights."

***Minimum Number of Uprights*:** The minimum number reflects higher levels of confidence in the decision-making process (i.e., excellent and good).

***Maximum Number of Uprights*:** The maximum number includes what are called "possible uprights" in the site descriptions in Volume 2. A "possible upright" corresponds to a fair or poor confidence level.

6.3.6.3 Range of Variability in Upright Numbers

The number of uprights on a site that can confidently be called shrine varies from 1 to 27, in contrast to possible shrines where the number is zero (Table 6.1; Figure 6.12). Based on a histogram of numerical frequencies using minimum number (see Table 6.1), six groups of shrines were identified. The frequency distribution of the six groups is shown in Figure 6.13 and discussed below. Of the 58 shrines used in the analysis 49 or 84.45% have just 1 to 3 uprights (see Figure 12). The vast majority of shrines thus tend to be "small," which is what one would expect of shrines in contrast to more elaborate religious structures, such as *heiau*.

Group 1: 1 Upright

Single upright shrines are the most common (31 or 53.45% of the total) and in fact constitute a separate category or type (see discussion of shrine typology following). Single upright shrines are widely distributed throughout the NAR (Figure 6.14). They are the only shrine type that is found in all three of the toolstone source areas or zones.

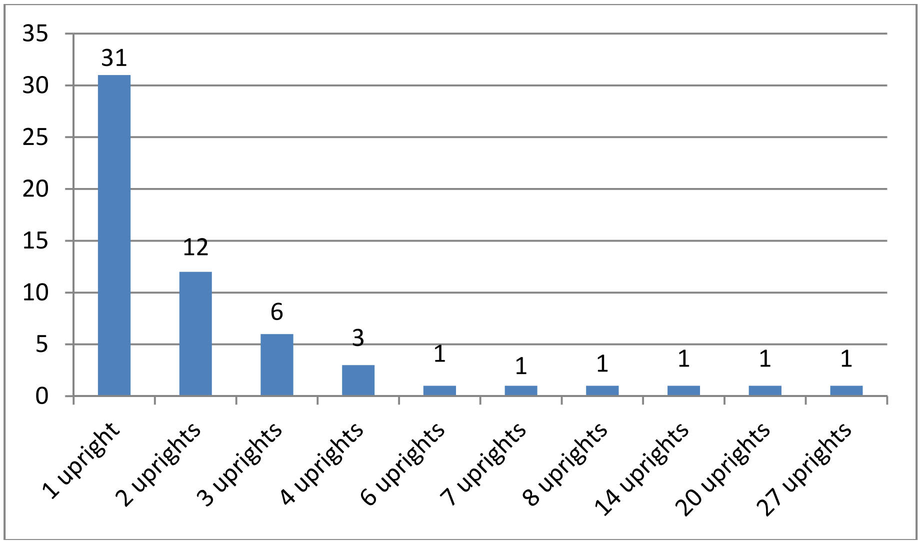
Group 2: 2 Uprights

Pairs of uprights are quite common, with a total of 12 or 20.69% of the total shrines). They occur over a broad area of the upper adze quarry area (Figure 6.15).

Pairs of uprights appear to be widespread, though not necessarily common, in the Hawaiian Islands. It is possible that they might represent an emic type that heretofore has not been described, though there are numerous ethnographic accounts relating to pairs of gods, such as Ku and Hina, which are widely recognized as symbolizing the male and female principles:

> Leaving the heiau, we passed by a number of smaller temples, principally on the sea-shore, dedicated to *Kuura*, a male, and *Hina*, a female idol, worshipped by fishermen, as they were supposed to preside over the sea, and to conduct or impel, to the shores of Hawaii, the various shoals of fish that visit them at various seasons of the year. The first of any kind of fish, taken in the season, was always presented to them, especially the *operu*, a kind of herring. This custom exactly accords with the former practice of the inhabitants of Maui and the adjacent islands, and of the Society Islanders (Ellis 1969:117).

> Ku and Hina, as well as their varied aspects, function as man and wife in daily rites performed by the populace. With his sister-wife Hina (whose name means "prostrate"), Ku ("upright") united the people into a single stock, for Ku and Hina represented the male and female reproductive principles. Ku also symbolized the east, sunrise, and the right hand; Hina the west, sunset, and the left. Such antithesis was common (Luomala 1987:217).



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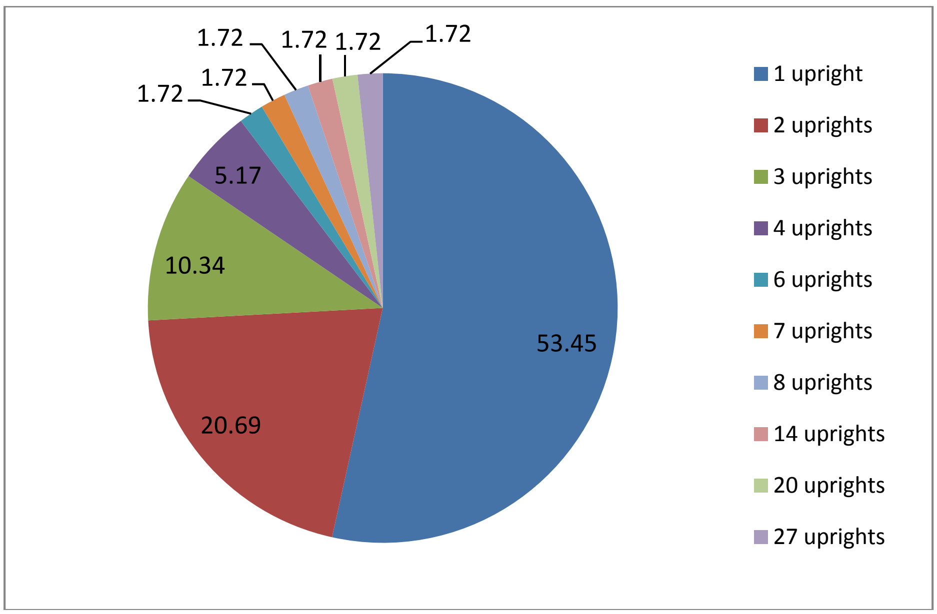


Figure 6.12. Frequency Distribution of Uprights per Shrine Based on Minimum Number.

This pair of gods (male-female or husband-wife) has in fact been identified archaeologically at least at one location where the stones are of different lithology, color and size:

> Stokes...has recorded two upright stones connected with, though not on, a *koa* at Pearl Harbor, Oahu. One is a dark stone, 4.5 feet high, representing Kuula, a patron of fishermen, the other a coral stone slab 2.5 feet high, representing his wife, Hina (Emory 1928:107).

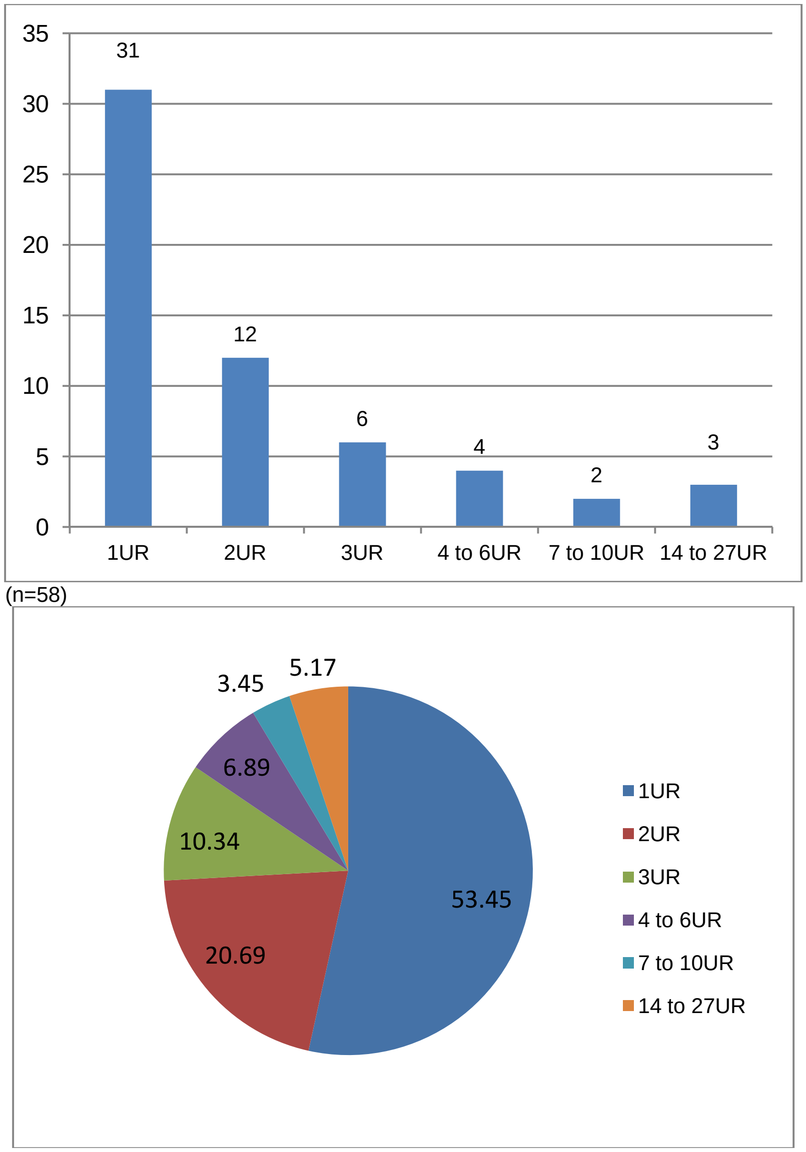


Figure 6.13. Frequency Distribution of Shrine Upright Groupings.

A pair of rounded upright stones have been identified as the gods Kane and Kanaloa in a photograph included in the revised edition of *Ruling Chiefs* (Kamakau 1992). Pairs of pointed upright stones occur on some of the Mauna Kea shrines and are inferred to symbolize two male gods.

> The structure of the pantheon--like that of the *Kumulipo*--reflects the primacy of the sexual principle. The duality of the sexes is in effect divinized in the couple, Ku (male)/Hina (female). At least in certain representations, this Ku-and-Hina godhead (NK, 2: 122, cf. 147) encompasses all the deities: "Ku is said to preside over all male spirits (gods), Hina over the females" (Beckwith 1940:13). In fact, in this context Ku encompasses all the properties of the masculine gods, Hina (whose name means "prostrated," "horizontal," "woman"), all feminine attributes.

Figure 6.14. Location of Shrines with 1 Upright.

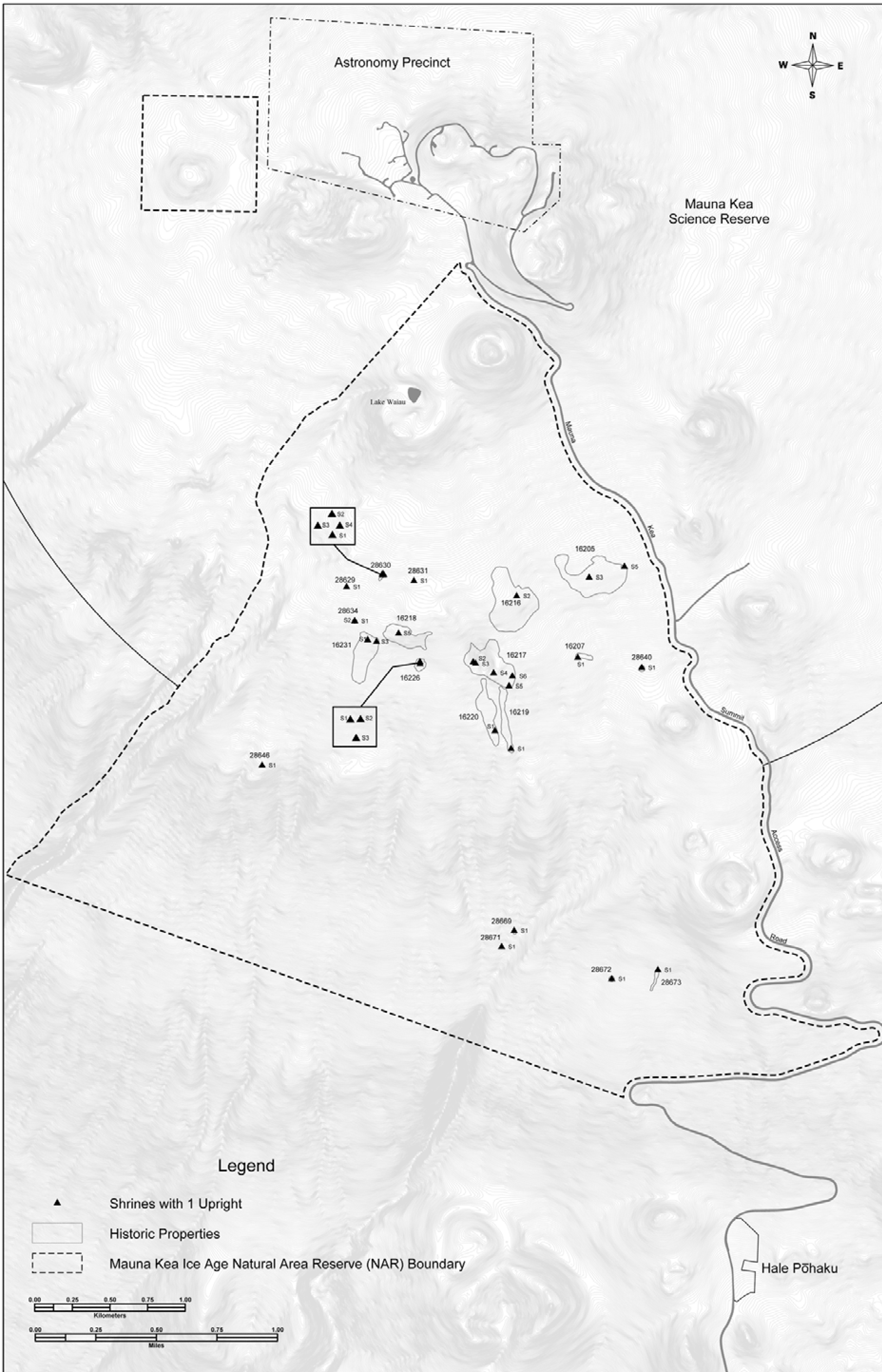
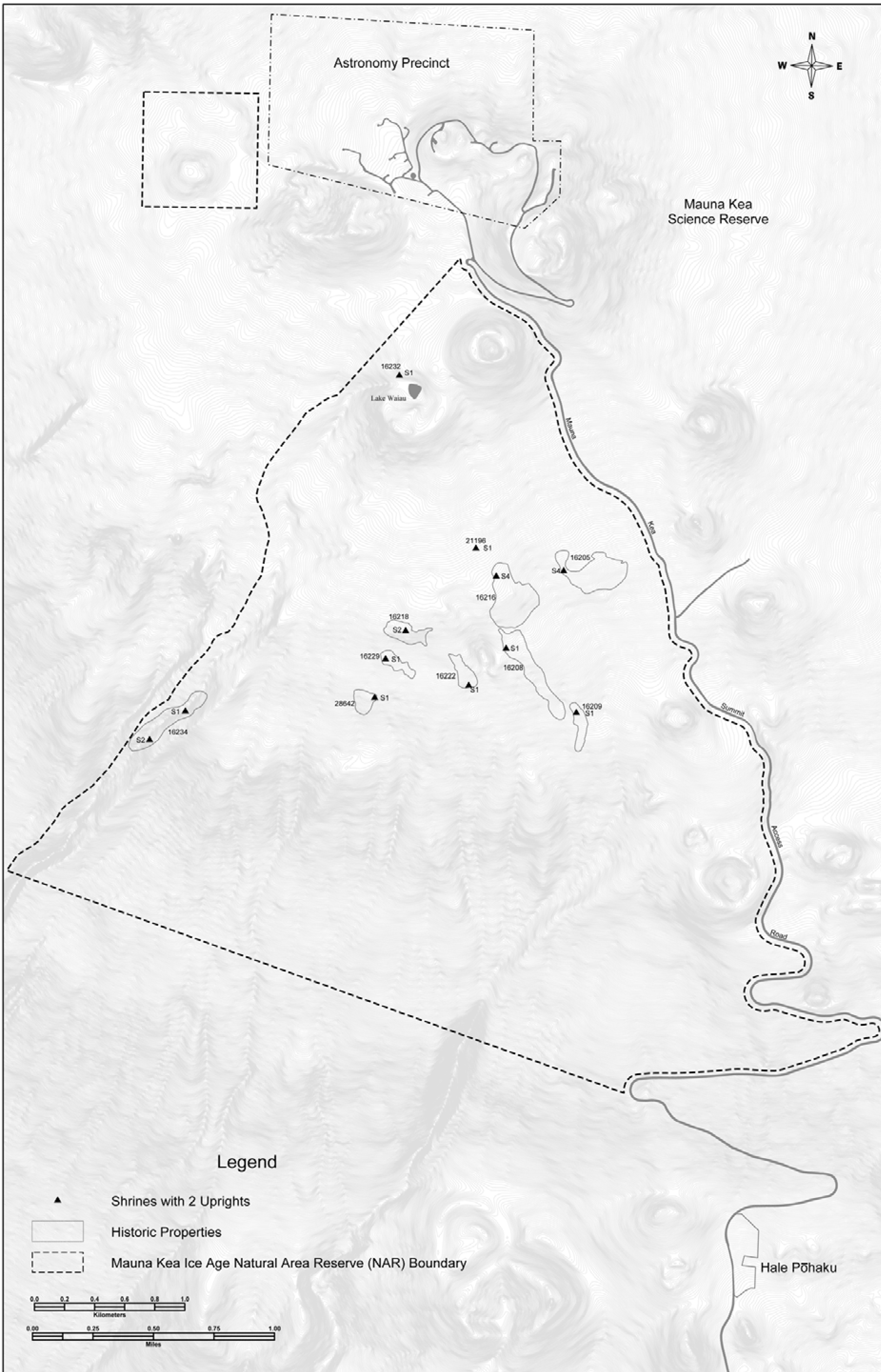


Figure 6.15. Location of Shrines with 2 Uprights.



> As many myths demonstrate, this divine couple is purely and simply the essence, or type, of the human couple and manifests itself in everything in nature associated with men and women, respectively, as well as with their activities (pp. 12-13) (Valeri 1985:12).
>
> We can also suppose that the roof, which at least in the mana house is connected with Ku, is masculine, while the lower part of the house is feminine. A similar opposition must exist between the posts, which being erect (*ku*) must be masculine, and the floor, which being horizontal must be feminine. We also know that the head of the family, the ali`i, or the priest is equated with house posts (cf. Apple 1971, 29; Handy and Pukui 1972, 174; Kamakau 1961, 135). This implies that the house as a whole is assimilated to a social group. A commoner's house is equated only with his family, but the house of a chief is equated with the social group he rules. There are indeed indications that different parts of the king's house symbolize different districts of his realm, since each is built by a different *ahupua`a* and thus embodies its work (cf. Ellis 1842, 321; Brigham 1908: 87) (Valeri 1985:302-303).

Victor Turner noted that "One common mode of positioning is binary opposition, the relating of two symbol vehicles whose opposed perceptible qualities or quantities suggest, in terms of the associative rules of the culture, semantic opposition" (Turner 1977:187). The male/female, husband/wife and brother/sister pairings found in Polynesia are examples of binary opposition. The forms used to symbolize each member of the pair are not always recognizable, however, and in the case of the shrines with two uprights, the pairs are not always perceptibly different (e.g., some shrines have two uprights of the same form—parallel-sided with pointed tops). This illustrates yet another point made by Turner "Ritual symbols are multi-vocal---that is, each symbol expresses not one theme but many themes simultaneously by the same perceptible object or activity (symbol vehicle)" (Turner 1977:185).

Group 3: 3 uprights

Shrines with three uprights occur in almost the same numbers as pairs. There are six shrines in this group, representing 10.34% of the total. The distribution pattern is much more restricted than paired upright shrines, however (Figure 6.16).

Group 4: 4-6 uprights

The four shrines that fall into this category (6.89% of the total) are localized to the northeastern part of the adze quarry, and more particularly, to just three sites (Figure 6.17).

Group 5: 7-10 uprights

The number of shrines with 7 to 10 uprights is two. They are just slightly less numerous than the Group 4 shrines (3.44% of the total). One is found along the escarpment in Zone 1, while the other is located near the western boundary of the NAR, along Pohakuloa Gulch (Figure 6.18).

Group 6: 12-27

This grouping is clearly rare as the range in the number of uprights indicates. There are three shrines in this group, one on each of three of the sites along the escarpment in Zone 1 that was the locus of long-term adze manufacture (Figure 6.19).

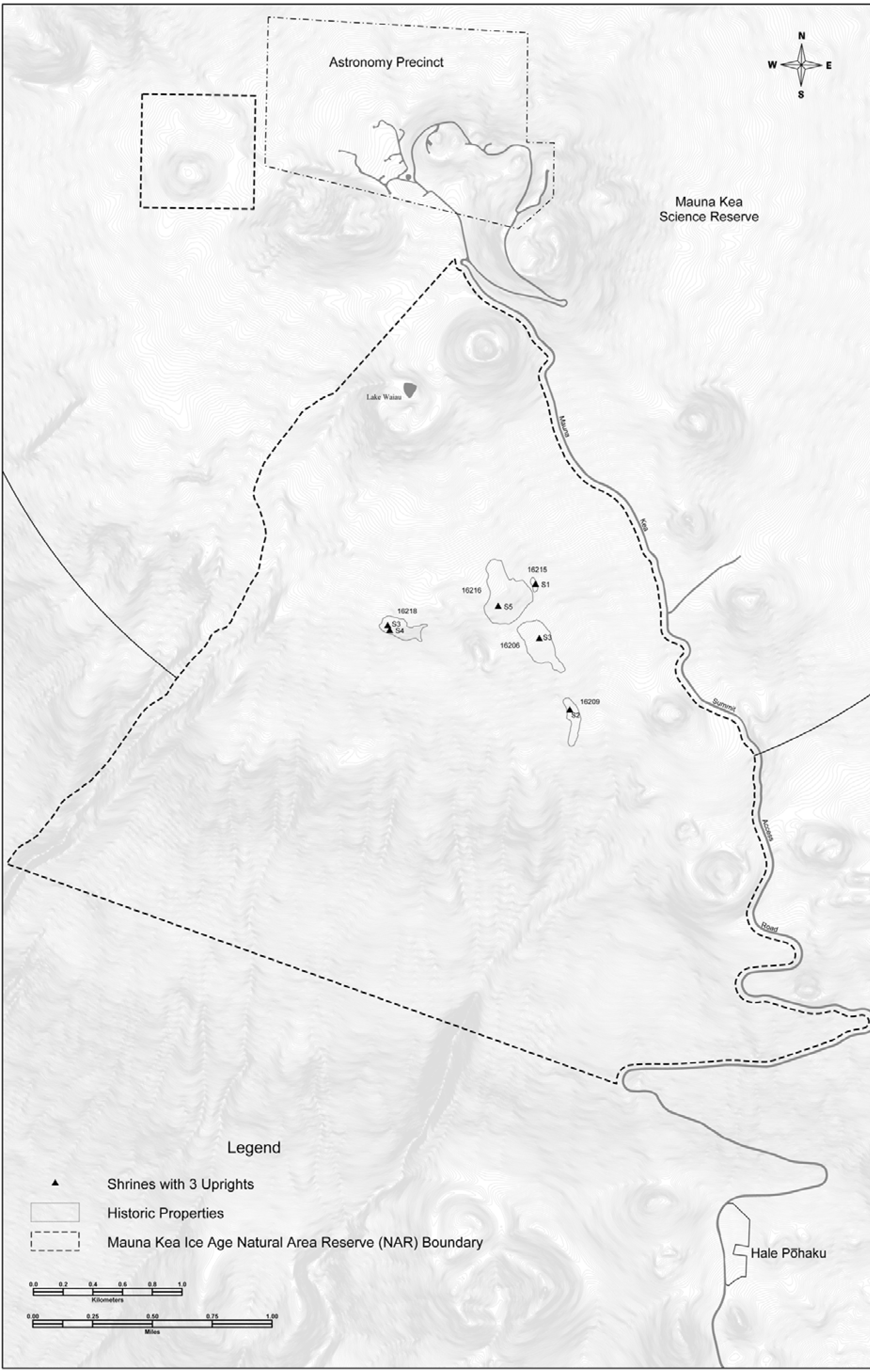


Figure 6.16. Location of Shrines with 3 Uprights.

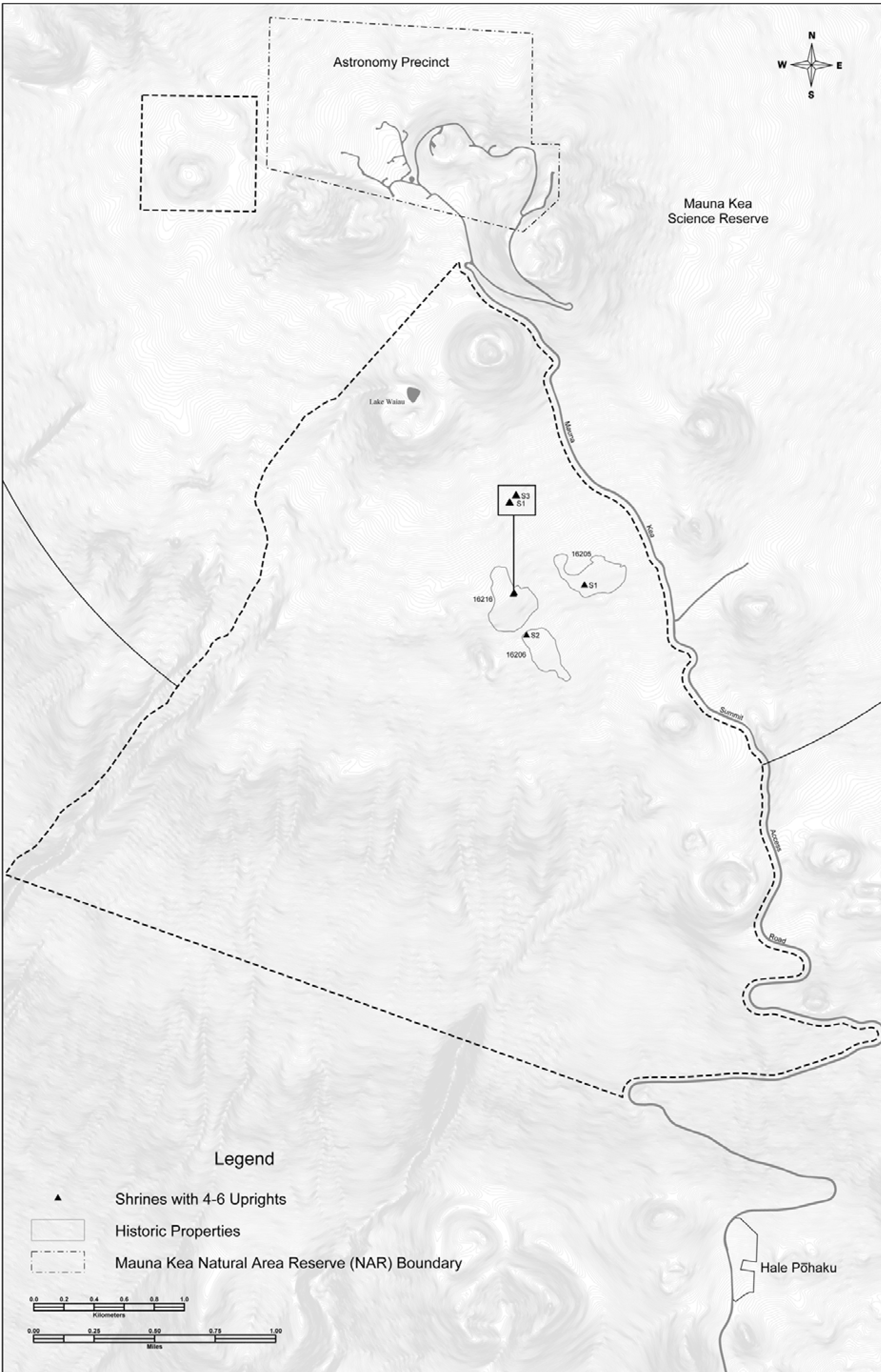


Figure 6.17. Location of Shrines with 4-6 Uprights.

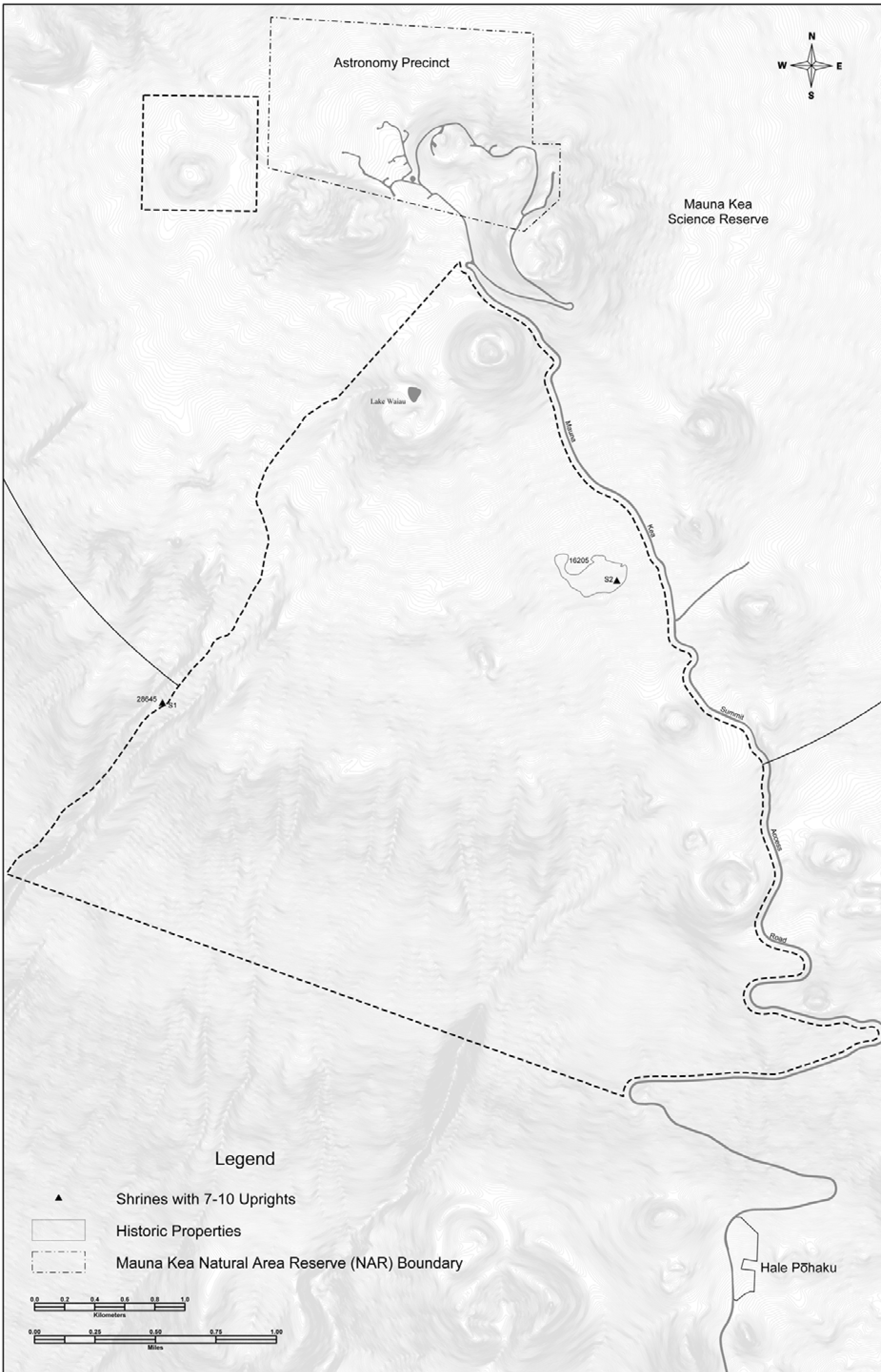


Figure 6.18. Location of Shrines with 7-10 Uprights.

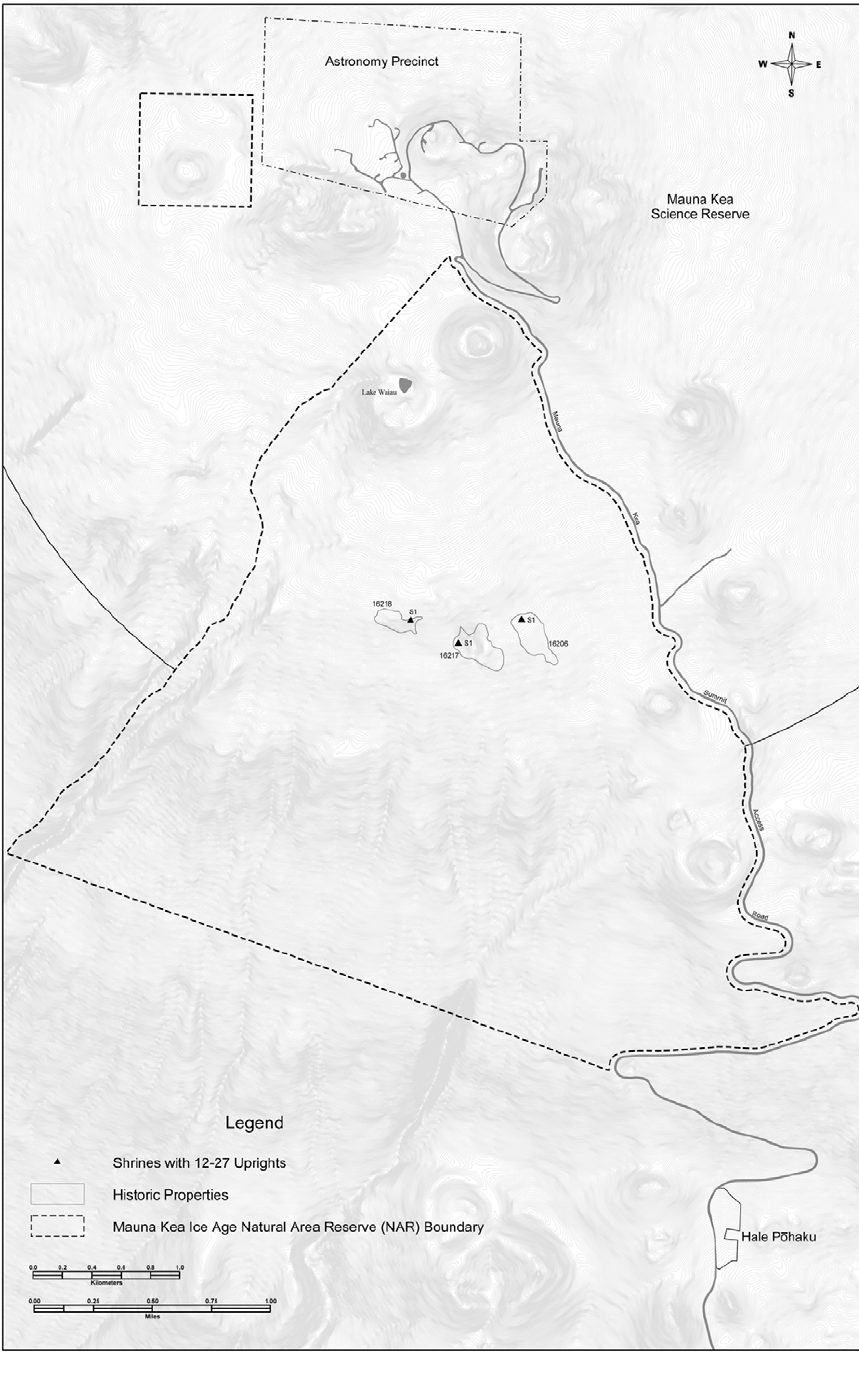


Figure 6.19. Location of Shrines with 12-27 Uprights.

6.3.6.4 Size (Height, Width, and Thickness)

Three measurements were taken of each upright—height, width and thickness. All are maximal dimensions. In the case of broken uprights, the height measurement is the sum of the measurements on the individual fragments. An effort was made to take the measurements in the same way, but because the uprights were not individually photographed or drawn, the measurements are not reproducible (i.e., a second set of measurements would probably differ from the first to some varying degree). This is more so with width and thickness, which can sometimes vary considerably along the length of the stone. The difference in most cases would be inconsequential in terms of what the measurements “mean” and the purposes to which they are put. The exception would be uprights of highly irregular form. Like most field measurements, those taken on the uprights are “general.” and though giving the impression of objectivity they are not absolute or true in the scientific sense of objectivity. They serve the practical purpose of indicating “norms” and the range of variability within and between sites, which can then be used for comparative purposes.

> ***Height*****:** the maximal distance between the top and bottom or two ends (i.e., the long axis).
>
> ***Width*****:** the maximal breadth of the stone at or near the mid-point between the top and bottom.
>
> ***Thickness*****:** the maximal dimension between the front and back; in most cases this is at or near the base or lower end of the stone, but this can vary with the shape of the stone.

6.3.6.5 Shape or Form

Upright shape or form was inconsistently recorded in the earlier surveys. The emphasis in the earlier work was on recording the shape at the top end or “head” of the upright (e.g., pointed, flat), rather than the shape of the whole stone.

Three different attributes were recorded in the 2005-2009 survey: (1) body shape; (2) top or “head” shape, and (3) “treatment,” which refers to natural occurring, or, more rarely, manufactured forms, such as notches and flanges on either the sides or top end of an upright. Figure 6.20 illustrates examples of the three attributes.

Earlier generations of Polynesian archaeologists and ethnologists, such as Emory and Buck, noted the existence on *marae* throughout Central and East Polynesia of unusual forms of uprights, with such distinguishing characteristics as flanges, notches and grooves. Some uprights were described as exhibiting human or animal forms (e.g., Emory 1947:29). In the Tuamotus these were distinguished by the name *tiki* (Emory 1947:13-14). Though sometimes identified as a human or anthropomorphic characteristic, the tendency was to dismiss flanges, notches, grooves and other apparently unusual characteristics as nothing more than “ornamentation” or “embellishment” (Emory 1947:29, 1970:80). The similarities between some of the uprights found on Mauna Kea and *marae* uprights in selected areas of East Polynesia is examined in Section 7.

(1) **body form:** defined as the sides of the upright; the sides can extend the full distance between the top and the base if there is no change in the angle of one or both margins, but such stones are rare; more common are stones with a “shoulder,” which is the point

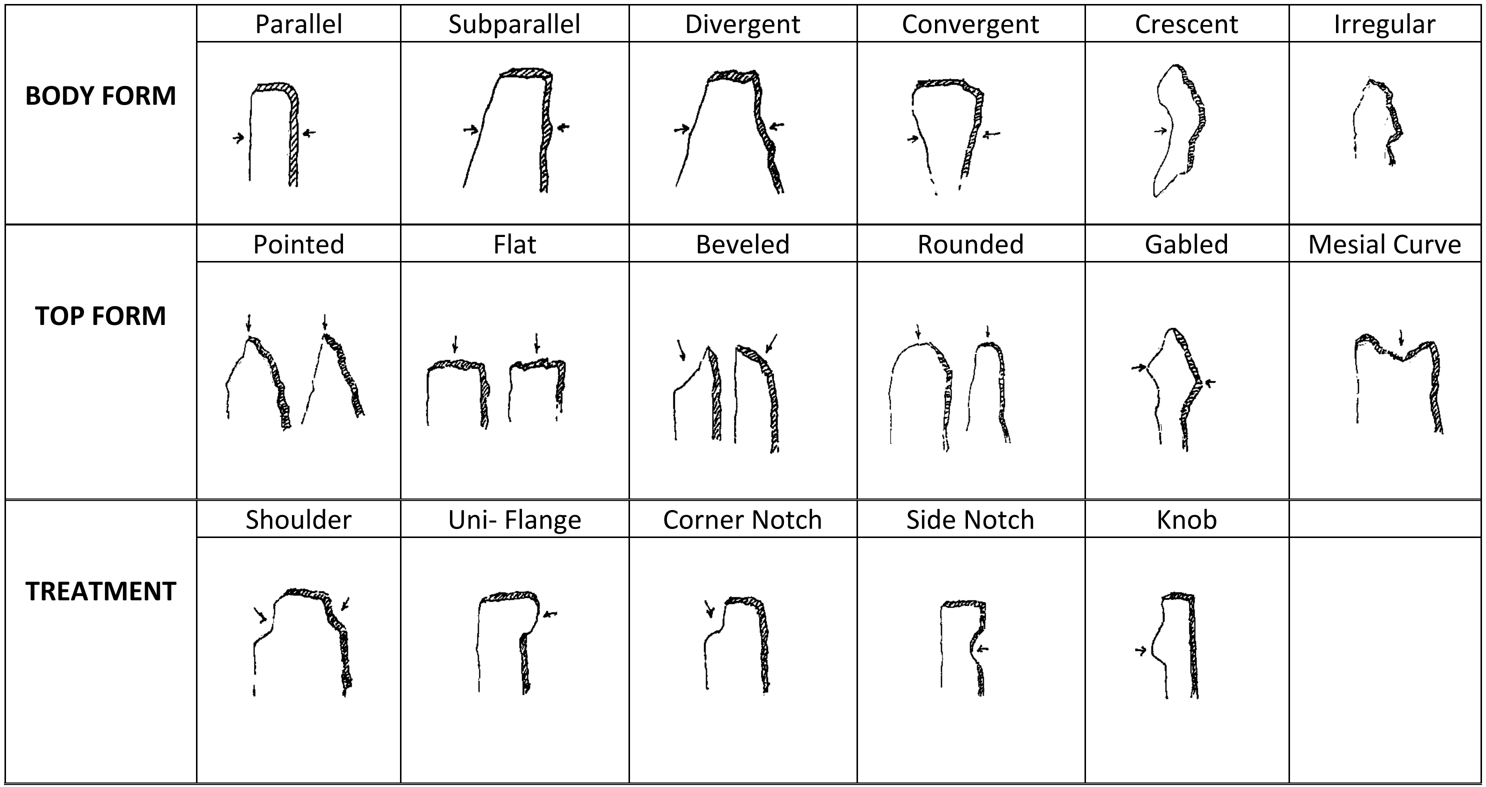


Figure 6.20. Illustrations of Upright Body, “Head” and “Treatment” Shape Categories.

at which there is a change in the angle of the sides and the top. Illustrations of the following categories are presented in Figure 6.20 and their frequency distribution in Figure 6.21:

> ***parallel*:** edges are straight and roughly equidistant.
>
> ***sub-parallel*:** edges are nearly parallel.
>
> ***divergent*:** stones that are narrower at the top than the bottom or base.
>
> ***convergent*:** stones that are wider at the top than the bottom or base.
>
> ***crescen*t:** this is a rare form; one the only example appearing at Site 16184; on that site the stone curves from back to front along the long axis of the stone platform on which it rests; in side view it resembles a crescent.
>
> ***irregula*r:** odd shapes that do not fit any of the other categories.

The data indicate a preference for three body shapes: 61 parallel (30.96%), 24 sub-parallel (12.18%) and 45 divergent (22.84%). The parallel and sub-parallel forms taken together (n=75) make up 38.07 of the total 197 uprights recorded on the 58 shrines. The other forms are much less common (see Figure 6.20). The obvious preference for straight-sided forms may indicate that many of the uprights are representations of male gods and possibly Kū in particular. Things in nature that are high and straight, for example, were believed to be manifestations of the god Kū's virility.

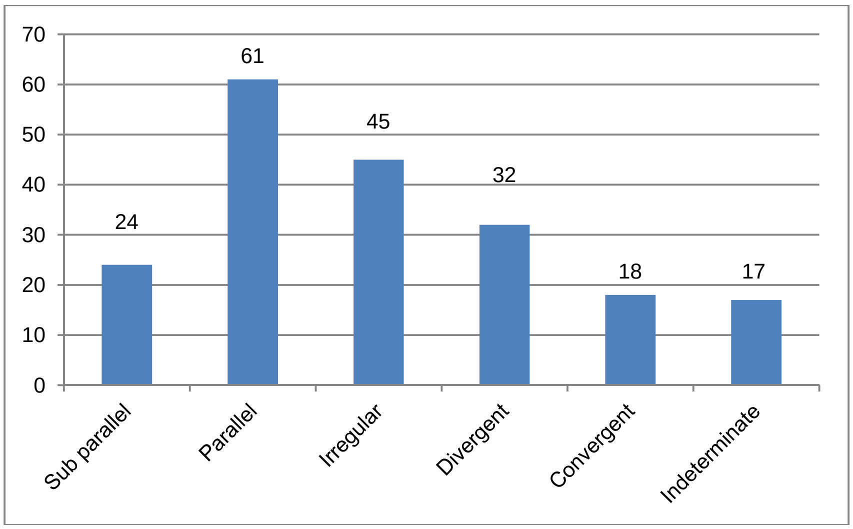
(2) **top** ("head') **form:** the top end of most uprights can be described by a single term, but there are some where it is necessary to use a combination of attributes to adequately characterize the form; there are some uprights, for example, that are beveled above the shoulder and flat or notched on the very top; these are classified in the site tables as beveled/flat. Illustrations of the following categories are presented in Figure 6.20 and their frequency distribution in Figure 6.22.

> ***pointed*:** A broad category that includes any stone that tapers from the bottom to the top to end in a "point"; the "point" can vary considerably in terms of the degree of angularity or sharpness and the location of the point relative to the sides of the stone (what might be "centeredness"). Of the 197 uprights on the 58 shrines 86 or 43.45% are pointed.
>
> ***fla*t:** There are two variants of this category of uprights, those with parallel or nearly parallel sides and those that are narrow at the bottom and wider at the top; the latter resemble some of the wooden slab images in Hawaii; this form appears to be widespread in Polynesia. There are 44 uprights (22.33% of the total) with a flat top.
>
> ***beveled*:** Stones with parallel or nearly parallel sides that like the gabled category also have a shoulder and pointed top end; the difference is in the centering of the point; the direction in which the angle points varies.
>
> ***gabled*:** This category is characterized by stones with parallel or nearly parallel sides and a top end that resembles a gabled roof; similar looking uprights, which have clearly anthropomorphic characteristics in the presence of both a lower and upper "body" separated by a "shoulder" are widespread in Polynesia.
>
> ***rounded*:** This category is relatively uncommon in the summit region of Mauna Kea; it is generally found where tabular slabs are rare or absent; some of the stones in this category appear to have been derived from the rounded edges of glaciated lava flows.

***mesial notched*:** This category is characterized by a concavity in the top of the upright.

irregular: odd shapes that do not fit any of the other categories.

(3) **"Treatment":** a term commonly used in the analysis of pottery or ceramics; the term is being applied in the current project to other attributes of the "head" and "body" of an upright; most are natural, except for some notches which have been created by flaking.



(n=197)

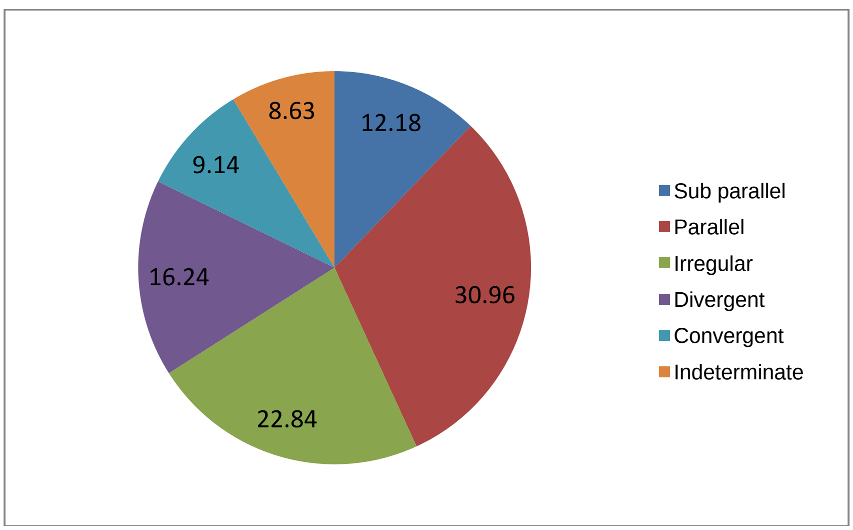
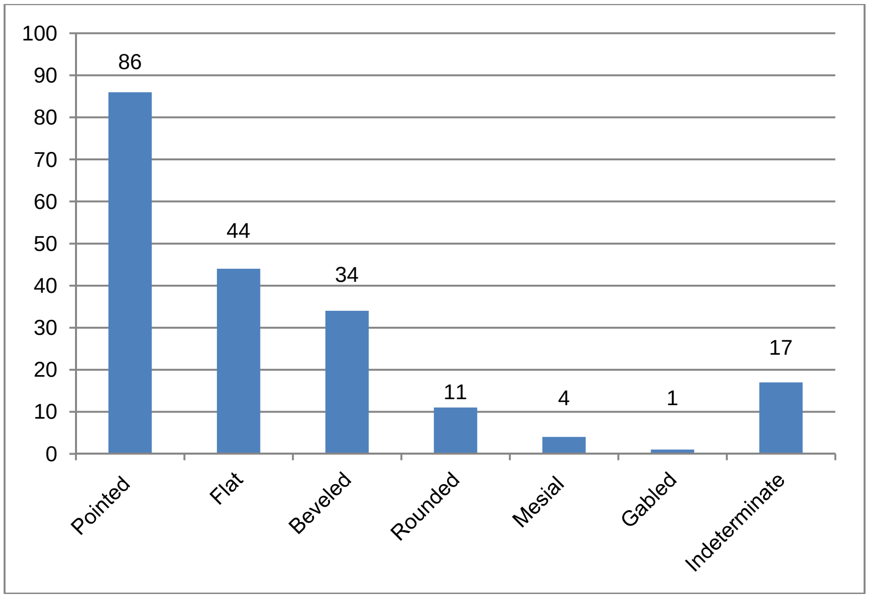


Figure 6.21. Frequency Distribution of Upright Body Shape Categories.



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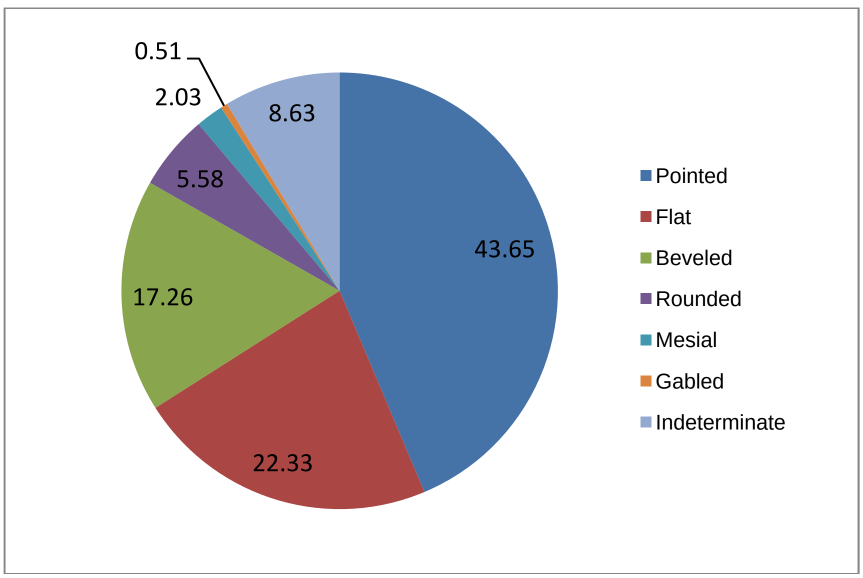


Figure 6.22. Frequency Distribution of Upright Top or "Head" Shape Categories.

Each of the following categories is illustrated in Figure 6.20. During the 2008-09 survey no "treatments" were recorded.

corner notched: a more or less right angle at the juncture (shoulder) between the body and the top.

side notched: a concavity in the side of an upright.

***shouldered*:** uprights with what could be described as two corner notches at the the juncture between the “body” and “head”; beveled and corner notched uprights are distinguished by the presence of a single shoulder.

***flanged*:** this term appears in some of the early archaeological literature on East Polynesian marae where it appears to have been used interchangeably with notched (Buck 1932); in some cases it is clear that the flange was used to describe a more or less “right angle” cut or notch; the few examples found to date in the NAR are flanged on just one side and thus referred to in the tables as *unilateral flanged*.

***knobbed*:** a natural protrusion on the side.

Ethnographic evidence suggests that the different upright forms or shapes are likely to be manifestations of the attributes of different gods or classes of gods, such as male and female. Things in nature that are high and straight, for example, were believed to be manifestations of the god Ku’s virility. Sexual symbolism of this kind was widespread throughout Polynesia, including Hawai`i. Martha Beckwith noted, for example, that in Hawai`i:

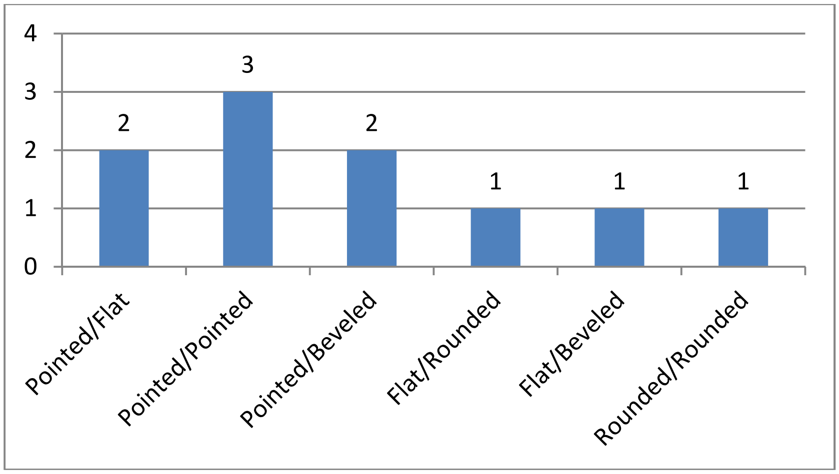
> A slab-shaped or pointed stone (pohaku) which stands upright is called male, pohaku-o-Kane; a flat (papa) or rounded stone is called female, papa-o-Hina or pohaku-o-Hina, and the two are believed to produce stone children. So the upright breadfruit (ulu) tree is male and is called ulu-ku; the low, spreading tree whose branches lean over is ulu-ha-papa and is regarded as female. These distinctions arise from the analogy, in the shape of the breadfruit blossom and of the rock forms, with the sexual organs, an analogy from which Hawaiian symbolism largely derives and the male expression of which is doubtless to be recognized in the conception of the creator god, Kane" (Beckwith 1970:13).

On the basis of ethnographic information the large number of straight-sided uprights and uprights that come to a point indicate a high percentage of male god-stones (*`eho*) on the shrines in the Mauna Kea summit region.

> Rocks have sex: the solid rock, columnar in shape, is male; the porous rock, loaf-shaped or split by a hollow, female. Chiefs and priests worshipped these rocks and poured awa over them as representatives of the god. If a stone of each sex was selected, a small pebble would be found beside them which increased in size and was finally taken to the heiau to be made a god (Beckwith 1970:88).

> Ku and Hina, as well as their varied aspects, function as man and wife in daily rites performed by the populace. With his sister-wife Hina (whose name means “prostrate”), Ku (“upright”) united the people into a single stock, for Ku and Hina represented the male and female reproductive principles. Ku also symbolized the east, sunrise, and the right hand; Hina the west, sunset, and the left. Such antithesis was common (Luomala 1987:217).

The frequency distribution of head shapes for pairs of uprights is shown in Figure 6.23. It is of interest of those that might be interpreted as male/female, two or 10% of the total are pointed/ flat, one is flat/rounded and one is flat/beveled. The most common pairs are two pointed uprights (3 or 30%). In addition to the possibility that upright shapes denote male or female, there are other possible meanings. These are discussed in Section 7.



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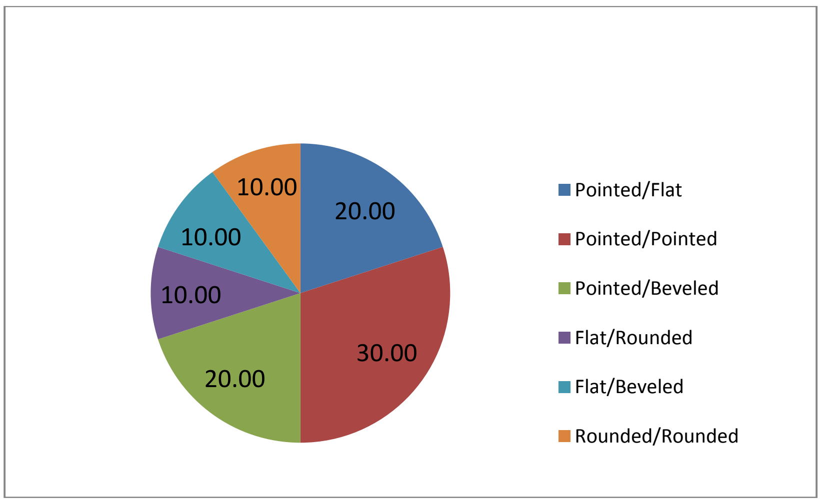


Figure 6.23. Frequency Distribution of Head Types in Shrines with Two Uprights.

6.3.6.6 Upright Types

Theoretically, a typology of upright forms would be based on the combination of body, top and treatment variables. Such a typology would be unwieldy, however. This is a common and widely recognized problem in the initial stages of developing typologies, as Adams and Adams recognized:

> In the initial search for identifiable types, we will probably have to give some consideration to all of the variables and attributes present in our material, or at least to all those that are readily observable (Adams and Adams 1991:183).
>
> It should be observed that in formulating provisional types we have, in most cases, established only their identity and not their meaning (Adams and Adams 1991:185).

They note that “It is nevertheless true that every identifiable type has an implicit or unstated definition, in that it must possess a unique combination of attributes, present and absent, that distinguish it from all other types. Yet type concepts are constantly changing in the course of use…Some types are redefined, some are split into two or more separate types, and some are combined with other types” (Adams and Adams 1991:184).

In the end we decided to omit the treatment variable since relatively few uprights exhibit it. A classification based on the combination of just body and top attributes yields 28 “types” which is still a large and undoubtedly not totally meaningful number as Table 6.2 and Figure 6.24 demonstrate.

6.3.6.7 Upright Location

On some of the more complex sites uprights are found in locations that correspond to what are generally referred to as the “altar” (*ahu*) and the “court” in much of the earlier literature on East Polynesian religious structures (e.g., Emory 1933, 1947). Ethnographic information indicates that the meaning of the uprights varied with their location (on the *ahu* vs. on the court). Emory had the following to say about the uprights on Society Island *marae*:

> The *marae* of the Society Islands follow a pattern of a rectangular court with a stone platform (*ahu*) at the head serving as a raised seat for the gods. Stone uprights designate the position of the worshippers on the court. When they occur on the *ahu*, they seem to designate the position of gods invoked (Emory 1970:91).

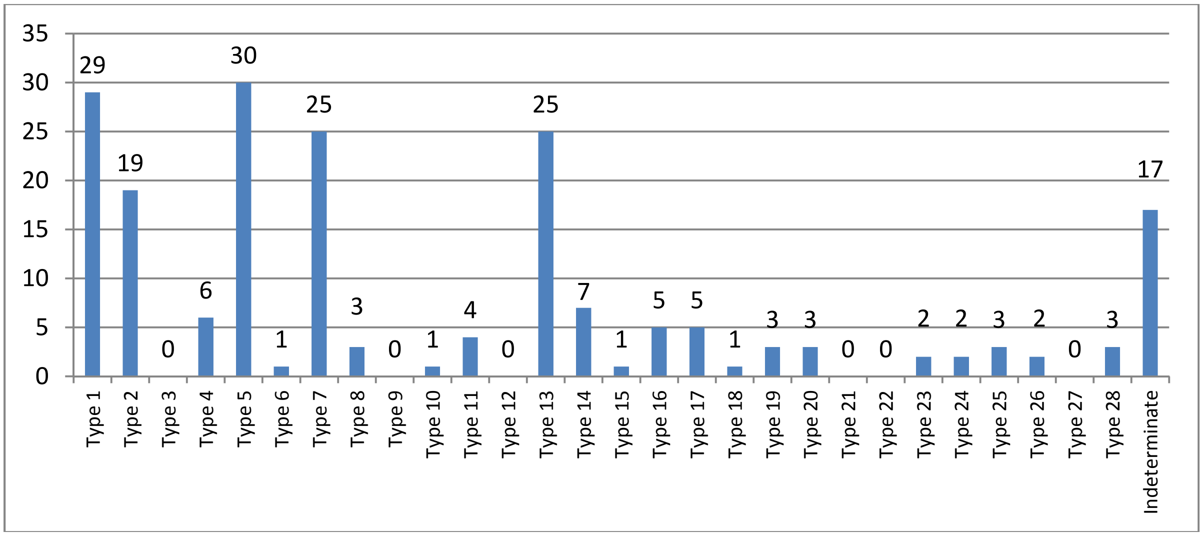
It is possible that the locations of uprights on the Mauna Kea shrines had the same symbolic significance, although there is no known firsthand knowledge of this and no way to confirm it. The few court uprights that could be considered “backrests” may have occasionally functioned the way Emory described for Tahitian marae, but given the environmental context and remote location, it may be that the court uprights had a primarily symbolic rather than instrumental function or use.

A particularly interesting example of an upright with convergent sides and a roughly flat top is located on Shrine 3 at Site 16204 (McCoy 1999b: Figure 10). Upright 2 is of a form that on current evidence appears to be relatively rare in the shrines on Mauna Kea. The sides diverge toward the top, which though somewhat jagged and irregular is overall rather flat. It resembles in a general way the wooden slab images on the Kauai *heiau* illustrated by Webber (see Emory 1928:108 for a discussion of this *heiau*). Though only a single example, it illustrates that there are some similarities between stone and wooden images.

6.3.7 Shrine Classification, Types, and Spatial Distribution Patterns

There are a number of different classifications of Hawaiian shrines. McAllister (1933:15), for example, divided shrines into three groups: fishing, family, and road shrines. Buck thought it useful, however, to divide McAllister’s family shrines into household and occupational shrines. Buck described occupational shrines as follows:

> Malo (1951, p. 81) writes that “each man worshipped the *akua* that presided over the occupation or profession he followed...” Thus what may be termed occupational shrines were built to the presiding gods in convenient places, and



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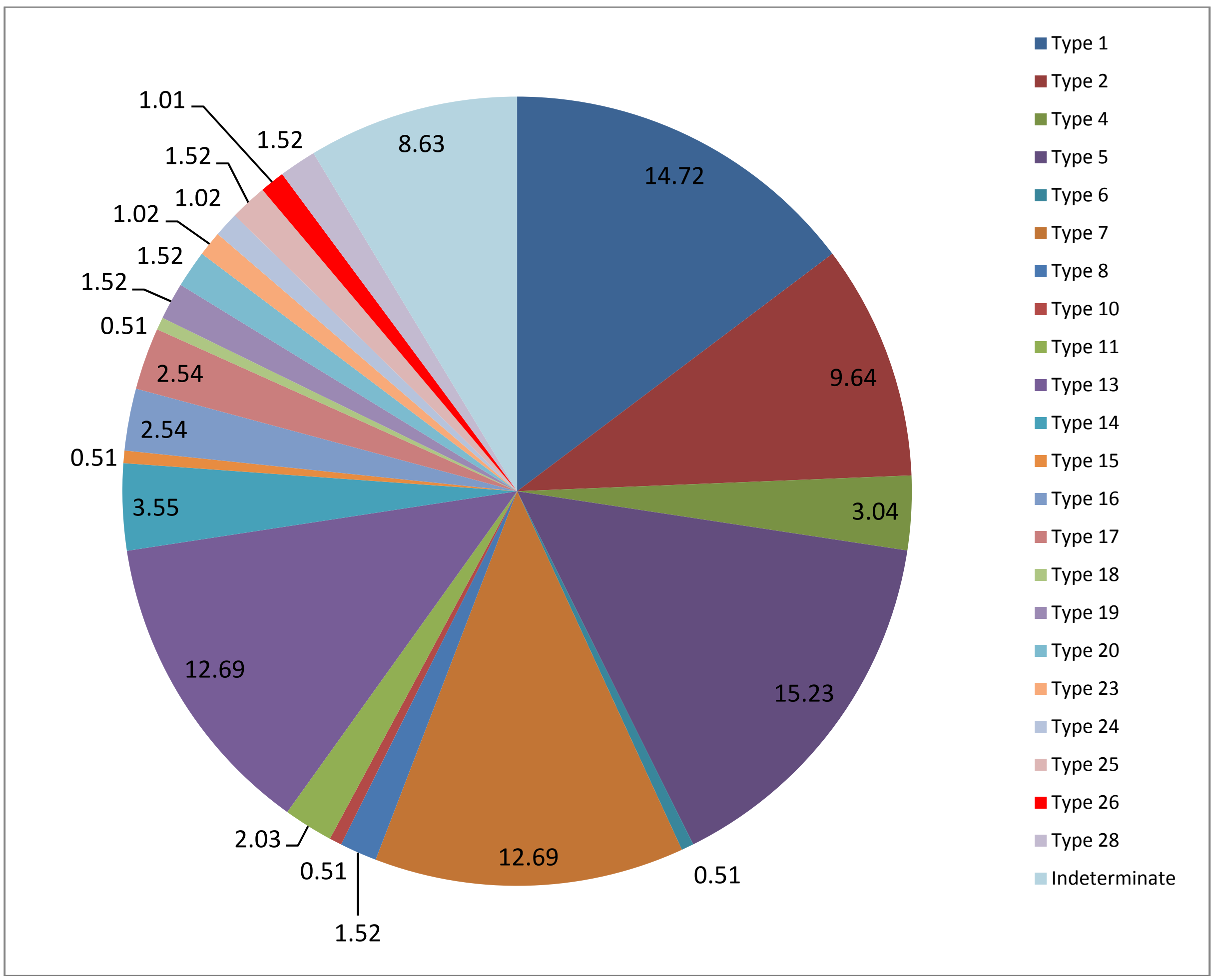


Figure 6.24. Frequency Distribution of Upright "Types".

> cultivators, woodsmen, fowlers, and others recited their rituals and laid their offerings upon their particular shrine before engaging in their work. There was nothing to distinguish this form of shrine from others, except, perhaps, the locations of the sites, which were away from the beaches and could not be readily confounded with the shrines of fishermen (Buck 1957:529).

Table 6.2. List of Shrine Upright Types.

Upright Type	Parallel/ Subparallel	Upright Type	Divergent	Upright Type	Irregular	Upright Type	Convergent	Upright Type[1]	Parallel/sub-parallel
1	Pointed	**7**	Pointed	**13**	Pointed	**19**	Pointed	**25**	Pointed
2	Beveled	**8**	Beveled	**14**	Beveled	**20**	Beveled	**26**	Beveled
3	Gabled	**9**	Gabled	**15**	Gabled	**21**	Gabled	**27**	Rounded
4	Rounded	**10**	Rounded	**16**	Rounded	**22**	Rounded	**28**	Flat
5	Flat	**11**	Flat	**17**	Flat	**23**	Flat		
6	Mesial notched	**12**	Mesial notched	**18**	Mesial notched	**24**	Mesial notched		

Buck's discussion illustrates the problem of relating form and function and, thus, the tendency to focus on the recognition of functional types.

There is no existing, standard classification or typology of Hawaiian shrines used by archaeologists. Though it makes inter-site and regional comparisons difficult, it must be remembered that site classification is a tool rather than an end it itself (Adams and Adams 1991). To reiterate a point made earlier, the purpose of classification is not to just organize the data and make them amenable to comparison, but to make comparisons meaningful.

6.3.7.1 Classification: Objectives and Methodological Issues

There any number of ways of classifying shrines--e.g., single upright shrines and multiple upright shrines. The second group exhibits significant variability in terms of the arrangement of the uprights and the presence/absence of architectural features, such as pavements. A classification that recognized only two types would be of little use.

Adams and Adams describe the development of types as a two step process—the formulation of provisional types followed by the selection of types that are useful for our specific purposes (Adams and Adams 1991:185):

> …there may at the outset be no rational basis for the selection of attributes; we have no choice but to consider most or all of them, and to formulate a large number of provisional types. Thereafter it is not attributes but types that must be selected on the basis of whether or not they are useful for our purposes (Adams and Adams 1991:185).

We have the followed the lead of Adams and Adams in developing a provisional typology based on the number and arrangement of uprights. Pavements were considered in developing the provisional typology, but they are not defining characteristics of any one group. Shrines with courts, which are some of the largest and most complex structures in the Science Reserve, on the other constitute a type.

6.3.7.2 Previous Classifications

The fact that archaeological classifications are mutable and subject to change is illustrated in the several attempts that have been made to classify the shrines on Mauna Kea. The first attempt to classify the shrines in the Science Reserve was made in 1982 based on the analysis of 21 structures. Three provisional “types” were recognized at that time (Table 6.3): (1) single feature shrines; (2) multiple feature shrines, and (3) *marae* (McCoy 1982:2.9).

Table 6.3. 1982 Classification of Shrine Types.

Type	Defining Characteristics	No.	% Total
1	Single feature shrines	11	52.38
2	Multi-feature shrines	8	38.10
3	Primary row of uprights, off-set uprights and a court	2	9.52
Totals		**21**	**100%**

Type 1. Single Feature Shrines

The simplest and most common “altars” are those with one to three, and possibly four, juxtaposed and frequently aligned uprights in a small delimited area. The readily apparent dichotomy of one- and three-upright “altars” is the basis for recognizing two provisional subtypes.

Type 2. Multiple Feature Shrines

Structures of this type are distinguished by the presence of two or more physically discrete, but close, structural components with the same or different architectural characteristics.

Type 3. *Marae*

Use of the Eastern Polynesian term, *marae*, follows Emory (1928) who employed it in describing the religious structures on Nihoa and Necker Islands. The two structures in this category bear a general resemblance to the Nihoa and Necker remains in the existence of a "court" area with secondary uprights fronting the main altar. This is the distinguishing feature of this type, which also occurs in the Mauna Kea adze quarry (McCoy 1981) and in Haleakala Crater (Emory 1921, 1970:89).

A second classification, developed in 1999 and based on a sample of 84 shrines recognized 5 categories (Table 6.4). There is a general progression in structural complexity from simple to complex in the move from one category to the next. There is no indication, however, that this is necessarily an evolutionary sequence, with the more complex shrines developing from the simpler ones and dating to a later time period. It is highly likely that the various ground plans all existed at the same time, and that the differences are to be explained in social terms. Unlike the 1982 classification, the term "category" was used instead of "type" based on the preliminary nature of the analysis (McCoy 1999a).

6.3.7.3 Revised Classification: Defining Characteristics, Number and Distribution Patterns

The 1982 and 1999 shrine classifications were for a variety of reasons not entirely satisfactory. It illustrates once again that classifications and typologies are not immutable or static. With the completion of the inventory survey of the Science Reserve and a significant increase in the number of shrines there is more variability than previously recognized, thus leading once again to revision of the previous typology.

Table 6.4. 1999 Classification of Shrine Types.

Category	Defining Characteristics	No.	% Total
1	Single upright	30	36.14
2	Single row of two or more uprights	33	39.76
3	Row of uprights and off-set uprights	10	12.05
4	Multiple rows of uprights	6	7.23
5	Group of dispersed uprights	4	4.82
Totals		**84**	**100%**

The revised typology is similar in many respects to the 1999 classification except that the variability noted in the definitions of the Category 2 and Category 3 shrines has been given added importance, resulting in the recognition of two new types (Table 6.5). The Category 2 shrines have been divided into two types. Type 2 shrines are single row shrines comprised of closely spaced uprights. Type 3 shrines are single row uprights where the uprights are physically separated by 50 cm and in some cases several meters. The Category 3 shrines with "courts" are now recognized as Type 5. The decision to treat these more elaborate structures as a separate type represents a return to the original 1982 classification. Figure 6.25 is a schematic diagram illustrating the seven types. The frequency distribution of the seven types is illustrated in Figure 6.26 and their spatial distribution in Figure 6.27.

Table 6.5. Revised Classification of Shrine Types.

Type	Defining Characteristics	No.	% Total
1	Single upright	25	43.10
2	Row of juxtaposed uprights	19	32.76
3	Row of separated uprights	1	1.72
4	Row of uprights and off-set uprights	5	8.62
5	Multiple uprights with a pavement and defined court	4	6.89
6	Multiple rows of uprights	0	0.00
7	Group of dispersed, non-aligned uprights	4	6.89
Unclassified		0	
TOTAL		**58**	**100%**

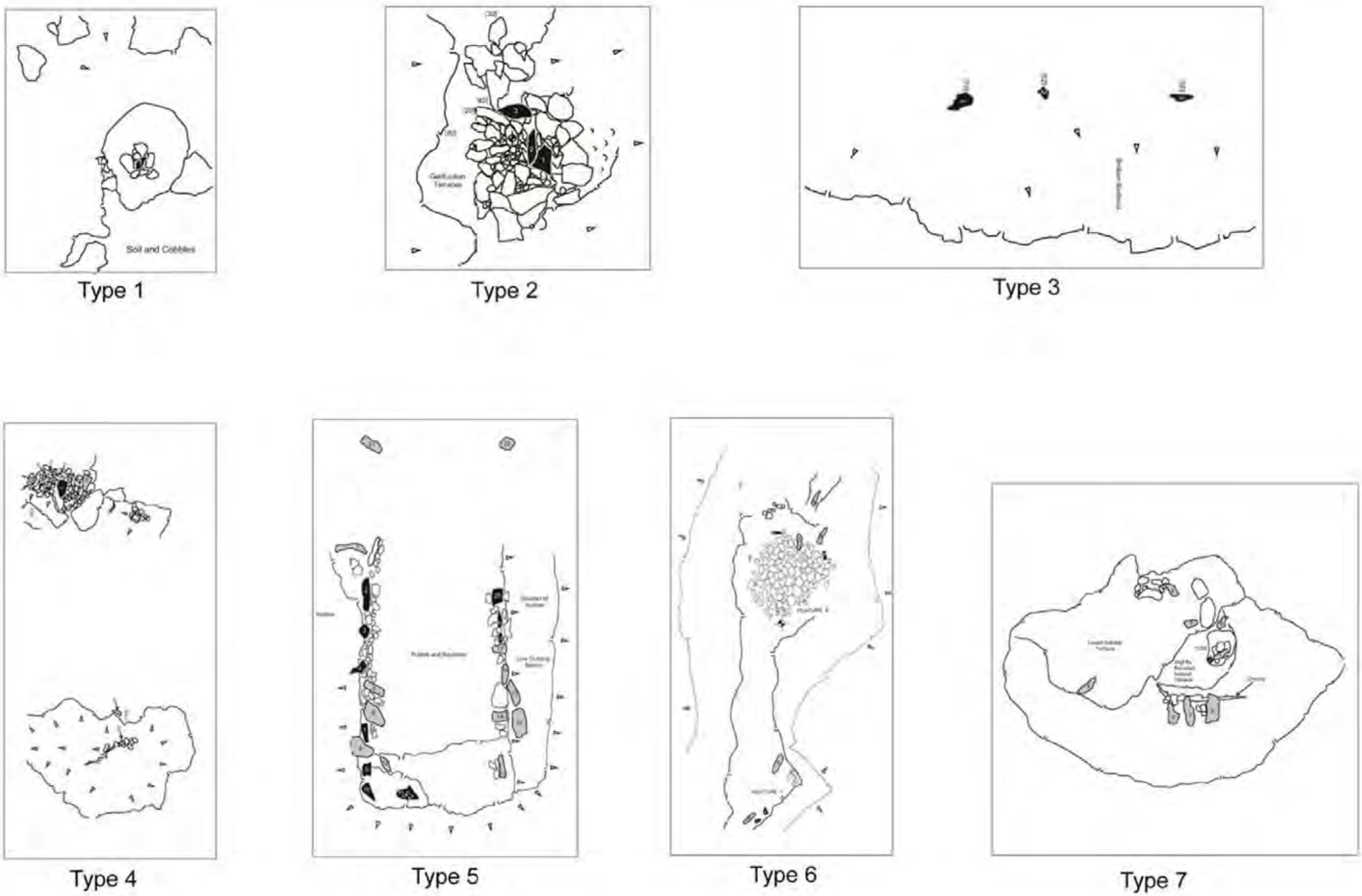
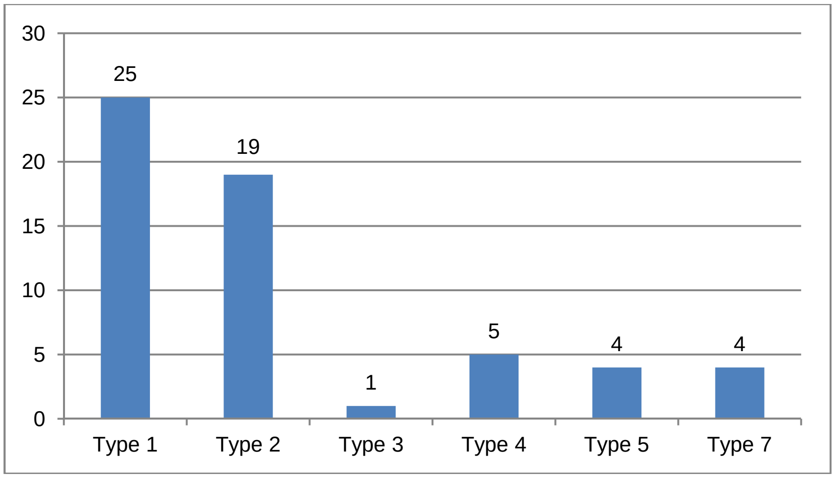


Figure 6.25. Examples of Shrine Types.



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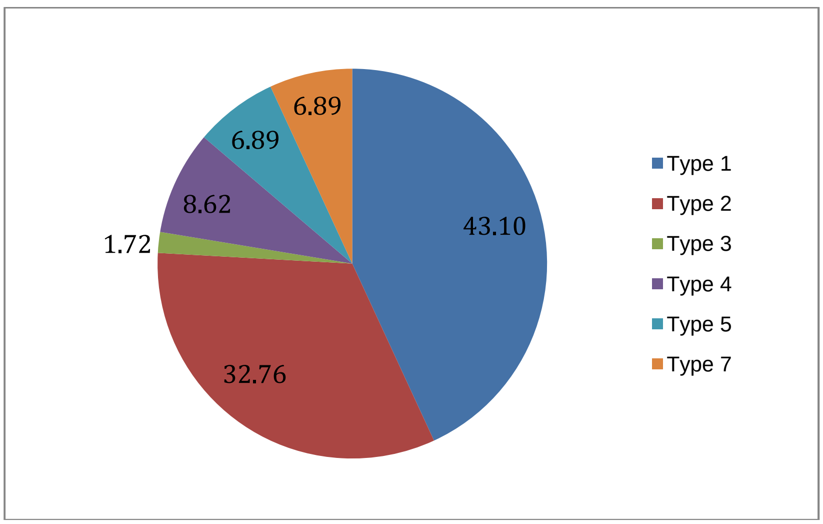


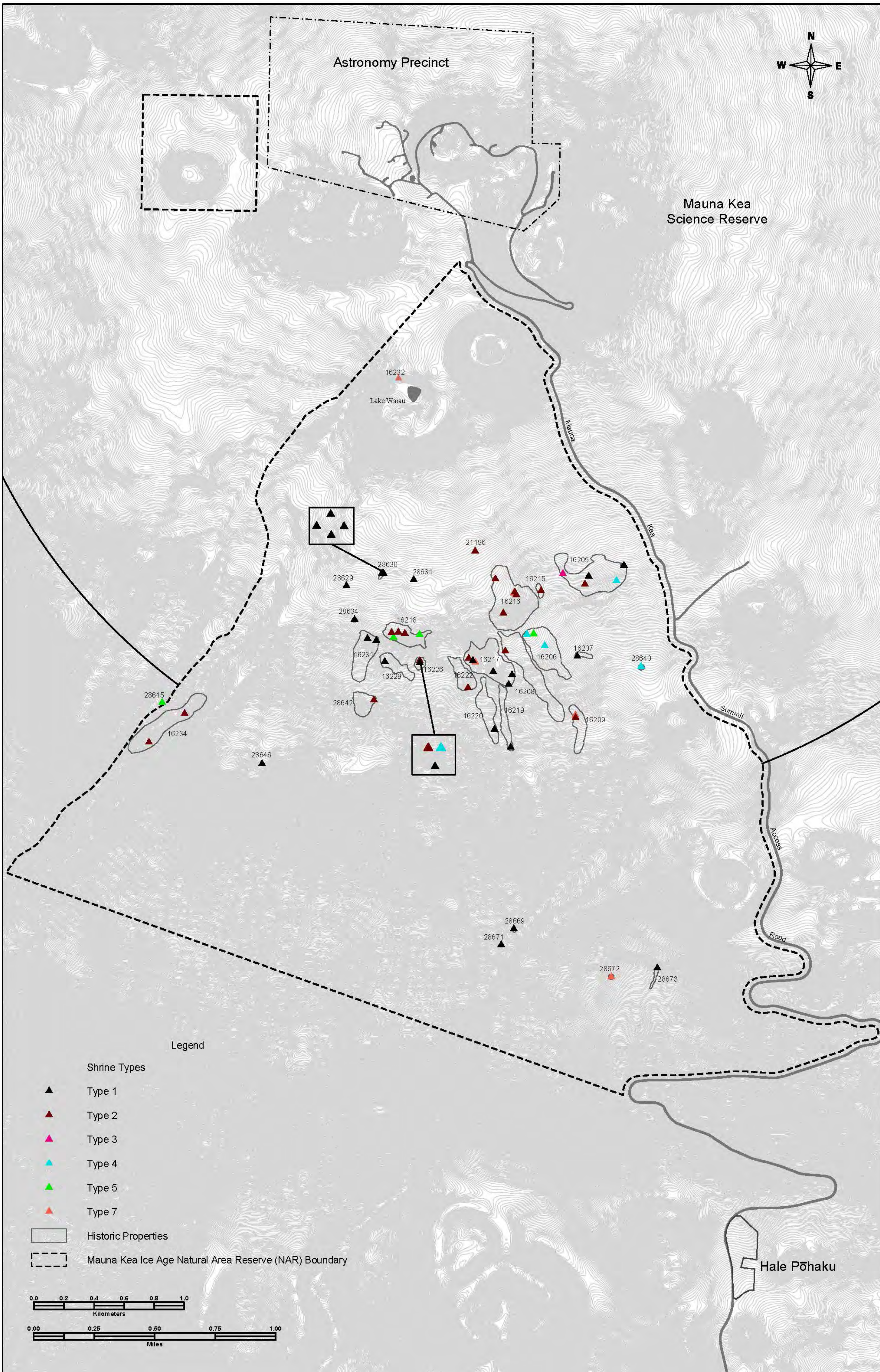
Figure 6.26. Frequency Distribution of Shrine Types.

There is a general progression in structural complexity from simple to complex in the move from one category to the next. There is no indication, however, that this is necessarily an evolutionary sequence, with the more complex shrines developing from the simpler ones and dating to a later time period. Based on ^{230}Thorium branch coral dates for two shrines in the NAR the different forms are contemporaneous (see Section 7).

Type 1

The simplest or most elementary kind of shrine, but at the same time the most problematical for reasons outlined above, is the single upright stone. A total of 25, or 43.10%, of the shrines in the NAR fall into this category (see Table 6.5; see Figure 6.14). As nothing more than a point, a simple mark on the landscape, shrines such as these

Figure 6.27. Spatial Distribution of Shrine Types



clearly have no ground plan. Though small, it is unlikely that the boundaries of these simple shrines were defined by the upright alone. How large of an area would have been regarded as a “sacred precinct” is obviously unknown.

As discussed above, single upright shrines are widespread, but the distribution pattern is uneven. The largest numbers are found in Zone 1 and outside of the quarry complex on the northwest side of Puu Ko`oko`olau (see Figure 6.27).

Type 2

Next to the single upright shrines the most common type of shrine in the Science Reserve are those consisting of a series of uprights aligned in a single row. There are 19 sites in this category which makes up 32.76% of the total (see Table 6.5; see Figure 6.27).

Single row shrines are widely but unevenly distributed. Their distribution is more restricted than the Type 1 shrines. A large majority is found on the escarpment in Zone 1 of the adze quarry and at several places on the rim of the pit crater below Pu`u Ko`oko`olau (see Figure 6.27).

Type 3

Type 3 shrines are defined as a single row of uprights with a gap of at least 50 cm between stones and in many cases a meter or more. In some cases the individual uprights are located on physically discrete boulders or outcrops. There is just one Type 3 shrine in the NAR (see Figure 6.27).

Type 4

The defining characteristic of this type, which distinguishes it from Types 2 and 3, is the presence of additional uprights located on one side of the primary row. There are 5 sites in this category (8.62% of the total; see Table 6.5). Because the off-set uprights occupy a different space than the main row of uprights, what might be considered the “altar”, they may have been essentially the same thing as “court uprights.” Type 4 shrines are widely dispersed (see Figure 6.27).

Type 5

Type 5 shrines are similar to Type 4 shrines except that there is a clearly defined “court” on which are sometimes found more or more offset uprights (see Table 6.5). Following the established practice in describing East Polynesian *marae*, these are called “court uprights.” In parts of East Polynesia, such as Tahiti and the Tuamoutu Islands the uprights on the court were used as backrests for persons of honor. Type 5 shrines number four, representing 6.89% of the total. The 4 examples are limited to just two sites in Zone 1 of the quarry (16217 and 16218) (see Figure 6.27). Shrine 1 on Site 16206 is a classic example of an U-shaped “enclosure” (Figure 6.28).

Type 6

There are no unambiguous sites of this type in the NAR, which is defined as a shrine with more than one row of uprights (see Table 6.5).

Type 7

This is a rare form of shrine with only four known examples (6.89% of the total, see Table 6.5). The defining characteristic is a small number of uprights that do not appear to be aligned in any obvious way, but are rather dispersed. Some of the Type 7

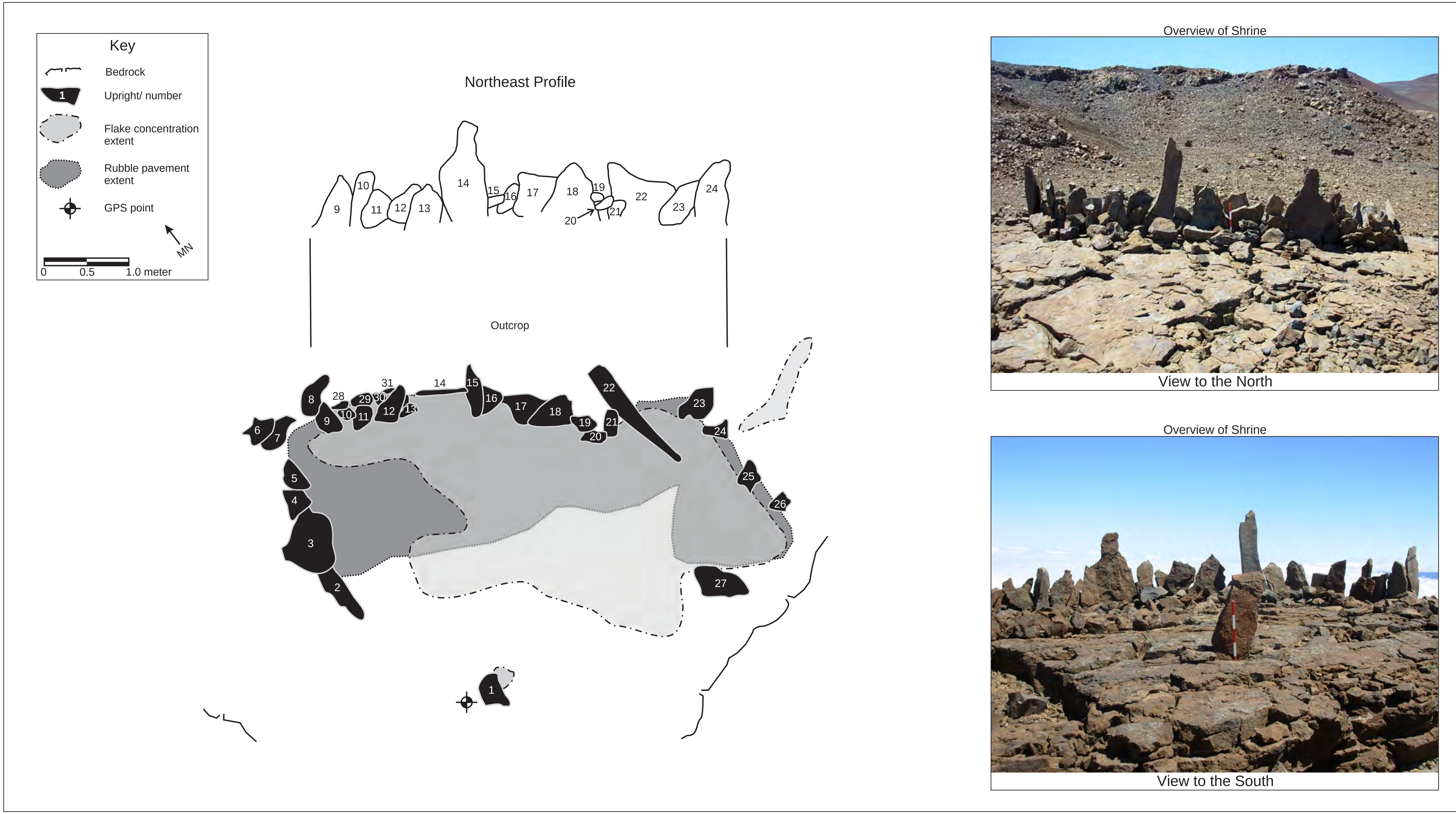


Figure 6.28. Site 16206 Shrine 1, Plan View and Photographs.

shrines consist of one or more uprights located on boulders that form a cluster. Site 16216, Shrine 1 is the best example of this type (Figure 6.29). Located adjacent to Shrine 2, the dispersed group of uprights may have symbolized something different. It has been suggested that instead of a shrine in the usual sense, the group of dispersed uprights may have been a "map" of the island political organization, with each upright representing one of the traditional districts (McCoy 1990).

Figure 6.29 Site 16216, Shrines 1 and 2. View to Northwest.

6.3.8 Shrine Artifact Assemblages

At first sight many shrines appear to be small workshops with the usual range of manufacturing by-products and frequently occurring discarded hammerstones. These materials tend to be tightly clustered around the base of the structure. Where there has been little post-depositional disturbance, the distribution is often localized to one side of an alignment, which suggests the front side or approach to the structure.

From the behavioral perspective of the more detailed compositional analysis that follows, it is particularly noteworthy that there are five assemblages composed of waste flakes and nothing else. Waste flakes are, moreover, the only by-products common to all assemblages. This is one of many lines of evidence that shrines were not workshops in the usual sense of the term.

A salient characteristic of many of the shrines in the NAR and reason for initially regarding them as *in situ* workshop debitage is the presence of artifact assemblages comprised of one or more of the following: cores, flakes, preforms and what were called blanks in the 1975-76 work, and hammerstones. As worked progressed, it became increasingly clear that the artifacts found on shrines were offerings to the gods, and thus very much like the first fish from a catch that were left on fishermen's shrines called *ko`a* (Malo 1951: 212 Note 2; Buck 1957:528).

Of the 58 shrines recorded in the NAR, 38 or 65.51% have clearly associated artifacts (Table 6.6 and Figure 6.30). The artifacts tend to be tightly clustered around the base of the upright(s). Where there has been little post-depositional disturbance, the distribution is often localized to one side of an alignment, which suggests the front side or approach to the structure.

Cores, blanks, preforms, waste flakes, and hammerstones are common to a number [8] of assemblages, but the common pattern is a more restricted range of by-products. Examination of the site survey records reveals the following statistics on by-product category frequencies for the 38 assemblages in the quarry proper.

Table 6.6 summarizes the kinds of artifacts found on each individual shrine. The number of artifact categories provides a crude index of assemblage richness. Table 6.6 indicates that only 6 or 15.79% of the shrines have assemblages comprised of cores, flakes, preforms, and hammerstones. The only artifact category that occurs on all but one of the shrines is flake debitage. The one aberrant shrine is located on the northeastern edge of Site 16205 on a boulder. Instead of flakes, the only artifact found on this shrine (16205, Shrine 5) is a hammerstone. There are 10 or 26.32% of the total shrines where the only artifacts observed were flakes. Many of these are located at lower elevations in Zones 2 and 3 of the quarry complex, where the primary source of raw material for adze manufacture was boulders and cobbles in glacial drift deposits. The presence of hammerstones, though not common (n=11) is of interest since these are tools in contrast to manufacturing by-products, including discarded preforms.

The artifacts on six of the shrines recorded in 1975-76 were collected for analysis. The preliminary results were presented in an unpublished paper written in 1981 (McCoy 1981). The sample included shrines located in the higher elevations (Sites 16205, 16206, 16216) and mid elevations (Sites 16207 and 16209) of the quarry complex, and both small and large assemblages (Table 6.7 and Figure 6.31). The total number of artifacts collected from the six shrines is 3,590. Table 6.7 summarizes the number and variety of artifacts collected on each of the six shrines in terms of counts and percent, which are illustrated graphically in Figures 6.32 and 6.33.

Table 6.8 presents the results of an attribute analysis of the preforms. For reasons explained in Section 6.4.6 the original distinction between adze blanks and adze preforms has been abandoned and replaced with a single category--adze preforms. The combined numbers are used in the tables presented below. The attributes selected for study including condition (whole vs. broken); cross-section; presence/absence of a tang, and cortex location if present. Table 6.9 presents a summary of whole preform measurements.

Inter-site variability in assemblage composition is high, although there is a degree of similarity between the shrines in each of the two elevation based sample populations. The higher elevation shrines, which may have been in use over a longer period of time have significantly larger artifact assemblages compared to the sample from the mid-elevation area of the quarry where the raw material sources cover a smaller area.

Table 6.6. Shrine Artifact Assemblage Characteristics.

SIHP Site Number	BPBM Site No.	Shrine No.	Shrine Type	Locational Context	Artifact Category: Cores	Flakes	Adze Preforms	Hammerstones	Total No. Artifact Categories
16205	G28-2	S1	2	Workshop	X	X	X	X	4
		S2	4	Rockshelter 2		X			1
		S3	1	Rockshelter 1		X	X		2
		S4	3	Rockshelter 6		X	X		2
		S5	1	Isolated				X	1
16206	G28-3	S1	5	Isolated	X	X	X	X	4
		S2	4	Workshop		X			1
		S3	4	Workshop		X	X		2
16207	G28-4	S1	1	Workshop	X	X	X	X	4
16208	G28-5	S1	2	Workshop	X	X			2
16209	G28-6	S1	7	Rockshelter 1	X	X	X		3
		S2	2	Workshop	X	X	X	X	4
16215	G28-13	S1	2	Workshop		X	X		2
16216	G28-14	S1	7	Workshop		X			1
		S2	2	Workshop	*	**X**	**X**	*	**2****
		S3	2	Workshop		X	X		2
		S4	2	Rockshelter 3	X	X	X	X	4
		S5	2	Rockshelter 1		X	X	X	3
16217	G28-15	S1	2	Workshop	X	X	X	X	4
		S2	1	Workshop	X	X			2
		S3	7	Workshop		X			1
16218	G28-16	S1	5	Isolated	X	X	X	X	4
		S2	2	Workshop	X	X	X		3
		S3	2	Workshop	X	X	X	X	4
		S4	5	Workshop	X	X	X		2
		S5	2	Workshop		X	X		2
16220	G28-18	S1	1	Rockshelter		X			1
16222	G28-20	S1	2	Workshop	X	X			2
16226	G28-24	S2	2	Isolated	X	X	X		3
		S3	1	Isolated		X			1
16231	G28-29	S1	1	Workshop	X	X	X		3
28634		S1	1	Rockshelter?		X			1
		S2	1	Rockshelter		X			1
28640		S1	4	Workshop		X			1

Table 6.6. Shrine Artifact Assemblage Characteristics.

SIHP Site Number	BPBM Site No.	Shrine No.	Shrine Type	Locational Context	Artifact Category: Cores	Flakes	Adze Preforms	Hammerstones	Total No. Artifact Categories
28642		S1	2	Isolated		X			1
28645		S1	5	Isolated		X	X		2
28671		S1	1	Isolated	X	X			2
28673		S1	1	Rockshelter		X	X	X	3
TOTALS		**38**			**17**	**37**	**23**	**11**	

** Site 16216, Shrine 2 may have cores and hammerstones

Table 6.7. Composition of Six Collected Shrine Artifact Assemblages.

Site/Structure Number	Cores		Preforms		Flakes: Diagnostic		Flakes: Non-Diagnostic*		Hammerstones		Total Artifacts
	#	%	#	%	#	%	#	%	#	%	
16205 S1	10	1.40	127	17.68	391	54.46	187	26.04	3	0.41	718
16206 S1	28	2.98	220	23.37	504	53.56	185	19.66	4**	0.42	941
16206 S1	1	4.17	12	50.00	8	33.33	2	8.33	1	4.17	24
16209 S1	1	25.00	1	25.00	2	50.00	0	0.00	0	0.00	4
16209 S2	2	2.53	13	16.45	44	55.69	10	12.66	1	1.27	79
16216 S4	8	0.44	74	4.05	660	36.18	1,081	59.27	1	0.05	1,824
TOTAL	**50**		**321**		**1,609**		**1,465**		**10**		**3,590**

The flakes were sorted into diagnostic and non-diagnostic categories. This corresponds to whole and broken flakes where the length, width and/or thickness could not be measured.

The ratio of whole to broken preforms is fairly homogeneous for all six assemblages; at least the number of whole preforms always outnumbers the number of broken ones (Figure 6.34). Of the 153 preforms, 82 or 61.65% are whole, as opposed to 51 or 38.35% broken. The presence of broken preforms, which make up close to 40% of the total is something that at first might be hard to understand, if as commonly believed, the artifacts found on all of the shrines are offerings by the adze makers to their tutelary gods. Why leave so many broken preforms or examples of failure if the purpose of the offerings was a show of respect to the gods?

The presence/absence of a tang is a variable of some interest with regard to understanding the reduction sequence and more specifically, at what point in the reduction sequence was the tang made, if at all in the quarry (Figure 6.35). The low number of preforms in the sample with tangs (n=30 or 22.56% of the total) is not unusual

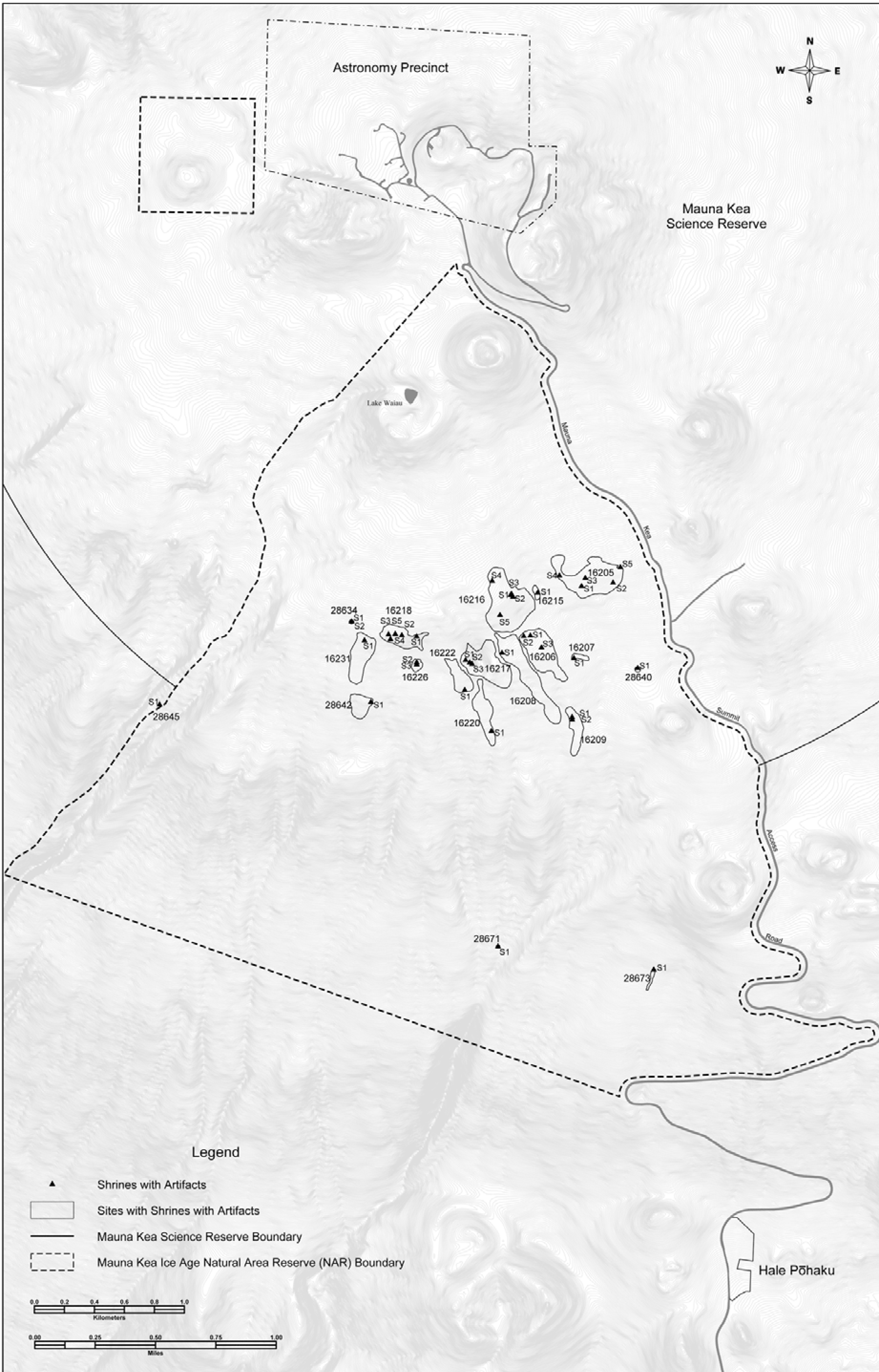
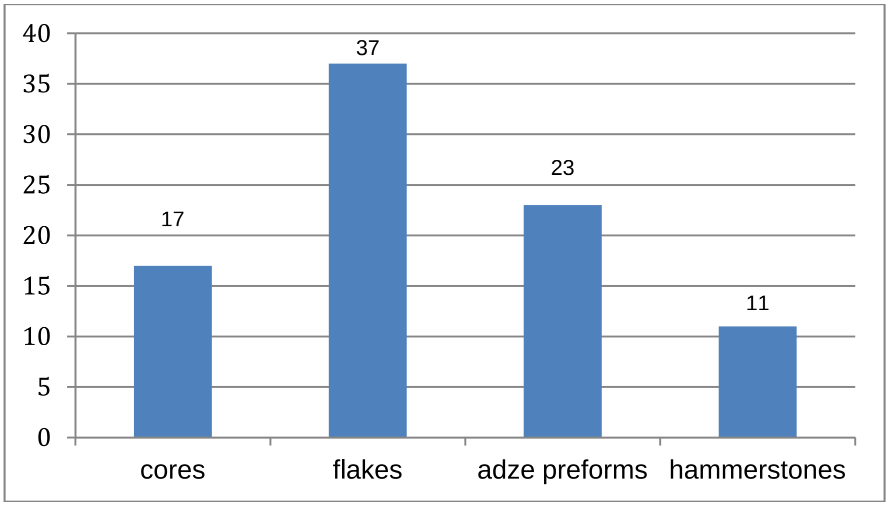


Figure 6.30. Spatial Distribution of Shrines with Artifacts.

based on the data currently available (see Cleghorn 1982).

Rectangular preforms are by far the most common (84 or 63.16% of the total, with reverse trapezoidal the next most common cross-section (31 or 23.31% of the total). The other two cross-sections represented, triangular and reverse triangular) are rare (see Table 6.8 and Figure 6.36). The rectangular and reverse trapezoidal adzes tend to be made on tabular cores or core blanks as evidenced by the amount and location of cortex (see Table 6.8). The other two cross-sections are commonly associated with preforms made on flake blanks.



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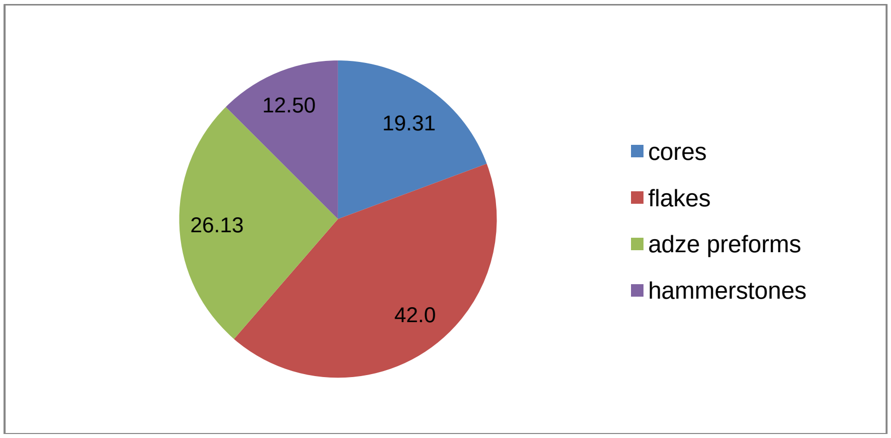


Figure 6.31. Frequency Distribution of Artifact Classes in Six Shrine Artifact Assemblages Combined.

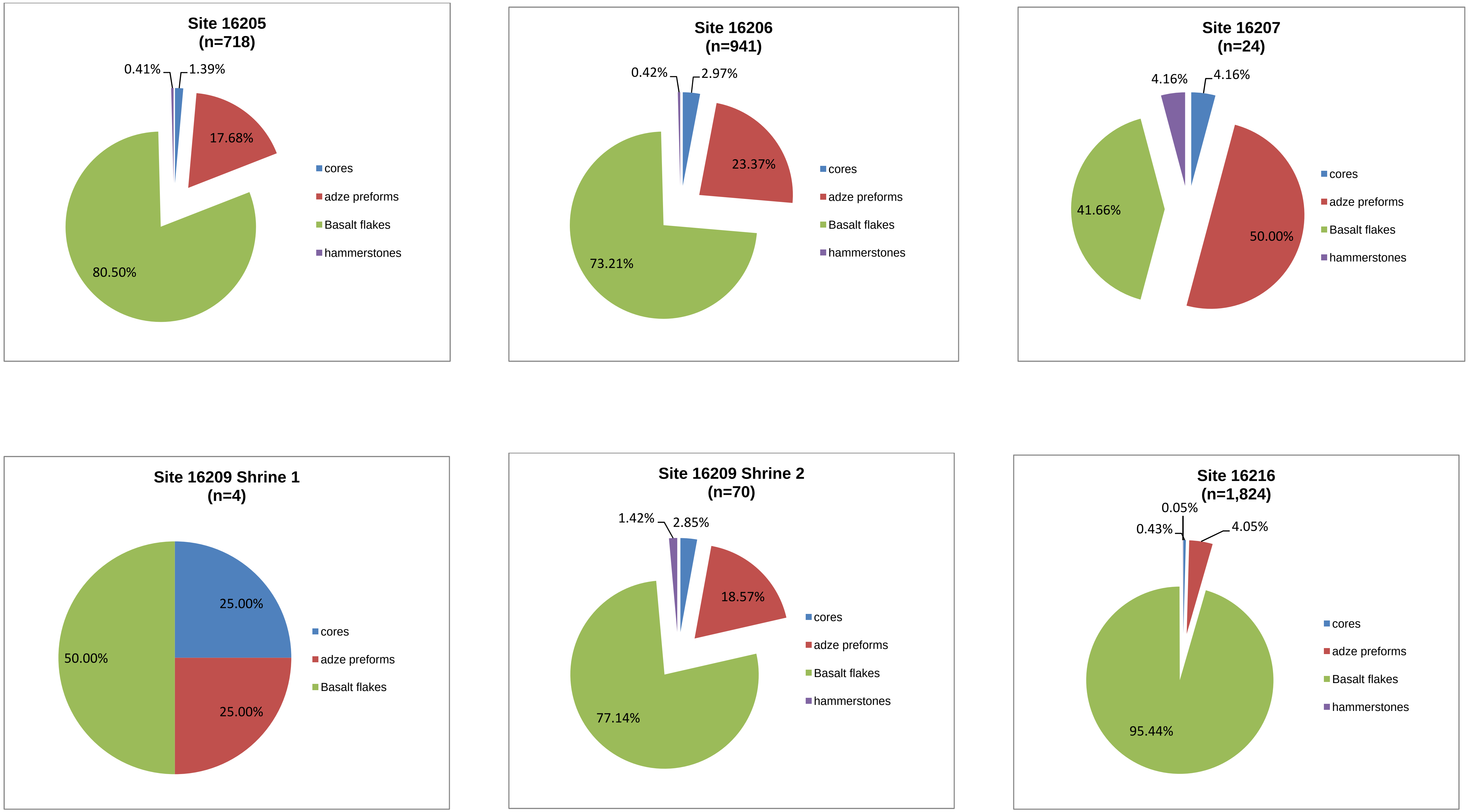


Figure 6.32. Frequency Distribution of Artifact Classes in Six Shrine Artifact Assemblages (Collected) by Site.

Table 6.8 Summary of Non-Metric Adze Preform Attributes from Six Shrine Assemblages.

ATTRIBUTE	16205 Shrine 1	16206 Shrine 1	16207 Shrine 1	16209 Shrine 1	16209 Shrine 2	16216 Shrine 4	Total	% Total
Condition								
whole	14	20	7	4	1	36	82	61.65
fragment	9	8	6	1	0	27	51	38.35
Cross-Section								
rectangular	8	16	10	4	1	45	84	63.16
reverse trapezoidal	9	9	1	1	0	11	31	23.31
triangular	3	1	0	0	0	1	5	3.76
reverse triangular	3	2	2	0	0	6	13	9.77
Tang								
tanged	3	5	1	3	0	18	30	22.56
untanged	9	16	6	1	1	23	56	42.10
indeterminate	11	7	6	1	0	22	47	35.34
Cortex								
absent	11	5	4	3	0	40	63	47.37
front	1	3	2	0	0	10	16	12.03
back	5	4	4	0	0	1	14	10.53
lateral edge	2	3	0	0	0	6	11	8.27
butt	1	0	1	1	0	1	4	3.00
front + back	1	4	1	0	0	4	10	7.52
front + back + 1 edge	1	4	0	0	0	0	5	3.76
front + back + 2 edges	0	2	0	1	0	0	3	2.26
other	1	3	1	0	1	1	7	5.26

Table 6.9. Summary of Selected Metric Data for Whole Adze Preforms.

Site/ Structure Number	No.	Length (cm)		Width (cm)		Thickness (cm)		Weight (gms)	
		Range	Avg.	Range	Avg.	Range	Avg.	Range	Avg.
16205 S1	14	8.36-20.66	14.82	3.70-10.68	6.78	2.74-7.42	4.38	144.0-2,215.0	688.66
16206 S1	20	9.38-42.90	18.03	3.40-9.82	6.70	2.30-7.70	4.74	230.2-3,000.0	1288.40
16207 S1	4	10.44-21.60	16.06	3.70-7.83	5.26	3.28-5.00	4.24	286.3-1,434.5	788.65
16209 S1	1		12.00		4.02		3.80		357.20
16209 S2	7	10.39-20.95	15.81	3.68-7.55	5.76	2.09-7.20	4.82	178.4-1,165.2	788.60
16216 S4	36	4.54-21.30	12.88	1.84-7.13	4.35	0.73-4.97	2.99	13.4-1,427.8	375.90

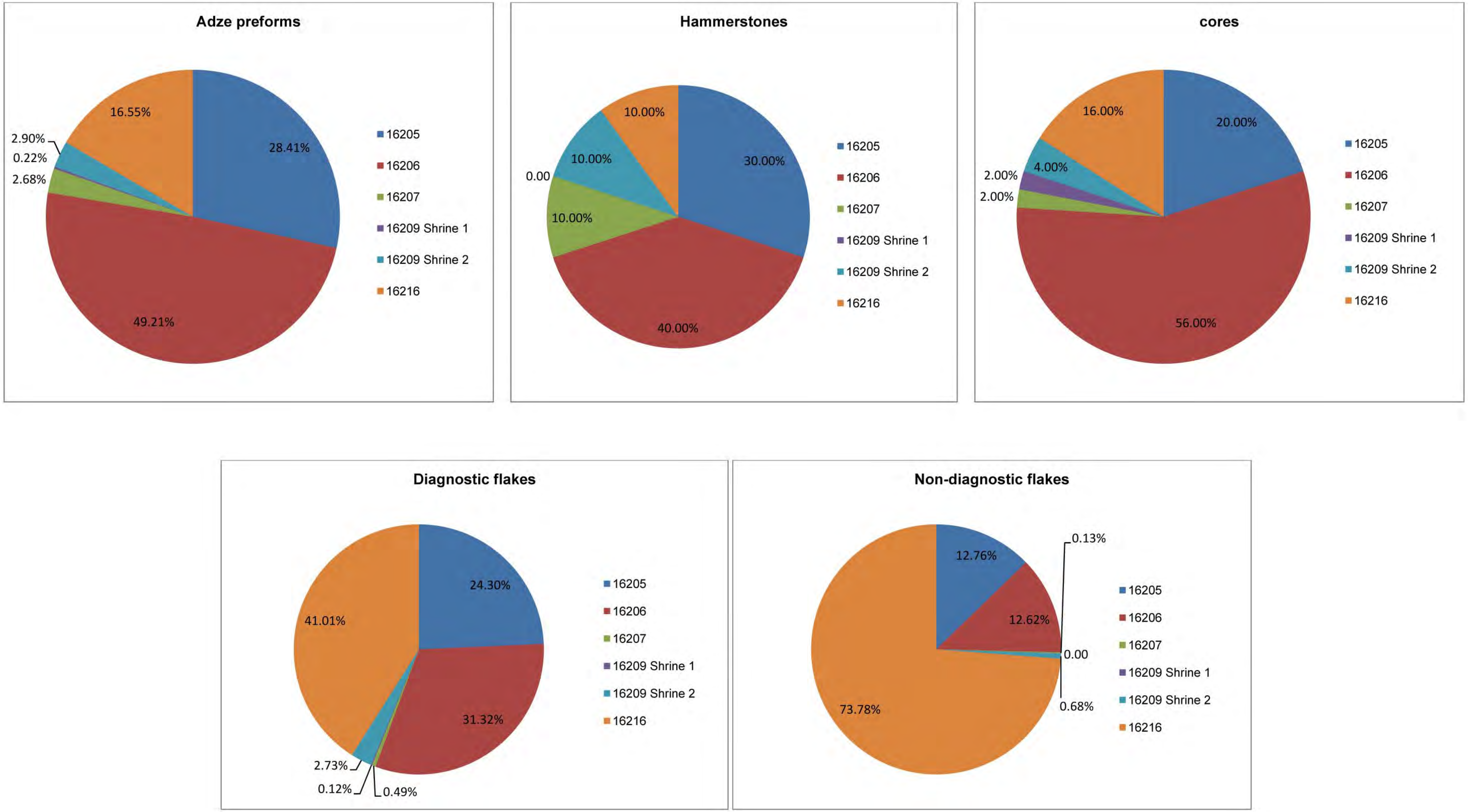
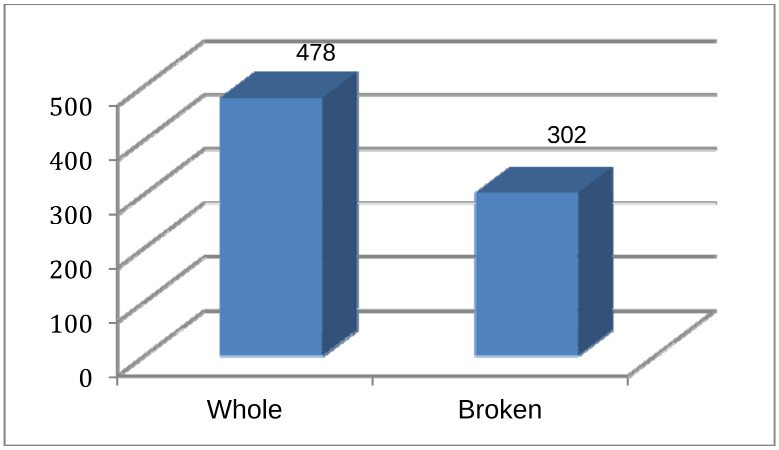


Figure 6.33. Relative Abundances of Cores, Flakes, Adze Preforms and Hammerstones from Six Shrine Assemblages.



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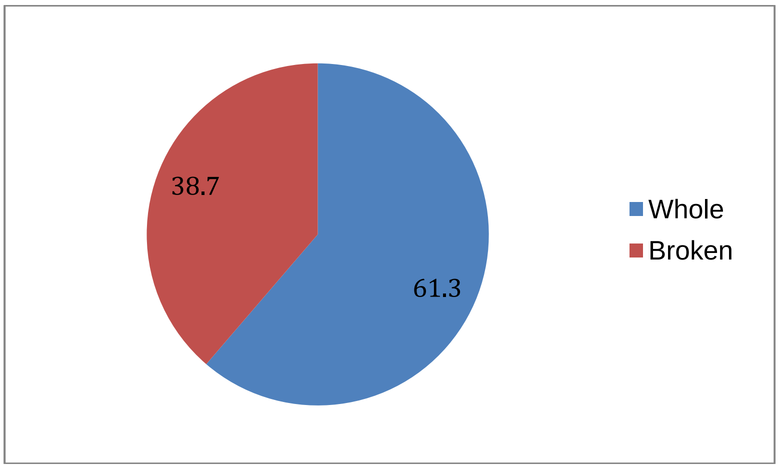
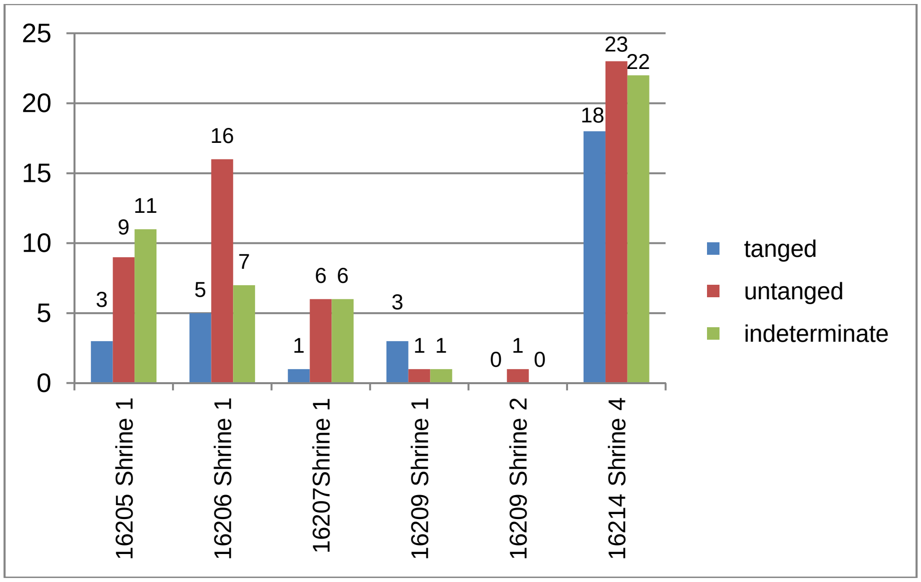


Figure 6.34. Frequency Distribution of Whole and Broken Adze Preforms.

Whole preform measurements show a rather wide range in length, width, thickness, and weight within each sample (see Table 6.9). With the exception of Site 16206, Shrine 1, the maximum lengths are all remarkably similar. The same is true for width and thickness. The length:width:thickness ratios for all six assemblages is also similar—3:1:1. Weights are more variable both within and between assemblages, with the lightest preform, from Site 16216 weighing only 13.4 gms and the heaviest, from Site 16206 weighing 3,000 gms.

6.3.9 Functional Variability and Use

To reiterate a point made earlier, on current evidence there are at the minimum two functional classes of shrines in the NAR: (1) the occupational specialist shrines that are part of the adze quarry complex, and (2) all the others, which on current evidence appear to be "non-occupational." Morphologically, there is nothing to distinguish these two classes, each of which exhibits considerable variability in ground plan, number of uprights, etc. The Mauna Kea shrines are in this regard no different from Hawaiian shrines in general. According to Buck, "Shrines varied considerably in construction, and



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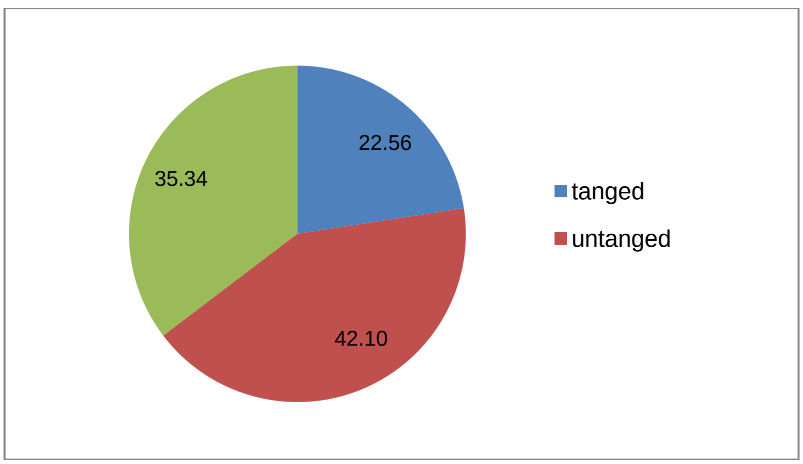
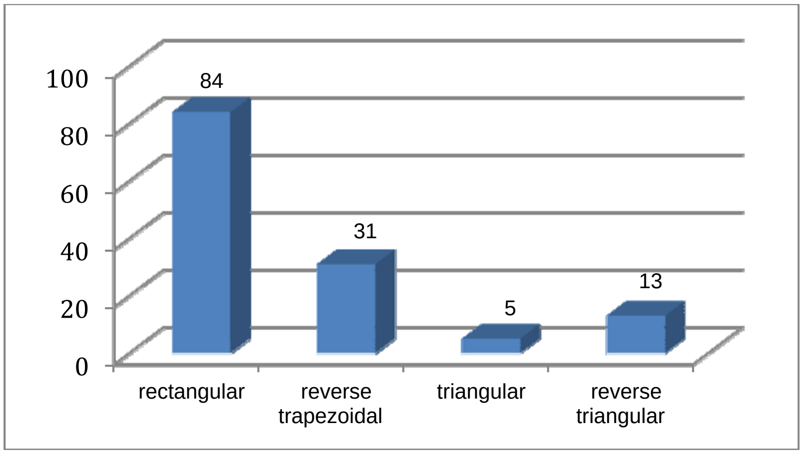


Figure 6.35. Frequency Distribution of Tanged and Untanged Adze Preforms.

similar forms were distinguished merely by their function" (Buck 1957:528). The only thing that distinguishes the occupational shrines from all the others are the associated lithic scatters and adze manufacturing by-products (offerings) found on the surfaces of these shrines. There is good reason to believe that the shrines on Mauna Kea had a function similar to the fisherman's shrine. McEldowney (1982:1.11), citing Kamakau, noted that "The dedication by bird catchers of *ko`a* to the increase or maintenance of bird populations may suggest that those seeking *`ua`u,* or any other resource for collection or immediate use, may have built shrines for this purpose" (Kamakau 1976:133).



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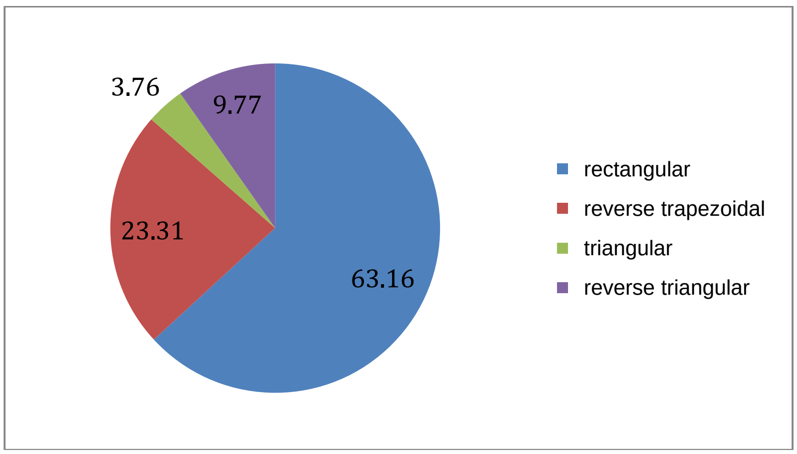


Figure 6.36. Frequency Distribution of Adze Preform Cross-Section at Five Sites.

Apart from a single `*opihi* shell of questionable age on Shrine 2 of Site 16204, a single piece of branch coral found on Site 16206, Shrine 1 and possibly Shrine 4 located above the entrance to Keanakako`i (Site 16205) and the adze preforms and flakes found on the shrines associated with the adze quarry complex, no discernible offerings were found on any other shrines. It is hard to imagine that nothing was offered to the gods, thus leading to the obvious supposition that the offerings must have all been perishable materials, such as strips of pandanus that might, for example, have been tied around the uprights.

It is highly unlikely that all of the shrines in the NAR had the same function, use and meaning. There is, for example, a contrast between shrines with and without associated lithic assemblages, which have been interpreted as offerings to the gods of adze manufacture (McCoy 1999b). The absence of this one kind of offering would appear to indicate a different function. Some shrines, including those found within a quarry site, with no associated artifacts may have functioned as territorial boundary markers. The shrines found above the entrances to rockshelters, referred to as "roof-top" shrines, were interpreted in the past as marking the location of base camps utilized by different social groups (McCoy 1990:110). While this interpretation would still appear to hold true for some sites, the discovery of additional "roof-top" shrines above overhangs in the lower elevation areas of the quarry complex where there is no evidence of long-term or repeated use as indicated by small amounts of debitage, suggests that some of the uprights served primarily as a way-marker.

6.3.10 Dating

Until recently none of the shrines on Mauna Kea had been dated and it appeared unlikely that the age of any would ever be determined, except by comparison to the shrines in the adze quarry, where similar forms are found in association with workshops and dated rockshelters (McCoy 1999a). It was believed that some of the shrines might be potentially quite early based on the assumption that pilgrimages to the snow-topped may have occurred soon after human colonization of the Hawaiian Islands.

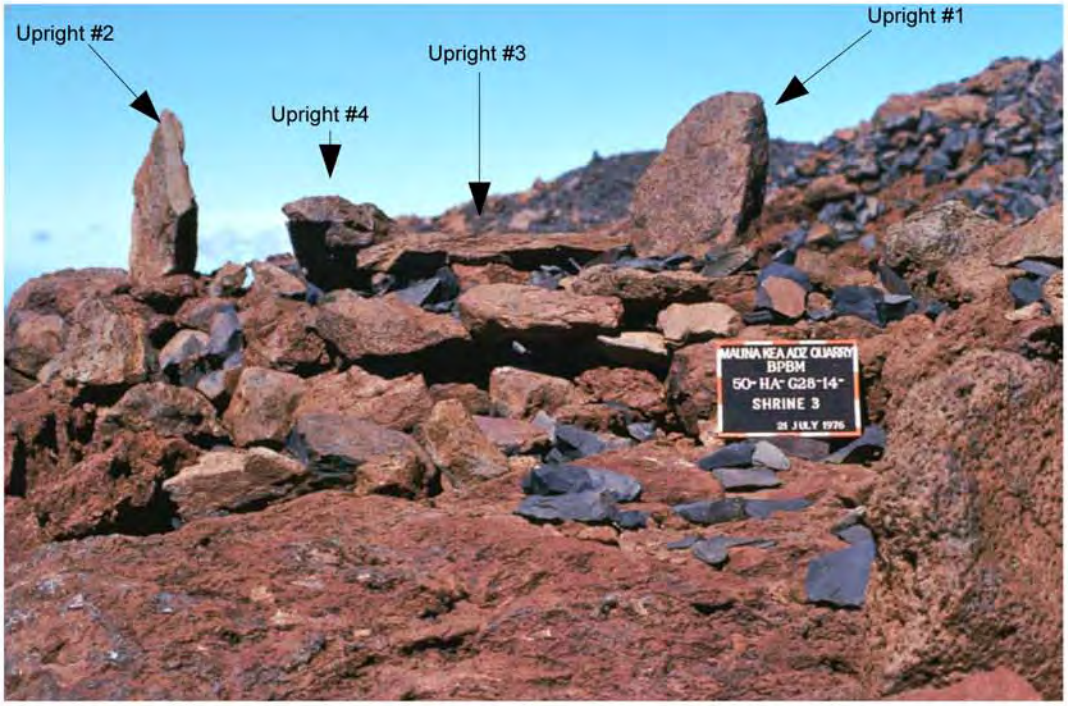
Two shrines in the NAR with pieces of branch coral were recently dated using the ^{230}Thorium method. The first shrine, which was destroyed and not recognized until a few years ago, is located above the entrance to Keanakako`i (literally "cave of the adze"). Keanakako`i is a habitation rockshelter (Site 16205, Rockshelter 6) with a large mound of debitage in front of the entrance located at the ca. 3,780 m elevation on a modern section of the Humu`ula Trail. The dated sample, which was collected from the surface of the debitage mound below the remains of the shrine, yielded an age-determination of AD 1398 $\pm$ 13. The second sample, which came from a secure provenience beneath an upright at Shrine 3 of 16216 was dated to AD 1441 $\pm$ 3 (McCoy et al. 2009). This shrine, which was "restored" by some unknown individual or group of people in the 1980s, is illustrated in Figure 6.37. The map and photos show the shrine as it appeared in 1975. The map also shows the location of the coral sample that was dated.

6.4 Rockshelter and Workshop Artifact Assemblages: Selected Analyses

The large number of artifacts in the Mauna Kea Adze Quarry Complex precludes a detailed analysis of every assemblage. The focus in this report is on selected adze preform and hammerstone attributes from selected sites. Tables presenting artifact data by site and component are located in Appendix G. The analyses that follow are preceded by a discussion of a number of different kinds of theoretical and methodological issues in stone tool quarry studies and a list of commonly used terms in the field of lithic technology.

6.4.1 Stone Tool Quarry Studies: Theoretical and Methodological Issues

The increasing importance given to lithic tool quarries and workshops in studies of regional exchange systems, craft specialization and the evolution of so-called complex societies (e.g., Arnold 1987; Purdy, 1984; Singer and Ericson 1977; Torrence 1984, 1986; Bayman and Moniz 2000) reflects a primary concern with the socio-cultural consequences of production rather than the technology of production which continues to be described largely in terms of manufacturing stage models of the kind that W.H. Holmes conceptualized nearly a century ago (Holmes 1890). The explication of linear reduction sequences is considered to be both possible and necessary (e.g., Muto 1971; Bradley 1975; Collins 1975; Sheets 1975), but in the absence of experimental replication (e.g., Flenniken 1981) such constructs, as with stage models in general, obviously constitute nothing more than empirical generalizations or, indeed, rather simplistic



Photograph Taken in 1976

Photograph Taken in 2008

Figure 6.37. Photographs of Site 16216, Shrine 3 in 1976 and 2008.

classifications devoid of explanatory potential. The extent to which an understanding of quarry production systems can contribute to these studies and the most important questions of all, cultural stability and change, is ultimately dependent on defining the organizational properties, internal structure, and developmental history of quarry industries. This goal is clearly dependent in large part on identifying and then explaining in terms of their own dynamics the totality of constraints that account for the range of behavioral variability observed in the archaeological record of the production process (Ericson 1984; Torrence 1986, 1989).

The study of process in many stone tool quarries is often limited to inferring the dynamics of production based on an analysis of the resultant static by-products, or debitage that is the quintessential characteristic of quarries. The distributional and techno-morphological attributes of quarry debitage are in themselves one aspect of the organizational dynamics in the sense that they reflect certain material-behavioral and spatial-behavioral relationships of manufacture and discard. Debitage analysis alone is an insufficient basis for elucidating the organizational properties of quarry industries, however, since it does not take into consideration non-material factors, such as possible prescriptive behaviors that may have been codified in some manner, or even the full complexity of material-behavioral relationships.

The distinction between material and non-material dimensions of production indicates the need to isolate both environmental [the "earthly basis"] and social [the "social basis"] constraints (McCoy 1990:87). Each of these delimits certain boundaries within which behavior can be expected to vary, but it is the dynamic relationships between the two, of how nature is mediated, that is of primary concern in terms of the immediate goal of elucidating aspects of organizational variability and the broader interest in culture change and stability.

A widespread problem in lithic analysis is that it is either theoretically sophisticated or methodologically sophisticated but rarely both (see Sullivan and Rozen 1985; Amick and Mauldin 1989; Rozen and Sullivan 1989a). Of the many problems that currently exist one of the most contentious is the manufacturing stage concept or stage analysis (see Rozen and Sullivan 1989b), which tends to be seen as synonymous with technological analysis. A brief introduction to the concept is followed by a summary of its application in the quarry research up to the present time.

The lack of a unified body of theory in lithic analysis means that methodological issues are still the primary concern in this field of study. Chief among these in quarry sites are: (1) the classification of artifacts in terms of the manufacturing stage concept or some alternative; (2) formal and functional typologies; (3) site formation processes, and (4) production estimates. These and other issues underlie the structure of the various analyses that are briefly discussed below.

6.4.2 Artifact Terminology

A brief description of each class and category of artifacts and other relevant terminology is presented below for the purpose of making the site descriptions and preliminary interpretations in the next section of the report more comprehensible. A more detailed analysis of the artifacts that were recorded in the field is presented in the following section.

Adz/Adze and Chisel. In a classic methods paper by some of the most distinguished names in Oceanic studies adze, axe and chisel were defined as follows:

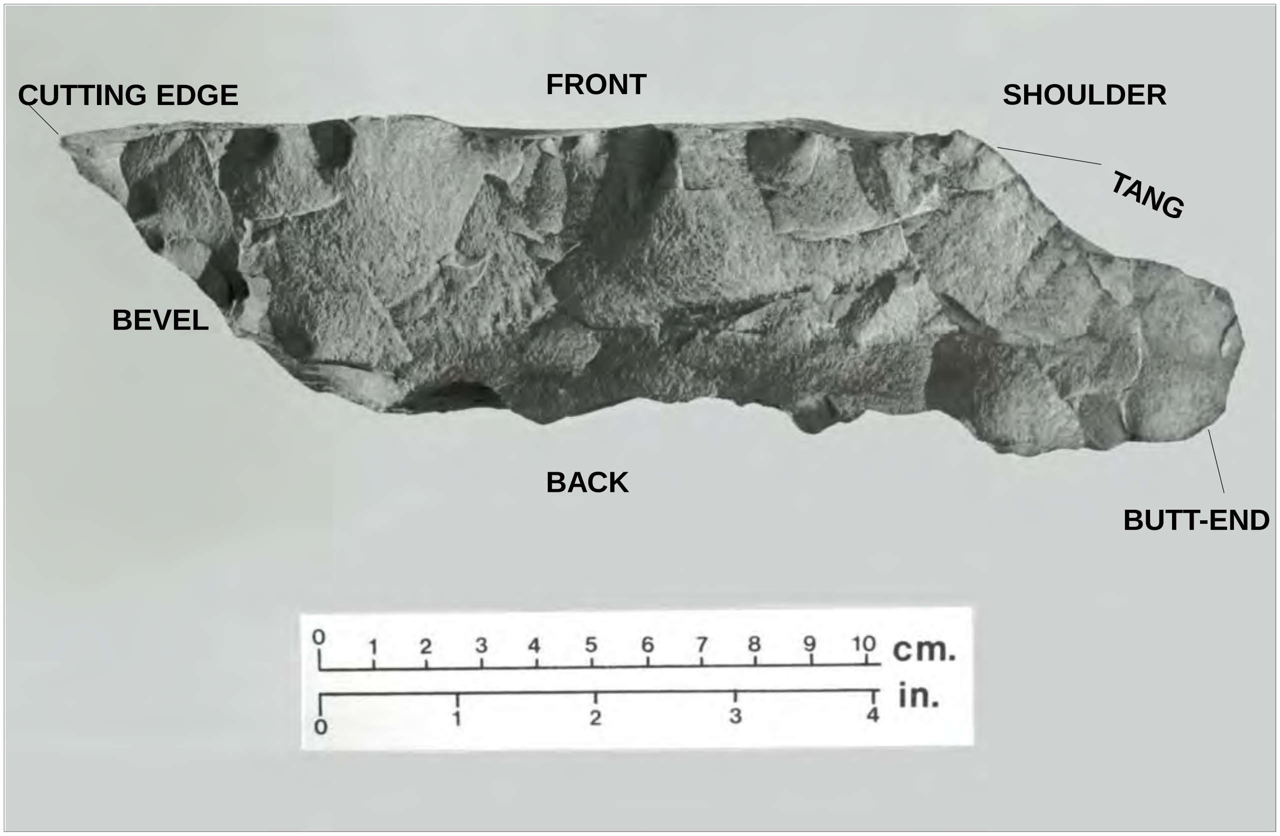
> An adze is a cutting-implement of stone, shell, or other resistant material, with the cutting-edge running transversely to the long axis of the haft. The motive power is supplied by a swinging blow...The term adze is restricted to the implement without the haft and lashings (Fig. 1). When attached to a haft it is referred to as a hafted adze (Fig. 2) (Buck et al. 1930:175).
>
> An axe is a hafted cutting-implement with the edge running parallel or nearly parallel to the long axis of the haft. The power is supplied by a swinging blow (Buck et al. 1930:179).
>
> A chisel is a cutting-implement which is hafted with its long axis continuous with the long axis of the haft. The motive power is supplied sometimes by pressure and sometimes by mallet blows. It is not at present possible to draw a definite line between small adzes and large chisels. It seems probable that some implements were used both as adzes and chisels according to the convenience of the owner (Buck et al. 1930:179).

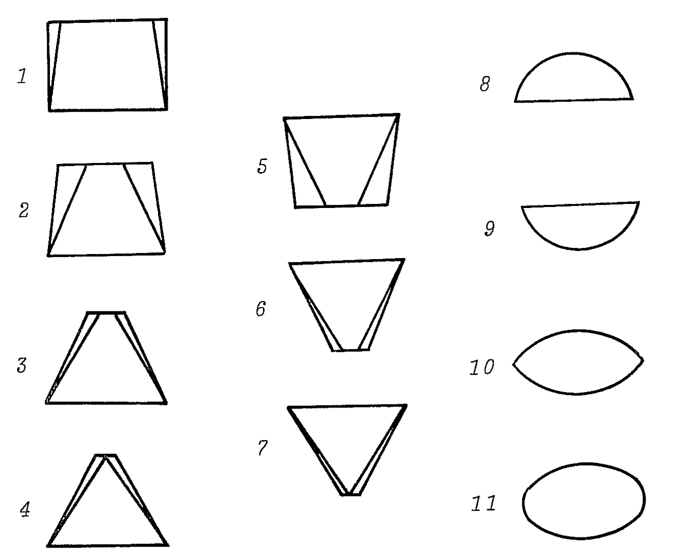
Though these definitions contain some ambiguities [for example, in assuming that the tool was hafted everywhere in the same manner] and could be improved, they have been adopted and used by generations of Polynesian archaeologists (Figure 6.38). These and the common dictionary definitions which mirror them are not universally applied throughout the Pacific, however. In an article titled “The Last Stone Ax Makers” the authors note the conventional method of distinguishing adze and axe, but opt for a definition based on use rather than haft design or method (Toth et al. 1992).

An archaeologist would normally classify these implements as adzes, because in side view their ground edges assume an asymmetric, plano-convex shape rather than the symmetric shape typical of axes. Moreover, they are hafted with the working edge at right angles to their handles, whereas ax edges generally lie in the same plane as the handle. But we call them axes because they are used to chop wood and fell trees and because the literature has generally classified such implements according to their use rather than their design. In some other groups, adzes are commonly used not to chop down trees but to shape wood (Toth et al. 1992:88).

The Polynesian literature contradicts their assertion because it consistently refers to adzes classified according to their assumed haft design. The use is variable and in the case of Hawaiian adzes it is clear that they were primarily used to fell trees and shape wood. There are references in the Hawaiian literature to other, perhaps occasional or less regular, uses of stone adzes. The possibility that adzes were used in agriculture was noted by Kamakau (1961:237) who wrote, “With their hands alone, assisted by tools made of hard wood from the mountains and by stone adzes, they tilled large fields...” There is another reference to the use of adzes in digging a well:

> According to Mea Kakau (1902), while Kaiakea was the ruling chief of Molokai (in the time of Kamehameha I), a well was made at Kalaeokala’au; “This well was dug with *pahoa* adzes by the men of Moloka’i until they found water” (Summers 1971:54). *Ko’i pahoa* are also defined as “battle-axes” (Pukui and Elbert 1971:276). Lastly, there are Hawaiian legends that adzes were symbols of power (Beckwith 1970:49).





Classification of adzes based on form of cross section at shoulder or midway between cutting edge and poll. Cross sections shown base down. 1—Rec. or Quad.; Rectangular or Quadrangular (face width 80-95 percent of base width, or vice versa). 2—Trap.; Trapezoidal (face width 30-79 percent of base width. 3—Subtri.; Subtriangular (face width 15-29 percent of base width). 4—Tri.; Triangular (face width less than 14 percent of base width). 5—Rev. Trap.; Reversed Trapezoidal (base width 30-79 percent of face width). 6—Rev. Subtri.; Reversed Subtriangular (base width 15-29 percent of face width). 7—Rev. Tri.; Reversed Triangular (base width less than 14 percent of face width). 8—Pl-con.; Plano-convex. 9—Rev. Pl-con.; Reversed Plano-convex. 10—Len.; Lenticular. 11—Oval. To these suggested abbreviations can be added "T" for tanged, or "t" for incipiently tanged.

(Adze Classification as Presented in Emory 1968: Figure 1)

Figure 6.38. Hawaiian Adze Preform Terminology and Cross-Section Classification.

***Adze reject*.** The term *adze reject* is used in place of *blank* and *preform* given the present confusion surrounding these terms (see discussion of this issue in McCoy 1986, 1991; Williams 1989; Weisler 1990). The use of this term assumes, of course, that all of the adzes that we find in a quarry, with only a few possible exceptions, were rejects that were intentionally discarded because of breakage or design flaws in the shape of the incipient tool. The primary example of the latter is asymmetry in the transverse and/or longitudinal sections or the length:width:thickness ratio. Cleghorn (1982) discussed some other probable reasons for discard.

***Assemblage*.** The word assemblage is used here in two different ways: (1) to refer to the totality of artifacts from a locality [e.g., the Site 26253 artifact assemblage] and (2) to refer to all of the artifacts of a single kind or class [e.g., the adze manufacturing by-product assemblage].

Blank. In the present study the term blank is used to refer to cores and flakes that exhibit more than a few flake scars. Adzes in the quarry were made on tabular blocks from the edges of flows and cobble/small boulders of generally sub-rounded form obtained from glacial drift deposits [***core blanks***], and flakes detached from cores [***flake blanks***] where the ventral surface of the flake was almost invariably utilized as the face or front of the adze.

***Core*.** Crabtree (1972:54, 56) defined a core as a “Nucleus. A mass of material often performed by the worker to the desired shape to allow the removal of a definite type of flake or blade...Cores can be embryonic--such as a piece of natural, unprepared, raw material with scar or scars, reflecting the detachment of one or more flakes.” Some of the naturally occurring cores in the quarry are referred to in this report as *boulder cores* or *tabular slab* cores.

***Debitage*.** Crabtree (1972:58) defined debitage as “Residual lithic material resulting from tool manufacture. Useful to determine techniques and for showing technological traits. Represents intentional and unintentional breakage of artifact either through manufacture or functions. Debitage flakes usually represent the various stages of progress of the raw material from the original form to the finished stage.” Debitage and by-products are used interchangeably to refer to the exhausted cores, flakes, shatter, and all of the other waste resulting from the manufacturing process.

Extraction areas. These are bedrock exposures from which raw material has been removed (i.e., extracted). The exposures can be along the margin of a lava flow where there is a “face” that can be worked, or the exposure can be a bedrock surface that is mined for subsurface material, resulting in a pit.

***Fabricator*.** Fabricator, as the term has been used elsewhere (McCoy 1986, 1991), is a catchall term for a variety of manufacturing tools or implements. These include, in the instance of the Mauna Kea adze quarry, hammerstones, abraders, and implements with signs of use both as a hammerstone and an abrader.

***Facility or Appliance*.** The one known adjunct to adze manufacture was a stone anvil that was used to support the incipient tool during the flake removal process. Items such as this are variously referred to in the archaeological literature as facilities or appliances.

***Flake*.** Crabtree (1972:64) defined a flake as “Any piece of stone removed from a larger mass by the application of force—either intentional, accidentally or by nature. A portion of isotropic material having a platform and a bulb of force at the proximal end.”

***Manufacturing by-products*.** Another term for the residual material left from tool manufacture; commonly used as an alternative for debitage.

***Preform*.** A preform as used in this report is an unfinished adze that has been roughed out from either a core or a flake blank. In contrast to earlier studies, there is no assumption that a preform represents the final form of the adze blade.

***Shatter*.** This term refers to material removed in the reduction process that does not possess any of the landmark characteristics of flakes, such as a striking platform or bulb of force.

***Test areas*.** Archaeologists frequently refer to small lithic scatters consisting of a core and a few flakes as test areas. Their material characteristics suggest that the material was found unsuitable for whatever reason.

***Utilized/modified flakes*.** The collection includes a small number of adze waste flakes with edge and surface alterations that were probably utilized as scraping or cutting tools.

6.4.3 Artifact Description and Classification

The description and classification of artifacts can no longer be regarded as a totally objective and purely methodological undertaking given the fact that description is interpretation. The purpose of classification, moreover, is not to just organize the data and make them amenable to comparison, but to make comparisons meaningful. What is required then is theory to structure and organize classification. Shanks and Tilley write:

> Now, as all archaeologists know, or should know, there are a multitude of possible competing descriptions of an artifact, an assemblage, or any set of remains encountered in the archaeological record. The choice involved in the description of these remains is related to the theories used to understand them (Shanks and Tilley 1987:109).

> As regards to artefact classification, it has begun to be recognized that classification is not independent of theory ...and there is no such thing as a `best' classification. All classifications are partial and selected from observed features of the data set (Shanks and Tilley 1988:83-84).

6.4.4 Artifact Analysis: Basic Concepts and Approaches

The artifact analysis is based on the use of both an assemblage approach and an attribute approach. The word assemblage is used here in two different ways: (1) to refer to the totality of artifacts from a site and its constituent components (workshops, habitation shelters and shrines) and (2) to refer to all of the artifacts of a single kind or class [e.g., the adze manufacturing by-product assemblage]. Our interest is in both similarities and differences and more particularly in the variability within and between assemblages. We agree with Cowgill (1989) and Conkey (1989) that more attention should be given to explaining and interpreting diversity rather than just measuring it. Data are presented in terms of both raw counts and percentages. Measurements were made with dial calipers and rounded off to the nearest millimeter and weights to whole grams.

The primary objective of the analysis that follows is to provide a general characterization of the assemblages in terms of technological, functional and stylistic properties for the purpose of achieving an understanding of the manufacturing technology in terms of the skills, knowledge, and procedures that are the defining characteristics of all technologies (Merrill 1968:576). The major emphasis in the present analysis has been the recording of attributes deemed to have technological, functional and/or stylistic significance. We hold to the common view that technology, function, and style are all integrally related. As Isaac noted in regard to the shape of a stone tool:

> On logical grounds it would appear that the morphology of a stone tool is governed by the interaction of (1) the *physical properties* of the stone being employed, and (2) the *'intentions'* (design concepts) and the *motor habits* of the craftsman. The design concepts themselves are presumably related in turn to two kinds of determining influences: firstly, the *functional requirements* of the tool will place limits on the range of forms that would be effective; secondly, systems of *transmission of traditions* provide a craftsman with a set of technical and morphological patterns that are functionally adequate and socially acceptable (Isaac 1972:176).

> It can be seen that in trying to make inferences about the specific 'design norms', or 'traditions', manifest in a set of artefacts, it is necessary to resolve and subtract other factors, such as those than can be attributed to the physics of conchoidal fracture or to the primary form of the raw material. Now, for complex artefacts such as refined hand-axes or tanged points, each involving a great many technical acts (e.g. flake removals), the role of a specific tradition in determining form may be quite clear. However, the shorter the sequence of technical acts, the more decisive will be those aspects of form imposed by 'physics' and 'geology' rather than by design. Thus, there is a limited range of forms than can result from the simple sharpening of common, naturally occurring, stone fragments. This situation creates difficulties in the study of early tool-kits: it is hard to distinguish separate 'intentions' or 'traditions' from opportunism, and there is a continual danger of over-interpreting the material (Isaac 1977:40).

The primary frame of reference in the present analysis is technological. The initial concern is with the relatively straightforward but by no means simple task of describing the salient aspects of the manufacturing technology, including: (1) a description of manufacturing techniques and tools and (2) an explication of the stages of manufacture, beginning with the raw material procurement process, and consideration of more specific behaviors and causal relationships, such as: (a) the effect of raw material form and abundance on the frequency of manufacturing by-product categories and variability; (b) stockpiling behavior; (c) materials testing, and (d) other non-technological behaviors.

The attributes selected for study include a combination of qualitative and quantitative variables. They are specific to each artifact class, though there are a number of individual attributes that all artifacts share in common and which have been judged important enough to record. In using the attribute approach it is important to remember that:

> To define or describe an artifact according to immediately given attributes is not enough because an object always has a surplus of meaning over and above any definition or description. A definition or description can never be identical with or sufficiently summarize the complexity of the overlapping relational aspects of an object. Any single definition or description applies to only a particular frame of reference which is necessarily value-laden. The particular perspective from which an object or event is viewed is an integral part of the object of study. Concepts and categories of analysis are internal to, they constitute the object of study; they are not separate from what they are categories of. So there can be no formal and general method separate from the structure of the object of study... (Shanks and Tilley 1987:66).

6.4.5 Technological Analysis and the Manufacturing Stage Concept

Technological analysis, which is primarily concerned with how artifacts are made, is fundamentally a behavioral study, founded on the assumption that an artisan's behavior is recorded on tools and manufacturing debris (Sheets 1975). The objectives and assumptions on which this kind of analysis rest are described by Sheets:

> A technological analysis attempts, among other things, to determine the procedures used to manufacture implements through the examination of both the implements and the manufacturing debitage. Lithic analysis of manufacturing procedures is based on two assumptions. First, manufacturing behavior is recorded on the implements and on the wastage of the lithic industry. Second, we as archaeologists can train ourselves to read that record-to recognize the procedures used in the past which resulted in the various morphological attributes in the collections. Our objective is to translate, with as high a degree of accuracy as possible, the attributes observed into past actions, and then to place those actions in a hierarchy of procedures and products which represents the original organization of that industry (Sheets 1975:371-372).
>
> Because technological analysis is interpretive, and not purely descriptive, it must be based on a foundation of theory. As Phagan (1973:2) comments, the basis of a technological analysis is the "establishment of a theoretical framework or system within which various traits of flakes or implements can be seen to have technological significance" (Sheets 1975:372).

The focus of technological analysis is the lithic reduction strategy which has been operationally defined by Muto (1971) and others (e.g., Sheets 1975; Bradley 1975) as a continuum or sequence of manufacturing stages. The stage concept is applied and/or is thought by many to be applicable to the study of stone tool manufacture. It is regarded by many lithic technologists as the main analytical concept and by others as highly problematical and of limited utility. On one important point there is a general consensus: that stone tool manufacture is a continuum and that because it is a reduction technology the parent material becomes smaller and at the same time there is a decreasing amount of cortex. The chief complaint against the use of the concept is the artificiality of dividing a continuum into arbitrary parts.

What seems to have gone largely unnoticed in the debate over the utility of the manufacturing stage concept is the effect that the use of stage typologies has on interpretation and the realization of both particularistic and generalizing goals in view of the fact that the manufacturing stage concept, like all stage concepts, is descriptive and non-explanatory, as well as inherently reductionistic. Stage typologies clearly sacrifice detail for generalization. The stage concept, moreover, is incapable of answering the question "why this particular sequence or number of stages and not some other"?

Apart from the debatable efficacy of the stage concept, what is missing in this area of lithic analysis is a theory that establishes the relevance of stage analysis to an understanding of social processes. There is clearly a need to move beyond re-description in the reconstruction of reduction sequences and strategies to interpreting reduction sequences and strategies in meaningful ways –as illustrations of or, indeed, evidence of social processes, such as the development of institutions like craft specialization and the possibly changing relationship between social constraints and individual freedom. For example, do the reduction sequences become more complicated [in the number of techniques used] and/or more standardized as has been hypothesized? This is the fundamental problem in applying a generalized model, of proceeding, for example, by simply applying Muto's (1971) three stage model rather than working out a stage sequence that fits the particular case and in relation to some general theory linking stages to other cultural and social variables.

There is a clear need to rethink the stage concept in terms of its definition, and application or utility. It is not an end in itself but rather a means to an end, a precursor (a classification) to the explanation of varied aspects of the manufacturing technology. Part of the definition problem is the lack of standardized terminology (e.g., technique, method, etc.), but there are other difficulties as well, such as the complexity of the manufacturing process. For example, is there a change in tools and/or techniques, and if so, how is it reflected in the archaeological record, if at all? In the case of Hawaiian adze manufacture, that from any perspective or standard of comparison surely qualifies as one of the most complex stone tool manufacturing technologies in the world in terms of the number of technical actions, it would appear that there were only two techniques – percussion flaking and grinding/polishing in the final stage, which took place outside the quarry. There is some evidence to suggest that pecking/abrading was employed as a "secondary technique" prior to grinding and polishing. On current evidence the stage products in the quarry cannot be distinguished on the basis of "techniques." In the end the only useful stage classification scheme is one that relates the two classes of residues–tool rejects and debitage –in terms of their techno-morphological attributes that are widely held to reflect certain behaviors.

One of the primary methodological issues in manufacturing stage analysis is the use of size and cortex variables in the definitions of stages. Neither one is by itself, or in combination, a clear or unambiguous signature of a specific stage. Size and cortex are both related in part to raw material form [cores and flakes and morphological variations within each of these two categories], but if size and cortex are omitted from study then there is little or no opportunity to determine raw material form and hence to say anything about raw material procurement–the first stage in the manufacturing process.

6.4.6 Manufacturing Reduction Strategies and Sequences: A Review of the Use of the Stage Concept in Research on the Mauna Kea Adze Quarry Complex and the Pu`u Moiwi Adze Quarry

The first systematic attempt to conduct an attribute analysis of Hawaiian adze quarry tool rejects and debitage for the purposed of developing a manufacturing stage sequence was based on an attribute list compiled by the senior author and Paul Cleghorn in 1975-76 (McCoy 1981; Cleghorn 1982:113). Subsequent studies have resulted in a number of modifications to the original classification, including a re-evaluation of the attribute selection criteria and rationale (McCoy 1986, 1991, 1993; Williams 1989). The revision process is unfinished, however, for two related reasons. First, typologies are "mutable and always to some extent experimental" (Adams and Adams 1991:61). Second, because typologies are imposed constructs "they must be held open to continuous revision as new material accumulates" (Wylie 1992:487).

All of the existing classifications of Hawaiian adze preforms discussed in this report are based on the different parts of the adze as defined by Buck et al. (1930) and the cross-section following the classification established by Emory (1968: Figure 1). Figure 6.23 above illustrates the terms used in this study.

6.4.6.1 Previous Classifications

A brief synopsis of the various classifications that have been used to characterize the Mauna Kea quarry reduction sequence are presented below.

1982 Classification (Cleghorn)

The blank and preform analysis follows on earlier studies by McCoy (1981) and Cleghorn (1982) who jointly developed the analytical framework used in the study of this one class of quarry products.

Cleghorn's study postulated a four step manufacturing sequence for tanged rectangular and trapezoidal preforms that was then compared to the sequence that resulted from his replicative experiments. The two sequences are similar in terms of the serial order of actions and resultant products, except a fifth step, final side straightening step was recognized in the replicative sequence (Cleghorn 1982:328). These steps are defined in Table 6.10 below.

Table 6.10. 1982 Adze Reduction Sequences.

Step	Archaeological Sequence	Replicative Sequence
1	Basic cross-section formation	Initial width reduction
2	Bevel creation	Bevel creation
3	Tang formation	Poll straightening
4	Final trimming	Tang formation
5	N/A	Final side straightening

In both sequences, Step 1 results in a preform. A preform was defined, following (Crabtree 1972:85), as "an unfinished adze whose general final form is evident, but which has not been ground" (Cleghorn 1982:40). Where the final form, which was defined as the cross-section, could not be determined the object was classified as a blank.

1986 Classification (McCoy)

An analysis of collections recovered in data recovery work conducted the Hopukani and Liloe Springs area, in 1985, departed from previous analyses in the use of a new and different stage classification scheme in which greater importance was placed on the isolation of techno-morphological changes throughout the manufacturing sequence (McCoy 1986). Prior to this time adze rejects had been classified as either a blank or a preform. One major problem with this classification is that it fails to recognize significant variability within and between these two groups which have been normally defined, moreover, in terms of form or morphology alone, rather than a combination of formal and technological attributes. A second, related problem is the widely held notion that the form (cross-section) of the emerging tool and, thus, intent of the tool-maker, is only apparent at the preform stage. The result has been a long-standing preoccupation with the classification of preforms in terms of formal adze types to the exclusion of blanks which have been essentially defined as a product group lacking standardized forms.

The new scheme reflects a growing dissatisfaction with the old system and the basic assumptions on which it and many other stage classifications are based. The new stage classification is based on the premise, held by the late Glynn Isaac and others, that there is a direct relationship between the complexity of tool form and the complexity of the manufacturing technology in terms of the number of technical acts or stages. Four stages of manufacture have been defined in the present study. The word "blank" is retained provisionally to refer to the first three stages that are defined as follows:

Table 6.11. 1986 Adze Reduction Sequence.

Stage	Defining Characteristics
Blank 1	Front/back and sides not yet distinguishable. The longitudinal and transverse sections are by definition irregular.
Blank 2	The front/back can be distinguished from the sides but the front cannot yet be distinguished from the back. Both profiles are more regular than the previous stage.
Blank 3	The front and back and sides are all clearly distinguishable from one another. The profiles are more regular but the cross section does not yet fit an ideal geometric form.
Preform	The front and back and sides are all clearly distinguishable from one another. The cross section fits an ideal geometric form.

The Blank 1 to Preform reduction sequence characterizes what may be called a "core series" in contrast to adzes made on flakes wherein the flat ventral surface of the flake becomes the front of the adze. The "flake series" is by definition a truncated reduction sequence in which the first stage product can be classified as a Blank 2 tool type.

1989 Classification (Williams)

Williams developed a revised stage classification in 1989 based on an analysis of debitage from one of the major habitation rockshelters in the quarry. His classification recognized problems with both Cleghorn's study (1982), which he noted "only proposed general manufacturing steps, not true reduction stages" (Williams 1989:22) and McCoy's (1986) analysis. He noted that "McCoy could not link his flake attributes to the reduction stages he proposed, both because the attributes he chose to analyze were heavily dependent on raw material form and the stages he proposed required highly subjective classification" (Williams 1989:22-23).

Williams proposed a five stage reduction stage model of Hawaiian adze manufacture. The model he developed also included raw material selection, which was not included as a reduction stage, however (Williams 1989: Fig. 3.1). His five stages are defined in Table 6.12 below.

The focus of Williams' analysis was the primary and secondary reduction stages since these are the stages that produce the bulk of the debitage and from what is known, all of the debitage in the quarry. Primary reduction, as defined by Williams (1982:53), results in what he calls a blank that is defined as a piece of raw material that has been flaked enough to create a "regular shape" (Williams 1989:53). Secondary reduction results in a preform (Williams 1989:55). His reduction model, though based on a different approach, is clearly similar to the original blank to preform continuum.

Williams was careful to note that although his model is relatively "simple" this does not imply that the manufacturing technology was correspondingly "simple." He also noted that his reduction sequence model was not the only possible model and that it was developed, moreover, for just quadrangular adzes (Williams 1989:51).

Table 6.12. 1989 Adze Reduction Sequence

Stage	Description
1	Primary reduction
2	Secondary reduction
3	Grinding
4	Polishing
5	Rejuvenation

1991 Classification (McCoy)

The original blank-preform stage typology employed in the quarry research (Cleghorn 1982; McCoy 1977, 1981) and Williams' more recent debitage based typology (1989) are similar in recognizing only two stages of manufacture–early and late. In the first instance the use of stages was nothing more than a heuristic device for characterizing the manufacturing technology. In 1986 a four stage sequence was developed, which though far from perfect, represented what the senior author believed was an improvement over the other stage models (McCoy 1986 and below). Williams' model has certain merits but it is flawed in because it recognizes only two stages of manufacture, which means that there is a beginning and an end with nothing in between. A second problem with his and many other stage typologies is that procurement has been separated out and/or simply taken for granted as a logical first stage or step in the manufacturing process. Because no analyses of attributes, such as size and cortex, are undertaken the dynamics of the procurement process remains unaccounted for in the model, which means that there is no basis for inferring raw material form and its influence on the reduction strategy.

There are, in the very simplest of terms, two adze manufacturing reduction strategies and sequences: (1) a core reduction sequence and (2) a flake reduction sequence which I have earlier referred to as a ***core series*** and a ***flake series*** to reflect what is in the senior author's opinion significant techno-morphological variability within the two "ideal types"(McCoy 1986:12). There is, for example, a significant difference in tabular and non-tabular core shapes and in lamellar flakes and side-struck flake blanks, so that there would be a lamellar flake blank reduction sequence and associated production code or grammar differing in some respects with adzes made on other flake types in the sense that the two produce different kinds of debitage assemblages. This same approach has been used elsewhere in Polynesia (e.g., New Zealand cf. Leach and Leach 1980:112). Figure 6.39 illustrates examples of adzes made on flake blanks and cores.

The core and flake reduction sequence contrast is a useful analytical construct because it exists independent of "type" or "style", in addition to the fact that it helps to clarify the present confusion surrounding the widely used blank-preform stage terminology [see also Dye et al. 1985] if we follow the lead of Crabtree (1972) and others (Shafer 1985) in using the term *blank* to refer to what is in fact raw material form [a boulder core or cobble vs. a flake] so that we have only *adze preforms* rather than a continuum comprised of adze blanks and adze preforms --a distinction that was both simplifying and obfuscating with respect to the "type" concept.

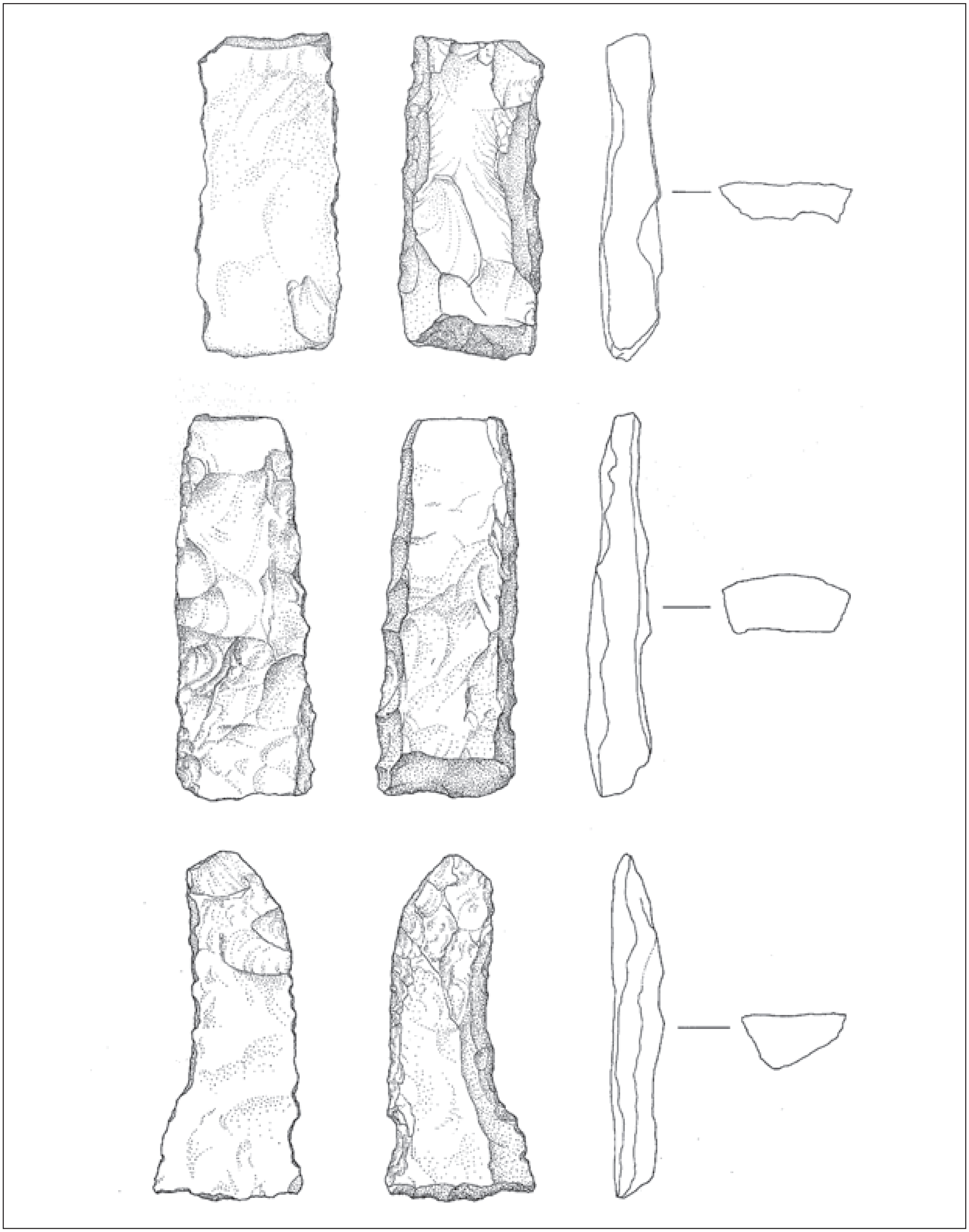


Figure 6.39. Examples of Adze Preforms Made on Flake Blanks (Top and Bottom) and Core Blanks (Middle) (70% Natural Size).

If we employ the term blank as a convenient short-hand for "raw material type or form" and the term preform for anything that is clearly an adze in the making then technological and morphological ["type"] dimensions or properties are clearly separated or disentangled [stage and "type" are two separate variables or attributes] which means that all specimens can thus be described in terms of both their position or place in the continuum [e.g., stage 1 preform and their "type" or cross-section [e.g., reverse triangular] in addition to other salient attributes.

The alternative is to do away with the blank and preform terminology and replace it with a less biased terminology like "product group" 1, 2, 3, Etc. Another way to avoid the blank to preform sequence terminology is to simply refer to Stage 1 [early], Stage 2 [middle] and Stage 3 [late]. The definitions that follow (Table 6.13) are those used in used in the 1991 report. They are similar to those employed in the 1986 report except that *blank* and *preform* have been replaced with *stage*:

Table 6.13. 1991 Adze Reduction Sequence.

Stage	Defining Characteristics
1	Front/back and sides not yet distinguishable. The longitudinal and transverse sections are by definition irregular.
2	The front/back can be distinguished from the sides but the front cannot yet be distinguished from the back. Both profiles are more regular than the previous stage.
3	The front and back and sides are all clearly distinguishable from one another. The profiles are more regular but the cross section does not yet fit an ideal geometric form and there is always some identifiable flaw or imperfection in the shape to explain why the incipient tool was left unfinished to enter the archaeological record as a tool reject.
4	The front and back and sides are all clearly distinguishable from one another. The cross section fits an ideal geometric form and there is no obvious reason why the incipient tool would not have been ground and polished and then used. Such specimens are understandably rare in most quarry/workshop contexts.

Stage 4 adzes are the objects that, saving breakage in the final finishing process, loss, or deliberate secreting away in caches as unfinished implements (see Weisler 1988) ultimately enter the archaeological record in a number of different contexts other that quarries and workshops where they are understandably rare or absent. The first three stages of manufacture by contrast are common in quarry/workshop sites.

1993 Classification (McCoy et al.)

Yet another different classification was used in the analysis of four site assemblages from the Pu`u Moiwi Adze Quarry on Kaho`olawe in 1993 (Table 6.14). Stage was replaced by what was called Techno-Morphological Type*.* Four types were recognized (McCoy et al. 1993:123-124):

Type 4 adzes are the objects that, saving breakage in the final finishing process, loss, or deliberate secreting away in caches as unfinished implements (see Weisler 1988), ultimately enter the archaeological record in a number of different contexts other than quarries and workshops where they are understandably rare or absent. The first three types by contrast are common in quarry/workshop sites.

Table 6.14. 1993 Pu`u Moiwi Adze Quarry Techno-Morphological Types.

Type	Defining Characteristics
Type 1	Front/back and sides not yet distinguishable. The longitudinal and transverse sections are by definition irregular.
Type 2	The front/back can be distinguished from the sides but the front cannot yet be distinguished from the back. Both profiles are more regular than the previous stage.
Type 3	The front and back and sides are all clearly distinguishable from one another. The profiles are more regular but the cross section does not yet fit an ideal geometric form and there is always some identifiable flaw or imperfection in the shape to explain why the incipient tool was left unfinished to enter the archaeological record as a tool reject.
Type 4	The front and back and sides are all clearly distinguishable from one another. The cross section fits an ideal geometric form and there is no obvious reason why the incipient tool would not have been ground and polished and then used. Such specimens are understandably rare in most quarry/workshop contexts.

6.4.6.2 The Need for a New Adze Preform Typology

All of the classifications summarized above have strengths and weaknesses and none, therefore, are totally satisfactory. One of the problems is the assumption that there is a single reduction sequence. As noted in the discussion of the 1986 classification (McCoy 1986:12), the Stage 1 to Stage 4 reduction sequence applies only to adzes made on core blanks. The flake blank reduction sequence is by comparison a shorter and simpler sequence because the first stage that can be recognized as an incipient adze is a Stage 3 product as defined above. The core and flake blank sequences are thus not directly comparable in terms of the number of manufacturing stages as presently defined.

A second problem is although raw material procurement has been normally been taken for granted as the beginning of the tool manufacturing sequence, it has not been included as a stage of reduction. Another issue is the tendency amongst some archaeologists (e.g., Williams 1989; Mintmier 2007) to develop reduction sequences that are really “life history” sequences and based on evidence that is not evident in a quarry setting, at least not in the Mauna Kea Adze Quarry Complex (e.g., grinding, polishing and cutting edge rejuvenation).

Cleghorn (1982) found that the degree of bidirectional flaking is a good stage indicator based on the number of surfaces that exhibit the negative flake scars of this technique (see also Weisler 1990:38). Figure 6.40 shows an example of a square cross-section preform that has extensive bidirectional flake scars. This attribute was not recorded in the field because of the amount of time and expertise it would have required. This illustrates once again the value of collections that can be studied over and over again.

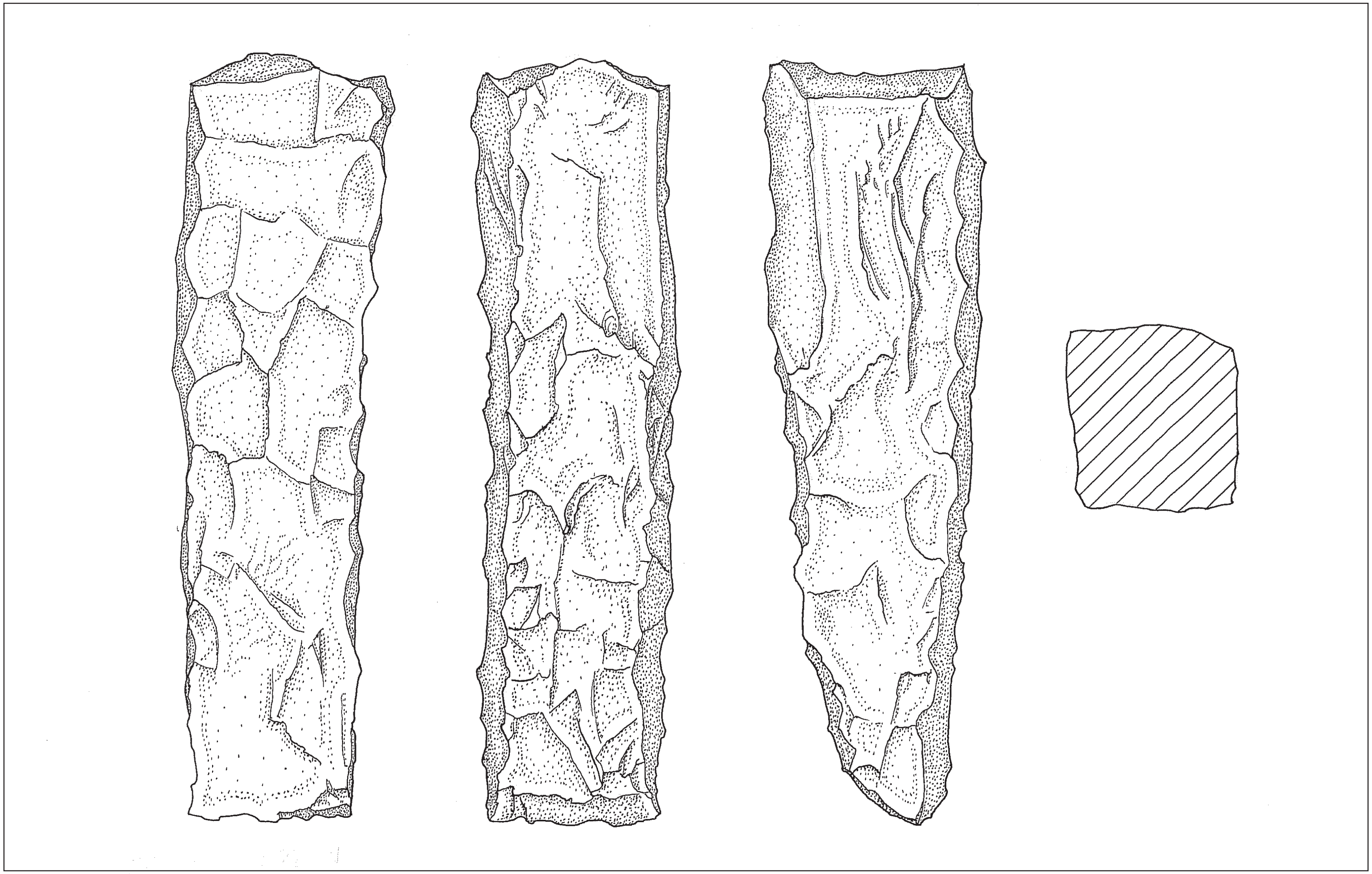


Figure 6.40. Adze Preform with a Square Cross-section Showing Extensive Bidirectional Flake Scars.

Previous analyses of the preforms from the Mauna Kea Adze Quarry Complex have followed the established practice in Hawaiian archaeology of talking about types in terms of cross-section (at the tang or mid-section of untanged adzes). Thus, there are descriptions of quadrangular, trapezoidal, reverse trapezoidal, triangular, reverse-triangular, and other less common types.

Cross-section is clearly an important attribute, but it is both limited and limiting in terms of addressing the significance of morphological variability in Hawaiian adzes. Earlier studies by Bennett (1931) and others demonstrated on the basis of small samples of adzes from various islands that there are differences in the form of the butt end and the blade. Some are parallel-sided from the butt end to the cutting edge. Others have a parallel-sided tang, but a blade that "flares" outward at the cutting edge. Yet others, but probably a small number compared to the former, have a "tapered blade" that is narrower at the cutting edge than at the butt end (see Figueroa and Sanchez 1965 for discussion of tapered and flared blade forms). In the case of the Mauna Kea Adze Quarry Complex, there is also a wide range of variability in preform thickness (at the mid-section of untanged adzes and shoulder of tanged adzes).

Brigham (1902:412/80) recognized three classes of adzes—parallel side and angular tang; divergent sides and angular tang, and divergent sides, thin and nearly flat –he believed that each class was used for a different purpose.

Weisler's study of the Kapohaku Adze Quarry on Lana`i is one of few studies that have attempted to go beyond Emory's long-used typology based on cross-section in recognizing a distinction between broad thin forms and forms that are more square in cross-section (Weisler 1990:41-42). His work points to the need for a new adze preform typology. We believe that what is needed is a typology based on a consideration of blank type (core or flake), cross-section, longitudinal profile (tanged vs untanged), the shape of the sides and the blade, and relative thickness. Thickness and overall mass (weight) is probably one of the best potential indicators of gross function and use. Three thickness intervals were used in a trial and regrettably unfinished analysis of the preforms collected in the survey: (1) thin [<4 cm], (2) medium [4.1-5.0 cm], and (3) thick [>5.1 cm]. These intervals may change when examining a larger number of specimens.

The core reduction and flake blank reduction sequences are in our view key to the development of a more complete and satisfactory typology. The provisional types we have established so far correspond fairly closely to the difference between adzes made on tabular slabs and large boulders (cores) and those made on flake blanks. As with any analysis there is a degree of subjectivity involved in determining whether a preform was made on a core or a flake, particularly when there are no landmark features, such as a bulb of percussion and striking platform in the case of flake blanks. While it is not uncommon to observe flakes in the quarry that are 15-20 cm or greater in length, the thickness is usually less than 5-8 cm. The trimming of a flake this large would result in a preform that would not only be shorter, but also thinner.

6.4.7 Analysis of Selected Adze Preform Attributes from a Sample of Rockshelter and Workshop Assemblages

The adze preform recording form used in the field had both metric and non-metric attributes. The attribute selection criteria and rationale are briefly described below for each attribute. The analytical data presented in this report are limited to selected non-metric attributes for a small sample of preforms from rockshelters and workshops. Table 6.15 summarizes the condition, cross-section and longitudinal profile

Table 6.15. Sample Data for Adze Preform Non-Metric Attributes from Five Rockshelters at Four Sites.

ATTRIBUTE	Site 16205 R2 [n=127]		Site 16205 R6 [n=25]		Site 16210 R1 [n=45]		Site 16216 R1 [n=106]		Site 16233 R1 [n=54]	
	Number	% Total	Number	% Total	Number	% Total	Number	% Total	Number	% Total
Condition										
Whole	65	51.2	21	84.0	33	73.3	68	64.2	15	27.8
Butt End	10	7.9	0	0.0	0	0.0	5	4.7	6	11.1
Mid-Section	15	11.8	0	0.0	0	0.0	6	5.7	8	14.8
Bevel End	17	13.4	3	12.0	6	13.3	14	13.2	13	20.1
Indeterminate	20	15.7	1	4.0	6	13.3	13	12.2	12	22.2
Cross-Section										
Rectangular	69	54.3	9	36.0	21	46.7	41	38.7	29	53.7
Reverse Triangular	10	7.9	2	8.0	0	0.0	4	3.8	4	7.4
Reverse Trapezoidal	13	10.2	3	12.0	9	21.7	6	5.7	3	5.6
Square	12	9.4	7	28.0	10	21.7	22	20.7	4	7.4
Indeterminate	23	18.1	4	16.0	5	10.9	33	31.1	14	25.9
Longitudinal Profile*										
Tang	3	2.4	11	44.0	10	22.2	18	17.0	2	3.7
Untanged	49	38.6	8	32.0	16	35.6	46	43.4	14	25.9
Indeterminate	75	59.0	6	24.0	19	42.2	42	39.6	38	70.4

* = Partial data missing on some attributes so total do not always add up

attribute data for a sample of 357 adze preforms from five rockshelters at four sites (16205, 16210, 16216, and 16233). This sample and another sample of 109 preforms from 16 workshops at 14 sites, summarized in Table 6.16, are used in a preliminary evaluation intra-site and inter-site variability in Section 6.5. The rockshelter samples are from collections made in 1975-76. They are samples drawn from larger assemblages which have not yet been fully analyzed. The workshop data are from sites recorded in the 2008-2009 survey; these data were recorded on forms in the field. The two data sets are thus geographically separate.

6.4.7.1 Attribute Definitions

(1) **Condition:** Specimens from archaeological sites are obviously found in either a whole or broken condition. In quarry sites there is a predominance of either broken and/or rejected tools. One of the primary reasons that tools are rejected in the manufacturing process is breakage due to such factors as flaws in the material and human error in the calculation of the flaking angle and insufficient skill to solve technological problems.

Adze fragments include three diagnostic parts --butt end, mid-section, and bevel end (see Figure 6.38). The recording of section frequencies was done to facilitate the calculation of minimum numbers of incipient tools and to examine the relationship between part frequency and manufacturing “stage as a means of testing the hypothesis that there is a higher incidence of breakage later in the manufacturing sequence.

The use of part frequencies is similar to the method used by Foss Leach to calculate minimum numbers based on avian limb bone fragments (Leach 1979: Fig. 8.1). There is, of course, nothing inherent in the relative numbers or frequencies of whole and

Table 6.16. Sample Data for Adze Preform Non-Metric Attributes from 16 Workshops at 14 Sites.

ATTRIBUTE	Site 16209 W1 [n=12]		Site 16212 W4 [n=3]		Site 16213 W1 [n=4]		Site 16213 W2 [n=11]		Site 16216 W19 [n=3]		Site 16216 W23 [n=5]		Site 4136 W [n=18]	
	Number	% Total	Number	% Total	Number	% Total	Number	% Total	Number	% Total	Number	% Total	Number	% Total
Condition														
Whole	12	100.0	2	66.7	4	100.0	11	100.0	2	66.7	4	80.0	15	83.3
Butt End	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	11.1
Mid-Section	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	5.6
Bevel End	0	0.0	1	33.3	0	0.0	0	0.0	1	33.3	0	0.0	0	0.0
Indeterminate	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	20.0	0	0.0
Cross-Section														
Rectangular	1	8.3	1	33.3	0	0.0	0	0.0	1	33.3	1	20.0	10	55.6
Reverse Triangular	4	33.3	1	33.3	2	50.0	1	9.1	1	33.3	1	20.0	3	16.6
Reverse Trapezoidal	2	16.7	0	0.0	2	50.0	3	27.3	0	0.0	2	40.0	1	5.6
Square	2	16.7	0	0.0	0	0.0	4	36.4	0	0.0	0	0.0	1	5.6
Lenticular	0	0.0	0	0.0	0	0.0	0	0.0	1	33.3	1	20.0	0	0.0
Indeterminate	3	25.0	1	33.3	0	0.0	3	27.3	0	0.0	0	0.0	3	16.6
Longitudinal Profile														
Tang	3	25.0	0	0.0	0	0.0	10	90.9	0	0.0	0	0.0	5	27.8
Untanged	7	58.3	1	33.3	2	50.0	0	0.0	2	66.7	4	40.0	9	50.0
Indeterminate	2	16.7	2	66.7	2	50.0	1	9.1	1	33.3	1	20.0	4	22.2

Table 6.16. Sample Data for Adze Preform Non-Metric Attributes from 16 Workshops at 14 Sites.

ATTRIBUTE	Site 28633 W1 [n=10]		Site 28635 W3 [n=8]		Site 28637 W1 [n=10]		Site 28638 W7 [n=10]		Site 28639 W1 [n=14]		Site 28644 W1 [n=9]		Site 28668 W1 [n=10]	
	Number	% Total	Number	% Total	Number	% Total	Number	% Total	Number	% Total	Number	% Total	Number	% Total
Condition														
Whole	7	70.0	8	100.0	7	70.0	9	90..0	10	71.4	7	77.8	7	70.0
Butt End	1	10.0	0	0.0	1	10.0	1	10.0	2	14.3	0	0.0	0	0.0
Mid-Section	1	10.0	0	0.0	2	20.0	0	0.0	1	7.1	0	0.0	3	30.0
Bevel End	1	10.0	0	0.0	0	0.0	0	0.0	1	7.1	1	11.1	0	0.0
Indeterminate	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	11.1	0	0.0
Cross-Section														
Rectangular	4	40.0	2	25.0	8	80.0	7	70.0	6	42.9	6	66.7	5	50.0
Reverse Triangular	0	0.0	1	12.5	1	10.0	0	0.0	3	21.4	0	0.0	5	50.0
Reverse Trapezoidal	4	40.0	0	0.0	0	0.0	1	10.0	4	28.6	0	0.0	0	0.0
Square	1	10.0	0	0.0	0	0.0	0	0.0	1	7.1	1	11.1	0	0.0
Indeterminate	1	10.0	5	62.5	1	10.0	2	20.0	0	0.0	2	22.2	0	0.0
Longitudinal Profile														
Tang	1	10.0	1	12.5	6	60.0	2	20.0	0	0.0	5	55.6	3	30.0
Untanged	7	70.0	2	25.0	1	10.0	8	80.0	8	57.1	2	22.2	3	30.0
Indeterminate	2	20.0	5	62.5	3	30.0	0	0.0	6	42.9	2	22.2	4	40.0

Table 6.16. Sample Data for Adze Preform Non-Metric Attributes from 16 Workshops at 14 Sites.

ATTRIBUTE	Site 28673 W2 [n=4]		Site 28676 W5 [n=5]		TOTAL (n=136)	
	Number	% Total	Number	% Total	Number	% Total
Condition						
Whole	1	25.0	3	60.0	109	80.1
Butt End	0	0.0	0	0.0	7	5.1
Mid-Section	2	50.0	0	0.0	10	7.4
Bevel End	1	25.0	2	40.0	8	5.9
Indeterminate	0	0.0	0	0.0	2	1.5
Cross-Section						
Rectangular	3	75.0	4	80.0	59	43.4
Reverse Triangular	1	25.0	0	0.0	24	17.6
Reverse Trapezoidal	0	0.0	1	20.0	20	14.7
Square	0	0.0	0	0.0	10	7.4
Lenticular	0	0.0	0	0.0	2	1.5
Indeterminate	0	0.0	0	0.0	21	15.4
Longitudinal Profile						
Tang	0	0.0	3	60.0	39	28.7
Untanged	1	25.0	0	0.0	57	41.9
Indeterminate	3	75.0	2	40.0	40	29.4

broken specimens. Breakage, for example, occurs during manufacture, but except for very small thin adzes few whole adzes would be expected to have been broken after they were discarded.

(2) ***Blank Type*****:** Data for this attribute, which to reiterate is a term applied to cores and flakes that exhibit more than a few flake scars, is limited to the sample of collected artifacts studied in the lab (Appendix J). The data are not discussed any further, however.

(3) **Cross-section:** Polynesian adze typologies are based almost exclusively on the cross-section at the shoulder of tanged adzes (see Figure 6.38) or the mid-section of untanged adzes (Buck et al. 1930). The importance given to this one attribute in Polynesian adze studies is highlighted by Emory:

> For Polynesian adzes as a whole, the shape of the cross-section at the middle, or where the division between butt and blade is discernible, has proven essential to type designation. It has been equally important to note the presence or absence of a grip or tang, that is, the modification of the butt by reduction of its face or sides or both.
>
> If we sort Polynesian adzes according to the shape of this cross-section and separate the tanged from the untanged, we have gone a long way toward their useful classification. The associated features can then be described and those adzes which have such features in common may be grouped according to our needs in comparative studies (Fig. 1) (Emory 1968:153).

The established convention for describing the cross-section rests on what is known regarding the orientation of the few hafted adzes that were collected prior to the replacement of stone adzes with metal counterparts. The established procedure is to orient the adze with the front or face always up and the back down (see Figure 6.38); this explains the difference between a triangular and a reverse-triangular adze (see Figure 6.38). Strict adherence to this convention imposes obvious constraints on classifying unfinished adzes and especially fragments of broken adze rejects. Other difficulties are encountered in adhering to the established procedure for determining cross-section. For example, the cross-sections of early stage adzes are more irregular for the most part except in the case of some tabular cores where the cross-section is inherently rectangular, so that even though the front and back may not be distinguishable the cross-section is nevertheless very regular.

The classification employed here follows Emory (1968: Figure 1) but because we took only one width measurement--the maximum width at the middle of both whole adzes and fragments--rather than the width of both the front and back, there are some specimens that should be properly classified as reversed subtriangular. In the case of reversed trapezoidal and reversed triangular adzes, the maximum width is the front width. Back width measurements would be necessary to make the quarry types conform to Emory's criteria, which were of course developed for finished adzes and are in any case arbitrarily imposed distinctions. Emory's classification is in some ways too rigid for use in the analysis of quarry assemblages, yet we agree that we should continue to classify adzes in terms of the cross-sections and to distinguish, for example, thick and thin, square, rectangular, and trapezoidal.

(4) **Longitudinal Profile:** This attribute (see Cleghorn 1982:171 for a fuller discussion) was recorded as (1) tanged (see Figure 6.38), (2) untanged, or (3) indeterminate in the case of some of the fragments.

(5) **Cortex:** Cortex, a term employed by mainly archaeologists to refer to the exterior weathered surface of rocks, is the result of natural processes that produces what geologists call a rind (Crabtree 1972:56). Cortex is an important attribute for determining blank type. Cores collected from the surface of the landscape or removed from the upper surface of lava flows are completely covered with cortex in contrast to flakes which by definition [a piece of a core] have cortex only on the outer or dorsal surface. In the present study the recording of this attribute was limited to recording presence/absence rather than the more involved and time consuming quantification of the actual amount of cortex in terms of, for example, the percentage of the surface with cortex. In the lab analysis of the collected preforms the location was recorded as follows: front, back, 1 side, 2 sides.

(6-8) **Length, Width and Thickness:** Size measurements recorded in the field include length, width, and thickness. Measurements were taken on all specimens, whole and broken as follows:

Length: maximal distance between the cutting edge and the butt end.

Width: maximal dimension taken at the mid-section of untanged adzes and at the shoulder of tanged adzes.

Thickness: maximal dimension between the front and back.

(9) **Cutting Edge Width:** the width or breadth of the cutting edge measured from side to side.

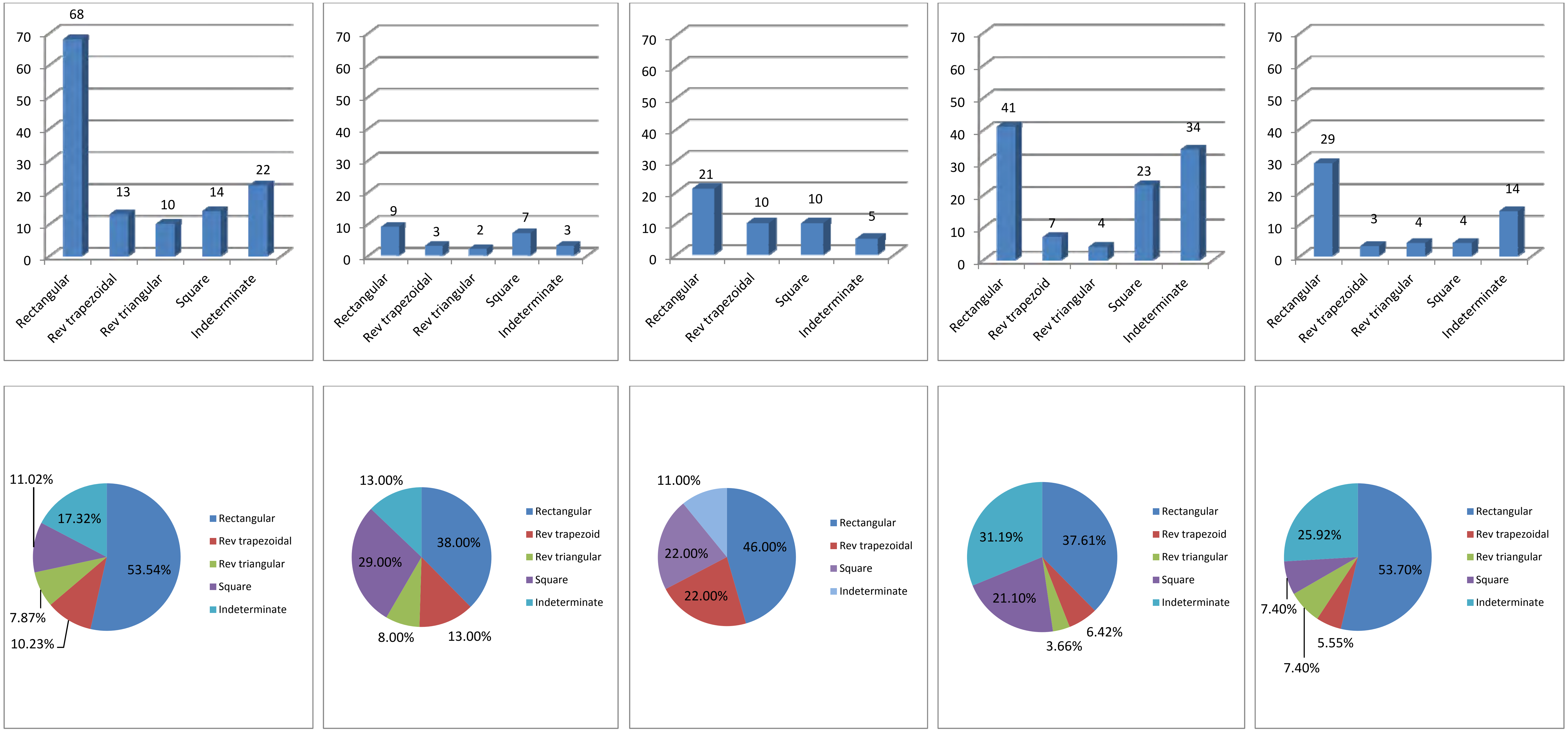
(10) **Weight:** weight, which is a size variable, is limited to the sample that was collected and brought back to the lab (Appendix J).

6.4.7.2 Inter-Site Variability

As noted in this report and elsewhere (McCoy 1990; McCoy and Nees 2010), the Mauna Kea Adze Quarry is not a monolithic whole exhibiting uniformity in raw material procurement methods, reduction strategies and sequences, and preform types. The following comparisons demonstrate variability in preform assemblages within and between rockshelters and workshops; the data used in the comparisons are from Tables 6.15 and 6.16.

While there is almost definitely a sampling bias reflected in the collections of adze preforms made at each of the five rockshelters used in this analysis toward the selection of more complete preforms, except for those recovered in the excavation of \`Ua\`u Rockshelter (16205, R2), the number of broken preforms indicates the presence of a substantial number in each assemblage (Table 6.15). The same caveats hold true for the 16 workshop assemblages (Table 6.16).

When the cross-sections of the preforms found at the five rockshelters are compared two things stand out. Figure 6.41 shows that in each assemblage there are three to four determinate cross-sections, in addition to a large number of indeterminate types. This figure also shows that rectangular and square cross-sections are the most common. In the larger assemblages, such as those from \`Ua\`u Rockshelter (16205, R2) and Ko\`oko\`olau Rockshelter No. 1 (16216, R1), there are a much smaller number of reverse trapezoidal and reverse triangular types. The data thus show both uniformity and variability—uniformity in the presence of several cross-section types in every



Site 16205 Rockshelter 2 (n=127)　Site 16205 Rockshelter 6 (n=24)　Site 16210 Rockshelter 1 (n=46)　Site 16216 Rockshelter 1 (n=109)　Site 16233 Rockshelter 1 (n=54)

Figure 6.41. Frequency Distribution of Adze Preform Cross Sections at Five Rockshelters in Four Sites.

assemblage, and variability in the relative frequencies of types. In short, there was no one dominant type, but instead a focus on just a few types, most of which, when lumped together, would be quadrangular.

The workshop assemblages, which are significantly smaller in total number of specimens, are similar to the rockshelters ones in the presence of a variety of cross-sections (see Table 6.16). A degree of uniformity in rockshelter and workshop assemblages is to be expected given the evidence that the initial reduction and shaping frequently began in workshops and was finished at a rockshelter basecamp. In the samples used in this analysis it is significant that the similarities in cross-section types are found in different areas of the quarry.

The data on the number and relative percentage of tanged and untanged preforms from the five rockshelters shows that in every case the frequency of tanged preforms is significantly lower, except for Site 16205, R6 –the rockshelter identified on early maps as Keanakako`i (Table 6.15). The same holds true for the 14 workshops, where the number in each sample are significantly smaller (see Table 6.16). The pattern that emerges in the current data set has been observed previously at some of the rockshelters/workshops located in the NAR (Cleghorn 1982). It is even more clear in a combined sample of 730 adze preforms the quarry complex. Figure 6.42 shows that though a large number (329) and percentage (45.1%) in even this sample have an indeterminate longitudinal profile, of the 401 preforms where the presence/absence of a tang could be reliably determined, the tanged variety made up less than 15% of the total.

6.4.8 Analysis of Selected Hammerstone Attributes

In the 2008-09 project a form was used in the field to record selected hammerstone attributes based on samples, which were often 100% because hammerstones generally occur in small numbers at most workshops. The selected attributes are described below. The complete data set for hammerstones is presented in Appendix J. Data were collected on a sample of 63 hammerstones in the 2008-09 fieldwork (Figure 6.43).

(1) **Condition.** This attribute was recorded as either whole or broken. Many of the fragments are sheared or split, often into half sections that exhibit an extremely flat ventral surface. Most of these fragments are undoubtedly the unintended consequence of use, rather than post-depositional breakage. The frequency of sheared fragments is of great interest in terms of providing possible clues to raw material constraints and/or use. Some appear to have been used as anvils. The frequency distribution of whole and broken hammerstones by shape is shown in Figure 6.43.

(2) **Shape.** Hammerstone shapes in the sample analyzed in this report include: (1) discoidal; (2) spherical, and (3) irregular. A variety of hammerstone types from a cache found at Site 16216 are illustrated in Figure 6.44.

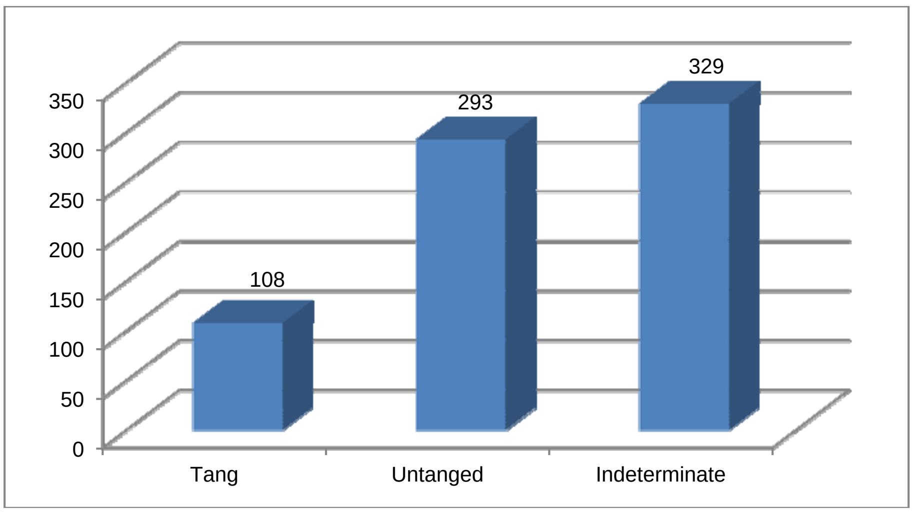
(3) **Raw Material Form.** The materials utilized for hammerstones include (1) vesicular pieces of basalt; (2) dense and fine-grained pieces of basalt, usually cobbles and (3) recycled adze rejects.

(4) **Raw Material Source.** Unlike the other attributes or tool properties, raw material source must always be inferred and the inference is based primarily on raw material form and, more specifically, the rounding and texture, especially the surface finish. On current evidence, which consists of field observations made over a number of years and EDXRF analyses of a small sample, all of the hammerstones in the quarry, indeed everywhere in the summit region, are local volcanics. In contrast to other stone tool

quarries, where hammerstones had to be imported, the lavas flows on Mauna Kea provided a readily available source of hammerstone material. The most commonly used material is a vesicular basalt, although some hammerstones are non-porous and dense.

Howard Powers brief description of the hammerstones found in the adze manufacturing sites on Haleakala is of considerable interest with regard to their origins and the selection for specific properties, such as porosity and shape. He noted that:

> ...the stones used for hammers in shaping the adzes are always of tough, porous rock which shatters less readily. Most of the hammerstones were carried in by the workmen; some from deposits of stream gravel lower on the mountain; and some even from the sea beaches, as many of the hammers show remnants of the smooth rounded surface typical only of wave-rounded cobble stones (Powers 1939:24).



(n=730)

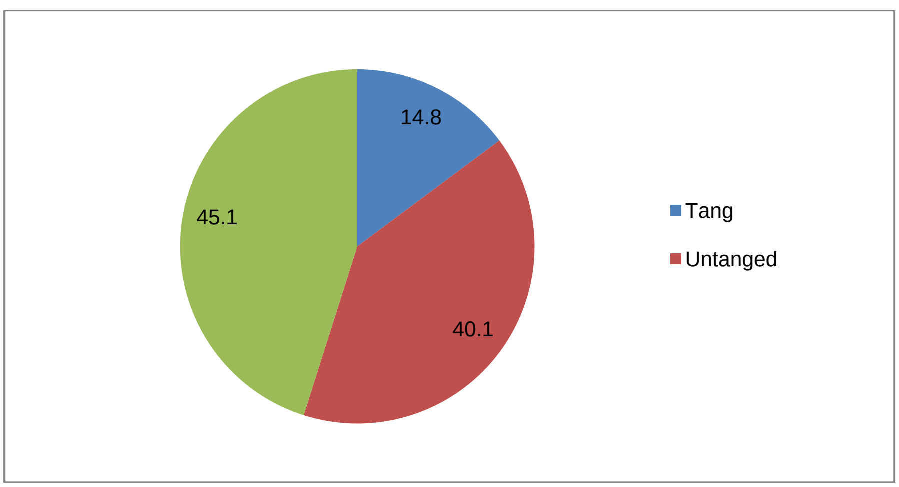


Figure 6.42. Frequency Distribution of Adze Preforms with and without Tangs.

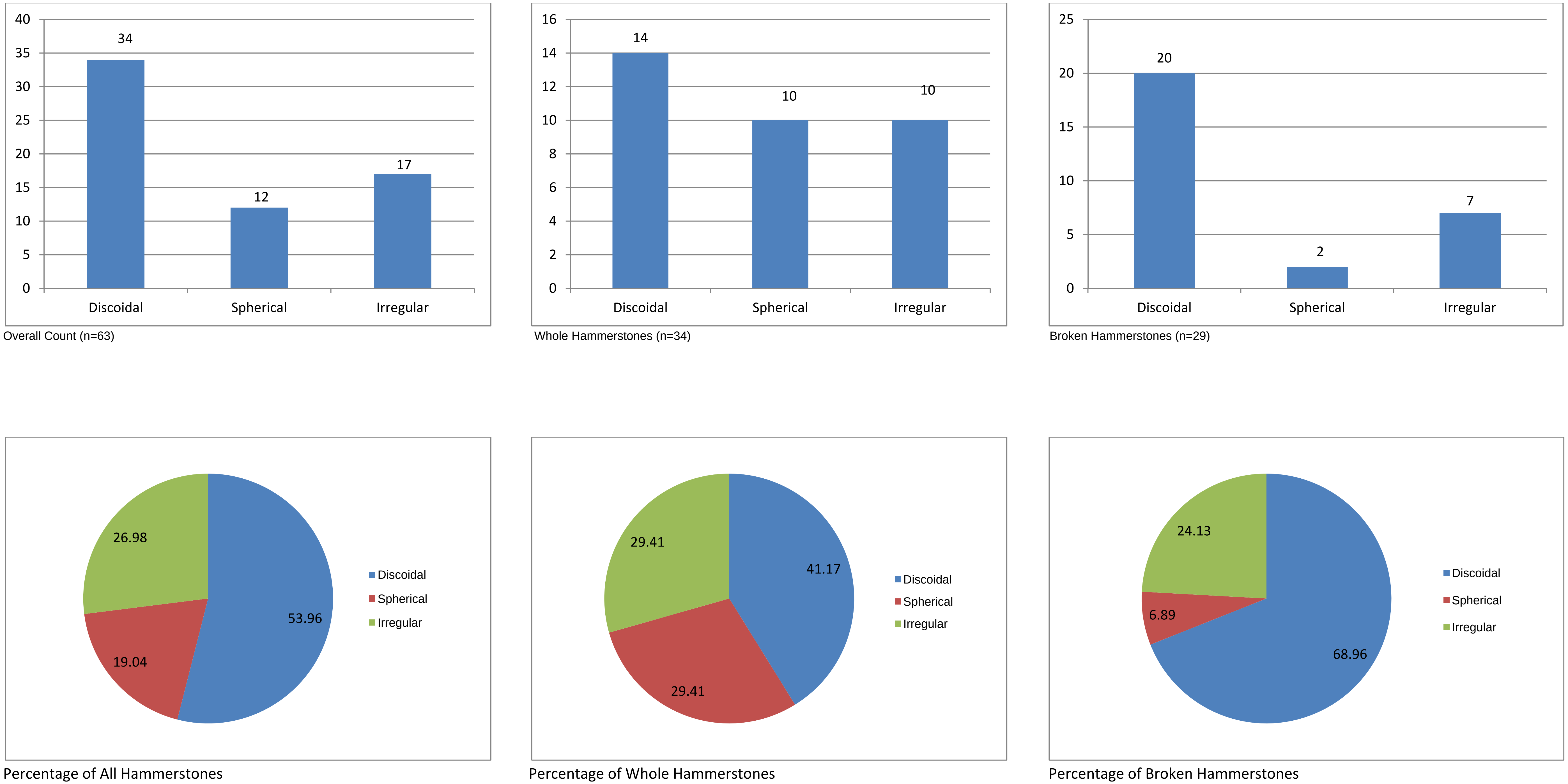


Figure 6.43. Frequency Distribution of Whole and Broken Hammerstones and Hammerstone Shapes.

Figure 6.44 Hammerstone Cache at Site 16216.

(5) **Maximal Dimensions.** Because measurements are shape dependent and the shapes of the hammerstones so variable, we have resorted to maximal measurements (Table 6.17). The maximal dimensions give a good and indeed better indication of the general shape of the tool.

The sample of 63 hammerstones analyzed in the field in 2008-09 includes 34 whole and 29 broken specimens. The number and relative percentages of shape categories show the discoidal form is the most common (34 or 53.96%) when the whole and broken counts are combined. There are 12 spherical hammerstones in the sample of 65 total specimens or 19.04% of the total. Irregular-shaped hammerstones are slightly more common than spherical ones (n=17 or 26.98% of the total). Some of the irregular-shaped hammerstones are likely to have been discarded for some reason, and in some cases may have ended up becoming either a spherical or discoidal tool through use and attrition.

6.4.9 Basaltic Glass Assemblages: A Summary

Volcanic glass or basaltic glass assemblages were recovered from three different locations in the adze quarry, in 1975-76. The largest assemblage, which consists of cores, flakes and non-diagnostic shatter, came from a 1 m^2 test unit at what appears to have been the primary source of volcanic glass toolstone in the NAR (see Volume 2 for a description of the excavation) (Figure 6.45). Two smaller assemblages with the same artifact categories were recovered in the excavation of `Ua`u and Ko`oko`olau

Table 6.17. Maximal Dimensions of Hammerstones Sampled in the NAR.

State Site Number	Workshop No.	Hammerstone Sample Number	Dimensions in centimeters			Condition	Shape
			Length	Width / Diameter	Thickness		
16205	N/A	1	9.0	8.0	3.0	Whole	Discoidal
		2	5.0	4.5	3.7	Whole	Discoidal
16234		1	8.5	7.0	7.0	Whole	Discoidal
		2	9.0	8.5	7.1	Whole	Discoidal
		3	7.8	7.5	5.6	Whole	Discoidal
		4	7.8	7.0	6.8	Whole	Spherical
		5	12.2	11.4	8.5	Whole	Irregular
		6	13.2	9.3	7.1	Whole	Irregular
		7	9.9	6.2	5.3	Whole	Irregular
28633		1	16.0	13.0	2.5	Broken	Discoidal
28635	1	1	12.0	7.0	4.3	Whole	Irregular
	3	1	12.0	10.0	4.5	Whole	Discoidal
		2	7.5	7.0	3.5	Whole	Discoidal
	5	1	13.0	9.5	8.0	Whole	Irregular
28636		1	15.0	13.0	8.5	Whole	Irregular
28637	1	1	14.4	8.3	5.6	Broken	Tabular
		2	9.5	8.1	8.8	Broken	Spherical
		3	8.1	9.1	8.2	Whole	Spherical
		4	16.4	11.6	4.2	Broken	Discoidal
		5	13.3	15.5	9.4	Broken	Irregular
28638	RS1	1	6.5	6.5	3.5	Whole	Discoidal
	WS7	2	6.5	6.5		Whole	Spherical
		3	10.5	10.5	8.0	Broken	Discoidal
		4	8.0	6.0	6.0	Broken	Irregular
		5	13.0	8.5	6.5	Whole	Irregular
28639		1	16.0	13.0	7.3	Whole	Irregular
		2	14.0	14.0	6.5	Whole	Discoidal
27641	1	1	9.1	7.8	5.3	Broken	Discoidal
		2	10.1	8.0	7.4	Broken	Discoidal
	2	3	13.6	14.5	3.8	Broken	Discoidal
		4	11.5	6.9	5.2	Broken	Discoidal
	3	5	9.3	9.3	7.0	Whole	Spherical
		6	10.6	10.4	9.5	Whole	Spherical
	4	7	9.7	9.3	7.8	Whole	Discoidal
		8	10.4	9.2	5.4	Whole	Discoidal
	5	9	11.5	10.1	9.3	Whole	Irregular
		10	10.7	8.9	4.8	Broken	Discoidal
28644	Fe1	1	9.4	8.3	4.0	Broken	Discoidal
		6	8.6	8.3	1.7	Broken	Discoidal
	Fe2	7	7.3	6.8	3.1	Broken	Discoidal
		8	8.1	8.0	7.1	Whole	Spherical
	WS1	9	8.9	7.8	6.0	Whole	Spherical
		10	11.4	4.7	5.6	Broken	Discoidal
		12	8.2	8.6	4.2	Broken	Discoidal
		13	14.2	13.4	7.2	Broken	Discoidal

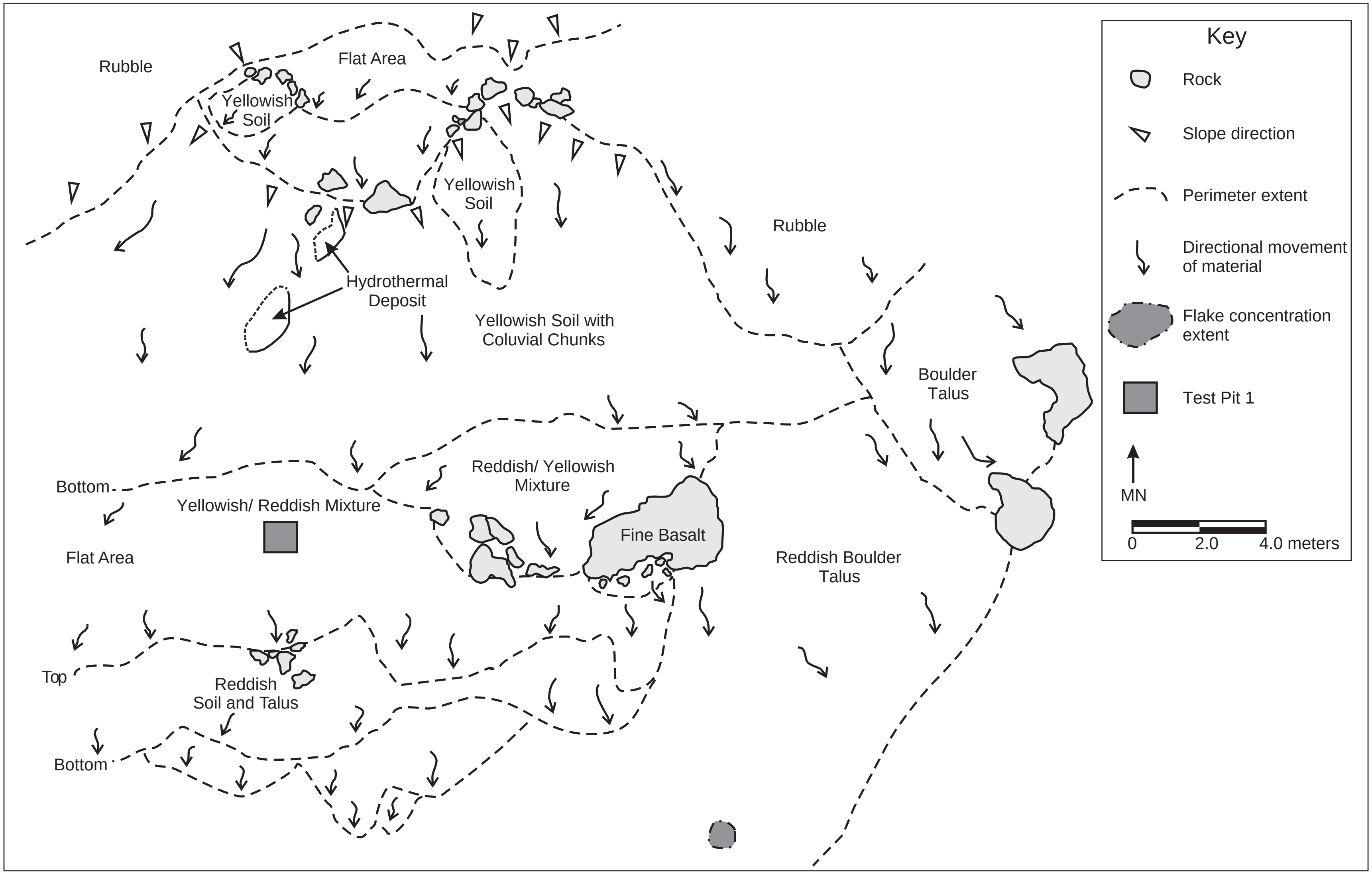


Figure 6.45. Basaltic Glass Works, Plan View at Site 16216.

Table 6.17. Maximal Dimensions of Hammerstones Sampled in the NAR.

State Site Number	Workshop No.	Hammerstone Sample Number	Dimensions in centimeters			Condition	Shape
			Length	Width/ Diameter	Thickness		
		14	8.5	5.4	5.6	Broken	Discoidal
		15	9.5	6.4	5.9	Broken	Discoidal
		16	11.2	7.3	5.9	Broken	Irregular
		18	6.6	6.7	4.6	Broken	Irregular
		20	7.4	6.2	5.6	Broken	Irregular
		21	9.1	9.0	2.0	Broken	Discoidal
		22	11.7	8.9	4.8	Broken	Discoidal
		23	11.3	7.9	7.4	Broken	Irregular
28666		1	14.5	17.0	9.5	Broken	Discoidal
28673	Fe1	1	11.0	11.0	8.0	Whole	Discoidal
		2	6.8	8.2	4.5	Whole	Discoidal
		3	14.2	15.4	5.8	Whole	Discoidal
		4	14.6	11.1	8.5	Whole	Spherical
		5	9.5	10.5	8.6	Whole	Spherical
		6	14.5	13.2	11.6	Broken	Spherical
		7	8.0	8.0	8.5	Whole	Spherical
	Fe2	8	10.5	13.5	8.5	Whole	Discoidal
		9	7.0	7.5	4.5	Whole	Discoidal
28676	4	2	8.6	6.9	4.3	Broken	Discoidal
	5	1	14.4	9.6	10.4	Whole	Irregular

Rockshelter No. 1, also in 1975-76 (Figure 6.46). The analysis of the three assemblages is limited to the presentation of selected attribute data, a brief comparison of the three assemblages, and discussion of the possible uses of volcanic glass artifacts in the adze quarry and possibility that some of the material was taken away and used elsewhere.

Excavation of the 1 m^2 test pit excavated at the primary source of volcanic glass at Site 16216, in 1976, was done using a combination of natural sedimentary layers and arbitrary levels for better stratigraphic control. The excavations, which are described more fully in Volume 2, yielded a substantial quantity of volcanic glass cores, flakes and shatter (Tables 6.18). A total of 76 basalt flakes or 5.92% of the total artifacts were also recovered in the excavation (Table 6.18 and Figure 6.46). The incorporation of these flakes into the deposit where the volcanic glass was found is a result of the close proximity to adze manufacturing workshops and post-depositional slope wash that has buried some of the basalt debitage.

6.4.10.1 Assemblage Characteristics

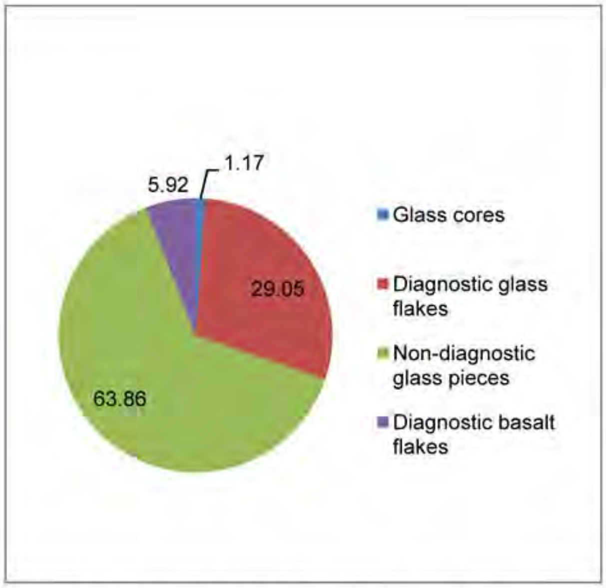
The general characteristic of each assemblage is summarized in Tables 6.18-6.22 in terms of the number and percent of cores, flakes, and non-diagnostic flake fragments and shatter. As might be expected, the artifact assemblage from the source area is considerably larger than either of the rockshelter assemblages (n=1,284). More

Table 6.18. Stratigraphic Distribution of Artifacts from Site 16216: Volcanic Glass Source and Workshop (Test Pit 1).

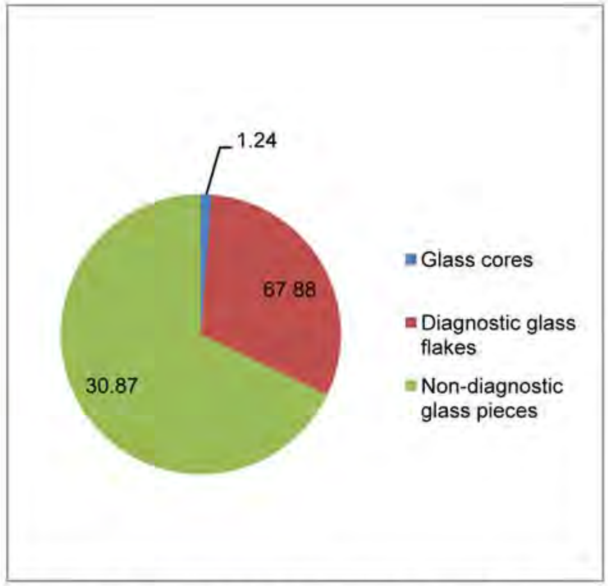
Category	Layer I												Layer II				Total Layer I-II	
	Level 1				Level 2				Level 3									
	No.	% T	Wt.	% T	No.	% T	Wt.	% T	No.	% T	Wt.	% T	No.	% T	Wt.	% T	No.	Wt.
Volcanic Glass Cores	2	1.90	39.85	3.95	7	1.27	45.70	1.16	6	1.95	736.6	21.56	-	-	-	-	15	822.15
Diagnostic Volcanic Glass Flakes	38	36.19	51.00	5.05	226	41.31	160.01	4.07	3	0.97	10.28	0.3	106	32.61	38	11.12	373	259.29
Non-Diagnostic Volcanic Glass Flakes and Shatter	50	47.61	770.60	76.40	292	53.38	3625	92.37	297	96.47	2526.13	73.95	181	55.69	283.2	82.87	820	7204.93
Totals	**90**				**525**				**306**				**287**				**1208**	
Diagnostic Basalt Flakes	15	14.28	147.10	14.58	22	4.02	93.50	2.38	1	0.32	142.8	4.18	38	11.69	20.5	5.99	76	403.9
Grand Total	**105**		**1008.55**		**547**		**3924.21**		**307**		**3415.81**		**325**		**341.7**		**1284**	

Table 6.19. Volcanic Glass Flake Measurements by Stratigraphic Layer, Site 16216, Volcanic Glass Source, Test Pit 1.

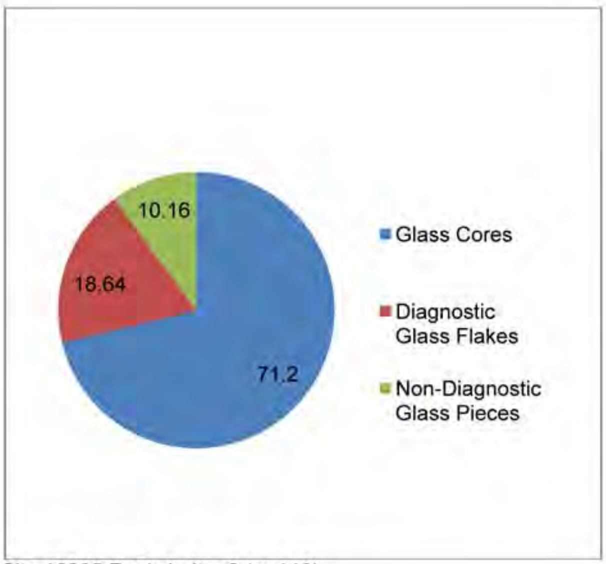
Measurement	**Layer / Level**								**Overall Mean Values (n=373)**
	I/1 (n=38)		**I/2 (n=226)**		**I/3 (n=3)**		**II (n=106)**		
	Range	**Mean**	**Range**	**Mean**	**Range**	**Mean**	**Range**	**Mean**	
Length (mm)	5.4 - 32.1	13	3.9 - 39.8	11.5	8.5 - 29.2	19.1	2.9 - 30.9	8.6	13
Width (mm)	6.0 - 33.5	13.7	3.0 - 35.4	10.1	8.9 - 23.9	18.4	3.0 - 25.0	8.4	12.7
Thickness (mm)	1.0 - 15.0	4.5	0.5 - 12.0	3.8	4.2 - 14.4	10.4	0.5 - 12.9	2.8	5.4
Weight (gm)	0.15 - 8.25	1.34	< 0.10 - 5.20	0.71	0.38 - 6.17	3.43	<0.10 - 10.5	0.36	1.46
Striking Platform Thickness (mm)	1.0 - 7.5	3.2	0.5 - 12.0	2.6	4.2 - 7.8	6.5	0.5 - 12.9	2.2	0.36



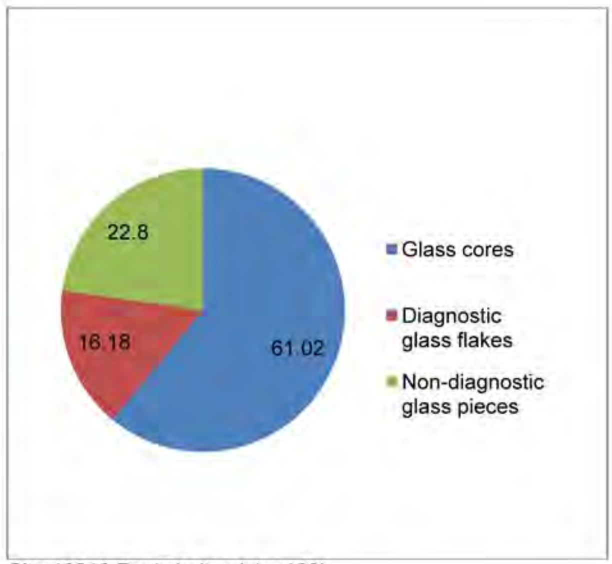
Excavated Cultural Material at Site 16216, Basaltic Glass Quarry With Basalt Flakes (n=1,284).



Excavated Cultural Material at Site 16216, Basaltic Glass Quarry **Without** Basalt Flakes (n=1,208).



Site 16205 Rockshelter 2 (n=118)



Site 16216 Rockshelter 1 (n=136)

Figure 6.46. Frequency Distribution of Basaltic Glass Artifacts at Sites 16205 and 16216.

Table 6.20. Stratigraphic Distribution of Qualitative Flake Attributes from Site 16216 Basaltic Glass Source, Test Pit 1.

Attribute	Layer I Level 1 %T n=38	Layer I Level 2 %T n=226	Layer I Level 3 %T n=3	Layer II %T n=106	Percent Total
CORTEX					
Sticking Platform	28.37	28.57	40.00	29.33	28.84
Dorsal Surface	37.83	33.24	20.00	27.33	32.20
Striking Platform & Dorsal Surface	24.32	18.95	20.00	14.66	20.40
None	9.45	19.23	20.00	28.66	18.55
DORSAL RIDGES					
One	47.36	62.11	33.33	53.77	58.02
Two	10.52	9.25	33.33	9.43	9.62
None	42.10	28.63	33.33	36.79	32.35
BULB TYPE					
Negative	0.00	2.60	0.00	1.88	2.12
Positive Salient	7.89	3.91	66.66	3.77	4.77
Positive Diffuse	92.10	93.47	33.33	94.33	93.10
TERMINATION TYPE					
Feather	26.31	11.21	0.00	23.80	16.26
Hinge	55.26	62.33	100.00	61.90	61.78
Outrepasse	15.78	13.45	0.00	5.71	11.38
Step	2.63	13.00	0.00	8.57	10.56
EDGE MORPHOLOGY					
Parallel	7.89	5.75	0.00	6.60	6.16
Sub-Parallel	23.68	24.77	0.00	20.75	23.32
Divergent	21.05	24.77	33.33	17.92	22.52
Convergent	31.57	34.07	33.33	48.11	37.80
Irregular	15.78	10.61	33.33	6.60	10.19

difficult to understand is the relatively small number of cores (n=15) at the source compared to the `Ua`u and Ko`oko`olau Rockshelter No. 1 assemblages are rather similar in total number of artifacts (108 vs. 136) and the proportions of cores to flakes, including non-diagnostic broken flakes and pieces of shatter, with cores representing 71.2% of the total assemblage at `Ua`u Rockshelter and 61.02% at Ko`oko`olau Rockshelter No. 1.

The data suggest that instead of a selection for flakes, the occupants of the two rockshelters were primarily transporting cores. The reason for this is hard to fathom. Perhaps more time was desired in reducing the cores at each of these two base camps and taking selected flakes back home at the end of a season.

Table 6.21 Stratigraphic Distribution of Basaltic Glass Artifacts from `Ua`u Rockshelter (Site 16205) by Number and Weight

Artifact Category	Layer												Total			
	II		III		IV		V		VI		VII					
	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	%T	Wt.	%T
Raw Material (chunks)	1	25.1	1	12.9	7	31.80	--	--	10	94.85	1	0.80	20	14.50	164.65	29.15
Cores & Core Fragments	2	4.70+	2	13.97	4	110.35	-	-	1	79.95	3	3.65	26	15.94	212.62+	37.64
Flakes	5	2.75+	14	9.77	37	45.60	1	1.40	17	12.48+	10	14.60	84	60.87	86.60+	15.33
Flake Fragments & Shatter	3	29.95	2	5.55	2	3.55	1	2.55	4	47.40	-	-	12	8.70	101.00	17.88
Totals	**11**	**62.50**	**19**	**42.19**	**50**	**191.30**	**2**	**3.95**	**32**	**234.68**	**14**	**19.05**	**138**		**564.87**	

*core data subject to revision

Table 6.22 Stratigraphic Distribution of Basaltic Glass Artifacts from Ko`oko`olau Rockshelter No.1 (Site 16216) by Number and Weight

Artifact Category	Layer																Total			
	I		II		III		IV		V		VI		VII		VIII					
	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	%T	Wt.	%T
Raw Material (chunks)	--	--	--	--	--	--	--	--	--	--	6	22.10	--	--	--	--	6		22.10	
Cores & Core Fragments	6	47.70	3	39.50	-	-	2	8.62	2	21.25	4	47.83	1	3.17	4	48.08	22	16.18	216.15	48.53
Flakes	3	3.90	3	18.05	1	0.35	15	15.82	1	3.80	39	42.20	12.	9.18	9	6.55	83	61.03	99.85	22.42
Flake Fragments & Shatter	-	-	2	1.00	-	-	-	-	-	-	22	55.27	6	8.5	1	64.60	31	22.79	129.37	29.05
Totals	**9**	**51.60**	**8**	**58.55**	**1**	**0.35**	**17**	**24.44**	**3**	**25.05**	**65**	**145.3**	**19**	**20.85**	**14**	**119.23**	**136**		**445.37**	

*core data subject to revision

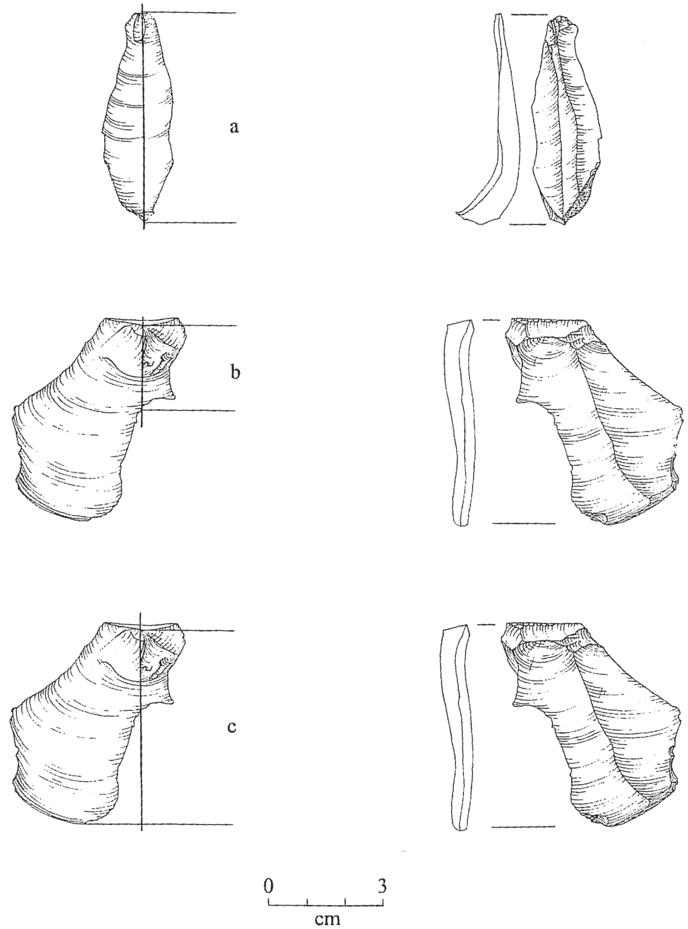


Figure 5.8 Flake length measurements: (a) length corresponding to a line perpendicular to striking platform width; (b) length taken on an irregular shaped flake where the line perpendicular to striking platform width is less than 3 cm; (c) length measured as the maximum distance from the proximal to distal end along a line perpendicular to striking platform width.

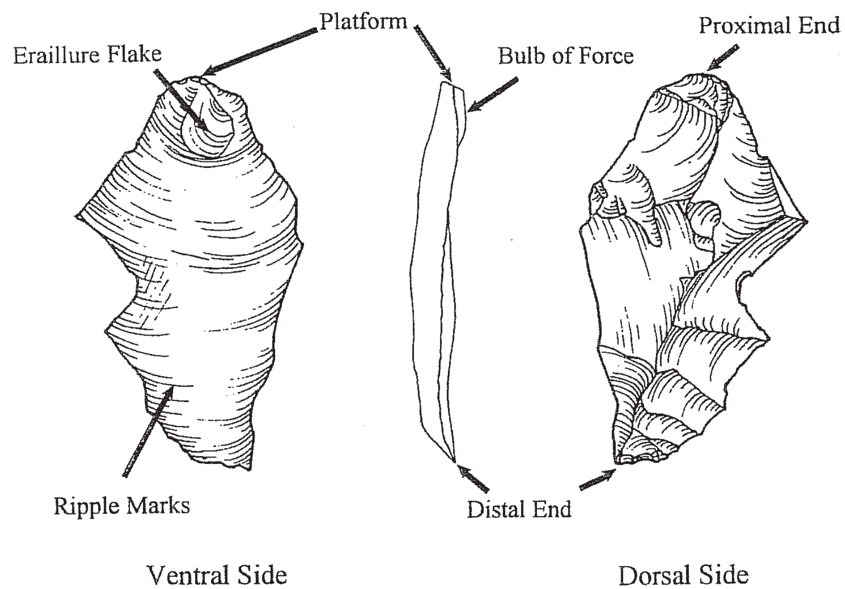


Figure 2.7 Conchoidal flake showing common elements and terminology.

Figure 6.47. Flake Terminology and Flake Length Measurement Methods (after Andrefsky, Jr. 1998).

6.4.10.2 Flake Debitage Analysis

The analytical data presented in this report are focused on the flake debitage. Core data will be presented in a future paper. The one thing that can be said about the cores is that there are several types, including unidirectional, bidirectional and multi-directional. The flake analysis, which is rather rudimentary, was aimed at presenting fairly summary statistics for fairly standard metric and non-metric attributes, such as length, width, thickness, cortex coverage, flake shape, etc (see Tables 6.19-6.22).

6.4.2.1 Flake Attributes

(1) Condition. Whole and broken flakes are distinguishable by the presence/ absence of a proximal and/or distal end. Breakage occurs during and after manufacture and as a consequence there is no inherent meaning in this variable. The relative frequencies of whole and broken flakes is contingent on a number of factors, such as raw material properties, skill, and the potential for post-manufacture breakage due to such processes as trampling and erosion (Sullivan and Rozen 1985).

The senior author finds it useful to partition assemblages into two populations--whole and broken flakes--and though I think that most archaeologists would agree that the focus should be on the whole flake population, I think it is important nevertheless to at least include counts and weights for the broken material. One reason is that such data are necessary to production output estimates based on the total volume of waste.

(2) Size. Size measurements, as already mentioned, were limited to length (defined as the straight line distance between the striking platform and the distal end of the flake; Figure 6.46, width (the axis perpendicular to the length), and thickness (maximal measurement between the dorsal and ventral surfaces). The relationship between length and width for all three assemblages is illustrated in scatterplot diagrams (Figures 6.47-51).

The small size of the flakes (see Table 6.19) is something that appears to be almost universal in basaltic glass assemblages throughout Hawaii, with the single exception of the chill glass assemblages at PTA where much larger cores and flakes are found (Williams 2002). Flake dimensions are rather uniform for all three assemblages. The scatterplot diagrams of length:width ratios indicate the occurrence of flakes that tend to be roughly equal in length and width, with the majority of flakes measuring 25mm or less in both length and width. The size data, combined with the data on bulb of force characteristics, points to a bipolar technology. It is significant that in all three assemblages the vast majority of flakes have a diffuse bulb of force, which is, moreover, extremely uniform (93.10% at the source, 92.10% at Ko`oko`olau Rockshelter No. 1 and 94.36% at `Ua`u Rockshelter—cf. Tables 6.20, 6.23, and 6.24). The extremely high percentage of diffuse bulbs indicates a shearing technique.

(3) Cortex. The weathering rind or cortex is commonly recorded attribute. Cortex location is an important attribute, providing insights on raw material form and size (Cleghorn 1982:114). On whole flakes cortex location was recorded as follows: (1) striking platform; (2) dorsal surface; (3) striking platform and dorsal surface, and (4) absent.

The three assemblages are similar in terms of the ratio of cortical (18.64 to 36.95%) to non-cortical flakes, which make up between 16.66 and 20.33%. The high percentage of flakes with cortex at the source is to be expected. Similarly high

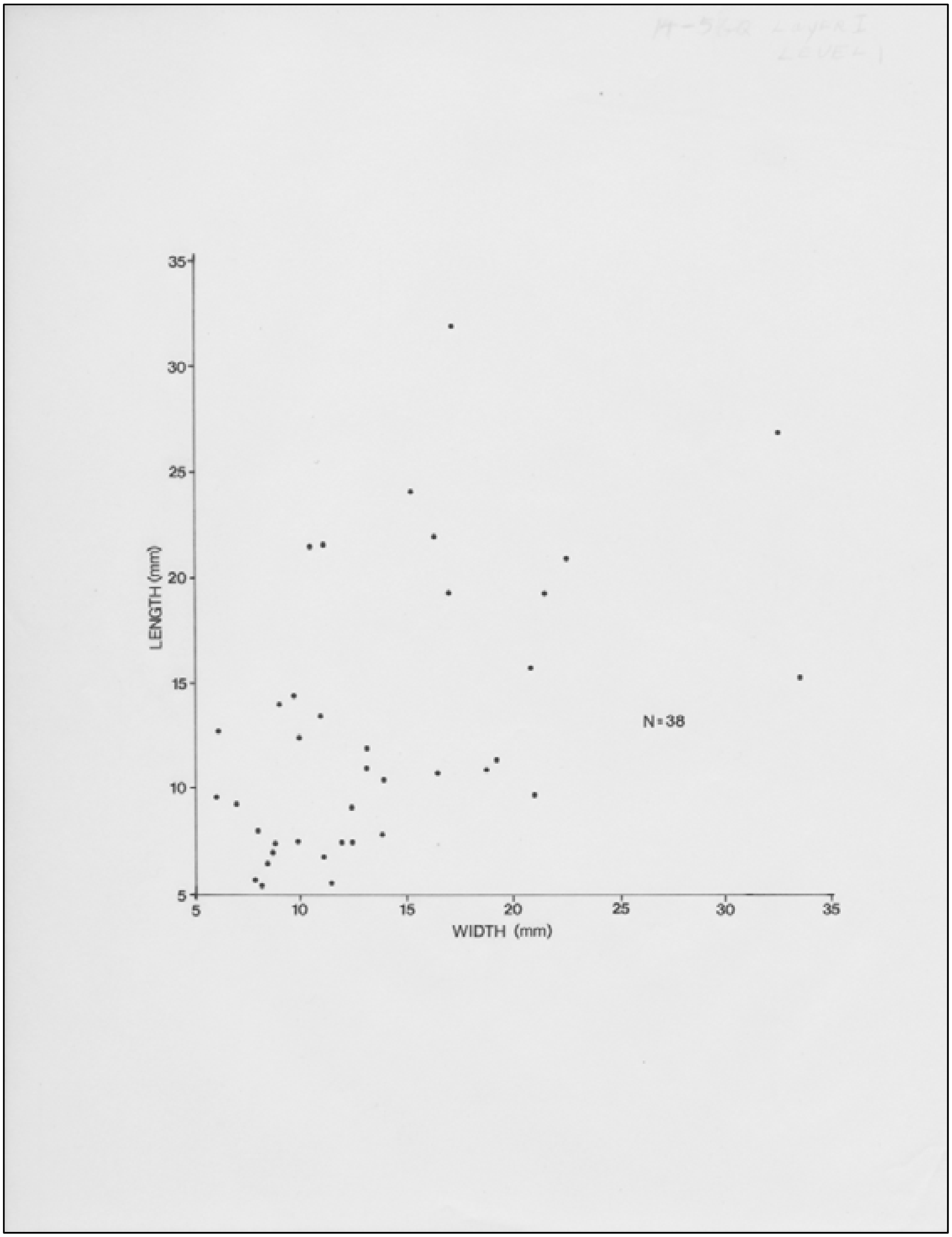


Figure 6.48. Scatterplot Diagram of Flake Length/Width Ratios, Site 16216 Basaltic Glass Source, Test Pit 1, Layer I, Level 1.

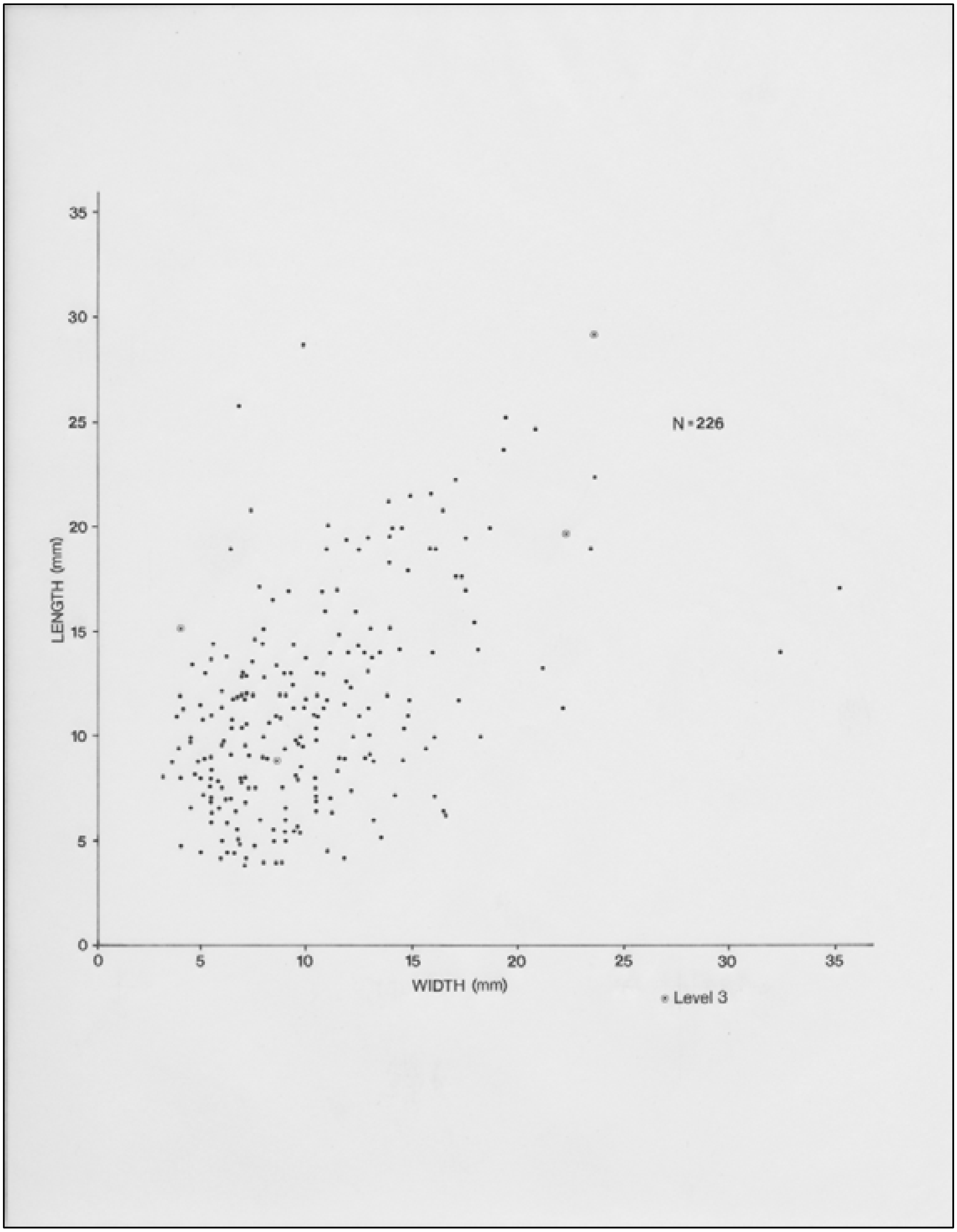


Figure 6.49. Scatterplot Diagram of Flake Length/Width Ratios, Site 16216 Basaltic Glass Source, Test Pit 1, Layer I, Levels 2 and 3.

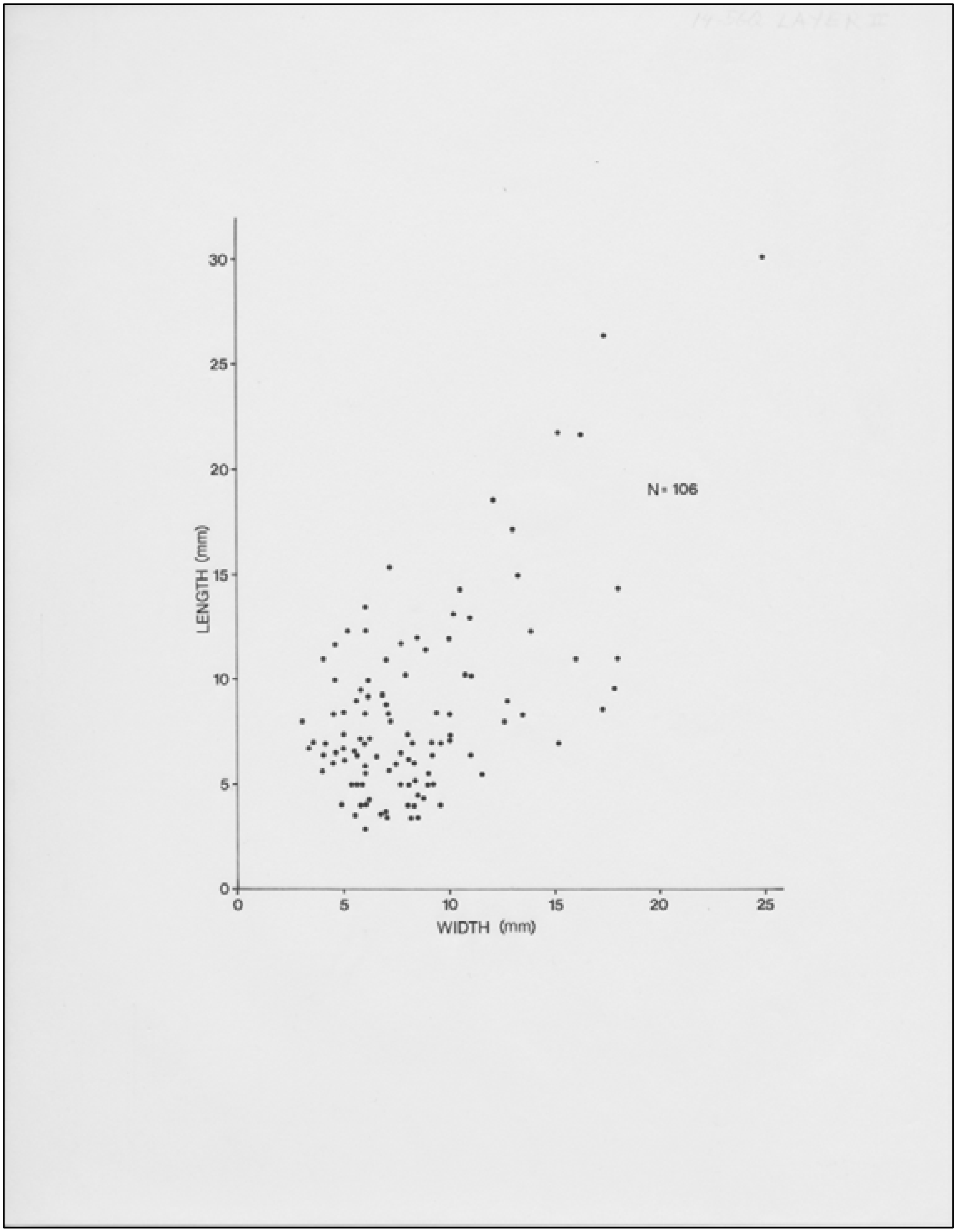


Figure 6.50. Scatterplot Diagram of Flake Length/Width Ratios, Site 16216 Basaltic Glass Source, Test Pit 1, Layer II.

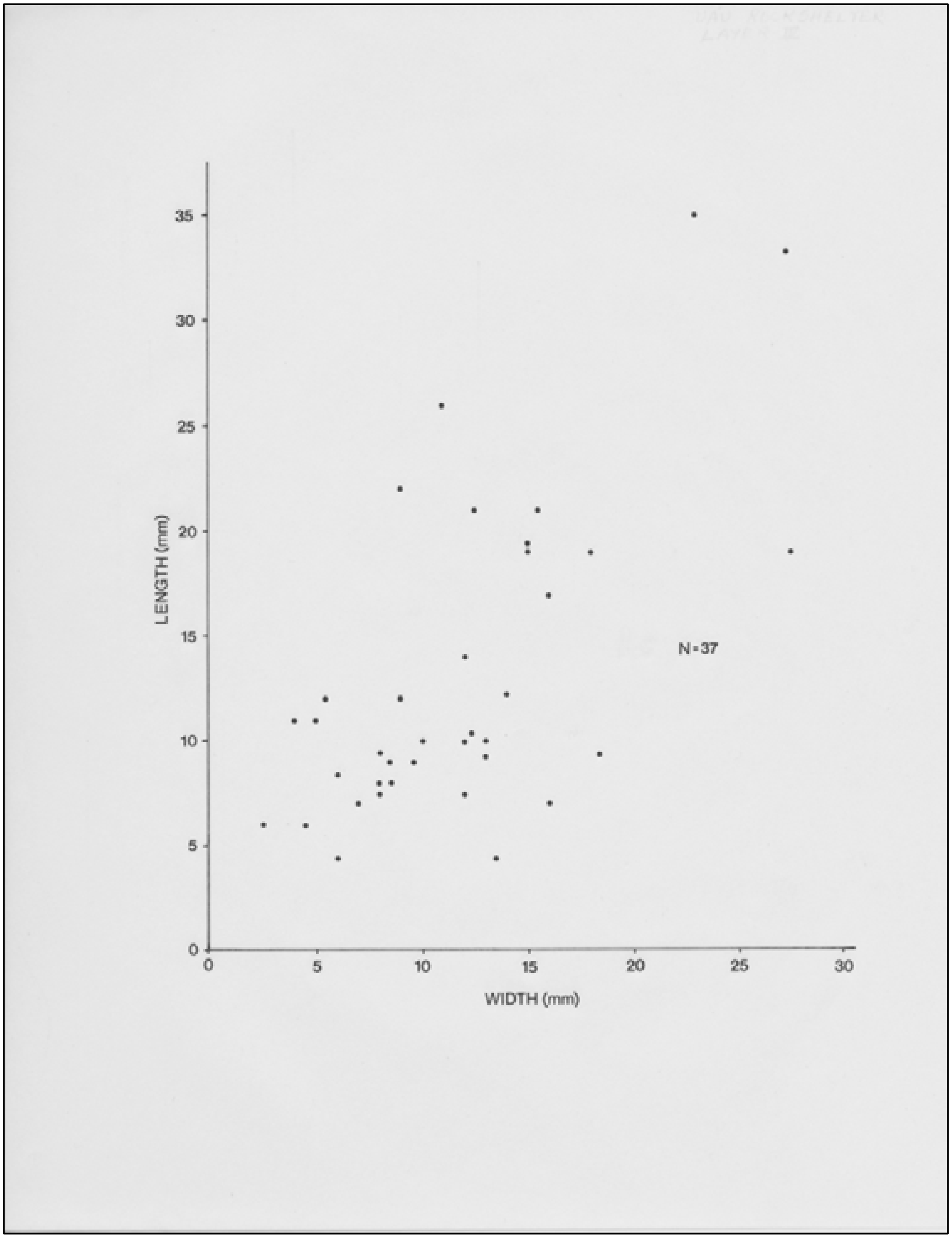


Figure 6.51. Scatterplot diagram of basaltic glass flake length/width ratios, \`U\`au Rockshelter (Site 16205) Layer IV.

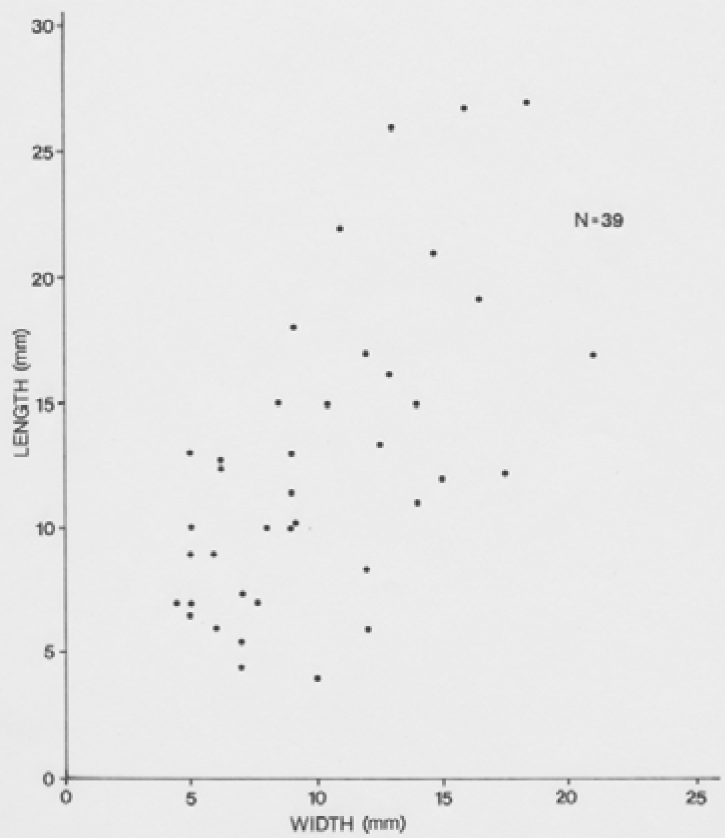


Figure 6.52. Scatterplot diagram of basaltic glass flake length/width ratios, Ko`oko`olau Rockshelter No. 1 (Site 16216) Layer VI.

Table 6.23. Qualitative Attributes of Basaltic Glass Flakes by Stratigraphic Layer from Ko`oko`olau Rockshelter No. 1, Site 16216.

Attribute	Layer I	Layer II	Layer IV	Layer VI	Layer VII	Layer VIII	Overall Percent Total
	%T (n=3)	%T (n=3)	%T (n=15)	%T (n=39)	%T (n=12)	%T (n=9)	
CORTEX							
Sticking Platform	0.00	0.00	42.85	23.52	27.27	23.52	26.08
Dorsal Surface	0.00	66.66	28.57	36.76	40.90	74.05	36.95
Striking Platform & Dorsal Surface	0.00	0.00	19.04	20.58	22.72	23.52	20.28
None	100.00	33.33	9.52	19.11	9.09	5.88	16.66
DORSAL RIDGES							
One	66.66	66.66	61.53	55.88	83.33	33.33	59.21
Two	0.00	33.33	15.38	17.64	0.00	0.00	13.15
None	33.33	0.00	23.07	26.47	16.66	66.66	27.63
BULB TYPE							
Negative	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Positive Salient	66.66	0.00	0.00	5.88	0.00	22.22	7.89
Positive Diffuse	33.33	100.00	100.00	94.11	100.00	77.77	92.10
TERMINATION TYPE							
Feather	0.00	0.00	11.76	11.76	0.00	0.00	6.66
Hinge	50.00	66.66	67.64	67.64	83.33	100.00	68.00
Outrepasse	0.00	0.00	2.94	2.94	0.00	0.00	5.33
Step	50.00	33.33	17.64	17.64	16.66	0.00	20.00
EDGE MORPHOLOGY							
Parallel	0.00	0.00	8.82	8.82	0.00	11.11	10.52
Sub-Parallel	33.33	33.33	20.58	20.58	25.00	0.00	22.36
Divergent	33.33	0.00	23.52	23.52	33.33	66.00	30.26
Convergent	33.33	66.66	41.17	41.17	41.66	22.22	34.21
Irregular	0.00	0.00	5.88	5.88	0.00	0.00	2.63

* 1 flake each in Layers III & V included in calculation of overall percent totals.

percentages at the two rockshelters correspond to the larger number of cores, compared to flakes. This suggests, once again, that the objective was to simply take some rough cores for further reduction elsewhere.

(4) Dorsal Ridges. One of the cornerstones of lithic analysis is the flake removal-negative scar relationship. Each flake that is detached from a core or an incipient adze, for example, theoretically leaves a negative scar. It follows that there should be an inverse correlation between cortex coverage and the number of dorsal ridges, though this will differ to some degree in terms of the core reduction versus flake blank reduction sequences contrast. In the case of the core reduction sequence one

Table 6.24. Qualitative Attributes of Basaltic Glass Flakes by Stratigraphic Layer from `Ua`u Rockshelter Site 16205.

Attribute	Layer I %T (n=5)	Layer III %T (n=14)	Layer IV %T (n=37)	Layer VI %T (n=17)	Layer VII %T (n=10)	Overall Percent Total
Cortex						
Sticking Platform	33.33	13.33	36.84	32.00	33.33	32.20
Dorsal Surface	50.00	20.00	28.07	28.00	33.33	28.81
Striking Platform & Dorsal Surface	16.66	6.66	22.80	24.00	20.00	18.64
None	0.00	60.00	12.28	16.00	13.33	20.33
Dorsal Ridges						
One	0.00	38.46	45.16	46.15	55.55	42.85
Two	25.00	30.76	25.80	30.76	33.33	28.57
None	75.00	30.76	29.03	23.07	11.11	28.57
Bulb Type						
Negative	0.00	7.14	0.00	0.00	0.00	1.40
Positive Salient	25.00	0.00	6.45	0.00	0.00	4.22
Positive Diffuse	75.00	92.85	93.54	100.00	100.00	94.36
Termination Type						
Feather	0.00	0.00	58.06	0.00	0.00	1.42
Hinge	50.00	53.84	3.22	61.53	66.66	58.57
Outrepasse	0.00	15.38	35.48	23.07	22.22	11.42
Step	50.00	30.76	17.64	15.38	11.11	58.57
Edge Morphology						
Parallel	0.00	0.00	12.90	0.00	0.00	5.71
Sub-Parallel	75.00	30.76	16.12	30.76	0.00	22.85
Divergent	25.00	23.07	38.70	23.07	11.11	28.57
Convergent	0.00	38.46	29.03	46.15	88.89	40.00
Irregular	0.00	7.69	3.22	0.00	0.00	2.85

* 1 flake each in Layer V included in calculation of overall percent totals.

would expect the first series of flakes to be cortical flakes with no dorsal ridges. This attribute was included in the original flake analysis (Cleghorn 1982:114-115). It was recorded in terms of a count of the number of ridges, but the rationale for including it was limited to determining the frequency with which later flake removals followed an existing ridge line.

The primary reason for including dorsal ridge counts in this study was to demonstrate, in conjunction with other related attributes, the existence of more than two stages of manufacture and to use this knowledge in interpreting site function. Some of the problems encountered in recording this attribute include making a decision as to what to include or exclude as dorsal ridges and the realization that though dorsal ridges are the result of physical processes there is a certain degree of deviation from the norm.

Theoretically the removal of a flake produces two dorsal ridges, but in reality this isn't always the case because the flake may be so thin and terminate in such a way as to leave no such ridges or just one ridge. The attribute is in some respects, then, not as promising as first thought. The several problems with recording and interpreting the significance or relevance of dorsal ridges or dorsal flake scars notwithstanding, it still remains useful in distinguishing earlier and later stage flakes. The recording methodology that was employed in this study made a count of the ridges in line with the long axis of whole flakes. The number was recorded as: (1) one; (2) two and (3) none.

(5) Bulb Type. The bulb of force was recorded as: (1) negative, (2) positive salient, and (3) positive diffuse. The latter, which is extremely flat in profile and sometimes hardly evident at all to the eye, is by far the most common type (see Tables 6.20, 6.23, and 6.24).

(6) Termination. This attribute was evident on the distal end of complete flakes or the distal end of a broken flake includes the following varieties: (1) feather, (2) hinge, (3) outrepasse, and (4) hinge (Crabtree 1972).

(7) Edge Morphology. The general shape of flakes is commonly described as one of the following: (1) parallel; (2) sub-parallel, (3) divergent (expanding in width from the proximal end toward the distal end), (4) convergent (the opposite of divergent—i.e., a flake with a proximal end that is wider than the distal end), and (5) irregular.

The three assemblages show a clear relationship between the small size of the raw material and manufacturing techniques. There is clearcut evidence of the use of the bipolar technique, which is one kind of direct-rest percussion. Diagnostic bipolar flake characteristics include crushed striking platforms and distal ends, diffuse bulbs of force, sheared cones, and directionally opposed compression rings on the proximal and distal end. These traits indicate the use of an anvil support which results in flakes with unusually flat ventral surfaces because almost directly opposite forces emanate from the hammerstone and the anvil (McCoy 1982:265). Experiments have demonstrated that the bipolar technique is ideally suited to the reduction of small nodules or chunks of material that are otherwise hard to hold in the hand (Crabtree 1972:10-11; Hayden 1980:2; Flenniken 1981:32).

Some flakes exhibit edge damage, which could be either natural or cultural because of the sedimentary contexts in which the glass was recovered. Several edges look to be deliberate retouch, thus indicating that some of the flakes were probably utilized. The presence of worked bird bone in both of the rockshelters with basaltic glass flakes suggests that the most likely use was the cutting and shaping of bone awls, needles or picks. A number of basalt flakes were recovered in the test excavation of the source area or “quarry.” The incorporation of these flakes into the deposit where the volcanic glass was found is a result of the close proximity to adze manufacturing workshops and post-depositional slope wash that has buried some of the basalt debitage.

6.5 Faunal and Floral Assemblages

Faunal remains and plant remains were recovered in all of the rockshelter excavations conducted in the NAR, in 1975-76. The faunal assemblages from the four excavated rockshelters in the NAR and two in the Hopukani Springs area of the Mauna Kea Adze Quarry Complex include a mixture of invertebrate and vertebrate remains, which in almost every instance are believed to represent a combination of food and non-food remains (Allen 1981; McCoy 1978, 1986, 1990). The salient characteristics of these assemblages are summarized below. The analysis begins, though, with a brief consideration of the depositional context of the faunal and floral assemblages and the effect of site formation processes on the condition of bones in particular. Following is a discussion of the analytical methods and procedures employed in the identification of the various assemblages including the names of the persons who donated their time to the effort. This brief examination of the faunal and floral assemblages concludes with a few words and thoughts about inter-site variability the Mauna Kea Adze Quarry Complex, and in particular the contrasts between the higher elevation sites along the escarpment in Zone 1 and the lower elevation habitations in the Waikahalulu and Pohakuloa gulch drainages.

6.5.1 Depositional Context, Site Formation Processes and Bone Condition

The excavated rockshelters in the NAR contain well-stratified deposits comprised primarily of tons of debitage (flake and other adze manufacturing by-products), but also including midden consisting of bone, shell, and plant remains. The depth of the deposits and stratigraphic distribution of features (primarily fire hearths), associated artifacts, and faunal and floral assemblages evidence a pattern of repeated, short-term occupations over a considerable span of time.

The reoccupation of such small living areas over the length of time so far indicated (several hundred years at the minimum to roughly 700 or possibly more years at the maximum) is manifested in the usual kinds of disturbances associated with the frequently confined spaces of rockshelters, especially at the mouth or entrance, just inside and exterior of the dripline. There is evidence for several kinds of disturbance, both natural and cultural, including enclosing wall construction and rebuilding; roof collapse; periodic cleaning of the living floor; excavation of the interior floor to create additional living space and trampling of the surface by humans and animals.

The result of these varied site formation processes is a complex set of stratigraphic relationships evidenced most clearly in overlapping interior (later) and exterior (earlier to later) sequences or stratigraphies. The exterior deposits are characteristically more mixed, reflecting the performance of more activities and accumulation of a more diverse assemblage of residues, including those from the interior floor that are inferred to have been periodically redeposited outside. These would have included food residues, charcoal and burnt wood, and large, bulky items like broken or misshapened adze preforms that were discarded rather than reworked. In some cases bones and shell from a later occupation were found in an underlying non-cultural soil layer or lens that is pedologically of different origin.

6.5.2 Analytical Methods and Procedures

Dr. Alan Ziegler was the first to examine the faunal remains recovered in the excavations of four habitation rockshelters, in 1975-76. Alan separated the bones from each assemblage into bird, mammal, and fish. Using the reference collections at the Bishop Museum, Alan was able to identify all of the mammals and most of the birds, except for some of the smaller forest species because of the lack of reference material. All of the bird bones were then sent to Dr. Storrs Olson and Dr. Helen James at the Smithsonian Institution for further identification. The fish remains were sent to Dr. William Follett, Curator Emeritus of Ichthyology at the California Academy of Sciences in San Francisco. Dr. Follett was able to identify a number of taxa based on the reference collection in San Francisco and additional specimens obtained from the fish markets in Honolulu with the assistance of Dr. Jack Randall of the Bishop Museum. Regretably, Dr. Follett's work was not completed before his death. His preliminary identifications were presented in McCoy (1978, 1990; Appendix M). Some time after the passing of Dr. Follett, the collections were returned to the senior author, who subsequently contacted Dr. Ziegler regarding his possible interest in completing the identifications. In recent years Alan had expanded his work from birds and mammals to include fish. Alan reanalyzed the collection in 2001 and provided a new set of identifications (Appendix L). Dr. Sara Collins analyzed the vertebrate fauna from the two rockshelters at Hopukani Springs that are used in a brief examination of inter-site assemblage variability.

In calculating the number of identified specimens or NISP we have followed Grayson in defining a specimen as "a bone or tooth, or fragment thereof" (Grayson 1984:16). Determining the NISP is complicated because some 92-98% of the bones from the 1975-76 excavations are fragments. Ziegler noted that many of the bird bones were "splintered" and that some of the breakage was deliberate. He called it "end-breakage" and conjectured that it was a form of butchering done prior to the possible portage of bird carcasses to the adze makers in the quarry from sites in the PTA area of the Humu`ula Saddle:

> Evidence of butchering of bird carcasses, consisting primarily of separating many various bones—even some of the quite small distal wing elements—at or near the joints, using a type of (presumably) stone implement is obvious on many of the skeletal elements assigned to Pterdroma phaeopygia (Hawaiian Petrel), as well as one of humerus of Branta sandvicensis. For lack of a better term, I have called this particular type of bone modification "end-breakage" (Ziegler 1993:4).
>
> My earlier identification work on faunal material from this same general area suggested that, in addition to a relatively few individuals of this species being eaten on-site, large numbers of (butchered) bodies of others had been stored in certain lava shelters, and I think it is conceivable that these were intended for periodic portage up to the Mauna Kea adze quarry during the annual working season there. Perhaps, this prepared bird material was carried up to the quarry workers by some of the same porters who, after taking adze blanks or performs to the lowlands by a more-direct route, were now detouring through this part of the Saddle Area on their way back up the mountain (Ziegler 1993:5).

Some of the breakage is also undoubtedly due to the matrix in which the bones were recovered—deposits of basically sharp-edged flakes and little else.

A highly fragmented assemblage would have higher NISPs for all species, but relative species abundance would remain unchanged. However, fragmentation need not affect all species equally (Klein and Cruz-Uribe 1984:25). For example, the bird and fish bone is more fragmented than the little mammal bone that was recovered. Bone preservation was otherwise good. In addition to breakage, Ziegler also noted evidence of rodent gnawing on a few bones.

6.5.3 Vertebrate Fauna

The vertebrate fauna includes fish, bird, and mammal (Table 6.25). The "small vertebrate" category represents essentially unidentifiable material that was recovered in small screens in a matrix analysis of selected soil samples from surface proveniences and features in the two Hopukani rockshelters (McCoy 1986:15-17). Figure 6.53 shows the NISP values for bird, mammal and fish by identified taxa for the four rockshelters in the NAR. Tables 6.26-6.29 present the identifications for each of the four rockshelters and corresponding NISP counts.

Table 6.25. NISP Summaries for Vertebrate Fauna Remains from Four Rockshelters,.

Zone/Rockshelter Name	Bird		Fish		Mammal		Sm. Vertebrate	
	NISP	%	NISP	%	NISP	%	NISP	%
Zone 1								
Ko`oko`olau 1	1,667	74.25	570	25.38	7	0.3	1	<0.1
`Ua`u	872	34.10	1,667	65.19	18	0.7	0	0.0
Zone 2								
`Ahinahina	24	42.85	32	57.14	0	0.0	0	0.0
Zone 3								
Waikahalulu	0	0.0	797	99.50	4	0.4	0	0.0
TOTALS	**2,563**	**42.66**	**2,271**	**40.10**	**29**	**0.5**	**4**	**0.07**

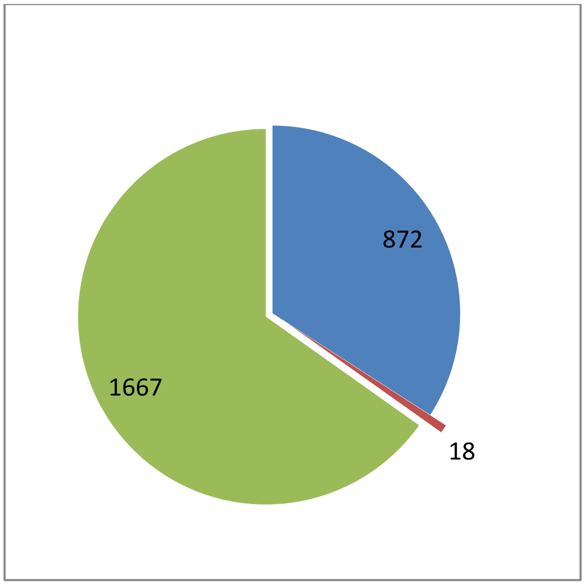
Table 6.26. NISP Summary of Vertebrate Faunal Remains from Site 16210 (`Ahinahina Rockshelter)

	Stratigraphic Layer							
	Surface		I		II		TOTAL	
TAXON	NISP	%NISP	NISP	%NISP	NISP	%NISP	NISP	%NISP
BIRDS								
Medium Procellariid	1	50.00%	3	50.00%		0.00%	4	12.50%
Small Passeriform	1	50.00%		0.00%		0.00%	1	3.13%
Small Bird		0.00%	3	50.00%	24	100.00%	27	84.38%
LAYER TOTAL	2	100.00%	6	100.00%	24	100.00%	32	100.00%
TOTAL ASSEMBLAGE	2	6.25%	6	18.75%	24	75.00%	32	100.00%

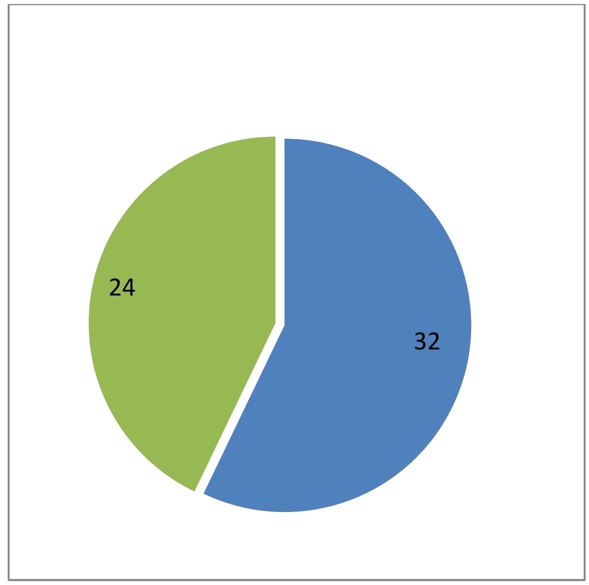
6.5.3.1 Birds

A total of 21 taxa of birds, including three taxa identified to a general size class (Table 6.30), have been identified at this time. The large number of bones assigned to only a size class (small, medium and large) is due to the high degree of fragmentation in all of the assemblages. According to Ziegler, there is reason to believe that most of the bones in both the "Small" and "Medium" Procellariid category are probably those of the dark-rumped petrel (cf. *Pterodroma phaeopygia sandwichensis*). The same opinion is held with regard to the large number of bones in the "Medium Bird" category [petrel, duck, crow size range] which is probably 90% or more dark-rumped petrel. The petrel bone includes skeletal elements of immature birds. The other 10-20% or so of the bird bones are distributed among seven families (Figures 6.54-6.57). The small passeriform material probably includes both thrushes and honeycreepers, which are probably also well represented in the otherwise unidentifiable material in the "Small Bird" category that might also include fragments of two or more taxa in the Rallidae family. The "Small Rallid" and coot (*Fulica americana alai*) from Hopukani Rockshelter No. 1 (McCoy 1986) represent yet two more newly reported members of the family Rallidae in the quarry avifauna, which also includes *Porzana sandwichensis* and an extinct "Medium Rallid" (Olson and James 1982).

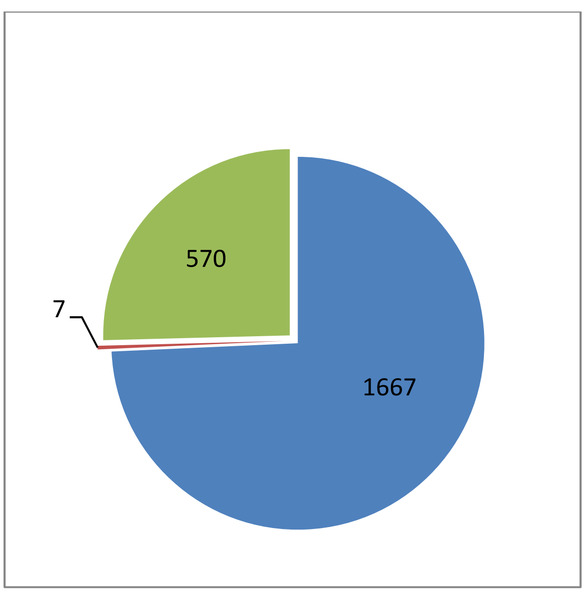
A comparison of the six assemblages (Table 6.31) shows a high degree of redundancy in the large percentage of bones in the "Medium" bird category with the exception of `Ahinahina Rockshelter. There is at the same time clear evidence of inter-site variability in species diversity, much of which is probably due, however, to sample size effects. On present evidence goose is restricted to Ko`oko`olau Rockshelter No. 1, and the rail material to earlier stratigraphic contexts (see Table 6.28).



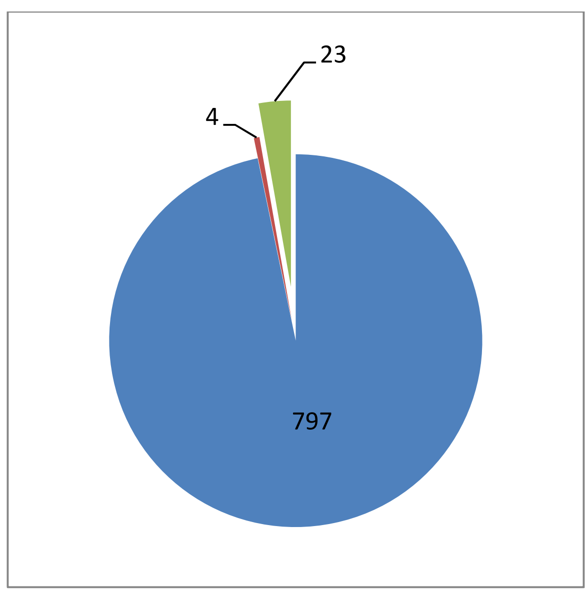
Site 16205 (`Ua`u Rockshelter) NISP=2,557



Site 16210 (`Ahinahina Rockshelter) NISP=56



Site 16216 (Ko`oko`olau Rockshelter) NISP=2,245



Site 16233 (Waikahalulu Rockshelter) NISP=824

Figure 6.53. Pie Charts Showing Number of Individual Specimen Counts at Four Rockshelters.

Table 6.27. NISP Summary of Vertebrate Faunal Remains from Site 16205 (`Ua'u Rockshelter).

	Stratigraphic Layer																									
	I		I/II		II		II-IV lens		III		III-IV-V		IV		V		VI		VI-VII		VII		VIII		TOTAL	
TAXON	NISP	% NISP	NISP	% NISP	NISP	% NISP	NISP	% NISP	NISP	% NISP	NISP	% NISP	NISP	% NISP	NISP	% NISP	NISP	% NISP	NISP	% NISP	NISP	% NISP	NISP	% NISP	NISP	% NISP
BIRDS																										
Pterodroma phaeopygia		0.00%	1	3.13%	1	0.55%	1	16.67%	6	2.30%		0.00%	10	5.18%	1	7.14%	2	2.08%		0.00%		0.00%		0.00%	22	2.52%
Medium Procellariid	3	8.82%	2	6.25%	12	6.59%		0.00%	16	6.13%		0.00%	18	9.33%		0.00%	1	1.04%		0.00%		0.00%		0.00%	52	5.96%
Small Anatid		0.00%		0.00%	1	0.55%		0.00%	3	1.15%		0.00%	1	0.52%		0.00%		0.00%		0.00%		0.00%		0.00%	5	0.57%
Gallus gallus		0.00%		0.00%	2	1.10%		0.00%	1	0.38%		0.00%	1	0.52%		0.00%	1	1.04%		0.00%		0.00%		0.00%	5	0.57%
Porzana sandwichensis		0.00%		0.00%	1	0.55%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%	1	4.17%		0.00%	2	0.23%
Corvus hawaiiensis		0.00%	1	3.13%	2	1.10%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%	3	0.34%
Psittirostra sp.		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%	1	1.04%		0.00%		0.00%		0.00%	1	0.11%
Himatione sanguinea		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%	1	1.04%		0.00%		0.00%		0.00%	1	0.11%
Small Passeriform		0.00%	2	6.25%	2	1.10%		0.00%	9	3.45%	5	22.73%	13	6.74%	4	28.57%	13	13.54%		0.00%	1	4.17%		0.00%	49	5.62%
Large Bird		0.00%		0.00%	2	1.10%		0.00%	2	0.77%		0.00%	1	0.52%		0.00%		0.00%		0.00%		0.00%		0.00%	5	0.57%
Medium Bird	25	73.53%	16	50.00%	157	86.26%	5	83.33%	218	83.52%	10	45.45%	139	72.02%	5	35.71%	61	63.54%	2	100.00%	22	91.67%	6	100.00%	666	76.38%
Small Bird	2	5.88%		0.00%	1	0.55%		0.00%	6	2.30%	6	27.27%	10	5.18%	4	28.57%	10	10.42%		0.00%		0.00%		0.00%	39	4.47%
Small / Medium Bird	4	11.76%	10	31.25%	1	0.55%		0.00%		0.00%	1	4.55%		0.00%		0.00%	6	6.25%		0.00%		0.00%		0.00%	22	2.52%
Layer Total	34	100.00%	32	100.00%	182	100.00%	6	100.00%	261	100.00%	22	100.00%	193	100.00%	14	100.00%	96	100.00%	2	100.00%	24	100.00%	6	100.00%	872	100.00%
Total Assemblage	34	3.90%	32	3.67%	182	20.87%	6	0.69%	261	29.93%	22	2.52%	193	22.13%	14	1.61%	96	11.01%	2	0.23%	24	2.75%	6	0.69%	872	100.00%
MAMMALS																										
Sus scrofa		0.00%		0.00%	4	80.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%	4	44.44%
Rattus exulans		0.00%		0.00%		0.00%		0.00%	1	33.33%	1	100.00%	1	100.00%		0.00%		0.00%		0.00%		0.00%		0.00%	3	33.33%
Medium mammal		0.00%		0.00%	1	20.00%		0.00%	1	33.33%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%	2	22.22%
Small mammal		0.00%		0.00%		0.00%		0.00%	1	33.33%		0.00%	8	0.00%		0.00%		0.00%		0.00%		0.00%		0.00%	9	0.00%
Layer Total	0	0.00%	0	0.00%	5	100.00%	0	0.00%	3	100.00%	1	100.00%	1	100.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	9	100.00%
Total Assemblage	0	0.00%	0	0.00%	5	27.78%	0	0.00%	3	16.67%	1	5.56%	9	50.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	18	100.00%
VERTEBRATES																										
Small / Medium Vertebrate		0.00%	2	100.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%	1	100.00%		0.00%	3	100.00%
Layer Total	0	0.00%	2	100.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	1	100.00%	0	0.00%	3	100.00%
Total Assemblage	0	0.00%	2	66.67%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	1	33.33%	0	0.00%	3	100.00%
FISH																										
Belonidae		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%	1	7.69%	1	0.06%
Holocentridae		0.00%	1	1.79%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%	1	0.06%
Polynemidae		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%	1	0.66%		0.00%		0.00%		0.00%	1	0.06%
Carangidae		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%	2	7.14%	1	7.69%	3	0.18%
Mullidae		0.00%		0.00%		0.00%		0.00%	1	0.23%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%	1	0.06%
Labridae	1	1.20%	3	5.36%	4	0.61%		0.00%	5	1.14%		0.00%	5	2.44%		0.00%	8	5.26%		0.00%		0.00%		0.00%	26	1.56%
Scaridae	2	2.41%		0.00%		0.00%		0.00%		0.00%		0.00%	2	0.98%		0.00%	2	1.32%		0.00%		0.00%		0.00%	6	0.36%
Acanthuridae	1	1.20%		0.00%	3	0.45%		0.00%	4	0.91%		0.00%		0.00%		0.00%	1	0.66%		0.00%		0.00%		0.00%	9	0.54%
Scombridae		0.00%		0.00%	16	2.42%		0.00%	2	0.46%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%	18	1.08%
Gobiidae		0.00%		0.00%		0.00%		0.00%	8	1.82%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%	8	0.48%
Unidentified Fish	79	95.18%	52	92.86%	638	96.52%	5	100.00%	419	95.44%	13	100.00%	198	96.59%	7	100.00%	140	92.11%	5	100.00%	26	92.86%	11	84.62%	1593	95.56%
LAYER TOTAL	83	100.00%	56	100.00%	661	100.00%	5	100.00%	439	100.00%	13	100.00%	205	100.00%	7	100.00%	152	100.00%	5	100.00%	28	100.00%	13	100.00%	1667	100.00%
TOTAL ASSEMBLAGE	83	4.98%	56	3.36%	661	39.65%	5	0.30%	439	26.33%	13	0.78%	205	12.30%	7	0.42%	152	9.12%	5	0.30%	28	1.68%	13	0.78%	1667	100.00%

Table 6.28. NISP Summary of Vertebrate Faunal Remains at Site 16216 Rockshelter 1 (Ko`oko`olau Rockshelter).

	Stratigraphic Layer																													
	Surface		I		II		II-III lens		III		IV		IV-V		V		VI		VII		VII-VIII		VIII		IX		TOTAL	
TAXON	NISP	% NISP	NISP	% NISP	NISP	% NISP	NISP	% NISP	NISP	% NISP	NISP	% NISP	NISP	% NISP	NISP	% NISP	NISP	% NISP	NISP	% NISP	NISP	% NISP	NISP	% NISP	NISP	% NISP	NISP	% NISP
BIRDS																														
Pterodroma phaeopygia	6	21.43%	5	5.21%	28	9.46%		0.00%	6	18.18%	3	3.19%	3	4.55%	7	6.80%	21	5.29%	7	2.72%		0.00%		0.00%		0.00%	86	5.16%
Medium Procellariid	2	7.14%	2	2.08%	27	9.12%		0.00%		0.00%	9	9.57%	2	3.03%	8	7.77%	20	5.04%	13	5.06%	6	3.59%		0.00%	1	3.03%	90	5.40%
Nesochen sandvicensis		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%	11	2.77%	5	1.95%	3	1.80%	3	3.13%		0.00%	22	1.32%
Small Procellariid		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%	1	0.60%		0.00%		0.00%	1	0.06%
Small Anatid		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%	2	1.94%		0.00%	2	0.78%	2	1.20%		0.00%		0.00%	6	0.36%
Gallus gallus	5	17.86%	17	17.71%	9	3.04%		0.00%		0.00%		0.00%	1	1.52%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%	32	1.92%
Porzana sandwichensis		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%	1	0.97%	1	0.25%	3	1.17%		0.00%	1	1.04%		0.00%	6	0.36%
Medium Rallid		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%	2	0.50%	1	0.39%	1	0.60%		0.00%		0.00%	4	0.24%
Corvus hawaiiensis		0.00%	1	1.04%	2	0.68%		0.00%	1	3.03%		0.00%	1	1.52%	1	0.97%	2	0.50%	2	0.78%		0.00%	1	1.04%		0.00%	11	0.66%
Hemignathus virens		0.00%		0.00%	1	0.34%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%	1	0.06%
Small Passeriform		0.00%	6	6.25%	1	0.34%		0.00%		0.00%	3	3.19%		0.00%	5	4.85%	7	1.76%	4	1.56%	1	0.60%		0.00%		0.00%	27	1.62%
Large Bird	5	17.86%	42	43.75%	2	0.68%		0.00%		0.00%		0.00%		0.00%	2	1.94%	61	15.37%	14	5.45%	17	10.18%	31	32.29%		0.00%	174	10.44%
Medium Bird	10	35.71%	19	19.79%	211	71.28%	1	100.00%	26	78.79%	77	81.91%	59	89.39%	74	71.84%	270	68.01%	200	77.82%	130	77.84%	57	59.38%	31	93.94%	1165	69.89%
Small Bird		0.00%	4	4.17%	15	5.07%		0.00%		0.00%	2	2.13%		0.00%	1	0.97%	2	0.50%	6	2.33%	6	3.59%	3	3.13%	1	3.03%	40	2.40%
Small / Medium Bird		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%	2	1.94%		0.00%		0.00%		0.00%		0.00%		0.00%	2	0.12%
LAYER TOTAL	28	100.00%	96	100.00%	296	100.00%	1	100.00%	33	100.00%	94	100.00%	66	100.00%	103	100.00%	397	100.00%	257	100.00%	167	100.00%	96	100.00%	33	100.00%	1667	100.00%
TOTAL ASSEMBLAGE	28	1.68%	96	5.76%	296	17.76%	1	0.06%	33	1.98%	94	5.64%	66	3.96%	103	6.18%	397	23.82%	257	15.42%	167	10.02%	96	5.76%	33	1.98%	1667	100.00%
MAMMALS																														
Sus scrofa		0.00%	1	100.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%	1	14.29%
Canis familiaris		0.00%		0.00%	2	50.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%	2	28.57%
Rattus exulans	2	100.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%	2	28.57%
Medium mammal		0.00%		0.00%	2	50.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%	2	28.57%
LAYER TOTAL	2	100.00%	1	100.00%	4	100.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	7	100.00%
TOTAL ASSEMBLAGE	2	28.57%	1	14.29%	4	57.14%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	7	100.00%
VERTEBRATES																														
Small / Medium Vertebrate		0.00%		0.00%	1	100.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%	1	100.00%
LAYER TOTAL	0	0.00%	0	0.00%	1	100.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	1	100.00%
TOTAL ASSEMBLAGE	0	0.00%	0	0.00%	1	100.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	1	100.00%
FISH																														
Albulidae		0.00%		0.00%	1	0.44%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%	1	0.18%
Priacanthidae		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%	1	1.00%		0.00%		0.00%		0.00%		0.00%	1	0.18%
Lutjanidae		0.00%		0.00%	2	0.88%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%	2	0.35%
Cirrhitidae		0.00%		0.00%	3	1.33%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%	3	0.53%
Labridae		0.00%		0.00%	1	0.44%		0.00%	3	2.27%		0.00%		0.00%	2	2.94%	4	4.00%	1	12.50%		0.00%		0.00%		0.00%	11	1.93%
Scaridae		0.00%		0.00%	9	3.98%		0.00%		0.00%		0.00%		0.00%	6	8.82%	2	2.00%		0.00%		0.00%	1	7.14%		0.00%	18	3.16%
Acanthuridae		0.00%		0.00%	4	1.77%		0.00%	1	0.76%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%	5	0.88%
Scombridae		0.00%		0.00%	9	3.98%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%	9	1.58%
Unidentified Fish		0.00%	11	100.00%	197	87.17%	3	100.00%	128	96.97%	8	100.00%		0.00%	60	88.24%	93	93.00%	7	87.50%		0.00%	13	92.86%		0.00%	520	91.23%
LAYER TOTAL	0	0.00%	11	100.00%	226	100.00%	3	100.00%	132	100.00%	8	100.00%	0	0.00%	68	100.00%	100	100.00%	8	100.00%	0	0.00%	14	100.00%	0	0.00%	570	100.00%
TOTAL ASSEMBLAGE	0	0.00%	11	1.93%	226	39.65%	3	0.53%	132	23.16%	8	1.40%	0	0.00%	68	11.93%	100	17.54%	8	1.40%	0	0.00%	14	2.46%	0	0.00%	570	100.00%

Table 6.29. NISP Summary of Vertebrate Faunal Remains from Site 16233 (Waikahalulu Rockshelter No. 1)

	Stratigraphic Layer															
	Surface		I		II		III		IV		V		VI		TOTAL	
TAXON	NISP	% NISP	NISP	% NISP	NISP	% NISP	NISP	% NISP	NISP	% NISP	NISP	% NISP	NISP	% NISP	NISP	% NISP
BIRDS																
Pterodroma phaeopygia	5	71.43%	0	0.00%	1	11.11%	1	0.70%	5	6.49%	4	0.78%	1	2.04%	17	2.13%
Medium Procellariid	1	14.29%	0	0.00%	0	0.00%	4	2.80%	3	3.90%	3	0.59%	0	0.00%	11	1.38%
Small Procellariid	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	2	0.39%	0	0.00%	2	0.25%
Small Anatid	0	0.00%	0	0.00%	0	0.00%	1	0.70%	0	0.00%	1	0.20%	0	0.00%	2	0.25%
Porzana sandwichensis	0	0.00%	0	0.00%	0	0.00%	2	1.40%	0	0.00%	0	0.00%	1	2.04%	3	0.38%
Asio flammeus	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	1	0.20%	0	0.00%	1	0.13%
Corvus hawaiiensis	1	14.29%	1	100.00%	0	0.00%	0	0.00%	1	1.30%	0	0.00%	0	0.00%	3	0.38%
Medium Bird	0	0.00%	0	0.00%	8	88.89%	128	89.51%	66	85.71%	488	95.50%	46	93.88%	736	92.35%
Small Bird	0	0.00%	0	0.00%	0	0.00%	7	4.90%	2	2.60%	12	2.35%	1	2.04%	22	2.76%
LAYER TOTAL	7	100.00%	1	100.00%	9	100.00%	143	100.00%	77	100.00%	511	100.00%	49	100.00%	797	100.00%
TOTAL ASSEMBLAGE	7	0.88%	1	0.13%	9	1.13%	143	17.94%	77	9.66%	511	64.12%	49	6.15%	797	100.00%
MAMMALS																
Rattus exulans	0	0.00%	0	0	1	50.00%	1	100.00%	0	0.00%	1	100.00%	0	0	3	75.00%
Medium mammal	0	0.00%	0	0	1	50.00%	0	0.00%	0	0.00%	0	0.00%	0	0	1	25.00%
LAYER TOTAL	0	0.00%	0	0.00%	2	100.00%	1	100.00%	0	0.00%	1	100.00%	0	0.00%	4	100.00%
TOTAL ASSEMBLAGE	0	0.00%	0	0.00%	2	50.00%	1	25.00%	0	0.00%	1	25.00%	0	0.00%	4	100.00%

Table 6.30 List of Identified Bird Taxa, Common Names and Hawaiian Name.

Taxa	Common Name	Hawaiian Name
Procellaridae	**Petrels, Shearwaters**	
Pterodroma phaeogygia	Dark-rumped petrel	*`ua`u*
Medium procellarid	Dark-rumped petrel?	
Small procellarid	Bulwer's petrel?	*`ou*
Anatidae	**Geese, Ducks**	
Nesochen sandvicensis	Hawaiian goose	*nene*
Small Anatid	Hawaiian duck ?	*koloa*
Phasianidae	**Francolins, pheasants, quails, chicken**	
Gallus gallus	Domestic chicken	
Raillidae	**Rails, gallinules, coots**	
Porzana sandwichensis	Hawaiian rail	*moho*
Fulica Americana alai	Hawaiian coot	*`ala eke`ke`o*
Medium rallid	Medium-size rail	
Small rallid	Small-size rail	
Strigidae	**Typical owls**	
Asio flammeus sandwichensis	Hawaiian owl (short-eared owl)	*pueo*
Corvidae	**Crows**	
Corvus hawaiiensis	Hawaiian crow	*`alala*
Corvus spp.	Crow species	
Drepanidae	**Hawaiian honeycreepers**	
Psittirostrini	Finch-billed honeycreepers	
Psittirostrinid		
Hemignathini	Slender-billed honeycreepers	
Hemignathus virens virens		*`amakihi*
Drepanidini	Red and black honeycreepers	
Himatione sanguinea		*`apapane*
Small passeriform	**Forest bird**	
Large bird (a)		
Large bird (b)		
Medium bird	**Petrel, duck, crow size range**	
Small bird	**Small passeriform, rail size range**	

6.5.3.2 Mammals

A total of only 32 mammal bones, representing 0.37% of the total bones of all classes, was recovered in the excavations. Of the 32 bones there are a total of only ten that fall into the dog and pig size range ["Medium" mammal] and of these only three could be positively identified as pig (*Sus scrofa*) and two as dog (*Canis familiaris*). The remainder of the bones are those of the Pacific rat (*Rattus exulans*), or in that size range ["Small" mammal].

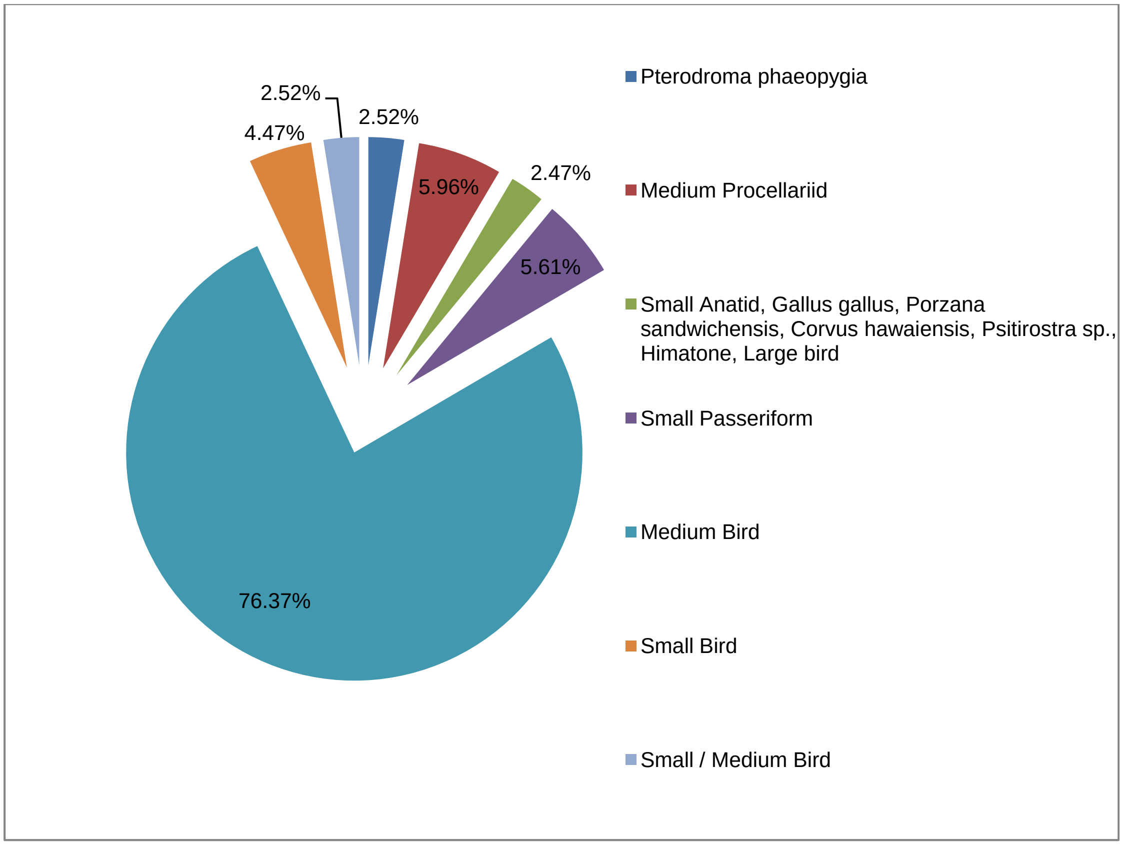


Figure 6.54. Relative Abundances of Bird Taxa at Site 16205.

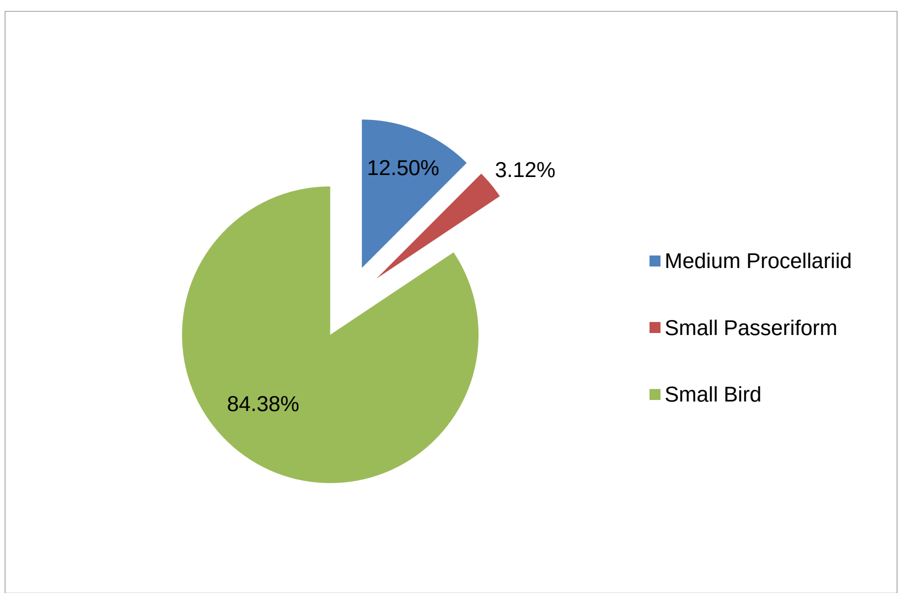


Figure 6.55. Relative Abundances of Bird Taxa at Site 16210.

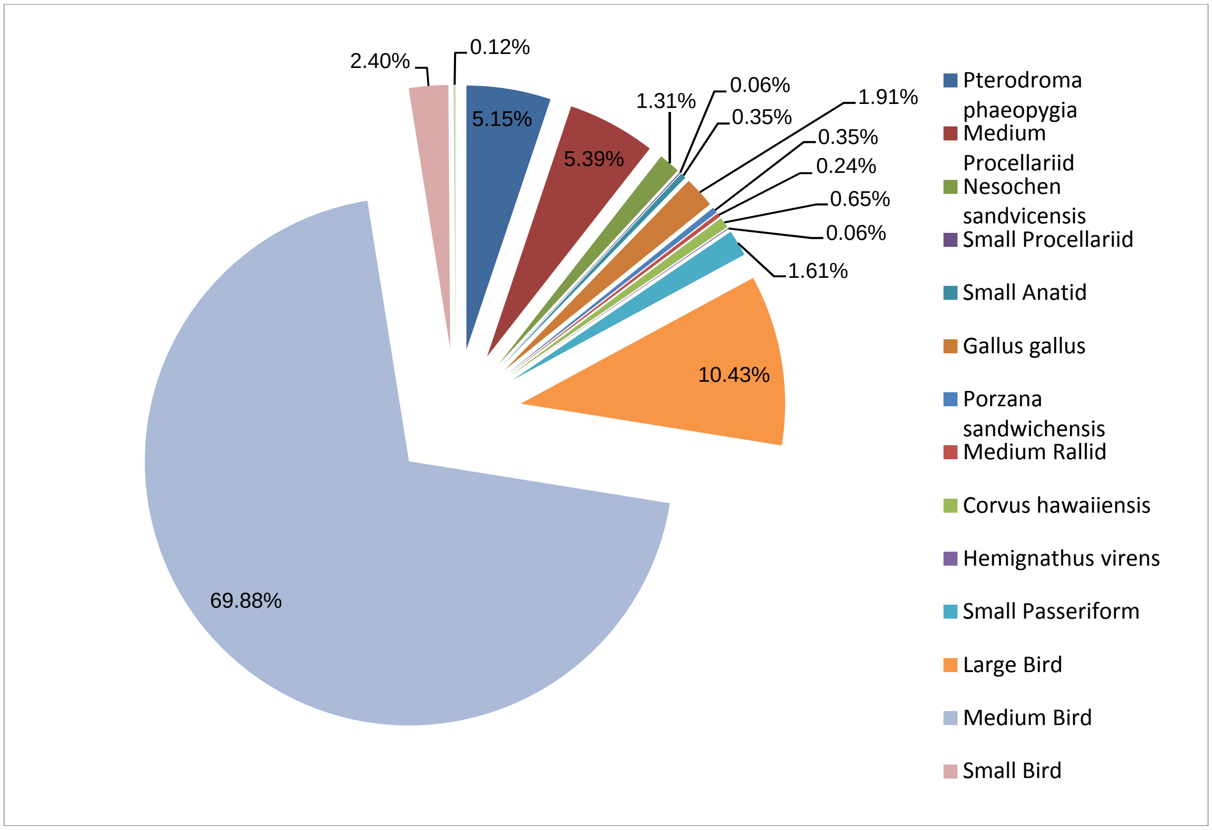


Figure 6.56. Relative Abundances of Bird Taxa at Site 16216.

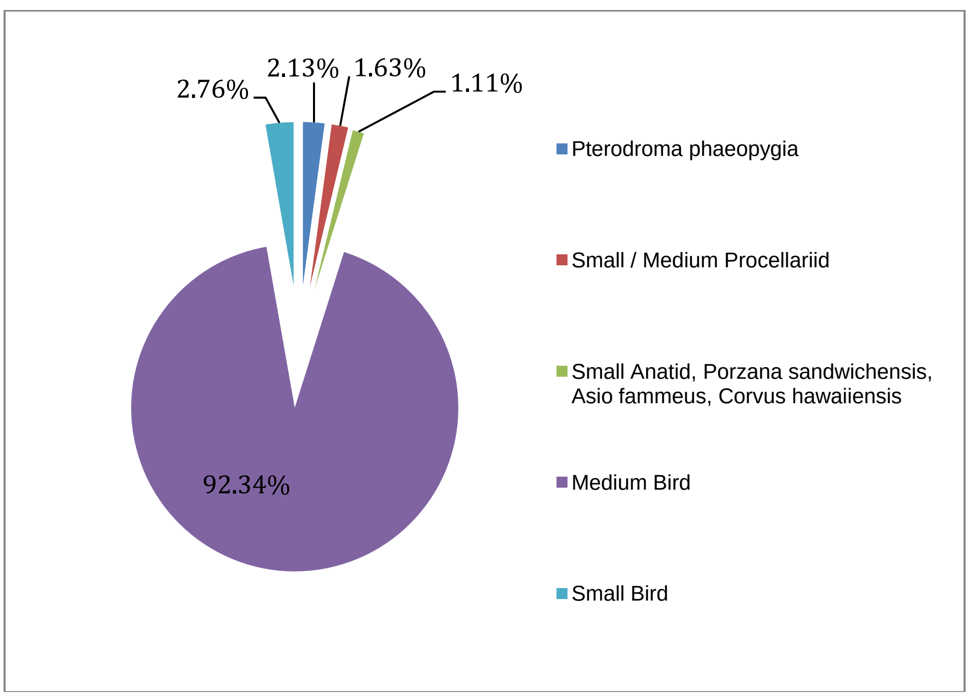


Figure 6.57. Relative Abundances of Bird Taxa at Site 16233.

Table 6.31. Birds and Mammal NISP for Six Rockshelters.

TAXON	Ko'oko'olau Rockshelter No. 1		`Ua'u Rockshelter		`Ahinahina Rockshelter		Hopukani Rockshelter 1		Hopukani Rockshelter 2		Waikahalulu Rockshelter		TOTALS (All Sites)	
	NISP	%T	NISP	%T	NISP	%T	NISP	%T	NISP	%T	NISP	%T	NISP	%T
AVES														
Procellaridae														
cf. Pterodroma phaeopygia	85	5.14	22	2.74			70	6.16			17	2.13	194	4.36
Medium Procellariid	92	5.56	43	5.36	4	12.5	77	6.78	6	23	11	1.38	233	5.24
Small Procellariid	1	0.06									2	0.25	3	0.07
Anatidae														
cf. Nesochen sandwicensis	22	1.33												
Small Anatid	5	0.3	5	0.62							2	0.25	22	0.49
Phasianidae													12	0.27
cf. Gallus gallus	33	2.0	5	0.62			8	0.7					46	1.03
Rallidae														
cf. Porzana sandwichensis	6	0.36	2	0.25							3	0.38	11	0.25
cf. Fulica americana alai							1	0.09					1	0.02
Medium Rallid	4	0.24											4	0.09
Small Rallid							4	0.35					4	0.09
Strigidae														
cf. Asio flammeus sandwichensis											1	0.13	1	0.02
Corvidae														
cf. Corvus hawaiiensis	12	0.73	3	0.37							3	0.38	18	0.4
cf. Corvis spp.							18	1.58					18	0.4
Drepanidinae							7	0.62					7	0.16
Psittirostrini														
cf. Psittirostrinid			1	0.12									1	0.02
Hemignathini														
cf. Hemignatus virens virens	1	0.06											1	0.02

Table 6.31. Birds and Mammal NISP for Six Rockshelters.

TAXON	Ko'oko'olau Rockshelter No. 1		`Ua'u Rockshelter		`Ahinahina Rockshelter		Hopukani Rockshelter 1		Hopukani Rockshelter 2		Waikahalulu Rockshelter		TOTALS (All Sites)	
	NISP	%T	NISP	%T	NISP	%T	NISP	%T	NISP	%T	NISP	%T	NISP	%T
Drepanidini														
cf. Himatione sanguinea			1	0.12									1	0.02
Small Passeriform	25	1.51	48	5.99	1	3.13	29	2.55					103	2.32
Large Bird (a)	165	9.98	2	0.25									167	3.76
Large Bird (b)	3	0.18	2	0.25									5	0.11
Medium Bird	1161	70.19	628	78.3			856	75.35	20	76.92	736	92.35	3401	76.48
Small Bird	39	2.36	40	4.99	27	84.38	66	5.81			22	2.76	194	4.36
TOTAL	**1654**		**802**		**32**		**1136**		**26**		**797**		**4447**	
MAMMALIA														
Sus scrofa	1	14.29	2	11.76									3	9.38
Canis familiaris	2	28.57											2	6.25
cf. Rattus exulans	2	28.57	4	23.53			3	60.0			2	66.67	11	34.38
Rattus spp.							2	40.0					2	6.25
cf. Medium Mammal	2	28.57	2	11.76							1	33.33	5	15.63
Small Mammal			9	52.94									9	28.13
TOTAL	7		17				5				3		32	

With the exception of a single "Medium" mammal bone from Waikahalulu Rockshelter, all of the dog and pig bone was recovered from the two upper elevation sites. The two dog bones, a cranial fragment and radius, were recovered from a late stratigraphic context in Ko`oko`olau Rockshelter No. 1. The pig bone from `Ua`u Rockshelter includes: (1) two matching fragments of a lower incisor from an individual of uncertain age, but almost surely older than a 2-3 month old piglet and (2) matching fragments of a lower 4th milk premolar estimated to be from a piglet 8 plus or minus 2 months old, both from Layer II. The one fragment from Ko`oko`olau Rockshelter No. 1 is a parietal that according to Dr. Alan Ziegler, who made the identifications, is that of a 3 plus or minus 1 month old individual. Ziegler noted cut marks on the dorsal surface of this bone. The cut marks are open to various interpretations. While it is hard to believe that a small piglet would have been butchered and that the head would have been cut, there are ethnographic descriptions of dogs being cut up and wrapped in *ti* leaf bundles (see below).

In the re-analysis of what was believed to be just fish bone based on the initial analysis in the 1970s, in 2001 Ziegler identified a single postcanine tooth fragment of cf. *Capra hircus/Ovis sp*. from Layer III of `Ua`u Rockshelter. The deposits in this area are shallow and mixed. The bone was found in association with the beak of an octopus or squid and bones of the freshwater gobie. Ziegler remarked that this puzzling find was hard to explain, especially since there was just this one tooth fragment. He noted that if a goat had died inside the rockshelter one would expect to recover more bone fragments. In reviewing the provenience of the tooth, it appears that a more likely explanation for the presence of this single artiodactyl tooth is stratigraphic disturbance. The tooth fragment was found at the back of the rockshelter, in an area with a shallow cultural deposit. It could have easily fallen into the trench during the excavation or have been introduced by a wild goat or sheep.

6.5.3.3 Fish

A total of 14 families of species of fish have been identified at this time (Table 6.32). There are no family level identifications available for the four lower elevation camps, but since there are only 66 fish bones from these locations (Table 6.33) this means that essentially all of the 14 families are from the two basecamps in Zone 1 (`Ua`u Rockshelter and Ko`oko`olau Rockshelter No. 1). The 14 families represent a wide range of habitats; including both marine and freshwater (see Table 6.32). The distribution is clearly uneven, however, with a better representation of inshore reef species, especially wrasses and parrotfishes (Figure 6.58).

With regard to the gobies, even though Ziegler did not have a reference collection, he included a handwritten note that he had no reason to doubt Dr. Follett's identification. Ziegler noted, though, a change in the name from *Chonophorus stamineus* to *Awaous guamensis*, that it was endemic to the Hawaiian Islands and that the Hawaiian name is *`o`opu nakea.* Ziegler also mentioned that the cranial bones of the gobiid are paired right and left, just as are the premaxillaries and dentaries. This suggests the strong possibility that all four bones may be from the same individual.

At `Ua`u Rockshelter many of the identifiable fish bones in Layers I and I/II are dentary and pharyngeal plates (i.e. the head and jaw area), some of which were recovered from distinctive lenses of the deposit. This suggests the possibility of the deliberate placement of the heads of fish as offerings.

Table 6.32. List of Identified Fish Taxa, with Common Name, Hawaiian Name and Habitats

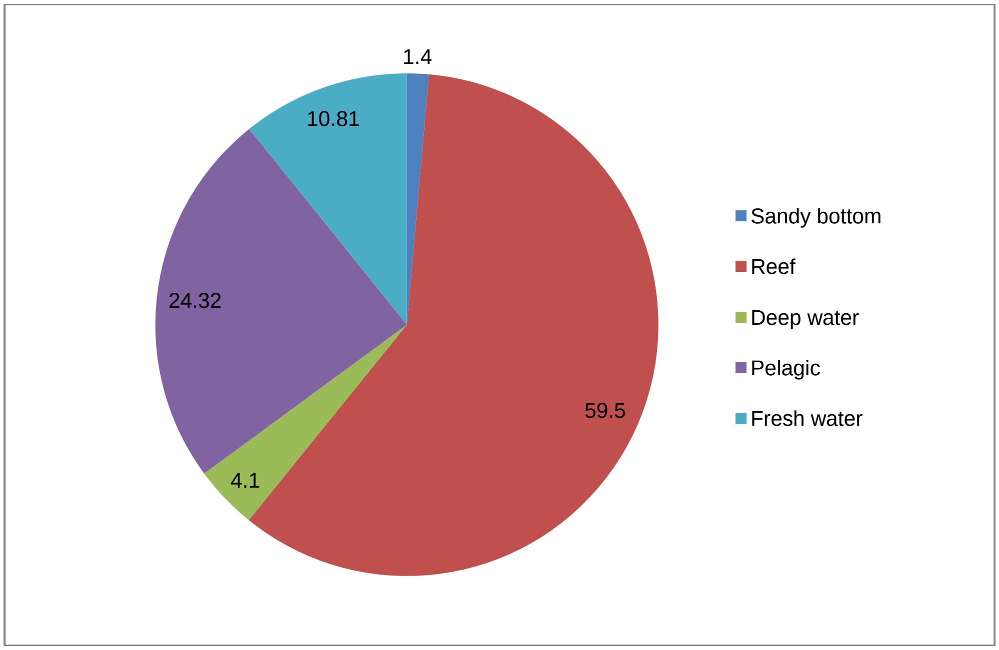
Family	Common Name	Hawaiian Name	Habitat
Albulidae	Bonefishes	*`oi`o*	Inshore/sandy bottom
Belonidae	Needlefishes	*`aha, a`ua`u*	Inshore/reef
Holocentridae	Squirrelfishes	*`ala`ihi, kalakoa, `u`u*	Inshore/reef
Polynemidae	Threadfins	*moi*	Inshore/sandy bottom
Priacanthidae	Bigeyes	*aweoweo*	Inshore/reef
Carangidae	Jacks	*akule, kahala, lai, omilu. ulua, pa`opa`o*	Inshore and deep water/semi-pelagic
Lutjanidae	Snappers	*ahunihuni, opakapka, uku, `ula`ula*	Deep water/benthic
Mullidae	Goatfishes	*kumu, weke, moano, munu*	Inshore/reef
Cirrhitidae	Hawkfishes		Inshore/reef
Labridae	Wrasses	*`akilolo, `ala`ihi, hilu, hinalea, hou, kupou, laenihi, omaka, opule, palemo, paniholoa, po`ou*	Inshore/reef
Scaridae	Parrotfishes	*uhu*	Inshore/reef
Acanthuridae	Surgeonfishes	*api, kala, kole, lai-pala, maiko, manini, naenae, paku`iku`I, pualu, palani*	Inshore/reef
Scombridae	Tunas and Mackerels	*`ahi, aku, kawakawa, ono, `opelu*	Pelagic
Gobiidae	Gobies	*`o`opu*	Freshwater

6.5.4 Invertebrate Fauna

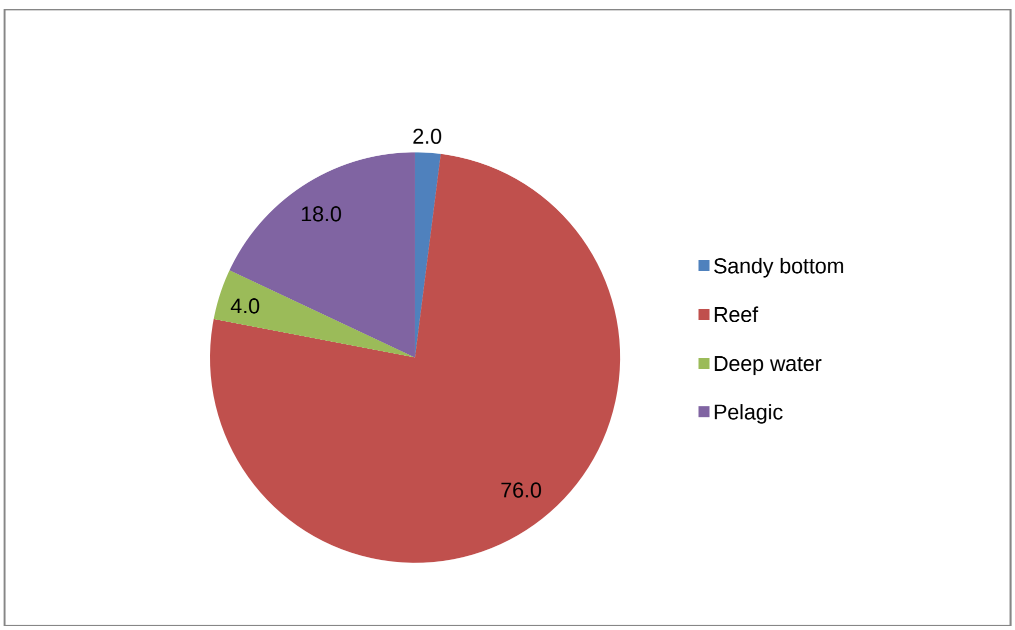
The invertebrate fauna is represented by small quantities of: (1) marine molluscs, including eight species of gastropods and one species of bivalves; (2) two species of echinoderms; (3) one species of barnacles, and (4) five species of land snails (Christensen 1981;Tables 6.34 and 6.35). The only taxon that is common to all of the excavated sites is a limpet (*Cellana spp.;* Hawaiian `*opihi*) and the only sites where it occurs in any numbers are Ko`oko`olau [MNI=119] and `Ua`u [MNI=100] rockshelters from which all of the other taxa were recovered. All of the marine invertebrates appear to have been collected from a rocky shore habitat.

The marine invertebrate fauna is limited, however, to small quantities of only eight (8) taxa of intertidal-rocky substrate shellfish. The dominant taxon and only one recovered in the two lower elevation rockshelters (`Ahinahina and Waikahalulu) is the limpet, *Cellana spp.* (Table 6.34). All three of the Hawaiian species of `*opihi* are represented (Alison Kay, personal communication).

Sample size effects, notwithstanding, shellfish were clearly a minor dietary constituent. The combined shellfish weights in the two upper elevation camps, both with cultural sequences spanning 600 years, is only 1,630 grams, 98.12% of which is *Cellana spp.* To further illustrate the point, the MNI of the 50% sample from Ko`oko`olau Rockshelter is 75—a figure multiplied by 10 or even 100, to allow for the numbers that may be buried in the massive debitage pile outside of the living area, still results in the same general conclusion that shellfish consumption provided little sustenance value and perhaps then, only for a privileged few. More important than food value, perhaps, was the use of `*opihi* shells as peelers, especially for taro (see Allen's data on plant assemblages).



Site 16205 Rockshelter 2 (`Ua`u Rockshelter) [n=74]



Site 16216 Rockshelter 1 (Ko`oko`olau Rockshelter) [n=570]

Figure 6.58. Relative Abundances of the Different Habitats Represented in the Fish Bone Assemblages from `Ua`u Rockshelter and Ko`oko`olau Rockshelter No. 1 (Sites 16205 and 16216).

Table 6.33. NISP Summaries for Vertebrate Faunal Remains from Six Excavated Rockshelters in the Mauna Kea Adze Quarry Complex

Zone/Rockshelter Name	Fish NISP/%		Bird NISP/%		Mammal NISP/%		Small Vertebrate NISP/%		Total NISP/%	
Zone 1										
Ko`oko`olau 1	1,975	54.32	1,654	45.49	7	0.19	0	0	3,636	42.00
`Ua`u	1,526	65.07	802	34.2	17	0.72	0	0	2,345	27.09
Zone 2										
`Ahinahina	24	42.86	32	57.14	0	0	0	0	56	0.64
Zone 3										
Waikahalulu	23	2.79	797	96.84	3	0.36	0	0	823	9.50
Hopukani 1	19	1.08	1,140	64.96	5	0.28	591	33.68	1,755	20.27
Hopukani 2	0	0	25	61.90	0	0	16	38.10	41	0.47
TOTALS	**3,567**	**41.20**	**4,450**	**51.40**	**32**	**0.36**	**607**	**7.01**	**8,656**	**99.97**

The invertebrate fauna is represented by marine molluscs, echinoderms, cephlapods, and barnacles, and land snails. Amongst the shellfish there is only one taxon (*Cellana)* common to all sites. This one taxon represents 96.48% total by weight in the two upper elevation sites that contain other invertebrate fauna. The other species in these two sites (`Ua`u and Ko`oko`olau) are all found along rocky shores, thus suggesting that they were collected together with opihi (the inference is that the archaeological assemblages from these two sites constitute a characteristic basalt shoreline assemblage from the eulittoral zone), rather than from some other habitat. Among the most noticeable of the some 15 species of mollusks that inhabit the basalt shoreline, one of six types of habitat in the eulittoral zone, (a zone roughly equivalent to the intertidal zone of other areas) are the patellid limpets *(`opihi*), *Cellana exarata* and *Cellana sandwicensis*).

> Interspersed among the opihi are the thaidids *Drupa ricina, D. morum, Morula granulata, Thais intermedia, and Purpura aperta*,...The minute bivalve...is sometimes found in the holdfasts of the algae *Laurencia* and... in this region ...Where the seaward face of the basalt is honeycombed with lava bubbles and sea urchins,the snakehead cowry, *Cypraea caputserpentis*, the vermetid *Petaloconchus keenae*, the thaidid *Morula granulata,* and the bivalve *Isognomon incisum,* occupy some of the holes (Kay 1979:7).
>
> The bivalve, *Barbatia divaricata* is found nestled in cracks and crevices on the undersurfaces of rocks on fringing reefs and in tide pools (Kay 1979:501).

Ziegler wrote in his memorandum of 16 May 2001 that he did not know whether the two cephalopod beaks were from an octopus, which would suggest transport from the coast, or those of squid, which “conceivably could have been stomach contents of procellariids caught on the mountain for human food.” If they are the beaks of squid and if they came from the stomachs of procellariids, it is surprising that no cephalopod beaks have ever been recovered in the faunal assemblages from sites at PTA, which are much larger in numbers of procellariids than what has been found to date in the adze quarry. In addition, if the beaks were indeed from the stomachs of procellariids it indicates the capture and transport of whole birds, instead of butchered parts..

Table 6.34. Marine Invertebrate Faunal Weights from `Ua`u, Ko`oko`olau and `Ahinahina Rockshelters (Sites 16205, 16216, and 16210).

TAXON	Ko`oko`olau Rockshelter 1 (gm)	`Ua`u Rockshelter (gm)	`Ahinahina Rockshelter (gm)	TOTALS
GASTROPODA				
Patellidae				
Cellana spp.	873.7	736.5	15.2	1625.4
Neritidae				
Theodoxus neglectus		0.5		0.5
Littorinidae				
Littorina pintado	+	0.1		0.1
Cypraeidae				
Cypraea sp.	3.5			3.5
Thaiidae				
Drupa ricina		13.2		13.2
Drupa morum		1.1		1.1
Purpura aperta	29.1			29.1
Colubraiidae				
Colubria tortuousa		3.4		3.4
BIVALVIA				
Arcidae				
Barbatia divaricata		0.6		0.6
UNIDENTIFIED SHELL		6.3		6.3
ECHINODERMATA				
Heterocentrotus mammilatus	0.3	0.9		1.2
Echinothrix diadema		+		+
CIRRIPEDES				
Chthamalus hembeli		0.2		0.2
TOTALS	906.6+	762.8	15.2	1684.6

Cellana spp., the only shellfish taxon common to all of the invertebrate assemblages, has the most food value in terms of the meat to shell weight ratio, in addition to the fact that the discarded shell serves a number of utilitarian functions, especially as a corm peeler/scraper.

The nonmarine mollusks, identified by Dr. Carl Christensen (Christensen 1981), are represented by four families and a minimum of five species recovered in four sites (Table 6.36). The most interesting of these are from Ko`oko`olau Rockshelter No. 1. The *Auricuella westerlundia* specimen is from Layer I and all of the remaining specimens from Layer II.

Table 6.35. `Ua`a Rockshelter Invertebrate Fauna.

	Layer Designation										
TAXON	I	I/II mix	II	IV	VIII	VI	VII	VIII	VIII/IX	X	Total Weight per Taxon
Gastropod											
Cellana spp	74.8	11.0	271.4	325.8	5.1	31.6	0.1	9.4	6.3	1.0	736.5
MNI	6	7	32	41	2	7	1	2	1	1	
Theodoxus neglectus						0.5					0.5
Littorina pintado				+		0.1					0.1
Drupa lorrida			1.1								1.1
Drupa ricina	0.7		7.7	2.7		0.8		1.3			13.2
Colubraria tortosa				3.0		0.4					3.4
Bivalve											
Barbatia divaricata					0.6						0.6
Unidentified Mollusc Shell	0.2		1.6	3.1		1.4		+			6.3+
Echinodermata											
Heterocentrotus mammilatus			0.3	0.3		0.3					0.9
Echinothrix diadema		+									+
Uithamlus hembeli						0.2					0.2
	75.7	11.0+	282.1	334.9+	5.7	35.3	0.1	10.7+	6.3	1.0	762.8

+ present but less than 1.0 gram

Table 6.36. List of Identified Nonmarine Mollusks from Four Sites.

TAXA	Ko`oko`olau No.1 (Site 16205)	Hopukani No.1 (Site 16238)	Hopukani No.2 (Site 16239)	Liloe Spring (Site 16240)
ACHATINELLIDAE				
Tornatellides sp.	x			
Elasmias sp.	x			
Auricuella westerlundia	x			
SUCCINEIDAE				
Succinea sp.	x			x
HELICARIONIDAE				
Philonesia sp	x	x	x	x
ZONITIDAE				
Nesovitrea hawaiiensis	x			

6.5.4 Plant Remains

The excavations yielded a diverse array and quantity of plant remains. Some 51 taxa have been identified to at least the family level, of which 39 (76%) are wild species and 12 (24%) are cultigens (Allen 1981; 1984:20-21). The number of taxa, which includes organic artifact raw materials, is a minimum number. There are a sizeable number of unidentified samples, primarily seeds, woods, and fibers, exemplifying a common problem in research on Pacific subsistence systems in the insufficient attention given to wild species in ethnobotanical studies (Yen 1985). The general neglect of wild species, especially in studies of agricultural societies (Yen 1985:315), makes it extremely difficult to not only identify the raw materials of many artifacts, but to determine the cultural significance of wild plants in terms of their practical uses and symbolic meanings. The problem is evident in Allen's efforts to determine plant use in the quarry (Allen 1981: Table 11).

Of the known species the number of taxa common to all sites is only five, including fragmentary material identified only as grass and wood (Allen 1981: Table 17; Allen 1986: Table 2). Most of the species diversity is represented in the Ko`oko`olau Rockshelter No. 1 assemblage which contains taxa from every major vegetation zone on the island (Allen 1981: Table 16), including everything from seaweeds to alpine mosses (Table 6.36). Two different seaweeds were identified by Kristen Schlech, of the Botany Department at the Bishop Museum in 1984, both from Ko`oko`olau Rockshelter No. 1. A piece of *Grateloupia sp*. was found in Layer II and a piece of *Laurencia sp*. in Layer V (Schlech memo to Patrick McCoy dated April 3, 1984).

<u>Wild Species</u>

A number of the wild species identifications were made on small fruits and seeds which were recovered in sizeable numbers from the previously mentioned stratified deposit at the rear wall of Ko`oko`olau Rockshelter No. 1 (Allen 1981:86-87, Tables 12 and 13). A sizeable number of wild species appear to be derived from the subalpine forest and xerophytic scrub zone, including several probable food plants-- *Chenopodium oahuense* and *Solanum nigrum* leaves and one or more species of ferns (Allen 1981:118-119). Identifications of a small number of charcoal samples from Ko`oko`olau Rockshelter No. 1, Hopukani Rockshelter No. 1, and Hopukani Rockshelter No. 2 suggest a preference for three high elevation species that could be readily procured in these two vegetation communities: (1) *Railliardia sp*.; (2) *Sophora chrysophylla* ; and (3) *Coprosma montana* (Murakami 1986).

Site 16205 (\`Ua\`a Rockshelter)

	Stratigraphic Layer																					
	I		I/II		II		III		III-IV-V		IV		V		VI		VII		VIII		TOTAL	
TAXON	weight in grams	% total	weight in grams	% total	weight in grams	% total	weight in grams	% total	weight in grams	% total	weight in grams	% total	weight in grams	% total	weight in grams	% total	weight in grams	% total	weight in grams	% total	weight in grams	% total
PLANT MATERIAL																						
Aleurites moluccana	53.2	96.38%	25.7	96.98%	99.7	97.94%	234.5	97.91%	1.6	42.11%	110.2	97.52%		0.00%	86.9	99.19%		0.00%		0.00%	611.8	97.02%
Cucurbitaceae	0.3	0.54%	0.2	0.75%	0.6	0.59%	0.8	0.33%	0.2	5.26%	0.1	0.09%		0.00%	0.2	0.23%	0.7	24.56%	0.1	33.33%	3.2	0.51%
Cocos nucifera	1.5	2.72%		0.00%	0.9	0.88%	2.4	1.00%		0.00%	0.7	0.62%		0.00%	0.0	0.00%		0.00%		0.00%	5.5	0.87%
Unidentified plant	0.2	0.36%	0.6	2.26%	0.6	0.59%	1.8	0.75%	2.0	52.63%	2	1.77%		0.00%	0.51	0.58%	2.15	75.44%	0.2	66.67%	10.1	1.60%
LAYER TOTAL	55.2	100.0%	26.5	100.0%	101.8	100.0%	239.5	100.0%	3.8	100.0%	113	100.0%	0	0.0%	87.61	100.0%	2.85	100.0%	0.3	100.0%	630.56	100.0%

Site 16216 (Ko\`oko\`olau Rockshelter)

	Stratigraphic Layer																													
	Surface		I		I/II		II		III		IV-V		IV		V		VI		VII		VII/VIII		VIII		VIII		IX		TOTAL	
TAXON	weight in grams	% total	weight in grams	% total	weight in grams	% total	weight in grams	% total	weight in grams	% total	weight in grams	% total	weight in grams	% total	weight in grams	% total	weight in grams	% total	weight in grams	% total	weight in grams	% total	weight in grams	% total	weight in grams	% total	weight in grams	% total	weight in grams	% total
PLANT MATERIAL																														
Aleurites moluccana	0.9	0.94%	11.9	4.06%		0.00%	110.5	3.05%	10.6	14.19%	14.6	31.81%	18.45	12.64%	61.5	78.53%	32.9	44.94%	23.5	13.66%	2.4	4.51%		0.00%		0.00%		0.00%	284.0	6.31%
Cucurbitaceae	0.9	0.94%	3.45	1.18%		0.00%	31	0.86%	1.2	1.61%		0.00%	0.2	0.14%	0.1	0.13%	0.9	1.23%		0.00%		0.00%		0.00%		0.00%		0.00%	36.9	0.82%
Cocos nucifera	4.3	4.51%	4.3	1.47%		0.00%	0.6	0.02%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%	4.9	0.11%
Saccharum spp.	0.3	0.31%	2.01	0.69%		0.00%	16.2	0.45%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%	18.2	0.40%
Pandanus spp.		0.00%	0.2	0.07%		0.00%	4.9	0.14%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%	5.1	0.11%
Unidentified wood	1	1.05%		0.00%		0.00%		0.00%		0.00%	6.3	13.73%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%	6.3	0.14%
Wood charcoal		0.00%	9.8	3.34%		0.00%	44.9	1.24%		0.00%	0.2	0.44%	36.1	24.73%	7.5	9.58%	20.2	27.59%	145.6	84.63%	50.8	95.49%	9.8	83.76%		0.00%	0.6	100.00%	264.3	5.87%
Unidentified plant	87.9	92.24%	261.6	89.20%	0.2	100.00%	3410.21	94.25%	62.9	84.20%	24.8	54.03%	91.2	62.49%	9.21	11.76%	19.21	26.24%	2.95	1.71%		0.00%	1.9	16.24%		0.00%		0.00%	3882.3	86.24%
LAYER TOTAL	95.3	100.0%	293.26	100.0%	0.2	100.0%	3618.31	100.0%	74.7	100.0%	45.9	100.0%	145.95	100.0%	78.31	100.0%	73.21	100.0%	172.05	100.0%	53.2	100.0%	11.7	100.0%	0	100.0%	0.6	100.0%	4501.89	100.0%
MARINE SHELL																														
Cellana talcosa	42.2	100.0%	75.8	72.26%	0.2	100.0%	445.5	100.0%	65.9	100.0%	3.2	100.0%	30.8	100.0%	82.4	100.0%	27.2	100.0%	45.5	100.0%	0.01	100.0%	5.5	100.0%	0.3	100.0%	5.0	100.0%	776.8	96.39%
MNI	6		8		1		56		9		1		11		11		9		7		1		1		1		2		124	
Cypraea spp.		0.0%		0.00%		0.0%	3.5	0.79%		0.0%		0.0%		0.0%		0.0%		0.0%		0.0%		0.0%		0.00%		0.00%		0.00%	3.5	0.43%
Purpura aperta		0.0%	29.1	27.74%		0.0%		0.0%		0.0%		0.0%		0.0%		0.0%		0.0%		0.0%		0.0%		0.00%		0.00%		0.00%	29.1	3.61%
LAYER TOTAL	42.2	100.0%	104.9	100.0%	0.2	100.0%	445.5	100.0%	65.9	100.0%	3.2	100.0%	30.8	100.0%	82.4	100.0%	27.2	100.0%	45.5	100.0%	0.0	100.0%	5.5	100.0%	0.3	100.0%	5.0	100.0%	805.9	100.0%
SEA URCHIN																														
Heterocentratus mammillatus		0.0%		0.0%		100.0%	0.3	100.0%		100.0%		0.0%		100.0%		0.0%		0.0%		0.0%		0.0%		0.0%		0.0%		0.0%	0.3	100.0%
LAYER TOTAL	0	0.0%	0	0.0%	0	100.0%	0.3	100.0%	0	100.0%	0	0.0%	0	100.0%	0	0.0%	0	0.0%	0	0.0%	0.0	0.0%	0.0	0.0%	0	0.0%	0	0.0%	0.3	100.0%

Table 6.37. Summary of Plant Remains at Two Rockshelters (Sites 16205 and 16216).

Domesticated Species

There is a wide variety of domesticated species represented (Allen 1981: Table 10 and Table 17; Allen 1986: Table 2) but the only cultigens that occur with any frequency are taro (*Colocasia esculenta),* ti (*Cordyline terminalis*), sugarcane (*Saccharum* sp.) and gourd (*Lagenaria siceraria*). Small quantities of all of the major Hawaiian food plants have been found with the exception of yam (*Artocarpus altilis*) for which Allen (1981:116) has offered a plausible explanation. The questionable presence of sweet potato (*Ipomoea batatas*) remains in the quarry, tentatively identified from only Ko`oko`olau Rockshelter No. 1, suggests that the adze makers did not consume much, if any, of this food which is claimed to have been "particularly the food of the common people" (Handy and Handy 1972:14). Taro, which has been identified from a layer near the base of the deposits in Ko`oko`olau Rockshelter No. 1 dated to AD 1045-1380 (see Figure 7.2), would appear to have been one of the staples of the adze makers' diet based on the abundance of corms from several sites.

6.5.6 Discussion and Inter-Site Comparisons

The faunal and plant assemblages taken as a whole are more complex than those from any known Hawaiian coastal settlement in terms of the number and diversity of taxa. Small sample sizes preclude any definitive statements regarding taxonomic abundance and the meaning of species diversity.

(1) Natural vs. Cultural Assemblages. In contrast to the land snails and some of the plant remains, which were probably accidental or unintentional introductions, the same does not hold true for the fish, birds, and mammals. Species diversity at the site level is to some degree time dependent given the natural propensity for changes in taste and the necessity of substituting one food for another at some times. Diversity also reflects a combination of purposeful and accidental human behaviors. The epitome of adventiveness and transported landscapes are the several different species of land snails found in Ko`oko`olau Rockshelter No. 1. The problem of distinguishing cultural behaviors and natural site formation processes is much more of an issue in the case of some of the plant remains where the identifications were based on seeds. Allen (1981) has discussed this problem, noting the probability of mixed formation processes in purposeful human introductions and aeolian transport.

At Hopukani Rockshelter No. 1 the probability that some of the bone, that of the dark-rumped petrel in particular, is of natural occurrence, rather than food remains, is suggested by: (1) the existence of a burrow and eggshell recovered in the matrix analysis of the soil sample from the surface of Unit P24, and (2) the articulation of two whole petrel bones (a scapula and coracoid) that were collected from the surface of the interior shelf area during the 1976 reconnaissance survey, and (3) observations made by biologists that “As recently as 1954 five fresh *`ua`u* burrows were found just above 2,743 meters (9,000 feet) altitude on the southeast slope of Mauna Kea, at about the *mamane* (*Sophora chrysophylla*) tree line. “All the burrows were located under old lava flows and all were over six feet long. Two of them contained birds and at least one egg” (Richardson and Woodside 1954:326). During the excavations in 1985, no eggshell or bones of immature individuals were found in subsurface contexts, thus favoring the interpretation that most, if not all, of the bird bone from undisturbed buried contexts in this site is of cultural origin and was consumed as food.

(2) Food vs. Offerings. While some of the issues that are common to faunal analysis of lowland and coastal faunal assemblages do not exist in the quarry, such as whether a particular fish was eaten or not (Dye 1994:391), this does not mean that all of the faunal

remains found in the quarry should be interpreted as food for humans, or humans alone. There is in fact a good case to be made that some of the vertebrate and invertebrate remains were offered to the gods as discussed briefly in Section 7.

(3) Skeletal Completeness: the degree of skeletal completeness (i.e., cranial and post-cranial elements both present) and occurrence of feathers indicate the transport and consumption of whole birds, most of which are small in any case

There appear to be noticeably fewer splintered bones in the earlier layers of Ko`oko`olau Rockshelter No. 1 and, correspondingly, more possibly complete skeletons. The figures, expressed as per cent total bones in whole condition, for the two upper elevation sites with the longest chronologies are similar: 8.83% and 6.86% for Ko`oko`olau Rockshelter No. 1 and `Ua`u Rockshelters respectively, in contrast to `Ahinahina Rockshelter and Waikahalulu Rockshelter which are similar to one another--3.13% and 2.26% respectively. This is another instance of inter-zonal patterns (upper and lower elevation sites with distinctive lithic resource characteristics) that appear to be significant given the assumption of essentially homogeneous matrices and thus breakage potential as one of the major taphonomic processes.

(4) Burned Bones: the number/frequency of burned bones varies from site to site, normally under 10% except for Waikahalulu Rockshelter where 37.01% of the total bird bones are burned. it is difficult to interpret these data given the uncertainties surrounding the distinction between purposeful (i.e. a cooking method such as roasting over an open fire or baking in an underground oven), and accidental behaviors (bones accidentally kicked into the fire) or a discard behavior, such as throwing all the bones into a hearth. The latter seems highly unlikely given the low frequency of burned bones.

(5) Age Classes: (mammal and bird): the data for birds (initially computed for all taxa, rather than petrels alone, or petrels + med. procellarids, or petrels + med. procellarids + med. bird) indicates that for Ko`oko`olau Rockshelter No. 1 and `Ua`u Rockshelter the percentage of bones that are those of young/immature individuals is 2% vs. Waikahalulu Rockshelter where this figure is only 0.25% (this is significant when compared to the other two sites and `Ua`u Rockshelter in particular which has an almost identical number of bird bones i.e. there is probably no sampling error/sample size effect); this is one more bit of evidence leading to the conclusion of significant inter-zonal variability at ca. A.D. 1400-1600 that in this particular instance is inferred to reflect status differentiation in consumption rather than procurement or access to the resource base since petrels are not only common to all of the assemblages, but consistently represent some 80-95% or more of all bones when the med. procellarid and med. bird categories are included; this data is amenable to several alternative interpretations, not all of which are necessarily mutually exclusive, however:

(a) the low frequency of immature birds confirms or is consistent with the ethnographic record on the prohibitions/kapu placed on the eating of young petrels (reserved for the chiefs) thus showing that occupational specialists were indeed commoners.

(b) the *kapu* was not universal given the consumption of some young petrels in the adze quarry, though not in the same relative proportions between sites--i.e that not all of the adze makers groups were equal in status --that there was an internal rank order;

(c) young petrels were never taken in large numbers, even for chiefly consumption, and that quarry figures are representative of the average consumption per capita;

(d) the ethnographic pattern was a late phenomenon reflecting increasing scarcity leading to conservation measures imposed from above i.e. the view that the uplands exploitation pattern was an adaptation to growing scarcity reflected in the small relict populations recorded in historic times

There is a significant difference between the number of bones in Layers I and II of Ko`oko`olau Rockshelter No. 1. The smaller number in the top layer is one more piece of evidence that Layer I is a fill. The small number of faunal remains, combined with the absence of features, and fire pits in particular, indicates that the surface layer was a deliberate deposit made after the shelter was abandoned.

6.6ARTIFACT SOURCING ANALYSIS

A number of artifacts were collected during the survey for sourcing analysis and comparison with the data obtained in previous studies. Figure 6.59 shows the locations where the collections were made. Analyses of Mauna Kea basalts and hawaiite have been undertaken by a number of researchers, both geologists and archaeologists (e.g., Cleghorn et al. 1985). The most thorough study to date was undertaken by Dr. Peter Mills and Dr. Steve Lundblad of the University of Hawaii at Hilo (Mills and Lundblad 2006; Mills et al. 2008; Lundblad et al. 2008) who obtained samples from bedrock exposures at multiple locations within the Mauna Kea Adze Quarry complex (Figure 6.60). The data from their sample were subsequently compared to flakes from four excavated rockshelters in the quarry (Mills et al. 2008).

6.6.1 Sample Size and Proveniences

A total of 28 artifacts, including three previously reported samples from Lake Waiau (McCoy and Nees 2010: Table 6.17 and Table 6.37 below) were sent to the University of Hawaii, Hilo for geochemical analysis using a non-destructive method that is briefly described below. The list of samples and results are presented in full in Appendix O. Table 6.37, below, presents non-metric data for the samples submitted for EDXRF analysis.

6.6.2 Methods

An Energy-dispersive X-ray Fluorescence (EDXRF) spectrometer was used which can rapidly generate broad-spectrum geochemical analyses with levels of precision in the parts per million range. The analyses were completed on a ThermoNoran QuanX EDXRF spectrometer with an extended sample chamber, using a rhodium (stable-isotope) X-ray tube, thermoelectrically cooled detector, and supporting Edmunds vacuum pump, with data processed on Wintrace™ software, version 4.1, build 16.

Figure 6.59. Location of Sites with Artifacts Collected and Submitted for EDXRF Analysis.

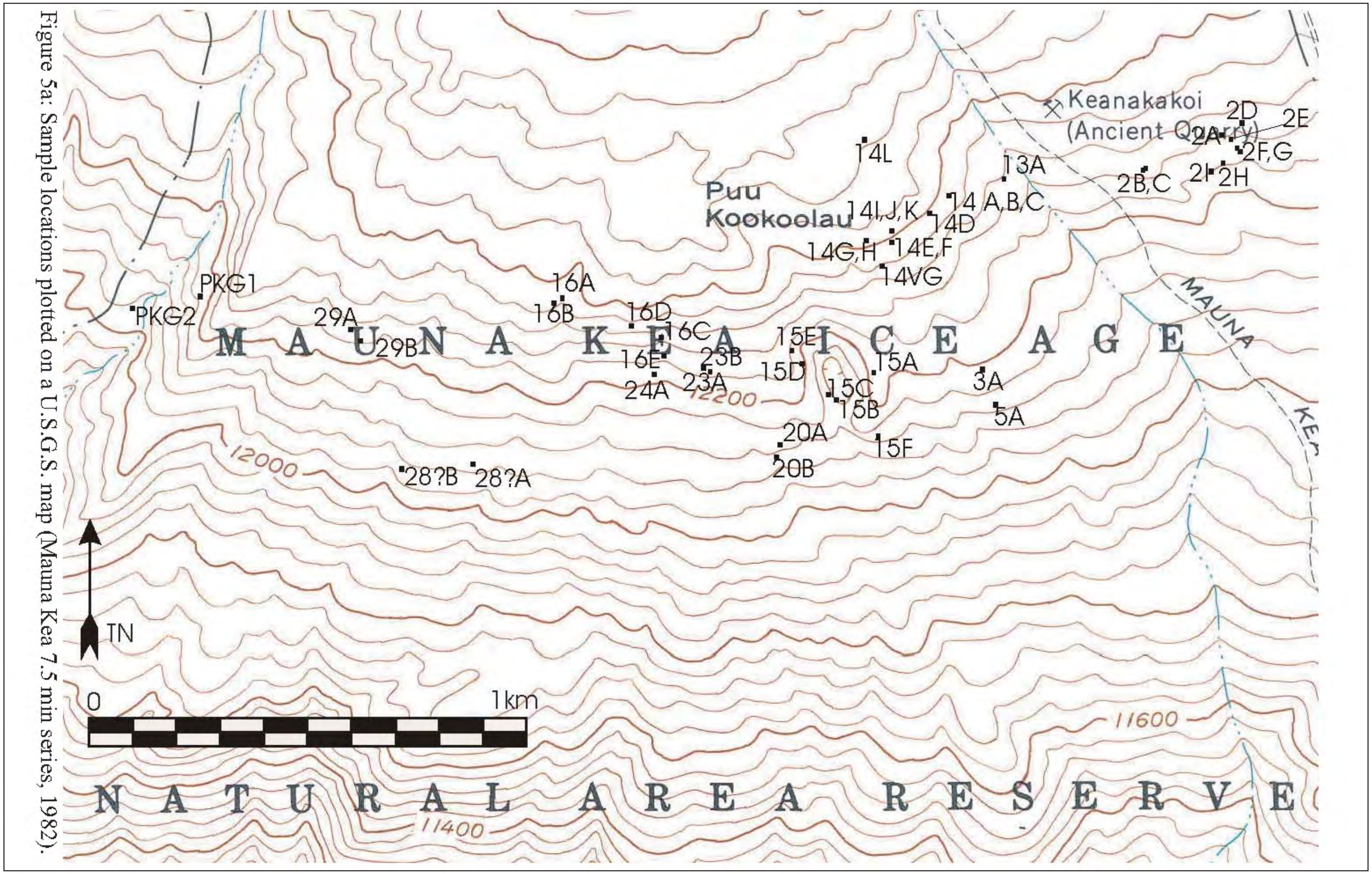


Figure 6.60. Geological Sampling Locations for EDXRF Analysis (Figure from Mills and Lundblad 2006).

Table 6.38. List of Samples Submitted for EDXRF Analysis.

PCSI ID #	Site 50-10-23-	Bag Number	Provenience	Artifact Type
1	28634	37	RS1	preform
2	28633	5	WS2	preform
3	28633	8	WS2	preform
4	28633	24	WS2	preform
5	28637	11	RS1	preform
6	28644	9	RS1	preform
7	28644	27	RS1	preform
8	28644	48	RS1	preform
9	28641	6	WS3	preform
10	4136	19	Isolate	preform
11	4136	1	Isolate	preform
12	4136	2	Isolate	preform
13	4136	3	Isolate	preform
14	4136	4	Isolate	preform
15	28650	17	WS13-14	preform
16	28663	18	WS1	preform
17	4136	10	Isolate	preform
18	4136	12	Isolate	preform
19	28634	52	RS1	flake
20	28634	44	RS2	flake
21	28634	50	WS1	flake
22	28634	50	WS1	flake
23	28668	51	WS	flake
24	28668	51	WS	flake
25	28668	51	WS	flake

The specimens were analyzed by placing the flattest interior surface on the specimen over the X-Ray beam. Each sample run also included the analysis of a known geological standard prepared by the USGS from a basalt source in Kilauea Caldera (BHVO-2; Wilson 1997).

In order for EDXRF spectrometers to yield precise measurements, the spectrometers must be calibrated by analyzing similar geological reference standards that contain well-established concentrations of elements. The UH Hilo spectrometer has been calibrated for the analysis of basalt with 27 geological standards, including 12 USGS standards (AGV-2, BCR-1, BCR-2, BHVO-1, BHVO-2, BIR-1, DNC-1, DTS-2, GSP-2, QLO-1, STM-1, W-2), 12 Geological Survey of Canada standards (LKSD 1-4, FER 1-4, TILL 1-4), two basalt standards from the Geological Survey of Japan (JB-2, JB-3), and one Geological Survey of China basalt standard (NCS DC 73303). In addition to the geological samples over 1,300 basalt samples from the Big Island, including over

900 from the Mauna Kea Adze Quarry collected in 1975-76 were used to establish a reference standard (Mills and Lundblad 2006; Mills et al. 2008). Some trace elements found in Pacific basalts exhibit better analytical precision with EDXRF than others, namely rubidium (Rb), strontium (Sr), yttrium (Y), zirconium (Zr), and niobium (Nb), while data for major elements are less precise. The reader is referred to Lundblad et al. (2008) for further technical information.

6.6.3 Results and Discussion

The results of the analyses included quantitative data for 19 elements, of which Sr and Zr values were used to characterize samples. It has been demonstrated (Mills and Lundblad 2006; Mills et al. 2008) that Sr has been effective in characterizing the dense fine-grained rocks from Kilauea and Mauna Loa. The results of the analyses are presented in Figure 6.61.

As expected, all 25 samples fall within the established reference standard for Mauna Kea basalts (Mills and Lundblad 2006). The samples were then compared to the samples submitted in 2008 from the Mauna Kea Science Reserve and samples submitted by the senior author to the UH Hilo EDXRF Lab from rockshelters at four sites (Sites 16205,16210, 16216, and 16233) excavated in 1975-76 (Mills et al. 2008).

The purpose of this comparison was to determine if any chemical differences are present in the data sets that could distinguish between different basalt sources. The trace elements Sr and Zr used in Figure 6.61 show that the samples collected in 2008-2009 fall within the reference standard but do not distinguish samples by site, location, or possible extraction area. However, by plotting non-trace elements (e.g., Mg, K, Al, Si) a different picture emerges. The two elements selected were Al (as measured in Al_2O3) and Si (as measured in SiO2) with the results presented in Figure 6.62. The samples are color-coded for ease of reporting. What shows in Figure 6.62 is that samples from the quarry area recorded in 2008 along Pohakuloa Gulch in the Science Reserve and samples from the 2008-2009 survey (NAR) fall at the extreme end of the reference standard, reported here as Sites 16205,16210, 16216, and 16233, with some overlap.

Though the results are preliminary, the data suggest that it may be possible to characterize extraction-related basalt source areas and possibly show movement (e.g., trails) from the quarry based on the analysis of non-trace elements. The data suggest that the artifacts found at Sites 16210 and 16233 include basalts from Site 16216. The rockshelters at Sites 16210 and 16233 both appear to be along proposed ascent/descent trails (see Figure 7.6).

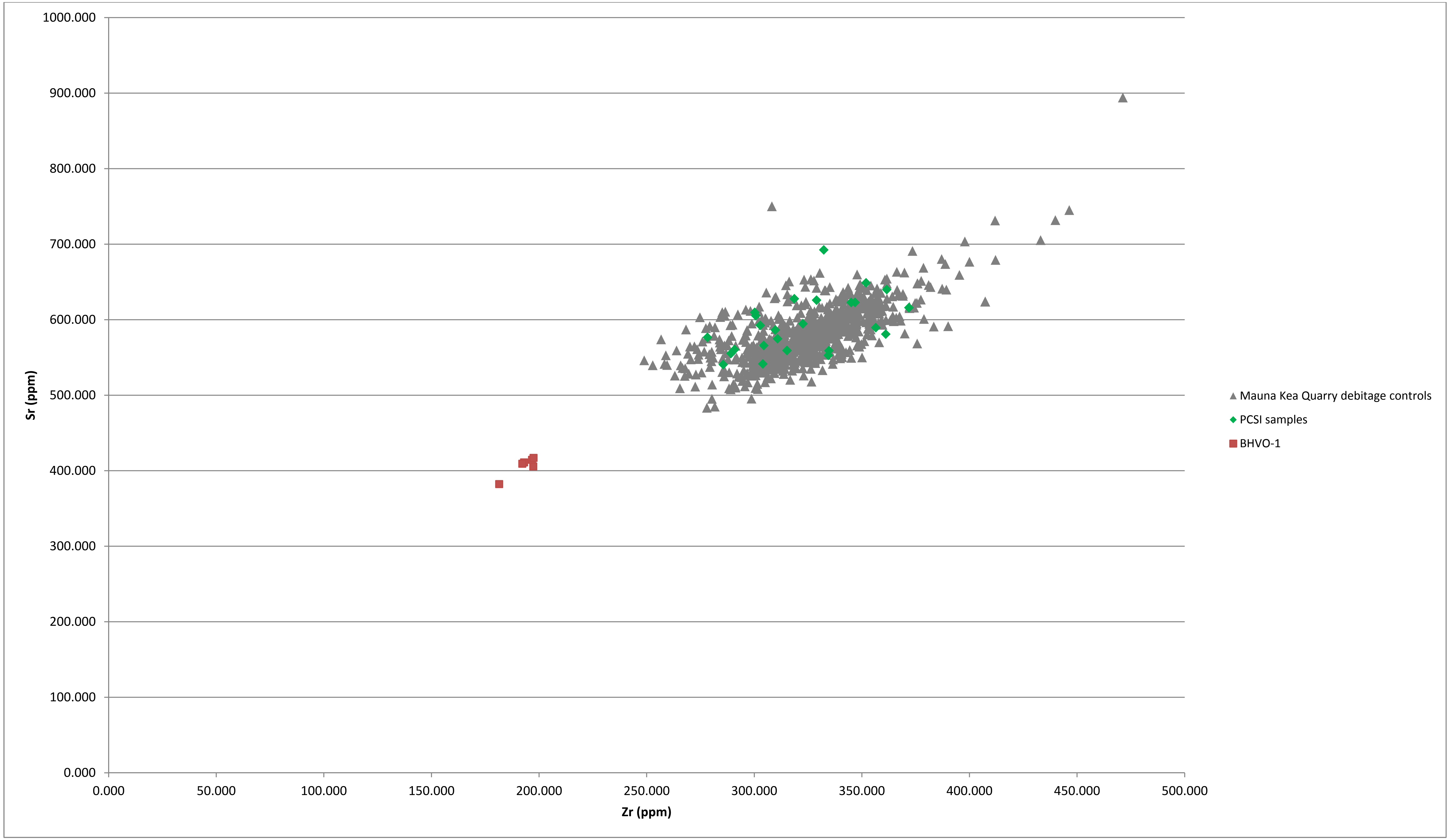


Figure 6.61. Graph Showing the Results of the EDXRF Analysis on Samples Collected within the Mauna Kea Ice Age Natural Area Reserve.

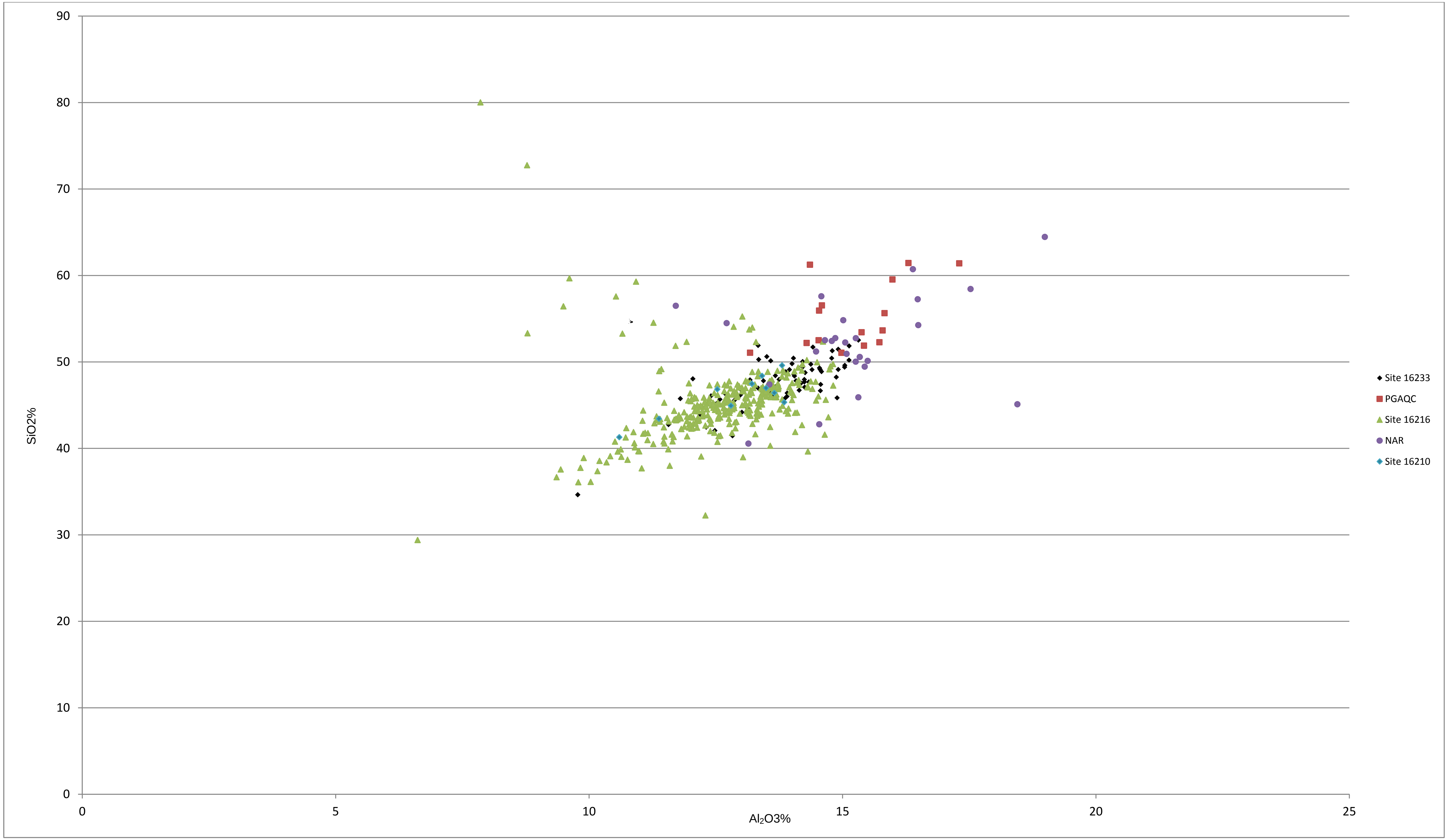


Figure 6.62. Scatterplot Comparison using Major Elements.

6.7 OTHER ARTIFACTS

Artifacts recovered in the 1975-76 excavations, other than the ubiquitous debitage and manufacturing tools, include objects made of stone, bone, tooth, shell, and other organic materials. The only shell artifacts are modified *'opihi* shells (*Cellanus sp.)* interpreted as taro corm peelers. They were found in `Ua`u Rockshelter and Ko`oko`olau Rockshelter No. 1 (Sites 16205 and 16216). The only ornament found in the excavations is a single perforated dog tooth from Ko'oko'olau Rockshelter No. 1 that appears to have been a pendant or part of a necklace.

The recovery at 'Ua'u and Ko'oko'olau rockshelters of bird bone awls and basaltic glass flakes, presumed to have been used for cutting and scraping wood and fiber, was originally interpreted as evidence of maintenance activities (McCoy 1977:234). The co-occurrence of these same artifacts with pandanus leaves in Ko'oko'olau Rockshelter No.1 formed the basis for conjecturing that personal gear, such as mats and carrying baskets had been repaired in the quarry, thereby suggesting that the duration of work was greater than a week or two (McCoy1976:140). The repair of personal gear in the quarry now seems highly unlikely; if it occurred at all, such activities would more likely have been performed at lower elevation camps, such as the Pu`u Kalepeamoa Site, located in a more hospitable treeline environment at the 9,200 ft elevation at Hale Pohaku, possibly by women and other family members (see Section 7.3.4 for a discussion of the division of labor). As suggested above, it is more likely that the basaltic glass flakes were used in the manufacture of bone awls and picks from the discarded remnants of meals.

All but a few of the perishable artifacts that have been collected from the quarry are from Ko'oko'olau Rockshelter No.1 (Figure 6.63). They include such items as fire ploughs, pandanus matting, tapa cloth, fragments of a possible ti-leaf cape, sandal fragments (?), twisted cordage and braided sennit (McCoy 1977: Figure 4; Allen 1981:103-05, Figures 18-20, Appendix B). Catherine Summers, who briefly examined the cordage from Ko`oko`olau Rockshelter No. 1, identified six fragments of *`aha* cordage and three pieces of *`ahu`awa* cordage (Summers 1990: Table 14). *`Aha* cordage, made from coconut palm fibers, had a number of uses, including carrying nets (Summers 1990: Figure 36). *`Ahu`awa* cordage (*Cyperus javanicus*) was also commonly used in the manufacture of carrying nets (Summers 1990:98-99).

Virtually all of the organic artifacts from Ko'oko'olau Rockshelter No.1 were found in a compacted, stratified deposit in one corner of the shelter. The items contained within this deposit were initially interpreted as having been purposefully placed as a cushion beneath sleeping mats (McCoy 1977:234). Allen (1981:130) noted some of the difficulties with this simplistic interpretation, but offered no explanation for this unique deposit, which also contains bone, shell and fragments of various food remains. The stratigraphic context of these particular residues suggests something more specific and meaningful than the use of the rear wall of the rockshelter for the discard of food remains and personal gear. All of this material is from a deposit in which there are no fire hearths. The absence of fire hearths, which are assumed to have been an absolute necessity in overnight stays at 12,400 ft above sea level, is an indication of a non-habitation fill deposit and a different kind of site formation process. This deposit and possibly several other layers in this and other rockshelters are interpreted as ritual fill deposits that were intended to cap and thus remove from view the accumulated residues of meals and offerings to the gods that are polluting and thus dangerous to man in a sacred context (Douglas 1966:160, 1975:xv). It is possible that the upper part of this

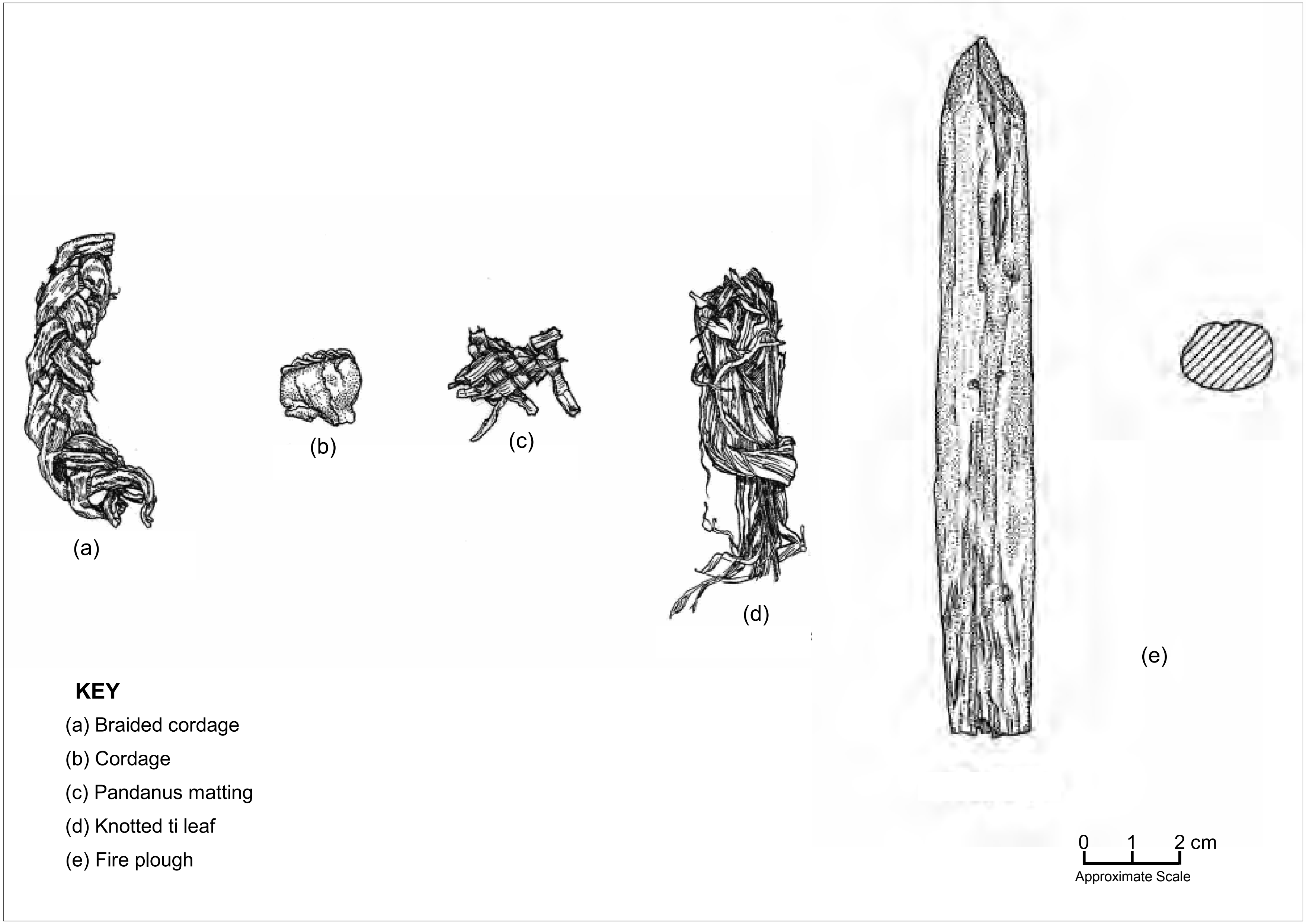


Figure 6.63. Illustrations of Perishable Artifacts Recovered during Excavations at Site 16216.

unusual organic deposit may post-date the abandonment of the quarry, and thus represent the remains of offerings left by the last of the traditional adze makers or their immediate families.

Two other artifacts deserve to be mentioned here. One is the base of a silversword (Hawaiian `*ahinahina*) wrapped with pieces of tapa cloth, pandanus leaf and a wooden bottle gourd stopper with the sennit cord attached (Allen 1981:Figure 11), which was found beneath an overhang at 'Ahinahina Rockshelter (Site16233). It is believed to be a different kind of god-image. A piece of the silversword was dated to less than 200 B.P. (Table 7.1 Lab No. W-4539), thus suggesting that it might be a post-abandonment artifact (see Section 7.3.2.2).

The other notable artifact is a wooden idol that was collected by Dr. Wm. Hillebrand at Keanakako`i Rockshelter (Site 16205-R6) in 1862 (Pacific Commercial Advertiser 1862). The image, which was apparently taken to Germany when Hillebrand left Hawai`i, appears to have been lost, possibly during WWII, according to Dr. Adrienne Kaeppler, who has made several unsuccessful efforts to find it (Adrienne Kaeppler, personal communication).

6.8 ^{230} THORIUM DATING

With the advent of ^{230}Thorium dating of branch coral (*Pocillopora* spp.) in Hawaiian archaeology an opportunity arose several years ago to refine the chronology of the Mauna Kea Adze Quarry Complex, which had been previously based on radiocarbon age-determinations alone. ^{230} Thorium dates were obtained for two shrines in 2009. The first shrine, which was destroyed and not recognized until a few years ago, is located above the entrance to Keanakāko`i (literally "cave of the adze") at Site 16205. The dated sample, which was collected from the surface of the debitage mound below the remains of the shrine, yielded an age-determination of AD 1398 $\pm$ 13. The second sample, which came from a secure provenience beneath an upright at Shrine 3 of 16206 was dated to AD 1441 $\pm$ 3 (McCoy et al. 2009).

Two additional pieces of branch coral were found in the adze quarry at Site 28637 during the 2008-2009 survey. One piece of coral, found on the surface of a workshop, was extremely weathered and unsuitable for dating. The second sample, dated to 1355 ± 28 AD, is from the interior surface of a habitation rockshelter. In contrast to the two previously dated pieces of coral from shrines at sites 16205 and 16206, both interpreted on contextual evidence as 'dedicatory offerings', the coral at site 28637 is more difficult to interpret in terms of why and when it was left on the floor of the rockshelter. Although it would appear to have been deposited at the time the rockshelter was abandoned, we cannot discount the possibility that it was introduced at an even later date as some kind of commemorative act performed in honor of earlier adze makers (McCoy et al. 2012).

7. 0 SUMMARY, SYNTHESIS, AND CONCLUSIONS

The primary aim of this final section of the report is to summarize and synthesize the data collected in the archaeological surveys and excavations in the NAR and to discuss their relevance to selected topics and issues in Hawaiian archaeology. In some places the senior author has taken the liberty of deliberately pushing the interpretations to a point reaching the "razor's edge." In a discussion of the issue of under and over interpretation that seems to be at the center of the scientific versus humanist debate in archaeology, Watson and Fotiadis made the point that "There is often a rather thin line between archaeological inference and the writing of fiction because archaeology is, by nature, an underdetermined kind of scholarship" (Watson and Fotiadis 1990:621). It is the senior author's view that the archaeological record is more commonly under-interpreted, that inferences are in many cases not extended far enough and that we are left, as a result, with shallow, uninteresting accounts of the past. This was the chief problem with much of the New Archaeology, which effectively "took the soul out of archaeology and out of the cultural past by denying or at any rate ignoring, the basic humanity of those who created the archaeological record" (Watson and Fotiadis 1990:621).

In deciding how the results of the survey were going to be presented and discussed there was recognition of the fact that one of the major problems with how archaeology is generally practiced is the manner in which data are collected, interpreted and presented. Jones has addressed this problem, which he calls *fragmentation* (Jones 2002:42), using as an example what he calls "exploding excavations" (Jones 2002: Figure 3.1). What happens is that during the course of an excavation and even more so in the post-excavation phase of a project, is that the material remains are separated from one another and in some cases handled by a number of specialists (e.g., faunal analysts and lithic technologists) who write up the results of their analyses. Final excavation reports thus often end up being compartmentalized representations of a site rather than holistic. In this report we have incorporated into the text the results of the analyses undertaken by a number of specialists in the fields of faunal analysis and stone sourcing, instead of simply or only attaching the findings in appendices.

In the discussion of theoretical and methodological issues in Section 4 it was argued that archaeology is inherently interpretive and that interpretations can vary depending on a whole host of factors, including theoretical presuppositions and context. In addition, "Different theories help us to understand alternative aspects of the mosaic. All simplify and none is adequate to an understanding of the totality" (Tilley 1995:339-340). Archaeological fieldwork itself is an interpretive practice in deciding, for example, not only what is cultural, as opposed to natural, but whether a pile of stones is old or recent and whether it might mark a trail, a boundary or something else. A classic example of this dilemma is how to prove that a cairn was a trail marker:

> A decayed cairn differs not at all from a couple of rocks accidentally and naturally clustered. Such reasoning is thus either probabilistic, in which the threshold for acceptance and action "on the trail" is very low, or even mere abductive or prima facie reasoning (Dipert 1993:82).

Lacking the means to prove that a cairn was a trail marker interpretations are in Tweed's words "more or less acceptable, where acceptable means internally coherent and contextually useful" (Tweed 2006:17). Tweed recognizes at the same time that "an acceptable interpretation is always contested and contestable and is always a matter of offering a plausible account within an accepted categorical scheme and within a particularly professional setting, with its scholarly idiom and role-specific obligations" (Tweed 2006:17).

Finally, as a preface to the discussions that follow, we want to note our agreement with what we regard as a fundamental principle in archaeological practice: that the "The interpretive practice that is archaeology is an ongoing process: there is no final and definitive account of the past as it was" (Shanks and Hodder 1995:5). In a similar vein, we also note our agreement with Tilley, who has written "Just as there is no one monolithic present in which we all live, there is no one single immutable past to be resurrected in our discourses" (Tilley 1995:339-340).

7.1 The Archaeological and Cultural Landscape of the NAR

The archaeological landscape of the NAR and the bordering Science Reserve, which most everyone familiar with both areas would say should be viewed together rather than separately, is an unique mix of a Pre-contact stone age industrial landscape and a more purely ritual landscape, like that found at Lake Waiau. The landscape is covered to varying degrees with the waste of a tool manufacturing industry and the associated remains of temporary habitations and ritual practices. It is more like the archaeological landscape made by a group of hunter-gatherers in their seasonal round than the archaeological landscapes found throughout tropical and sub-tropical Polynesia, except for the numerous shrines and, of course, the kind of tools that were being manufactured. The shrines are a telltale sign that this is a Polynesian landscape.

As impressive as the archaeological landscape is in terms of the extensive spread of portable artifacts and non-portable structural remains, it is important to remember that it is just a part of a broader, more encompassing cultural landscape. Pu`u Waiau, a formally designated and recognized Traditional Cultural Property (TCP), is itself one small part of a much grander cultural landscape. There is no doubt that all of the cinder cones, including those with and without burials, were culturally significant, as were the two named drainages, Waikahalulu and Pohakuloa Gulches and locally unique landforms, such as glacial moraines and whaleback ridges. Not only were the gulches a source of potable water, they also appear to have been major corridors used by adze makers and others in travelling to and from the summit region. Though it hardly seems worth saying because it is so obvious, the cultural landscape was not confined to the boundaries of the NAR. It also encompassed the lands that fall within the Mauna Kea Science Reserve, which together with the NAR and parts of the Mauna Kea Forest Reserve, make up what we have called the Mauna Kea summit region.

7.1.1 Site Diversity and Distribution Patterns: the Broad View

A summary of the number, functional diversity and spatial distribution patterns in the NAR is complicated by the existence of "simple sites," such as possible burials and markers and memorials that occur singly or together in small numbers and occupy relatively little space, and "complex" sites, namely the adze quarry complex which is comprised of a number of functionally related activity areas spread over vast areas. While the possible burials and memorials are easy to recognize as discrete entities, the opposite holds true of the adze quarry complex where boundaries are exceedingly difficult to establish because of the natural and cultural factors that have been discussed in Section 6. The numbers of each of these two broad categories of sites are not comparable, and thus have little or no meaning.

At the most general level of analysis the diversity of functional site types in the NAR is low. There are two ways of measuring diversity:

> First, of course, is *richness*, the number of categories present. Second, is *evenness*, which expresses the extent to which the categories are represented by similar quantities of objects (Cowgill 1989b:135).

Without performing an actual statistical test it is still possible to state that richness, defined as the number of functional site types in the NAR, is low, compared, for example, to the permanently occupied lands on the coast. Indeed, the vast majority of sites in the NAR are related to just two kinds of social practices—adze manufacture and ritual, which includes mortuary practices. There is at the same time little evenness in the relative numbers of different site types. Of the 109 sites recorded in the survey 72 or 66.1% are part of the Mauna Kea Adze Quarry Complex, which to reiterate once more, is comprised of the quarry proper and related sites, small lithic scatters, and isolated artifacts outside of the source of basalt toolstone. Isolated shrines and possible burials at Lake Waiau and several other localities are part of what is essentially a ritual landscape.

One of the puzzling things about the Mauna Kea summit region in general is the paucity of rock art. It is not for the lack of suitable surfaces or canvases for either petroglyphs or pictographs. Indeed, the geological formations that exist in the summit area contain an abundance of flat surfaced boulders and bedrock exposures where rock art would normally be expected to occur, at least from the point of view of lowland rock art sites. There are several possible explanations for why so little rock art has been found on the summit of Mauna Kea. One is the small number of people who probably ever ventured above treeline and may have been prohibited from doing so because of the reverent feelings for the mountain top. Another possible explanation is the difficulty of making petroglyphs because of the density and hardness of the local basalt as demonstrated in the field by Ed and Diane Stasack. There are undoubtedly more examples of rock art in the summit area that were not seen during the various surveys because of poor lighting conditions, of course, but on the whole the people who spent time there appear to have devoted little time to making petroglyphs and pictographs.

7.2 The Prehistory and History of the Mauna Kea Summit Region: A Preliminary Sketch

Any attempt to write even a sketch of the prehistory and history, or what is sometimes is still called a culture history, of the Mauna Kea summit region is fraught with numerous difficulties, besides being utterly presumptuous. For one, though there is a wealth of raw data now available, very little of it has been adequately analyzed and interpreted. Additionally, a discussion of changes in land use practices, and more specific cultural practices, for example, rests on a number of assumptions, including the validity and precision of current dating methods and how many dates are sufficient to draw generalizations on the timing of significant events or changes in various cultural practices.

Culture history, as defined in the Concise *Oxford Dictionary of Archaeology*, is synonymous with a cultural-historical approach, which is an older traditional approach primarily concerned with the ordering of archaeological data into “a basic sequence of events in time and space, usually as a generalized description of human achievement under broad period-based headings” (*Darvill* 2002). Though widely criticized, it is still practiced by many archaeologists in Hawai`i, as evidenced by the number of different periodization schemes that have and continue to be formulated (e.g., Kirch 1984, 1985; Hommon 1976, 1986; Carson and Mintmier 2006). Unlike the older cultural-historical approach, which was focused on such things as ethnicity and explanations of culture change in terms of diffusion and migration (Trigger 2007:313), the periodization schemes in Hawaiian archaeology are chiefly concerned with changes within what is called either the Prehistoric Period or Pre-Contact Period. While the senior author continues to see the value in broad-based stage sequences for the ordering of archaeological data, he is fundamentally opposed to breaking down or sub-dividing the prehistoric period of Hawaiian culture history into, for example, “colonization”, “expansionist”, “developmental”, and other similar sub-periods which rest on assumptions of universality and the notion of evolutionary changes in so-called “social complexity.” There is no reason that the culture history of the Mauna Kea summit region should fit neatly into one of the proposed cultural sequences, even though what occurred on the mountain was clearly related to historical events that took place elsewhere.

For the purposes of this report the “culture history” of the Mauna Kea summit region, has been arbitrarily divided into two time periods: (1) the Pre-Contact Period (pre-1778); (2) the Post-Contact Period, which is often referred to as the historic period.

7.2.1 Pre-Contact Sites, Land Uses, and Cultural Practices

While there is good reason to believe that the summit region was known to early Hawaiians because of the probable desire to investigate the snow-capped mountain (McCoy 1990), the only activity that is known with certainty to have occurred in the Pre-contact period is the manufacture of stone adzes. Radiocarbon dates from eight sites, including three from a site complex at Hale Pōhaku, which is outside of the quarry proper (McCoy 1985; 1991), indicate that the quarry was exploited over a period of possibly as much as 700 years between ca. A.D. 1100 and 1800 (McCoy 1986:Figure 28; 1990:Figure 4). As discussed in more detail below, when the quarry was abandoned is unknown and may never be known with any certainty, but there is some evidence that it may have occurred as late as European contact in 1778 or shortly thereafter.

Undated, but inferentially pre-Contact in age, are travel corridors marked by lithic artifacts and in some cases an associated shrine. Previously recorded examples in the Science Reserve and others in the NAR that are discussed below constitute the best evidence yet for early “trails.”

7.2.1.1 Adze Manufacture

The only activity that is clearly known to date to the Pre-contact period in the NAR is adze manufacture. Radiocarbon and ^{230}Thorium dates leave no doubt as to when most of the activity in the quarry was taking place. What remains to be determined is when the quarry was first used and when it was abandoned (see the discussion of this issue below in Section 7.3).

7.2.1.2 Mortuary Practices

The second activity that almost assuredly took place in Pre-contact times in the NAR was human burial. The oral traditions that talk about burials on Mauna Kea mentioned in Section 2 of this report don’t give a date, but the reason for taking human remains to such remote areas, and the remains of high ranking chiefs in particular, are known.

The 13 possible burial sites found in the survey are on current evidence localized to just a few locations in the NAR. Of the 13 sites six or 46% were found on just two of the major cinder cones located in the NAR. Two possible burials are located in the adze quarry (see Table 5.12). The structural remains at these two sites are rectangular pavements/low mounds that are architecturally different from the burial mounds found on the cinder cones, but similar to ones found on the shore of Lake Waiau (McCoy and Nees 2009) and two sites in the Science Reserve where adze manufacturing waste material was also found (McCoy and Nees 2010). The distinctive architectural characteristics and presence of adze manufacturing by-products suggests that if the sites are indeed burials they may contain the remains of adze makers, in contrast to the cinder cone burial sites where no such association is evident.

With the exception of the possible adze maker interments, the apparent restriction of the higher elevation burials to the apex of cinder cones is in sharp contrast to many of the burials found at Kanakaleonui, a well-known burial center located not too far outside of the Science Reserve, just below Pu`u Mākanaka and the summit plateau. Reconnaissance of this area indicates that there are an indeed a great number of structural remains at this locality. There are platforms on the top of the cone and a great number of smaller cairns at the base. On current evidence there are more burials in the general environs of Kanakaleonui than probably exist higher on the mountain, possibly on the entire summit plateau. The disproportionate number of burials in the environs of Kanakaleonui suggests that the edge of the plateau might have been a major social boundary, with the area below reserved for commoners and the plateau for persons of higher social status (chiefs and priests). If the very top of the cones were reserved for higher status individuals and the ground below for commoners, then Kanakaleonui must have both (McCoy 1999a:28).

Wherever they have been found, burial sites tend to occur in clusters of two to sometimes three mounds, platforms or terraces. The recognition of shrine clusters comprised of two sites and similar sized burial site clusters is a pattern that would seem to reinforce the notion of family units staking out a piece of land to be used over a number of generations. This interpretation, if true, indicates that it is perhaps wrong to view the burials in the summit region as simply reflecting high status and that we should take Hodder's advice and view burial patterns as "meaningful transformations of social differentiation" (Hodder 1982:150). In short, it is possible that the burial patterns in the summit region are the result of a social practice that recognized graded statuses and that the underlying principles or rules changed through time.

7.2.2 Post-Contact Sites and Land Uses

Sites that can confidently be categorized as of Post-contact (post-1778) age are few in number in the NAR. This is hardly surprising since the activities and more general land use patterns that characterized the Pre-contact period were largely discontinued in what became a more remote and less frequently visited area of the island until an age of exploration and recreation began.

Changes to the traditional Hawaiian lifestyle began soon after the arrival of Captain James Cook in 1778. One significant change was the rapid adoption in the major trading centers and nearby communities of Western tools, clothing and other items, initially by the chiefs and then the common people. The impact on traditional technologies is known in a general way from historic accounts, such as diaries and newspapers, but for remote centers of traditional crafts, such as the Mauna Kea Adze

Quarry, there is little or no information on how long they continued to be utilized before abandonment.

The first recorded ascent of Mauna Kea by a European was made by the Rev. Joseph Goodrich in 1823 (Goodrich 1833:200). A number of visits followed shortly thereafter, including ones by such prominent figures as the renowned botanist David Douglas (see Maly and Maly 2005 for a comprehensive overview of early visits and expeditions to the top of Mauna Kea). Gregory and Wentworth wrote that:

> There have doubtless been many unrecorded visits to the summit of Mauna Kea since Goodrich's time. Indeed, it is probable that fifty or more years ago, when ranch operations were of relatively greater importance and the old Makahalau-Keanakolu trail was in general use as a route from Kawaihae and Waimea to Hilo, the upper slopes of the mountain were more generally known to the residents of Hawaii than they are today (Gregory and Wentworth 1937:1722).

Kamehameha, in the company of Kekuhaupi`o, is reported as having made an offering close to Lake Waiau (Desha 2000:94; Maly and Maly 2005:50). Of the many people that made the arduous ascent of the mountain in the 19^{th} century, the trip made by Queen Emma in 1881 or 1882 [the dates vary from one account to another] is one of the best known (de Silva and de Silva 2007). The Queen Emma trip, which was made on horseback, started at Mana in Waimea. From there the party rode to Kalaieha [the name for the area occupied by the Humu`ula Sheep Station] where the night was spent before riding to the summit the next day. Mary Kalani Ka`puni Phillips, a descendant of W.S. Lindsey, one of the guides that accompanied the Queen, has written that:

> Queen Emma rode on the back of Waiaulima, and he swam around Waiau pond at Mauna Kea. And then he lifted Queen Emma, and carried her to a rocky place. The people were amazed to see Queen Emma's on-the-back swim, and they returned and told the mo`olelo to us (de Silva and de Silva 2007).
>
> The historical record of pilgrimages to Maunakea is not limited to Emma's mele and Phillips's mo`olelo. Steve Desha writes, that as a young man, Kamehameha Pai`ea went to Waiau to pray and leave an offering of `awa. Kamakau tells us that Ka`ahumanu made the same journey in 1828 in an unsuccessful attempt to retrieve the iwi of her ancestress Lilinoe. Kauikeaouli visited Waiau and the summit in 1830, Alexander Liloliho in 1849 and Peter Young Ka`eo in 1854 (de Silva and de Silva 2007).

The same view on the use of older trails and a more keen knowledge of the upland regions of the island is echoed in the unpublished report of the 1935 Hawaiian Academy of Science Expedition:

> Indeed, it is probable that in the early days of white settlement of the Hawaiian Islands, before the concentration of population in the sugar-growing areas, when the lack of good, coastal highways led to more general use of the now nearly abandoned high-level, belt trail, the summit area was relatively better known to the general population that now. In recent years a few people have visited the summit in small parties on horseback, with a guide from Umikoa or Humuula (Wentworth, Coulter and Hart n.d.:1-2).

Though what we believe to be the memorial cairn built to commemorate Queen Emma's visit does not possess the grandeur of Ahu a `Umi, the two are alike in celebrating the presence of a person of royalty at momentous places in the geography and history of Hawai`i. While a number of different ideas exist about the origins and meaning of Ahu a `Umi, it seems clear above all else that it is a monument that was built as a symbol of power to be venerated by the general populace for generations to come. It is a memorial to `Umi. In this view, the construction of Ahu a `Umi was an act of political legitimization. The display of power is central to ceremony as opposed to ritual, which most often affects a change of some sort (Grimes 1982:41). According to Grimes, ceremony has "imperative force;" it invites participants to surrender personal preferences for the sake of some "larger cause" that commands allegiance, loyalty, and homage" (Anonymous 1993:2). As noted, "because of its symbolic connection to power, *ceremoniousness may be thought of as a ritual strategy aimed at social control"* (Anonymous 1993:2). The Queen Emma memorial, though now off the beaten path of the Humu`ula Trail because of a realignment done in the 1930s, is nonetheless a surviving reminder of a time when Hawaiian royalty commanded the utmost respect. The memorial cairn embodies the power of royalty and a specific place and time in Hawaiian history.

As the summit area of Mauna Kea became better known to the public, it also began drawing the attention of scientists toward the end of the 19th century. The first major scientific study was conducted at Lake Waiau in 1892. W.D. Alexander, Surveyor General of the Kingdom E.D. Preston, an astronomer with the U.S. Coast and Geodetic Survey organized an expedition that is sometimes referred to as the "Pendulum Survey Party" because of Preston's objective of making pendulum and meteorological observations. A number of other individuals participated in the Pendulum Party survey which is described in detail in Maly and Maly (2005).

The first evidence of what can be called trails in the sense defined by Apple (1965) is the Humu`ula Trail that as discussed earlier, is likely to be of Post-contact age and related to either ranching or ranch hands taking interested parties to Lake Waiau and the summit area. Like the Ainapo Trail on Mauna Loa, one would expect that trails would have been situated in relation to favorable camp locations, availability of shelter and water (Apple ms.). Some evidence of these early excursions are preserved in the names of persons, including the infamous Eben Low, scratched on boulders and rock faces like the one found in the adze quarry at Site 16216. Another possible example of historic period rock art is the petroglyph at Lake Waiau that bears some resemblance to a horse.

On current evidence the cultural sequence of the Lake Waiau site complex most likely includes historic properties spanning the period from Pre-contact times to the modern era. With the exception of Sites 26127 (historic trash dump), 26128 (pendulum pier) and 26131 (the Eben Low Memorial Plaque) most, if not all, of the other 18 sites in the immediate environs of Lake Waiau are assumed to consist of traditional Hawaiian features. Some undoubtedly date to the pre-contact period, while others may date to the post-contact period.

With the exceptions noted above, there is little surviving evidence of the early scientific expeditions that camped at the lake. The 1935 Hawaiian Academy of Science Expedition and earlier expeditions appear in fact to have had little impact on the cultural landscape. A couple of examples of minor landscape alteration are described in the accounts of the 1935 expedition. While drinking water was most likely obtained directly from the lake by Hawaiian adze makers and others that made the long journey to the summit of the mountain, the 1935 Expedition obtained its drinking water from a well that was dug on the sandy margin of the lake—"where ground water, probably from ground ice, was seeping out a foot or more above lake level" (Wentworth, Coulter and Hartt n.d.:4). Clarence Raine, the expedition meteorologist, notes that on the second trip to the lake "I built a rock shelter and covered it with a blanket, on August 8th. This shelter was made square and with an opening facing the south. The rock-strewn earth of the lake shore supplied the building material…" (Raine 1939:98). A photograph of Raine in front of the shelter appears in Ed Bryan's popular account of the 1935 expedition (Bryan 1979:18).

The NAR, which except for a small sliver of land along the southern boundary is located above treeline, is unsuitable for any kind of livestock or farming. The only resource in the NAR that was important to early ranchers was water. There are archaeological evidence and oral history accounts that both Pōhakuloa and Waikahalulu Gulches were utilized by early ranchers as a source of water (McCoy 1984a, 1986:87).

7.2.3 The Development of Places: An Historical Perspective

There is accumulating archaeological evidence that the high elevation "wilderness" on Mauna Kea was the locus of a number of seasonal "special purpose" activities, including tool manufacture, burial and the worship of gods and spirits. There is a suggestion in all of these activities of a direct link to the exercise of political power in the person of a ranking chief, and more particularly of what Sahlins has called the "general cultural practice of heroic history" (Sahlins 1985:34). Dates for the quarry suggest that each of these practices has considerable time depth and continuity.

In the report on the 2007 archaeological inventory survey of Lake Waiau (McCoy and Nees 2009), we noted that the number and types of historic properties and other cultural resources found in the Science Reserve, combined with ethnohistoric and ethnographic data regarding cultural practices, points to the lake having developed as a *place* within a *region*, as the two terms are used by cultural geographers and philosophers of space and time (McCoy and Nees 2009). The discussion that follows is a synthesis of information regarding the development of places within the Mauna Kea summit area. It is based on our view that a non-site oriented approach is essential to understanding the long-term history of Mauna Kea.

7.2.3.1 Analytical Constructs: Region, Place, and Landscape

With the completion of the archaeological inventory survey of the Science Reserve and the NAR there is new evidence that the summit region of Mauna Kea was comprised of several different places, each with its own defining characteristics, but also exhibiting evidence of inter-connections. The phrase "Mauna Kea summit region" has been used repeatedly throughout this and other recent reports (e.g., McCoy 1999a), without being clearly defined, however. The geographer Edward Relph provides a useful definition of region:

> A geographical region is defined as a part of the earth that is distinctive from other areas and which extends as far as that distinction extends. It is characterized by internal similarities of landforms, cultural history, settlement forms, climate, or a combination of all of these (Relph 1985:21).

The higher elevations of Mauna Kea have all of the defining characteristics of a region as defined by Relph: similar landforms, climate and a locally unique set of land use practices. As used in this report and others before (e.g., McCoy 1991; McCoy and Nees 2010), the Mauna Kea summit region corresponds to the lands above treeline or roughly the 9,200 ft elevation.

Beyond the simple definition of what makes up a geographical region, there are numerous other definitions of region, as well as place and landscape. Some of the definitions that the senior author have found most useful are those presented in Edward S. Casey's book, *Getting Back into Place: Toward a Renewed Understanding of the Place-World* (Casey 1993). Casey, who is a philosopher, goes beyond simple definitions to consider the relationships between the different terms:

> A region, let it be noted, exceeds a given discrete place…But in what does the excess consist? If we consider the term *region* to designate a collection or gathering of places, *place* retains the particularity essential to its description…For places are the particular parts or portions of regions. But this is not to say that regions are abstract totalizations of places. Regions possess their own concreteness, as we realize when we consider the specificity of a regional landscape with which we are thoroughly familiar. (A landscape can be considered the phenomenal or sensuous manifestation of a region). On the other hand, if regions do act to collect or gather places, this is not because they serve as mere containers, as "the first unchangeable limit of that which contains." Regions are no more containerlike *things* than places are bare *positions*. Regions are forms of gathering, and in this capacity they have powers and virtues of their own, which are not foreign to the dynamism of lived bodies that make possible the configuration of places (Casey 1993:73).

Casey's view that "Regions are no more container like *things* than places are bare *positions*" (Casey 1993:73) is one that is also now held by a number of anthropologists and archaeologists. Rodman, for example, argues that "Places are not inert containers. They are politicized, culturally relative, historically specific, local and multiple constructions" (Rodman 1992:641). Knapp and Ashmore note a change in the way many archeologists now view landscape:

> In minimalist terms, a landscape is the backdrop against which archaeological remains are plotted. From economic and political perspectives, landscapes provide resources, refuge, and risks that both impel and impact on human actions and situations. Today, however, the most prominent notions of landscape emphasize its socio-symbolic dimensions: landscape is an entity that exists by virtue of its being perceived, experienced, and contextualized by people (Knapp and Ashmore 1999:1).

The manner in which landscapes are experienced is highlighted in this passage from one of Casey's several books on place:

> …the spatiality of the places between which we move in landscape is at once inconstant and variant, unsystematic and open: as anyone can attest from an afternoon's hike in the low foothills of the California Sierras. Even when there are marked trails, these follow the irregular lay of the land, converge and diverge unpredictably, vary in width and in regard to how cleared they are, and in still other ways they resist charting in strictly geographic terms. When we are in a landscape setting, in other words, we are very much in the presence of place in its most encompassing and exfoliated format, a format in which we are sensuously attuned to its intrinsic spatial properties rather than imposing on it our own site-specifying proclivities (Casey 2000:197-198).

The new emphasis on perception, experience and context in landscape and place echoes what Casey has been arguing for some time:

> Place as we experience it is not altogether natural. If it were, it could not play the animating, decisive role it plays in our lives. Place, already cultural as experienced, insinuates itself into a collectivity, altering as well as constituting that collectivity. Place becomes social because it is already cultural. It is also, for the same reason, historical. It is by the mediation of culture that places gain historical depth (Casey 1993:31-32).

The recognition that places are historical requires that they be viewed from an historical perspective if they are to be properly understood. In the words of the anthropologist Eric Wolf:

> What attention to history allows you to do is look at processes unfolding, intertwining, spreading out, and dissipating over time. This means rethinking the units of our inquiries--households, localities, regions, national entities--seeing them not as fixed entities, but as problematic: shaped, reshaped, and changing over time. Attention to processes unfolding over time foregrounds organization--the structuring arrangements of social life--but requires us to see these in process and change (Wolf 1990:590).

The focus on process and change draws attention to the fact that natural places, such as the summit of Mauna Kea and Lake Waiau, are to some extent also "socially constructed" places. There are obviously many different kinds of places. As the late Clifford Geertz so aptly put it for cultural anthropologists, "The ethnography of place is, if anything, more critical for those who are apt to imagine that all places are alike than for those who, listening to forests or experiencing stones, know better" (Geertz 1996:262).

The boundaries of places, and sacred places in particular, are not always easily defined. Tilley has noted that, "Places nest in landscapes, and their borders cannot usually be strictly defined" (Tilley 2004:25). This is true of the adze quarry, the boundaries of which have become less clear over time as more of the southern flank of Mauna Kea has been surveyed. Lake Waiau and the summit are exceptions. In contrast to the summit, which is surrounded with shrines and a few other kinds of sites, the base of Pu`u Waiau is an essentially open landscape. The site distribution pattern is the inverse of the summit, which shows little evidence of having been modified by Hawaiians in the past. The boundaries that define Lake Waiau as a place are the string of discontinuous sites around the rim of the cinder cone and margin of the lava flow that overlies the rim on the north side of the lake.

From the perspective of the people that were engaged in the various practices that made the various definable places in the summit regions, the boundaries of each place are essentially unmappable because of all of the "invisibilities that can never be made visible", which means that maps of such places "are by definition incomplete" (Caron 1995:126). As Caron notes, "The performance of the practice is itself the map" (Caron 1995:126).

Boundaries of sacred places also change through time. Lake Waiau and the summit have both become polymorphous spaces (Caron 1995) claimed by people of different religions. At different times it is possible that one may encounter at the lake such things as Native American prayer sticks and arrowheads, Tibetan prayer flags and various “New Age” objects such as crystals and other rocks and minerals. Similar objects have been placed on the summit *lele*.

7.2.3.2 The “Sacred Center”: Pilgrimages to the Mountaintop (Kūkahau`ula)

In many religions mountains are considered sacred places and in many areas of the world they are the focus of pilgrimages to communicate and make offerings to local gods.

> ...sacred places are places of communication with divinity, places where people go to meet the gods. This function is often indicated by symbols that represent a link between the world of humans and transcendent realms. Such symbols might be vertical objects that reach from earth toward heaven, such as mountains, trees, ropes, pillars, and poles (Brereton 1987:528).

Contrary to the generalizations of Eliade and others, not all mountains became sacred places, however (Robson 1995:121).

Mauna Kea, believed to be the firstborn of Papa and Wakea and regarded by Native Hawaiians as the “center” or *piko* of the island, has all the hallmarks of what Mircea Eliade, a distinguished historian of religions, referred to as a “sacred center” (Eliade 1987) and others have called a “cosmic mountain” (Eck 1987:130-131). Eliade, who followed Emile Durkheim (1912/1995) in distinguishing between the sacred and the profane, saw “a correlation between this distinction and distinctions in space and time” and argued that “These distinctions owe their existence to some non-human other, often termed “the sacred” (Gill 1998:302). Eliade thus concluded, in the words of Sam Gill, that “Human beings do not construct their world so much as they discover or recognize the distinctions, the sacred places that supernatural beings introduced into the world” (Gill 1998:302). Gill goes on to note that:

> Such spatial distinctions invariably correlate with the points of entry into the world of the supernatural creators. These places continue to function as the locations where humans may communicate with the gods. In Eliade’s analysis the strongest place, the place giving orientation to all space, is the center. Structurally the center can have no other valuation than sacredness since it is the locus of all creative and thereby religious activity, both divine and human. Thus “sacred space” is focused upon and oriented by the “the sacred center” (Gill 1998:303).

Eliade’s approach to the study of world religions was thus based on “territorial distinctions made significant by sacred events, “the center” (or “the sacred center”) in spatial terms and “the beginning” in temporal terms” (Gill 1998:304). While Eliade’s approach continues to be used, there are critics, such as Jonathan Z. Smith, who “sees humans as constructing their worlds of meaning” and for whom there is “no objective territory” (Gill 1998:305). Smith, the author of a much cited paper, “*Map is Not Territory*,” (Smith 1978:289-309) argues that the data used to study religions are like “maps” and because “there are endless ways to map a territory and to use maps to negotiate a territory, there are endless ways to perform rites and apply myths in the effort to construct meaning in life” (Gill 1998:307).

Though the sacred is clearly a contested concept and might only be useful as a heuristic device (Colpe 1987:511), archaeological evidence indicates that the summit region of Mauna Kea is quite unlike other mountain peaks and “sacred places” in

Hawai`i,  The large number of shrines in the summit region have been interpreted as the remains of an historically undocumented and apparently unknown pattern of pilgrimage to worship the snow goddess, Poli`ahu, and other mountain gods and goddesses such as Kūkahau`ula, Līlīnoe, and Waiau (McCoy 1982, 1990).

While there is no reason to expect that Mauna Kea would conform exactly to the idea of a modern pilgrimage center associated with one of historic religions (Turner 1974), and of the so-called "salvation" religions in particular, it does share some of the same general characteristics of all pilgrimages:

> At the heart of pilgrimage lies the notion of a journey (see, e.g., Morinis 1984). A journey involves two important dimensions--time and space. What distinguishes pilgrimage from other journeys is that its time and space are not ordinary time and space. Moreover, pilgrimage is both a "real" journey and a symbolic or metaphoric one in which spiritual and/or social transformation takes place (Dubisch 1995:35).
>
> Pilgrimage is based on the belief that certain places are different from other places, specifically, that they are in some sense more powerful and extraordinary--what Preston (1992) calls "spiritual magnetism." This power can not only be experienced by the pilgrim who visits such places; it can also be taken home in one form or another--whether as a feeling of spiritual renewal, as a healed illness, as a physical object imbued with the sacred power of the pilgrimage site, or as a transformation in one's social status (Dubisch 1995:35).

The probable origins of the pilgrimage process were earlier linked to one of Mauna Kea's most distinctive and unusual characteristics, the mantle of snow that often covers the top of the mountain (McCoy 1990:113-114):

> A large shrine complex located above the quarry suggests that the earliest activity on the top of the mountain was related to the worship of local gods and goddesses. This complex, which is interpreted as a 'pilgrimage center', is inferred to have had its origins in what would have been for the first colonists from east Polynesia a natural history anomaly--snow--which because it was 'matter out of place' must have been regarded as mystically dangerous. As Lewis (1976:109) points out, 'anomalies are always situational and relative, never or very rarely absolute.' The shrine complex, though undated, suggests that this anomaly was not avoided, but rather than it was quickly given a place in the local cosmology (Douglas 1966:38).

Reference was made earlier to chants that relate that because the island of Hawai`i was the firstborn of Papa and Wakea it was considered the older sibling or *hiapo* of all Native Hawaiians and that Mauna Kea was the origin point or *piko* of the island (Langlas 1999:7). The ascent of Mauna Kea has been described elsewhere as "a walk upward and backward in time to cosmological origins" (McCoy 1990:114).

Based on the large number of shrines in the summit area it is clear that Hawaiians went to the top of the mountain with a sacred purpose in mind, but it is doubtful that large numbers were involved at any one time. The ritual landscape that exists today is almost certainly the result of journeys by a number of families and adze makers over many generations.

The cluster of overlapping cinder cones that forms the "summit" of Mauna Kea, including those now called Pu`u Wekiu, Pu`u Kea, Pu`u Hau Oki and others that are not easily distinguished as discrete landforms (Porter 1979), has been designated an historic property (Site 21438) based on ethnographic information and archaeological data. Ethnographic information suggests that the “summit,” as just defined, was most probably known in the past by a single name, Kūkahau`ula, that on present evidence referred to both a legendary figure and to a character in traditional histories and genealogies. The latter includes references to Kūkahau`ula as the husband of Līlīnoe and as an `*aumakua* (family deity) of fishermen. The place name evidence thus indicates that the “summit” was at the very least a legendary place (*wahi pana* Pukui and Elbert 1971, 1986). The archaeological evidence indicates that it was much more than that. While there is little archaeological evidence of human activity on the “summit” itself, the large numbers of shrines that encircle the mountain, just below (McCoy and Nees 2010: Figure 5.4), indicate that the top of the mountain was the focal point of ritual practices. There is no knowledge of what these practices entailed, but it is reasonable to infer that they were centered on the worship of local mountain gods and goddesses, such as Poli`ahu and Līlīnoe, and presumably Kūkahau`ula as well. The summit is thus interpreted to have been the focal point of a major pilgrimage site or center.

Though no archaeological surveys were conducted prior to the construction of the summit road, which was completed in the mid-1960s, there is no indication that any archaeological sites on the “summit” were destroyed at that time, or at any time thereafter in the construction of the existing observatories. In 1998 Kepa Maly interviewed two Hawaiian men, Theodore “Teddy” Bell, who had worked for Morrsion-Knudsen on the road to the summit, and Alika Lancater, who had worked on the construction of the first observatories in the 1960s. Neither one had seen or heard of any human bones uncovered along the road, or on the summit (Maly 1999 Appendix A:123, A-232).

The most important observation to be made about the summit (Kūkahau`ula) is the meager evidence of human activity prior to the historic period. Indeed, with the exception of Site 21209, which is comprised of two features, a small rock outline and mound on the southeast rim of Pu`u Wekiu, there are no other known sites of probable pre-Contact age on the summit. The virtual absence of archaeological sites on the very top of the mountain may mean different things and is potentially open to a number of different interpretations. In the early to mid-19th century the opinion seems to have been that Hawaiians avoided the top of the mountain because of the cold environment and superstitious beliefs. The following accounts provide an indication of the thinking at that time:

> The natives have no passion for high mountains, or cold weather (Jarves 1844:222).

> It is very unlikely that any native had reached the top of the terminal cones on the summit, owing to being unprovided with warm clothing to resist the great cold and also to the fact that the natives had a superstitious dread of the mountain spirits or gods. About six months after the date of the first ascent of Mauna Kea by Mr. Goodrich the peak was scaled by Dr. Abraham Blatchley and Mr. Samuel Ruggle, both connected with the American Mission (Macrae 1922:55).

> The snow on the summit of the mountain, in all probability, induced the natives to call it Mouna-Kea, (mountain white), or, as we should say, white mountain. They have numerous fabulous tales relative to its being the abode of the gods, and none ever approach the summit---as, they say, some who have gone there have been turned to stone. We do not know that any have been frozen to death; but neither Mr. Goodrich, nor Dr. Blatchely and his companion, could persuade the

> natives, whom they engaged as guides up the side of the mountain, to go near its summit (Ellis 1979:292).

The lack of warm clothing was clearly not a deterrent to reaching the top of the mountain, as the numerous shrines located only a few hundred feet below the summit demonstrate. The repeated references to the top of the mountain being the "abode of the gods" and to the fear of the gods indicate why the early expeditions could not persuade their Hawaiian guides to go all the way to the summit. The top of the mountain was clearly a sacred precinct that must, moreover, have been under a *kapu* and accessible to only the highest chiefs or priests. The virtual absence of sites on the summit cones suggests that the same belief system had been adhered to and strictly enforced in the more remote past.

While the small number of shrines on the west and southwest side of the mountain suggest the possibility of people coming from the Kona and South Kohala districts, the number would appear to have never been high. The implications are quite interesting. It suggests that while the mountain may have been viewed from a distance by people from everywhere on the island as a sacred mountain, in practice those who made the journey and worshipped there did not represent an even cross-section of the island populace. The implication is that access to the summit region was under the political control of the east Hawai`i chiefdoms, a conclusion that is consistent with the ethnographic and historic evidence that the summit region of Mauna Kea was located in the Hāmākua District. A possible exception to this pattern, discussed below, is the adze quarry which may have been accessed from a number of different districts. In any case, most of the shrines in the southwest sector of the Science Reserve are part of the adze quarry complex.

Skeptics of the pilgrimage interpretation will probably argue that the scanty evidence of pre-contact Hawaiian activity on the summit is due to the destruction of sites during the road building in the 1960s and the construction of astronomical observatories that followed. Even if they are willing to accept that the near absence of structural remains on the summit is real, they might still say that the argument put forth is a case of special pleading. Anticipating such skepticism, it is important to note that Mauna Kea was not the only "high place" in Hawai`i where the common people were prohibited from entering. Another example is a hill named Pu`upane at Keokea in the Kula District, Maui that was described by Moses Manu in the late 19th century:

> This was a hill decreed by the ruling chiefs of Maui to be sacred; no commoner ascended this hill; for it was a *heiau* for the high chiefs of Maui from ancient times until Kihapi`ilani's arrival on the hill of Pu`upane, and that was the reason that this kahuna lived at `A`apueo, to watch out for it (Manu 1884:4, quoted in Kolb 1991:109).

On Hawaii Island there is another reference to the marking of boundaries on a hill in the Waimea area that involved a High Chiefess named Wao. The information is from the Edgar Henriques Collection:

> The servants of Wao would roll a stone down the hill to a flat land and wherever the stone would stop, that would be the tabu line, and no one would be allowed to pass. Especially would it be a sign for the people who lived below the hill called Pekepekelani who were a class known as Kauas or low born (Haun et al. 2002:12).

Whether a boundary is set by some practice, such as that described at Pekepekelani on Maui, or prescribed by some edict transmitted verbally, the scholar Van Gennep "saw that rites of transition treat all marginal or ill-defined social states as dangerous...Not only marginal social states, but all margins, the edges of all boundaries which are used in ordering the social experience, are treated as dangerous and polluting" (Douglas 1975:56). We believe that it is significant that, in contrast to the summit, there are no clusters of shrines at the base of any of the other cinder cones in the summit region, such as Pu`u Mākanaka, Pu`u Līlīnoe, Pu`u Poepoe, Poli`ahu and Pu`u Waiau. This implies a pattern akin to what Douglas called "graduated holiness," with the very top of the mountain or *piko* representing the holiest place in the Hawaiian world and accessible to only a special few.

The apparent absence, or at the very least, minimal evidence of human activity on Kūkahau`ula before European contact and written accounts is an example of "a larger pattern of presence-within-absence" (Herzfeld 1992:67). Though difficult to describe, it is the absence of human residues that points to the presence of spirits and gods on the mountain top.

7.2.3.3 Lake Waiau: A Central Place for Rites of Passage

In contrast to the summit, where there is little physical evidence of pre-Contact use, archaeological data and traditional evidence indicate that Lake Waiau was a center for a number of activities (McCoy and Nees 2009) that included:

1) Communication with the gods and goddesses of the lake;
2) A place where rituals associated with two of life's primary rites of passage, birth and death, took place; and
3) A place used by adze makers, some of whom may have been buried at the lake.

Based on the oral traditions relating to the placement of umbilical cords (*piko*) in the lake and the archaeological evidence of numerous human burials (see McCoy and Nees 2009 for a summary), Lake Waiau at some point in time became a central place for rites of passage related to both birth and death. Rites of passage are rituals that:

> mark the passages of an individual through the life cycle, from one stage to another, integrating the human and cultural experiences with biological destiny: birth, reproduction, and death (Myerhoff 1982:109).

Although no dates are available for either of the two rituals, it is likely that the lake was discovered relatively early after colonization of the island and that it became a *wahi pana* (storied place), at least for persons of high rank.

In the case of the *piko* we know that it was a practice that existed at the time of first known European contact in 1778. Sahlins (1981:41) cites an interesting example of *piko* being placed on board one of Capt. Cook's ships:

> ..and while the women remained alongside, the men, following their instructions, went on board and deposited the navel cords of newborn children into the cracks of the decks. Commenting on the incident, a modern Hawaiian authority on traditional custom observed: "Cook was first thought to be the god Lono, and the

> ship his “floating island.” What woman wouldn’t want her baby’s *piko* [umbilical cord] there” (Pukui et al. 1972:184).

As a place inhabited by the gods the concealment of *piko* at Lake Waiau is of the same general pattern as that which occurred on Cook’s arrival since he was regarded, according to Sahlins, as a god (Sahlins 1981, 1995). As noted earlier, the concealment of *piko* was a practice aimed at ensuring a long life and preventing a person from becoming a thief if the *piko* should have been taken before it was cared for in the proper way.

Given the occurrence of similar practices elsewhere in Polynesia (e.g., Easter Island or Rapa Nui, where the umbilical cord was called *pito* Fuentes 1960) and other information, such as that collected by Thomas Thrum on Maui, the practice is undoubtedly an old one:

> Reference to the place of deposit of the “umbilical cords of Kaupo babies” (page 16), and to the superstitions relating to the practice illustrates the strong hold of ancient customs on Hawaiians. The practice may be traced back a thousand years or more, and throws light on the name chants of Puna-imua, Hema, Kahai, and others, which mention not only the place of deposit of the *piko* (umbilical cord) but other evidence of birth, hid in different locations, an ancient method, it may be, of birth registration. Whatever may have been the original design in the custom, the facts recorded in name chants may be used as a means of identification of proof, of Hawaiian birth, particularizing it to locality (Thrum 1921:259 in Emory).

Ethnographic data indicate that Lake Waiau was home to a number of gods and goddesses. There are references to the lake as the home of the goddess Waiau and the goddess Mo`o-i-nanea, the water-form of a *mo`o* (Maly and Maly 2005:vi). The one-time used name, Pond Poli`ahu, suggests that Poli`ahu may have also called the lake home. There are also references to the lake as the home of the gods Kane and Kanaloa and the place “from which the “ka wai kapu o Kane” (the sacred water of Kane) was collected” (Maly and Maly 2005:vi). On current evidence the lake would appear to have functioned something like both a female and male “earth shrine.” The sacred water, whether female or male, was apparently used for healing purposes and the making of *awa* (Maly and Maly 2005:42). The consumption of *awa* may have been part of the rituals conducted at the lake and also in the adze quarry, where it was found in the cave called Keanakako`i by Eduard Arning in the 1880s (Arning 1931).

Many of the activities that took place at Lake Waiau involved hiding or concealment. According to Caron (1995:130), “hiding places and hiding practices are integral to the fabrication of sacred places.” The evidence for this can be seen in the rites of passage that were performed at the lake.

To complicate matters, it now appears that there were two *piko* or centers on Mauna Kea, the summit (Kūkahau`ula) and Lake Waiau. According to some accounts the lake was named Ka piko o Waiau after the goddess Waiau (Maly and Maly 2005:vi), while the summit was also called Piko o Wakea according to Queen Emma’s poets (de Silva and de Silva 2007). Though close spatially, the two centers were quite different places. Ethnographic accounts indicate that the summit region of Mauna Kea was located in the *wao akua*, a sacred region (Malo 1951:16-18). Like all sacred places, there were restrictions or *kapu* on what kinds of activities could occur. As argued above, the shrine distribution pattern indicates that the summit of the mountain was the focal point of the inferred pilgrimage process and that it was probably under a *kapu* that prevented all but the highest chiefs or priests from ascending the top or *piko* (McCoy 1999a).

7.2.3.4 Keanakako`i: A Central Place in Hawaiian Adze Manufacture

There is little doubt that what archaeologists today call the Mauna Kea Adze Quarry Complex, but which may have been known to native Hawaiians in the past as Keanakāko`i or Kaluaakāko`i (McEldowney 1982:1.7), was a central place in traditional Hawaiian stone adze manufacture. The vast areas encompassed by the quarry complex and its use over hundreds of years are in themselves indicators of a central place. Following the initial research, in 1975-76, and partial publication of the results of that earlier work, the quarry has gained more recognition and with it has come new and different interpretations. Some of this information is presented below, together with a brief discussion of some of the key debates that have arisen about some of the interpretations.

7.3. The Mauna Kea Adze Quarry Complex: An Overview and Discussion of its Relevance to Selected Topics and Issues in Hawaiian Archaeology

As described elsewhere (McCoy 1990), the structure of the adze quarry "industry" on Mauna Kea is inferred to have been more complex than any other known Hawaiian adze quarry based on a consideration of the number, diversity, spatial distribution and formal-functional variability within different classes of activity remains which have been called site components. This reflects the view, summarized earlier, that there is a functional relationship between the various activity remains or components, such as shrines and workshops and shrines and rockshelter habitations.

On present evidence the Mauna Kea Adze Quarry Complex is unique amongst Hawaiian adze quarries in the presence of volcanic and glacial toolstone sources, workshops of various kinds, the number of shrines, temporary habitations (primarily rockshelters), and possible burials. In short, the Mauna Kea Adze Quarry Complex is characterized by site components representing daily life and work in the quarry and death.

What follows is a general overview of the Mauna Kea Adze Quarry Complex, beginning with a consideration of where and how the boundaries should be drawn, the quarry chronology, including the important aspect of when it might have been abandoned, and various other aspects of what for the lack of a better word has been called the "quarry industry." This includes a consideration of such matters as seasonality and scheduling, the probability of the development of some form of territoriality and a division of labor, and other aspects of the quarry industry.

The overview and discussion of the relevance of the Mauna Kea Adze Quarry Complex to selected topics and issues in Hawaiian archaeology draws on previous papers and reports, such as the archaeological inventory survey report on the Mauna Kea Science Reserve (McCoy and Nees 2010). The inclusion of the Science Reserve in the discussion is deliberate and is based on the obvious fact that the Science Reserve and NAR boundaries have no bearing whatsoever on the prehistory and history of the summit region of Mauna Kea. It also reflects the view that the summit area of Mauna Kea was a region, rather than a mere accumulation of archaeological sites, and that in order to understand this region of Hawaii Island prehistory, the areas now separated by arbitrary modern administrative boundaries must be considered together as a whole.

7.3.1 Quarry Boundaries: A Container View vs. A Practice View

In previous papers the statement has been made that the Mauna Kea Adze Quarry Complex covers more area and contains a larger volume of debitage than all of the other known adze quarries in the Hawaiian Islands combined (McCoy 1990:92). Following the 1975-76 fieldwork, frequent mention has also been made of the fact that the boundaries of the quarry complex have become increasingly blurred over time with the discovery of new sites (McCoy 1990:92). The archaeological inventory surveys in the NAR and in the Science Reserve indicate that the quarry complex extends well beyond the southern boundaries of each of these reserves, into the Mauna Kea Forest Reserve lands below. How far is still unknown. As previously suggested, it is possible that the lower quarry boundaries are demarcated in a general way by the boundaries of the earlier glacial outwash deposits on Mauna Kea (McCoy 1990: Figure 5, 1991; see Figure 3.8, Figure 7.1).

The boundaries of the quarry complex have become increasingly blurred over time with the discovery of not only new sites, but a different perspective on how the boundaries should be conceived. Streck's (1992) comparison of the radiocarbon-based chronologies for the Mauna Kea Adze Quarry Complex and archaeological sites at the Pohakuloa Training Area (PTA), discussed below, is illustrative of one perspective. Streck separated the quarry complex from what he called the mid-elevation slope workshops. This split between the higher elevation quarry and lower elevation workshops reflects the age-old quarry/workshop definition problem. It implies, for example, the absence of toolstone sources in the lower region of the quarry complex, which is not the case as the data presented in this report and previous reports have demonstrated. The problem in this particular example is a misunderstanding or misrepresentation of the local geology.

Though a map of the local geology is helpful in predicting where the boundaries might lie, we believe that the quarry industry is more profitably viewed as a *process* --a three-part process of ascent, production, and descent--that involved a series of changes in the social persona, thus, emphasizing the "being" and "becoming" aspects of social life (Turner 1967; McCoy 1990). The difference is between the more traditional and orthodox view of quarries as containers, the limits of which are defined by the local geology and a practice theory view that quarry boundaries are more diffuse by virtue of the practices that took place outside of the "container" which can be described as the *quarry proper*.

In the case of a quarry complex like that on Mauna Kea, the container view has its limitations. It is an impoverished view that leaves out of account important social and ritual activities undertaken before entering and upon departing from the quarry proper. An alternative, and we think better but more difficult way of determining appropriate boundaries, is to adopt a practice theory approach that seeks to explain "the configuration of cultural forms, social relations, and historical processes that move people to act in ways that produce the effects in question" (Ortner 1989:12). This means looking at the locations, characteristics, and practices that took place on the margins of the quarry, beyond any *in situ* quarries and workshops.

7.3.2 Quarry Chronology

Not only does the Mauna Kea Adze Quarry Complex cover a larger area than all of the other known stone adze quarries in Hawai`i, but it also has what is probably one of the longest chronologies of any single place in Hawai`i. The chronology, which is now

Figure 7.1. Locations of Historic Properties in Relation to Geologic Rock-Stratigraphic Units.

based on both radiocarbon and ^{230} Thorium dates, is discussed below in terms of: (1) the probable beginnings and expansion of the quarry “industry,” and (2) its abandonment.

7.3.2.1 Beginnings and Expansion

An absolute date for the first adze preform made in what is today called the Mauna Kea Adze Quarry Complex, but might possibly have been known to Hawaiians prior to European contact as Keanakāko`i or Kaluakako`i (McEldowney 1982; Maly and Maly 2005), does not exist and never will because of the impossibility of making such a determination given what is a major sampling problem that we believe can never be overcome. The problem is that virtually every basecamp and associated debitage mound in the quarry would have to be extensively excavated to obtain dateable material from the basal deposits, which in some cases may reach depths of 6 meters or more. Establishing the beginnings of the quarry industry based on dates for lowland sites with adze blades geochemically sourced to Mauna Kea is another approach, but it, too, has major sampling issues to confront.

As noted in Section 6, two shrines in the NAR with pieces of branch coral were recently dated using the ^{230}Thorium method. The first shrine, which was destroyed and not recognized until a few years ago, is located above the entrance to Keanakāko`i (literally “cave of the adze”). The dated sample, which was collected from the surface of the debitage mound below the remains of the shrine, yielded an age-determination of AD 1398 $\pm$ 13. The second sample, which came from a secure provenience beneath an upright at Shrine 3 of 16206 was dated to AD 1441 $\pm$ 3 (McCoy et al. 2009).

The radiocarbon dates and ^{230} Thorium dates on branch coral that presently exist (McCoy et al. 2009; McCoy et al. 2012) indicate that the quarry “industry” spanned a period of approximately 700 years, between ca. AD 1100-1800 (McCoy 1990: 92-93), although a shorter chronology now seems more likely based on recently obtained radiocarbon age-determinations for the settlement of the Hawaiian Islands which some archaeologists now argue probably did not occur until AD 900-1000 (see Kirch 2011 for the latest discussion on this subject). A comparison of the available dates (Table 7.1 and Figure 7.2) indicates that the sites with the earliest and longest sequences are located along the escarpment in what we are calling Zone 1. In sharp contrast to this pattern are the lower elevation sites, such as the Pu'u Kalepeamoa Site, which appear to have been occupied for a brief period of time after ca. AD 1600-1700. The 650 $\pm$ 60 B.P. date from this site (Beta 71138) is on organic sediment and cannot be considered a reliable date for human occupation.

The 840 $\pm$ 60 B.P. date (Beta-15644) for the occupation of Hopukani Rockshelter No.2 is somewhat older than expected, but not out of line with the early dates for `Ua`u Rockshelter and Ko`oko`olau Rockshelter No. 1 (Table 7.1, Figure 7.2). The date is associated with a temporary occupation and, thus, should not be interpreted as marking the beginning of intensified adze manufacture at this locality, or even this region of the quarry. On present evidence the chronology of long-term, repeated exploitation of the drift deposits on and below the Makanaka and Waihu glacial moraines is believed to have begun ca. A.D. 1300. Terminal dates are not available for Hopukani Rockshelter No. 1, but the cultural sequence almost certainly ends prior to 1800. The 500 $\pm$ 90 B.P. date (Beta-15649) for the Liloe Spring Site is consistent with the two Hopukani Rockshelter dates, thus suggesting broad contemporaneity of adze manufacturing locales in the subalpine forest and the larger, more visible ones above treeline. This interpretation is consistent with the chronological relationships of lower and higher

Table 7.1. Radiocarbon Age Determinations

Zone	Elevation (meters)	State Site Number 50-10-23-	Site Name	Provenience[1]	HRC No.2	Lab No.	Uncorrected Age[3] B.P.	Uncorrected Age[3] A.D.	Corrected Age (A.D.)[4]	Corrected Age (A.D.)[5] at two sigma	Corrected Age (A.D.)[7] at two sigma
I	3,780	16216	Ko`oko`olau Rockshelter No. 1	B2 IV F1*	279	I-9128	355 +/- 80	1595 +/- 80	1400-1660	1400-1800	1416-1951
				B3 VI F3*	311	I-9743	470 +/- 75	1480 +/- 75	1350-1495	1300-1640	1304-1634
				B3-B4 VIII F4*	312	I-9744	775 +/- 80	1175 +/- 80	1045-1340	1040-1390	1041-1390
	3,727	16205	`Ua`u Rockshelter	C5 II F2*	267	I-9070	190 +/- 80	1760 +/- 80	1490-1950	1520-1960	1521-1954
				B5 IV F3*	263	I-9069	490 +/- 80	1460 +/- 80	1315-1520	1290-1640	1295-1631
				G5 VI/3**	275	I-9071	425 +/- 80	1525 +/- 80	1340-1465	1320-1650	1325-1648
				E5 VIII**	277	I-9072	355 +/- 165	1595 +/- 165	1335-1950	1300-2000	1306-1954
				E5 VIII F15**	299	I-9929	655 +/- 80	1295 +/- 75	1420-1650	1220-1430	1224-1423
II	3,475	16210	`Ahinahina Rockshelter	C3 II F2*	300	I-9741	345 +/- 75	1605 +/- 75	1420-1650	1400-1800	1429-1797
				surface*	340	W-4539	<200[5]			modern	modern
	3,400	26253	Pohakuloa Gulch	Layer II		Beta-256935	450 +/- 40		1400-1520	1400-1620	1406-1618
III	3,170	16239	Hopukani Rockshelter No. 2	7C-8C II F1*	828	Beta-15644	840 +/- 60	1110 +/- 60	1050-1265	1040-1280	1042-1276
	3,100	16238	Hopukani Rockshelter No. 1	M24 II/III*	862	Beta-15647	290 +/- 80	1660 +/- 80	1415-1950	1400-2000	1439-1954
				M24 V F5*	869	Beta-15648	250 +/- 70	1700 +/- 70	1495-1800	1450-1960	1460-1954
				M28 II F1**	836	Beta-15645	810 +/- 60	1140 +/- 60	1065-1285	1040-1290	1045-1288
				M28 III F2b**	842-843	Beta-16400	520 +/- 60	1430 +/- 60	1330-1430	1290-1470	1296-1467
				M28 IV**	845	Beta-16401	520 +/- 60	1430 +/- 60	1330-1430	1290-1470	1296-1467
				M28 V F3**	853-857	Beta-15646	470 +/- 60	1480 +/- 60	1350-1495	1310-1630	1313-631
	3,050	16233	Waikahalulu Rockshelter	C4 III F1*	304	I-9742	430 +/- 75	1520 +/- 75	1400-1515	1320-1650	1327-1644
				D4 V F3**	307	W-4538	370 +/- 60	1580 +/- 60	1415-1640	1430-1650	1440-1644
	2,712	16240	Liloe Spring Workshop		874	Beta-15649	500 +/- 90	1450 +/- 90	1310-1515	1280-1640	1287-1632
IV	2,800	10314	Pu`u Kalepeamoa	87-8 H8 II	979	Beta-23417	modern			modern	modern
		10314		87-8 H8 II	981	Beta-23418	250 +/- 70	1700 +/- 70	1495-1800	1450-1960	1460-1954
		10314		87-7 II	1008	Beta-26377	130 +/- 50	1820 +/- 50	1650-1950	1660-1950	1669-1946
		10310		10,310 II		Beta-71138	650 +/- 60		1260-1420	1260-1420	1266-1414
		10311		10,311 II		Beta-71139	260 +/- 60		1460-1950	1460-1960	1461-1954

1 Square or excavation unit [e.g., B2], [e.g., VI/3]; feature No. [e.g., F1]

2 HRC = Bishop Museum Hawaii Radiocarbon No.

3 the uncorrected dates for sites in Zones II and IV are C13 adjusted

4 based on Klein et al. (1982)

5 sliversword; all other dates are on wood charcoal except for Beta-71138 which is organic sediment

6 OxCal 3.1

7 OxCal 4.1.7

* interior context [back of the dripline]

** exterior context [beyond the dripline]

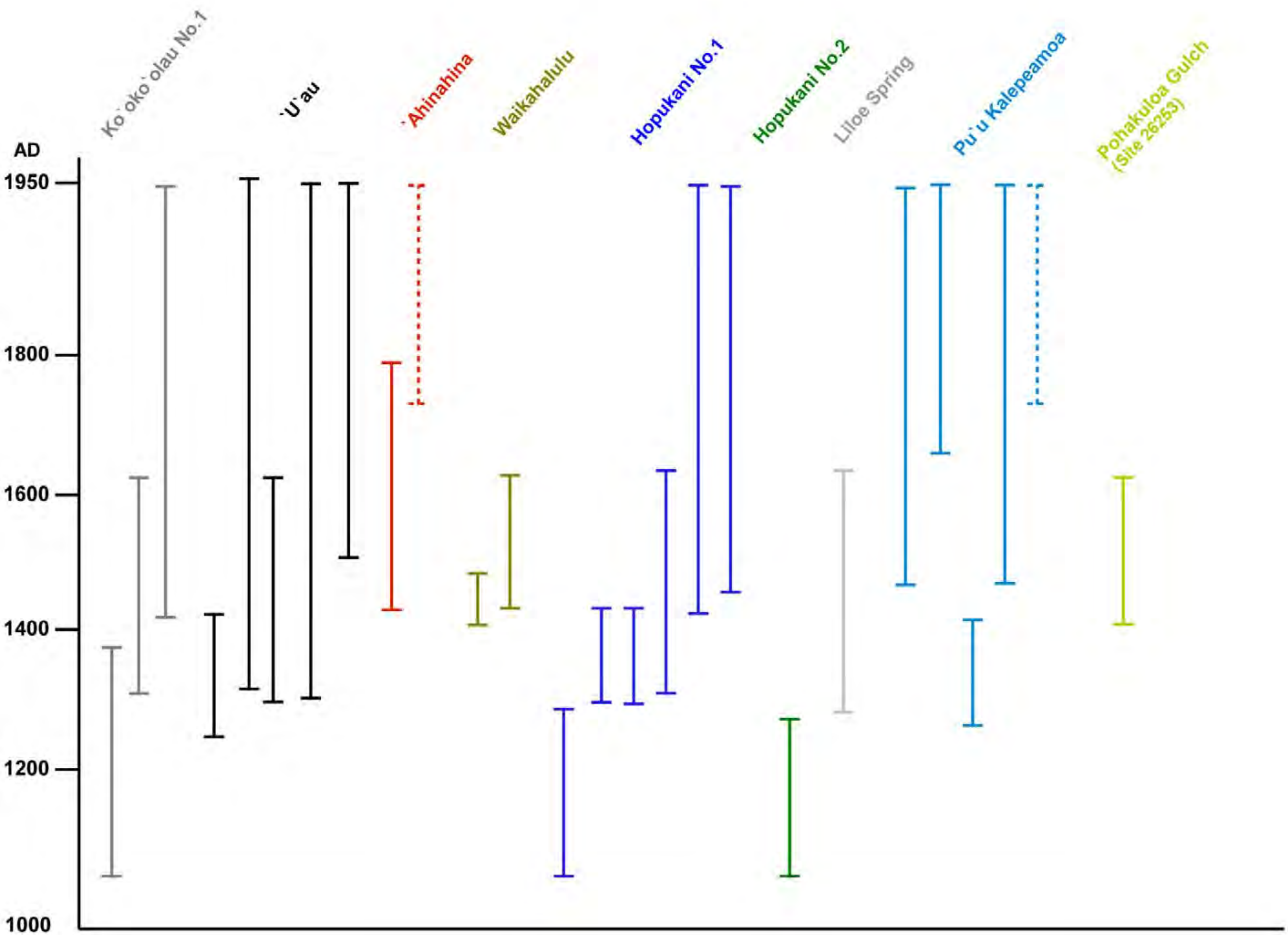


Figure 7.2. Radiocarbon Age Determinations for Apline and Sub-apline Sites on the South Flank of Mauna Kea [Date Ranges at the 95% confidence level based on OxCal 4.1.7. The dashed line indicates a less than 200 BP date. A "Modern" date was also obtained for the Pu'u Kalepeamoa Site.]

elevation sites elsewhere in the quarry. On current evidence the Pōhakuloa Gulch area and lower elevation toolstone sources at Hopukani, Waihu and Liloe springs were not used over a lengthy period of time. There are no large piles or mounds of manufacturing waste at any of the sites located in this part of the quarry complex, even allowing for the flattening out effect of long-term erosion.

Production appears to have peaked between ca. AD 1400-1600 or perhaps 1700 (McCoy 1990, Figure 7.2). Streck came to a similar conclusion in an analysis of radiocarbon dates from Mauna Kea and PTA:

> The annual frequency distributions suggest that prehistoric cultural activity in the uplands of Hawai`i Island may have been most intense from A.D. 1400 to 1450. The curves derived from samples from the Mauna Kea Adze Quarry Complex and the middle slope workshops differ slightly in that the workshop curve appears strongly unimodal with a sharp peak around A.D. 1425 (Fig. 1). There appears to be relatively infrequent use of the middle slopes before this time. The adze quarry curve suggests more intensive use over a longer period. The most intensive use seems to have occurred around A.D. 1440, with significant use between A.D. 1300 and 1650. Prehistoric use of Mauna Kea covers a maximum of around 700 years until the nineteenth century (Streck 1992:103).
>
> The available radiocarbon dates suggest that the main prehistoric use of the Mauna Kea Adze Quarry Complex was during a relatively short period of around 300 years. This covers the period when the development of class stratified societies and the formalization of traditional land tenure systems are thought to have occurred (Streck 1992:106)

7.3.2.2 Abandonment

Abandonment is a concept that according to some is often used “imprecisely and speciously” by archaeologists (Colwell-Chanthaphonh and Ferguson 2006:37). One problem is that the term “abandonment” when used in reference to archaeological contexts, often reduces “complex processes to a single event” (Colwell-Chanthaphonh and Ferguson 2006:37). For example, buried B2 horizon soils in the excavated rockshelters suggest that there were hiatuses or breaks in the production process. The soils, which should perhaps instead be called sediments, are probably of aeolian origin given the short chronology of quarry use and slow development of soils in an alpine desert environment (Ugolini n.d.).

When the quarry was abandoned is unknown and may never be known with any certainty, but there is some evidence that it may have occurred prior to European contact in 1778 or shortly thereafter (Welch 1993:31). Historic accounts indicate the rapid adoption of Western tools, clothing and other items in the major trading centers, initially by the chiefs and then the common people. As would be expected, the chiefs and commoners in the beginning had differential access to European goods, such as iron adzes. There are, for example, eye witness accounts of commoners having to relinquish iron and to obtain it on the sly –beyond the eyes of the chief’s retainers.

That some people, including craft specialists such as canoe makers, continued to use stone adzes for selected tasks into the historic period is well documented (Brigham 1902), but the extent to which stone tool adzes continued to be manufactured is open to debate. Remote quarries, such as the complex on Mauna Kea, may have been the first to be abandoned, although the manufacture of a small number of adze blades may have continued for a while given what is assumed to have been the high value of the adzes from this particular quarry.

The terminal date for adze manufacture on Mauna Kea has become a subject of debate fairly recently. In an earlier paper the senior author wrote the following regarding the abandonment of the Mauna Kea quarry (McCoy 1990:92-93):

> With regard to an upper limiting or terminal date, there is archaeological as well as ethnohistoric evidence (McEldowney ms:7) suggesting that the quarry may have been abandoned prior to first known European contact in 1778 and the ensuing rapid replacement of stone tools with metal counterparts. In any event, by 1793-94 there was a surplus of metal and the chiefs were apparently no longer interested in trading for iron tools such as adzes (Sahlins 1981:44).

Bayman (2003, 2007) has taken issue with this passage and used it to suggest that:

> The tendency to overlook evidence for the persistence of stone adze economies in the Hawaiian islands may reflect the view of some archaeologists (e.g., McCoy 1990:92-93) that stone adzes were quickly replaced by metal adzes after European contact (Bayman 2003:95).
>
> Some researchers (e.g., McCoy 1990:92-93) have concluded that stone adzes were quickly replaced by metal adzes after contact, and that large quarries like Mauna Kea were abandoned (Bayman 2003:98).
>
> This lack of attention to post-contact stone adze economies in the Hawaiian Islands clearly contributes to the “rapid replacement” view of some archaeologists (e.g., McCoy 1990:92-93)…that metal adzes were more efficient tools than stone adzes (Bayman 2007:5).

Bayman has deliberately distorted McCoy’s argument by not discussing it in full. He did not take into consideration the context of the statement which was made in a paper on the Mauna Kea Adze Quarry Complex and, thus, the manufacturing component of the production process. The statement regarding rapid replacement of stone adzes by metal counterparts did not specify an actual date or period of time and was, moreover, qualified with the following words: “In any event, by 1793-94 there was a surplus of metal and the chiefs were apparently no longer interested in trading for iron tools such as adzes” (Sahlins 1981:44). And nowhere has the senior author attributed the replacement of stone adzes with metal ones to efficiency.

Bayman does not seem to be aware, moreover, of the ethnohistoric evidence that was cited by McCoy (1990:92) and the extent to which it might actually bolster his argument for continued stone adze manufacture after contact. The evidence in question was presented in a report by McEldowney:

> The only native Hawaiian mention of this resource, or its use on Mauna Kea, found thus far is the testimony in the 1873 boundary dispute between Humuula and Kaohe *ahupua’a* (Bound. Comm. Bk., Vol. B:28-59, Haiki). In reciting noteworthy landmarks along the boundary, which he claimed crossed the summit, Haiki mentioned first “Kaluakaakoi a cave there they used to get stone adzes out” and later reiterated, “My parents told me Humuula went to Kaluakaakoi and Poliahu. We used to go there after adzes for Humuula people.” If these statements are valid, and if his knowledge of the boundaries came from his “father,” “grandfather,” and “father of my wife” as he claims and considering that he was born “after the battle of Kekuakalani” (i.e. 1819; Barrere, pers. Comm..), then the knowledge and use of the quarry as implied from these

> statements potentially stretch from the 1770s to the 1840s. A complicating factor in using these statements is that Haiki's overall testimony and placement of the boundary was rejected by the commission (McEldowney 1982:1.7).

If there is any fault to be had with archaeologists overlooking continuity in stone adze manufacture and use, part of it would seem to lie with the uncritical use of the ethnohistoric literature. Bayman's use of this literature is of interest in the larger debate, since in his 2003 paper he cites with approval Brigham's comments regarding the apparent cessation of large-scale stone adze manufacture after contact, but does not refer to Brigham's comments on the efficiency of the traditional adze:

> Of course the making of stone adzes ceased soon after the introduction of iron and I have never seen them made, nor have I talked directly with any of the surviving makers, but I have seen them used and sharpened, and I have been astonished at the dexterity of the man and the efficiency of the tool. In watching the shaping of a canoe I have seen the old canoe-maker use for the rough shaping and excavating an ordinary foreign steel adze, but for the finishing touches he dropped the foreign tool and returned to the tool of his ancestors, and the blunt looking stone cut off a delicate shaving from the very hard koa wood and never seemed to take too much wood as the foreign adze was apt to do. That skill was an important element in the use I was convinced, for with all the teaching of the native I could only make a dent where I tried to raise a shaving (Brigham 1902: 408-410).

Brigham's remarks, contra Bayman's conclusion in his 2007 paper of why Hawaiians stopped making stone adzes after contact (Bayman 2007:3), indicate that efficiency was *not* the reason for the replacement of stone adzes with metal ones, that the small stone adze was in fact preferred by a canoe maker in making the finishing touches.

Finally, the continued use of stone adzes after contact does not necessarily imply continued manufacture, especially in such isolated localities as Mauna Kea. Smaller adzes, if properly maintained, can have a long life history, and if they do enter the archaeological record they may be examples of "curation." Bayman has not only deliberately misread or misinterpreted the senior author's remark from a paper published more than 20 years ago, but has also taken no notice of the more recent remarks of others, such as Lass (1998:24) and the author of the following passage:

> While the use of stone tools did not disappear (iron and stone tools are found together in at some early post-Contact sites), iron replaced stone for most uses and the need for new lithic raw material disappeared. As a result quarrying activities on the Mauna Kea summit appear to have ceased very soon after contact. As noted above there are already indications in the archaeological record of decreased use during the last century before Contact. No materials introduced after Contact are found in the sites at the Mauna Kea Adze Quarry complex, nor are their discarded remains of any animals and plants that were introduced after contact …Early European visitors to Mauna Kea observed the piles of flakes and adze preforms and the shelters, but are quiet in terms of any discussion of Hawaiian stone procurement or tool manufacture…This is interpreted as suggesting the rapid demise of stone adze manufacture and thus a reduced need for the raw stone material after the introduction of iron (Anonymous 2005:13-14)

The recovery of stone tools and debitage in post-contact sites is not surprising, but this does not mean that Hawaiians were necessarily continuing to manufacture stone adzes on a regular basis well into the middle of the 19th century, or if they were, that the toolstone used was still being obtained from distant sources, such as Mauna Kea. It is likely, for example, that some adzes made ca. 1800 could still have been in use some years later, especially if the use was limited to certain technical acts, rather than being used as an all-purpose tool on a regular basis. There is also the "heirloom effect" to take into consideration in determining the date of manufacture. Any further discussion of this issue needs to recognize that there is a fundamental distinction between a manufacturing technology and use technology.

There is one other important account that has gone unnoticed in the debate over the abandonment of the quarry. The following article, which appeared in *The Pacific Commercial Advertiser*--Notes of the Week, in October 28, 1862, lends support to Brigham's and the senior author's conclusion that work in the Mauna Kea adze quarry ceased shortly before or just after European contact:

> Hawaiian Antiquities---On a recent tour around Hawaii, Dr. Wm. Hillbrnd ascended to the summit of Mauna Kea, in company with Charles Hall and Capt. Cummings. About 1500 feet below the top on a side of the mountain seldom visited by either foreigners or natives, they discovered an ancient manufactory of stone implements. It consists of a cave, in front of which was a pile of stone chips 25 feet high, which had evidently accumulated from the manufacture of stone adzes, maika balls, etc., and which lay scattered about in an unfinished state. In front of the cave a wooden idol, in good preservation, which, with the pedestal attached to it, measures nearly five feet high. In form the image very much resembles that pictured in Jarves' History, page 27. Bones of pigs and dogs, kapa, pieces of coconut shells, fragments of hewn wooden implements, sea shells, and many other curiosities were also found. The party loaded their guide and themselves with as many of these curiosities as they could carry, and returned to Waimea. On reaching Rev. Mr. Lyons' residence the discovery soon became noised abroad among the natives, who flocked to the mission premises to learn the truth of the report. On inquiry among them, no person appears ever to have heard of the existence of the manufactory, even the oldest natives were ignorant of it. From this it is inferred that its antiquity must date back beyond the present generation. On reaching Kona, Dr. H. learned from Capt. Cummings that an old native was living there, who in his younger days had heard the place spoken of by his fathers, but nothing definite can be learned regarding it. The discovery forms an interesting incident in Hawaiian history, and may lead to further searches and perhaps discoveries regarding the ancient customs of this people.

We believe that the true significance of this account has been overlooked. Not only does it establish that the quarry had been abandoned prior to 1862, it describes what can only be interpreted as a post-abandonment event, an offering made, most likely, by the people of a district associated with the site now commonly called Keanakāko`i. The wooden image, *kapa*, bones of pigs and dogs, and pieces of coconut shell and various carved wooden objects observed at Keanakāko`i by Hillebrand's party in 1862 suggest an offering or possibly the remains of several offerings made after the quarry was abandoned. The same diversity of items found inside Ko`oko`olau Rockshelter No. 1, in a corner and resting on the surface above a fill deposit (McCoy 1990), points to one other highly probable example of a post-abandonment offering (see Figure 6.62). In the first case we know that the remains were left prior to 1862. In both instances, what we believe are offerings, instead of maintenance and extractive tools as originally argued (McCoy 1990), there are no European objects and no European foods.

7.3.3 Scheduling and Seasonality

Ethnohistoric sources indicate that the lower flanks of Mauna Kea and the adjoining plain were the most probable source for most, if not all, of the petrels and geese which as earlier noted show indications of seasonality in nesting and feeding habits. Henshaw, for example, was told that the dark-rumped petrel formerly nested in great numbers in the saddle between Mauna Kea and Mauna Loa, and that the nestlings were considered a great delicacy and were tabooed for the exclusive use of the chiefs (Henshaw 1902:120). According to one historic account the young were taken in the downy stage from their burrows in late September and October (Bryan 1914:156). The presence of immature petrel bones in several of the rockshelter assemblages is of great significance then in providing clearcut evidence of seasonality and social rank. If the petrels in this upland region were under a taboo that was lifted after the birth of the young, there is reason to suspect that these same bones are those of young birds that were offered to the gods in first-fruits rites at the beginning of the hunting season. The different meanings given to these bones exemplifies the simultaneity of different ecological, economic, and sociopolitical facts and processes. Sahlins has drawn attention to the same thing in the observation that "Even the so-called economic or conservational tabus had a divine finality: they were consecrations of foods to be used in honor of the gods, thus organized in the first place in a system of sacrifice" (Sahlins 1981:45).

The influence of climate on the scheduling of work is somewhat problematical due to the lack of marked seasonality in temperature at the latitude of the project area (19-20 degrees North). While allowing for the possibility of work at any time of the year, increased wind velocities and shorter days in winter favor the summer season. On present evidence the optimal time would have been August-September when the mean maximum temperature range is reached. The immature petrel bones in several of the rockshelter middens (McCoy 1976, 1990 and Section 6 of this report) points to the same time of year. Although Bryan stated that young petrel chicks were caught in late September and October (Bryan 1914:156), Ziegler thought that there may have been two nesting periods for the dark-rumped petrel—one between February and April and a second about October to November (Reinman and Pantaleo 1998:4). While interesting from a biological point of view, there is no reason to believe that Hawaiians would have been working in the quarry between February and April.

The fit between the temperature and faunal evidence in delineating the same time of year is of considerable interest given the ambiguities of scheduling calculations based on climatic determinations alone. The faunal evidence also suggests the intriguing possibility that the scheduling of work in the quarry was planned to coincide with the optimal time for hunting petrels. In other words, it may have been that the availability of the dark-rumped petrel and several others species of birds was a factor in the scheduling of work in a quarry that is inferred to have been "the central place" in Hawaiian adze manufacture. This does not mean, however, as suggested by Bayman and his colleagues, that work in the adze quarry was embedded in a broader “economy” that included seasonal bird hunting (Bayman et al. 2004:85).

7.3.4 Territoriality and Division of Labor

According to Ingold, there are two dimensions, tenure and territoriality, common to all societies regardless of their mode of existence—as agriculturists, pastoralists or hunter-gatherer. For Ingold, “Tenure is an aspect of that system of relations which *constitutes* persons as productive agents and directs their purposes, territoriality is an aspect of the means through which those purposes are put into effect under given environmental circumstances” (Ingold 1987:130-131).

> Our provisional conclusion, then, is that tenure in hunting and gathering societies is not of surface area, but of *sites and paths within a landscape*. In agricultural societies, on the other hand, two-dimensional tenure does come into operation. The cultivator appropriates the land in *plots*, which may be relatively dispersed or consolidated, again within a landscape (Ingold 1987:153).

There are locational, material, and structural markers of intensification of production in the middle and later stages of the quarry sequence in the simultaneous exploitation of multiple toolstone sources and raw material types (e.g., tabular slabs and rounded boulders) and the mining of subsurface material. These are inferred to represent not only an increase in energy expenditure in terms of the use of more labor intensive techniques that are reflected in the "bounded spaces" of pits and walls, but a new division of labor and, thus, a change in the organizational properties of the quarry industry.

The semblance of a factory approach given by the constellation of quarried pits, walled compartments and large debitage mounds outside the several rockshelters in the heart of the older part of the quarry thus has a measure of credibility in our view with regard to the organization of labor that evinces a perhaps new element of functional specialization [mining] and a new relationship between the existing horizontal and vertical dimensions of labor. What this implies is that subsurface mining as a "technique" or "procurement strategy" almost always implies a functional division of labor in terms of variability in skills, knowledge and tools, if only on a temporary basis in the beginning of its development;

The simultaneous exploitation of two or more locales from the center of the quarry also implies a division of labor in terms of differential access to the raw material as a whole which is conjectured to have been rank ordered in terms of properties such as size and form, in addition to quality and abundance, thus leading to the conjecture that the internal organization of labor mirrored the rank order classification/perception of the resource base vis a vis the values [potential and real] of particular exposures of rock [surface and subsurface].

The hypothesized existence of a rank ordered resource base and its corollary, rank ordered task groups, finds further independent support in the evidence for a hierarchy of formally [architectural] and functionally [lithic and food residue evidence] differentiated ritual centers and dietary indications of between-group status differentiation in the access to prestige foods, such as immature petrels and certain species of fish.

Until recently there have been few studies of gender in Hawaiian archaeology. Kirch and O’Day (2003:494-495) presented some preliminary archaeological evidence from Kahikinui, Maui that is in accord with some of the distinctions between male and female foods described in the ethnographic literature. To our knowledge there have been no similar efforts to investigate the gender roles of Hawaiians engaged in quarrying and manufacturing adze blades.

There is no direct evidence bearing on the gender of adze makers, but the ethnographic literature, on which so many interpretations of Hawaiian prehistory are based, indicates that some of the specialist crafts, such as canoe making, were the work of men (Lass 1998:24).

Melinda Leach is one of few archaeologists to discuss gender roles in an aboriginal quarry. Leach examined the evidence from the opalite Tosawihi Quarries in Nevada investigated by Elston (2006). Leach summarizes the results of actualistic experiments in quarrying by both sexes. She notes that physical strength alone “was not sufficient for the task” and that women were able to extract material using fire, the use of small hammerstones and antler wedges (Leach 2010:27). The experiments demonstrated that not only was the extraction of toolstone material by women feasible, but that it was also *profitable* (her emphasis). In the discussion of the archaeological evidence from the quarry and associated camp sites, Leach assembles a variety of suggestive evidence for the involvement of women in the quarrying process, such as the high probability of mixed gender camps. She concludes that:

> At Tosawihi, we can see women’s behavior as central: what women decided and how they actively participated had long-term impacts on how the problem of getting toolstone was resolved. Quarrying decisions and behavior were powerfully affected by whether women were present or not—where, when, and how quarrying was accomplished depended on the full participation and collaboration of women, even if/when they were not physically present at the Quarries (Leach 2010:29).

Though no actualistic experiments have been conducted to determine the feasibility of women extracting and reducing large pieces of basalt in the Mauna Kea Adze Quarry Complex, the amount of strength required would have been substantially different from quarrying the opalite in the Tosawihi Quarries. It is possible, however, that women and even children may have had a collaborative role in the support of the adze makers based on the evidence for camp sites and what appear to be logistical support groups located below the main quarry area in a sub-alpine forest environment (see Section 7.3.7).

7.3.5 The Manufacturing Technology: Toolstone Sources, Procurement Techniques, Reduction Strategies and Inter and Intra-Site Variability in Preform Assemblages

What follows is a synopsis of the manufacturing technology. For a more detailed discussion the reader should consult Paul Cleghorn’s Ph.D. dissertation (1982) and Scott Williams’ M.A. thesis (1989).

7.3.5.1 Toolstone Sources and Procurement Techniques

As discussed elsewhere, (McCoy 1990:93-94), the extent to which "patchiness" is a predictable source of behavioral variability (Kirch 1980:124) is evidenced in procurement strategy variability in space and over time. An optimal, mixed strategy of initial surface collecting and later bedrock extraction (mining) characterizes the long-term, continuous exploitation of the primary source in Zone 1, along the escarpment and the older flows with scattered glacial drift deposits downslope. This is in sharp contrast to the almost pure collecting strategy employed in the somewhat later exploitation of the glacial drift deposits in Zones 1 and 2, which on current evidence was coeval with the former between ca. AD 1300-1600 and possibly as early as AD 1200. The material correlates of this spatio-temporal sequence are similar, yet contrastive, adze preform assemblages given the inherent limitations of raw material form and size on the shape and dimensions of the final product (Isaac 1972, 1977a), which in this particular quarry context is inferred to have meant not only differential exchange-value, but the differential potential to build a personal reputation (see Shanks and Tilley 1987:95; McCoy 1990).

7.3.5.2 Reduction Strategies, Production Goals and Inter and Intra-Site Variability in Adze Preform Assemblages

As described above, the Mauna Kea Adze Quarry is not a monolithic whole exhibiting uniformity in raw material procurement methods, reduction strategies and sequences, and preform types. The analyses of preform attributes in Section 6 demonstrated variability in preform assemblages within and between sites and workshops, as well as between workshops in different areas of the quarry.

Based on the sample artifact data collected in the field, the primary production strategy or goal was the manufacture of the large, thick quadrangular or square cross-sectioned variety of adze. Large preforms are comparatively rare in most Hawaiian adze quarries (McCoy et al. 1993; Weisler 1990; Dye et al. 1985). There are several possible explanations. Helen Leach, in an important study of New Zealand adzes, concluded that thick quadrangular and large triangular adzes were underrepresented in the surviving sample because of two factors: (1) a higher success rate compared to other types, and (2) the purposeful reworking of broken specimens, which is not generally possible in the case of thin adzes made on blades or flakes (Leach 1984:113). If anything is underrepresented in the Mauna Kea Adze Quarry Complex, it is the smaller preforms made on flake blanks. We know, for example, that flake blanks were being removed to what are being interpreted as logistical camps situated at or below treeline east of Waikahalulu Gulch (McCoy 1990, 1991) and below the terminus of Pōhakuloa Gulch (Welch 1991; Bayman and Moniz 2000).

The predominance of thick quadrangular [rectangular and trapezoidal] cross-section blanks and preforms (Cleghorn 1982) supports the unstated assumption that a higher value was placed on tabular material, which is virtually localized to the escarpment and nearby flows in Zone 2. It is here that the vast majority of the larger adzes used in felling trees for canoes and land clearance would have been made. Maximization of raw material form is obvious, yet there is also clear evidence throughout the history of the quarry of multiple reduction strategies in the manufacture of a range of adze types and sizes from core blanks and flake blanks (McCoy 1977, 1981, 1986; Cleghorn 1982).

As argued in an earlier paper (McCoy 1990:96), the larger, more massive adzes, such as those shown in Figure 7.3, are inferred to have had more value, in part because of the raw material constraints at other sources on the island and throughout the island chain. The source material at most, if not all of the major known adze quarries, would not have allowed the manufacture of many adzes more than 25.0 cm in length.

Figure 7.3 Examples of High Value Large Adze Preforms (Dick Gould and the late Bill Barrera)

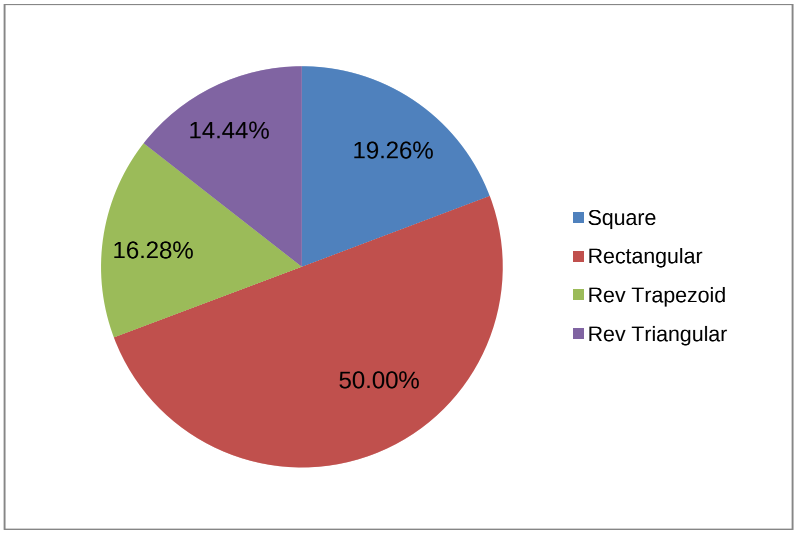
Inter-site and intra-site variability in preform assemblages is a topic of great importance, but one that is too complicated to adequately address in a report like this one. Though too much is made in our view of transverse cross-section comparisons in the study of Hawaiian adzes, to the exclusion of other attributes, we present below a simple diagram comparing samples of adze preforms from two parts of the quarry complex—the sites centered around Pu`u Ko`oko`olau on and just below the escarpment, and the sites located in the Science Reserve along Pōhakuloa Gulch. Figure 7.4 indicates that the two geographically discrete samples are similar in terms of the high percentage of rectangular and square cross-sectioned preforms. Another form of the quadrangular adze, the reverse trapezoidal, is found in the same relative percentage of the whole, as does the reverse triangular adze. This data set shows that in terms of cross-section there is little variability between the two areas of the quarry.

7.3.6 Living and Working in a "Non-Subsistence" Environment

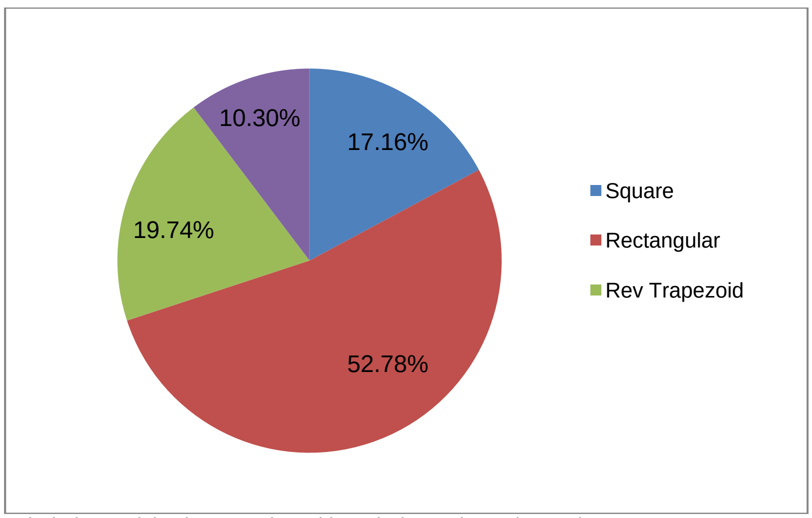
A lot of superlatives have been used in describing the Mauna Kea Adze Quarry Complex, but perhaps the one aspect that has not been given enough attention so far is the daily life of the adze makers in what has been characterized in an earlier paper as a "non-subsistence" environment (McCoy 1990). Living and working at elevations up to 12, 400 ft. and higher for any length of time in the absence of the conveniences of modern life is something to be marveled at, even for a people accustomed to the way of life that existed at say AD 1500.

7.3.6.1 Habitation

Because of the climatic conditions and other constraints on living at high altitude, Emory believed that the adze makers "lived at warmer altitudes, walking daily to their work during favorable weather in the summer months" (Emory 1938:22). The 1975-76 research yielded a variety of evidence indicating habitation in the quarry, including, for



Pu`u Ko`oko`olau Site Complex without indeterminate (n=436)



Pōhakuloa Gulch Site Complex without indeterminate (n=233)

Figure 7.4. Relative Abundances of Adze Preform "Types" from the Pu`u Ko`oko`olau and Pōhakuloa Gulch Areas of the Mauna Kea Adze Quarry Complex Based on Transverse Cross-Section.

example, fire pits and midden deposits with a variety of food remains and other objects. An earlier discussion (McCoy 1990) of what the evidence suggested in terms of the kinds of camps that might have existed is presented below.

Perhaps no area of archaeological research has caused such difficulties as developing an operational definition of the base camp or residential base concept (Thomas 1986:238). As Thomas makes clear it is easy to assign behavioral meaning to this concept as, for example, the "hub of all subsistence activities" (Binford 1980:9) or, more specifically, as "the locus of most processing, manufacturing, and maintenance." (Thomas 1986:238). The problem is taking these behavioral definitions and linking them to archaeological observations, a process that requires the use of unambiguous signatures to be successful (Thomas 1986:238).

A convenient starting point in the development of a camp typology for this quarry is the use of simple criteria such as the presence/absence of fire hearths and food remains to distinguish camps from rockshelters used exclusively for storage. All six excavated rockshelters can be regarded as camps on the basis of these two criteria. To proceed any further is difficult because of the uncertainties regarding the behavioral meaning of assemblage diversity due to sampling error problems related to small test excavations, for example. Waikahalulu Rockshelter and Hopukani Rockshelter No. 1 are especially difficult to interpret in terms of determining whether they: (1) were utilized as transient camps, which would imply a gradual ascent to the main quarry and conform to the expectation of a short period for acclimatizing to altitude and collecting provisions, or (2) functioned as permanent base camps for individuals and groups who did not have access to the primary source of material, which would imply rank differentiation and, as noted earlier, the differential potential to build a reputation. There are no unambiguous criteria to make such a distinction, but the paucity of shellfish, fish, food plants, and personal gear from all of the lower elevation sites is striking compared to the richness of the higher elevation camps. The contrast cannot be attributed in our view to differential preservation, thus suggesting that the first alternative is the most likely explanation for the assemblage characteristics of the lower elevation sites. In this regard, there is as yet no archaeological evidence in support of my earlier conjecture that these lower elevation sites were occupied by support groups whose task was to provision the adze makers with firewood, cooked food, birds and water from the treeline ecotone.

`Ahinahina Rockshelter, the only mid-elevation site in the present sample, would appear to represent a base camp given the size of the associated debitage mound, but it is clearly different from the `Ua`u and Ko`oko`olau No. 1 camps in the size and diversity of the faunal and plant assemblages. On current evidence the difference cannot be attributed solely to the shorter chronology of `Ahinahina Rockshelter.

The `Ua`u and Ko`oko`olau No. 1 camps are by any standard of comparison exceptionally rich and internally complex habitation sites. The presence of roof-top shrines, enclosing walls, and rich assemblages of food remains and personal gear suggest that they were akin to "club houses". The roof-top shrines are inferred to have made plain and visible the identity of the group while the rich assemblages of food offerings and personal gear in the interiors are interpreted as dramatizing the activities that were performed behind the enclosing walls at these two camps. Both of these camps would appear to have functioned as daytime work centers for a collective labor force that, with the exception of the few permanent and presumably high ranking occupants, dispersed to other camps at night. A consideration of lighting conditions and floor area constraints, especially in the case of Ko`oko`olau Rockshelter No. 1, casts some doubt on the amount of work that was actually undertaken in the interiors of these rockshelters. There is as earlier noted reason to believe that at least part of the fill is the result of ritual action rather than *in situ* manufacture.

The adze manufacturing debitage, combined with the evidence that the probable source of the volcanic chill glass from the Pu`u Kalepeamoa Site is a Mauna Loa pahoehoe flow (McCoy and Nees 2010), points to the high probability of an *ascent-descent camp*. The distinction between *ascent camps* and *descent camps* or *ascent-descent camps* occupied on both the way up and the way down the mountain is a first step in interpreting the social space and time dimensions of what has been inferred above to be a seasonal activity pattern. There is good reason to expect that the ascent and descent phases of the quarry operation were important social occasions based on ethnographic information relating to Hawaiian beliefs and the generalization that "The crossing of frontiers and thresholds is always hedged about with ritual, so also is the transition from one social status to another" (Leach 1976:35). Elsewhere (McCoy 1990:114) I inferred that the ascent to the quarry must have "involved a serious of religious rites in the process of passing through and across the boundaries of a number of different environmental zones perceived in cultural terms as wildernesses and known by the general term *wao* (Malo 1951:17)."

A variety of features have been found in surface and subsurface contexts at the rockshelters. They include enclosing walls, roof-top shrines, fire pits and ash lenses, and concentrations of artifacts and midden that I earlier interpreted as living surfaces (McCoy 1977:232).

Enclosing Walls

The entrances to many but not all of the higher elevation rockshelters in Zones 1 and 2 are partially to almost totally enclosed by a wall constructed beneath the dripline. Where such walls exist they are assumed to have functioned to retain heat and retard wind and cold, but these are constants of the local environment which means that the presence/absence of walls must signify some additional purpose and meaning. While they may also have served to retain accumulating debitage from inundating the interior living area back of the dripline, the degree of closure suggests a social use. There is some evidence to suggest that the enclosing walls at many of the larger camps were social barriers that functioned to control and possibly even prevent the movement of low-ranking individuals across these barriers, which are thus conceived as symbolic boundaries (Douglas 1966) of exclusion and inclusion. The purpose is inferred to have been the exclusion of the uninitiated from access to secret ritual knowledge (Childe 1942:85, 87).

The current evidence suggests the enclosing walls are late features in the quarry sequence. At `Ua`u Rockshelter the enclosing wall (McCoy 1977:Fig.3) is bracketed by dates of 190 $\pm$ 80 BP (AD 1490-1950) and 490 $\pm$ 80 BP (AD 1315-1520).

Fire Pits

Fire pits and ash concentrations are understandably common features. With the exception of a couple of pieces of fire-cracked rock from the Pu`u Kalepeamoa Site there is no evidence that any of the pits in the quarry proper were used as earth ovens. Rather, all of them appear to have been hearths over which some food might have been roasted. Some are stone-lined while others are nothing more than shallow basins. The majority of these features are located in the interior living area, yet at the three rockshelters were test excavations have been undertaken in more exterior contexts additional fire pits have been found. At `Ua'u Rockshelter and Waikahalulu Rockshelter fire pits were found below the dripline and at Hopukani Rockshelter No. 1 several were uncovered even farther out from the dripline on the debitage mound. The exterior hearths in all three sites have either yielded older dates or been found in earlier stratigraphic contexts than the interior hearths. The location of the earliest habitation layers outside of these shelters is further evidence that an enclosing wall is not an absolute necessity in occupying this high altitude, cold environment.

7.3.6.2 Food

The late Mary Douglas, a preeminent anthropologist of her generation, made many significant contributions to the study of culture, society and religion, including the study of food habits. It was her opinion that, “The study of food ought to enjoy a privileged status in cultural analysis. It combines the concrete and the ephemeral, it meets physiological and social needs, it provides the free gift of hospitality and the strict requirement of biological survival” (Douglas and Gross 1981:1). Her view of food as meeting bodily and social needs is one that has been adopted in earlier analyses of the adze makers’ diet, if we can use that term. Once again, the discussion that follows is taken primarily from earlier published work because of the lack of funds and time to extend the analyses and interpretations beyond what has already been presented in Section 6 of this report.

It is clear that the material provisioning of the adze makers was conditioned by factors other than basic human needs of survival, if such ever exist separate from cultural standards (Gellner 1973:140-141). The archaeological evidence indicates that there were in fact dual needs and cultural standards, one for men and one for gods, and that these were met in a variety of different ways and places. Religious beliefs are normally thought of as arbitrarily reducing the variety of resources in an economy (e.g., Clarke 1978:114) yet in the present context such beliefs would appear to have arbitrarily increased the variety of foods. The diverse range but small number of many of the inferred offerings suggests that the gods had broad tastes but small appetites. It also points to the fact that symbolic foods, as tokens, are expensive and cannot be deployed to the fullest degree (Gellner 1985:161). It is highly probable, for example, that certain plants and marine foods were substituted for pigs (see Valeri 1985:395, Note 156 on ‘leaf pigs’ and ‘sea pigs’).

Titcomb noted that the *kumu* a reddish colored goatfish, was classified as a “sea pig” (Titcomb 1972:92) and that

> The *kumu* was used extensively as an offering to the gods when the priests demanded a red fish. It was an appropriate offering when a canoe was launched, sometimes in hula ceremonies, and sometimes for atonement of sin. It was offered by those had who had been through a course of teaching and were now “master” of an art, for one meaning of the name is *master*. It was classified as one of the “sea pigs” (Titcomb 1972:92).

The meaning of the word *kumu* as “master” is one more suggestive piece of evidence that adze makers were skilled “masters” or craft specialists and that the presence of the bones of this fish in the quarry is most likely the result of a ritual offering to the gods. The same would appear to have held true of the *moi* found in the quarry:

> *Moi* is a fish for chiefs, and is much sought today as a delicious fish. Formerly commoners were not allowed to eat it. Some say it was always eaten raw, but other informants say it was salted, dried, or cooked in ti leaves or in the *imu* (Titcomb 1972:111)

Though somewhat overstated, viewed at the level of the quarry complex the potential and actual diet of the adze makers would appear to have been essentially one and the same based on the diversity of foods, which include marine and terrestrial, and domesticated and wild categories. While the total variety or richness of the combined site assemblages is an obvious indication of a "broad spectrum economy", it is also clear that there is considerable inter-site variability in both richness and evenness. With the exception of the two upper elevation sites, the evenness appears to have been low in terms of the greater dependence on just a few foods.

The marine foods, which include fish, shellfish and seaweeds, are of particular interest in this inland context. The fish fauna is somewhat unusual in the presence of the freshwater gobie and certain benthic and pelagic species that appear to be either rare and/or found in a restricted number of archaeological contexts (Goto 1986). Notably absent are any of the species raised in fishponds. The predominance of inshore species is predictable given what is known of Hawaiian fishing strategies (Goto 1986). The presence of the threadfins, which are reported to have been taken in large numbers during the spawning season from March to August, are of interest not only as a possible indicator of seasonality but as a status marker as well. They are said to have been reserved for the chiefs (Goto 1986:422). The only regularly occurring species of shellfish in the quarry is the `*opihi*. It was found at all of the camps but there are two few in any one place to interpret the shells as food remains alone, thus leading to the speculation that they were offerings to the gods.

Of the birds, there is clearcut evidence that the dark-rumped petrel was consumed in disproportionate numbers compared to other species. The abundance of this species is believed to reflect availability and cultural factors such as taste and nutritional value (Handy and Handy 1972:259). Ethnohistoric sources indicate that the lower flanks of Mauna Kea and the adjoining plain were the most probable source for most, if not all, of the petrels and geese which as earlier noted show indications of seasonality in nesting and feeding habits. Henshaw, for example, was told that the dark-rumped petrel formerly nested in great numbers in the saddle between Mauna Kea and Mauna Loa, and that the nestlings were considered a great delicacy and were tabooed for the exclusive use of the chiefs (Henshaw 1902:120). According to one historic account the young were taken in the downy stage from their burrows in late September and October (Bryan 1914:156). The presence of immature petrel bones in several of the rockshelter assemblages is of great significance then in providing clearcut evidence of seasonality and social rank. If the petrels in this upland region were under a taboo that was lifted after the birth of the young, there is reason to suspect that these same bones are those of young birds that were offered to the gods in first-fruits rites at the beginning of the hunting season. The different meanings given to these bones exemplify the simultaneity of different ecological, economic, and sociopolitical facts and processes. Sahlins has drawn attention to the same thing in the observation that "Even the so-called economic or conservational tabus had a divine finality: they were consecrations of foods to be used in honor of the gods, thus organized in the first place in a system of sacrifice" (Sahlins 1981:45).

The small number of mammal bones precludes any definitive statements regarding the meaning of the dog and pig, but it does appear significant that the meager remains of both of these domesticated species were recovered from late contexts and are, with the exception of a single dog forelimb, the cranial elements of young individuals. Ethnographically, both of these species were used in sacrifices as mediators between men and gods (Valeri 1985:119). The heads of both dogs and pigs were the share of chiefs and though both of these animals were suitable offerings to the gods, pigs are more frequently mentioned. Dogs are said to have been a more appropriate offering in the case of female deities (Titcomb 1969:14, 18).

The presence of seaweed and several species of shellfish, both of which were consumed in a fresh state, is one basis for inferring that some of the fish must have also arrived at the quarry in a reasonably fresh condition, as opposed to the bulk that were probably dried. The other basis for this inference is the ethnographic information relating to the transport of fresh catches of fish in canoe manufacturing expeditions to the interior, though just how far inland fresh fish were taken is obviously unknown. The alternative explanation for the occurrence of the seaweed and other items from the sea is that they were offerings, perhaps made after the quarry had been abandoned, as discussed above.

In his discussion of the elements of sacrifice in Hawaiian ritual Valeri (1985:50-51) mentions some species that were selected because of their names. One example of a sacrifice made at the birth of the first child according to Handy and Pukui was the chiton. Handy and Pukui claimed that this was the only time chiton was eaten:

> Another sea food that must be eaten was a chiton of the species *kuapa`a* (*Acanthochiton viridis*), a bilaterally symmetrical mollusc with a shell consisting of eight transverse plates, found on the under surface of stones in shallow water to which it "holds fast", *pa`a*. This was the only occasion on which this shellfish was eaten: *pa`a* mean to fix, hold fast, hence the implication that the *kuapa`a* would be instrumental in securing firmly through the mother and others who ate of it the goodness induced in the hearts of all present and especially the child (Handy and Pukui 1972,81-82).

The recovery of a chiton from `Ua`u Rockshelter poses an interpretive challenge if we accept the ethnographic information that it was consumed for only one specific reason-to celebrate the birth of a firstborn child.

7.3.7 Support Camps and Activity Networks

Lower elevation sites associated with the adze quarry, such as the Pu`u Kalepeamoa Site at Hale Pōhaku and Site 14638 near Mauna Kea State Park, are believed to have been occupied not only by adze makers on their way to and from the quarry, but also support groups engaged in activities such the collection and transport of firewood, and food preparation. The evidence for food preparation at both of these sites consists of the presence of bird cook stones called *pohaku `eho* used in the roasting or steaming of species such as the dark-rumped petrel (McCoy 2011). The presence of edge-altered basalt flakes and volcanic glass cores and flakes, especially at Site 14638, indicate that a number of other activities probably took place at these camps, such as woodworking and plant processing. It is reasonable to think that these camps may have been occupied by men and women related to the adze makers.

A functional relationship between some of the sites in the Humu`ula Saddle, at PTA, and the Mauna Kea adze quarry has been debated for years (Rosendahl 1977a, 1997b; Hommon and Ahlo 1983; Athens and Kaschko 1989; Streck 1992; McCoy 1986, 1991; Bayman and Moniz 2000; Bayman et al. 2004). A relationship between sites located in PTA and sites located on the south slope of Mauna Kea, most notably the Mauna Kea Adze Quarry Complex, was suggested more than 30 years ago in several preliminary papers on the 1975-76 research in the adze quarry (McCoy 1976; 1977). A reconnaissance survey of the Pōhakuloa Gulch area of the quarry in 1976 indicated the presence of workshops as low at 8,600 feet at Liloe Spring and the ca. 10,200 foot elevation on Waikahalulu Gulch (McCoy 1976:137; McCoy 1977:223).

Rosendahl, who conducted a reconnaissance survey of a portion of Pohakuloa Training Area (PTA) in 1977, noted that Site 5003 "has good research potential due to its apparent cultural deposits and its general proximity to (and possible association with) the prehistoric adze quarry sites on Mauna Kea" (Rosendahl 1977; quoted in Hommon and Ahlo 1983:42). A research design developed by Hommon and Ahlo a few years later, in 1983, posited that the PTA region was a major corridor in the distribution of adze preforms from the Mauna Kea Adze Quarry Complex to other parts of the island, including the Kona, Kohala, and Hilo districts. Though not explicitly stated, their hypothesis, presented as a proposition, implies that the lands occupied by PTA were not the exclusive territory of the people of Ka`ohe, as follows:

> Proposition 11: Adze blanks from the Mauna Kea adze quarries were distributed to Kona, Kohala and Hilo districts by means of routes through the PTA region.
>
> Most adze preforms carried out of the Mauna Kea quarries had probably been reduced in mass as much as possible by flaking to reduce the burden to be carried down the mountain (McCoy and Gould 1977:237; McCoy 1977:240). The final shaping by grinding and polishing probably took place down in the lower, more populated regions of the coastal, agricultural, and lower forest zones. While finished adzes may have been brought from anywhere in the more populated regions for use in the PTA, an adze preform in a PTA site was very probably left while in transit from the quarries to another part of the island. If the source of the perform can be identified, a portion of its route is indicated, though not necessarily its eventual destination (Hommon and Ahlo 1983:62)

Hommon and Ahlo (1983) recommended survey of the northeastern half of what was called Training Area 6 at the time, based on a consideration of the possible relationship between sites in that area and on the slopes and in the gulches above PTA on Mauna Kea:

> It is suggested that this area receive particular attention because it may contain evidence related to the use of the Mauna Kea adze quarries. Workshops in the Mauna Kea Adze Quarry Complex have been found along the west bank of Pohakuloa Gulch down to an elevation of as low as 2,621 meters (8,600 feet) at Liloe Spring (McCoy 1977:223; Figure 1, p. 224) and in Waikahalulu Gulch as well (McCoy 1976:137). These two named gulches and the third nameless one that parallels them about 3 kilometers (1.9 miles) west of Pohakuloa Gulch may have served as routes to the adze quarries from the south side of Mauna Kea. If so, small simple sites undetectable from the air or on aerial photographs may exist at the lower ends of these gulches. It is possible, for example, that boulders or outcrops in this area were tested for quality or actually used by adze quarriers searching for high quality basalt at relatively low altitudes. Archaeological evidence of such activity may be present. The bottom of the gulches, too, may have been resting places where quarriers rested before continuing to the east (e.g. to Hilo) or west (e.g. to Waimea or Kailua). If so, there may be small, open sites there with evidence of brief stops such as adze blanks tested and rejected to lighten the load (Hommon and Ahlo 1983:84).

Following work at Hopukani, Waihu, and Liloe Springs, in 1984-85, McCoy again put forth the idea of a relationship between the Mauna Kea Adze Quarry Complex and selected sites located at PTA, such as shelter caves and trails:

> Some of the PTA sites, primarily trails and shelter caves, may be related to the Mauna Kea Adze Quarry industry. The possibility of such a relationship is suggested by the presence of adze blanks in one shelter cave and flake debitage in this and several other caves, which, on other evidence, can be reliably inferred to have been temporary camp sites (Hommon and Ahlo 1983: 38-50). There is reason to suggest, moreover, that many of these are seasonal camps that were occupied by bird catchers engaged in the collection of the dark-rumped petrel, Hawaiian goose, and other species, some of which are inferred to have been distributed to the adze makers (McCoy 1986:6).

As late as 1994, some archaeologists were still questioning any kind of relationship between the Mauna Kea Adze Quarry Complex and the sites located at PTA:

> One of Streck's major conclusions from this work is that there is no support for the argument made by Hommon and Ahlo (1982:47) and McCoy (1986:6) that the Pohakuloa cave shelter sites provided logistical support in the form of food and resources for personnel engaged in adze-blank production at the Mauna Kea basalt quarry sites. As Streck (1986b:38) observes, the Pohakuloa sites are virtually devoid of the distinctive Mauna Kea basalt. Haun also arrived at a similar conclusion based on his investigations of the BTHC complex (Athens et al. 1991:71)

Reinman and Pantaleo (1998:19) provide a good summary of those who argued for a direct relationship between PTA and the adze quarry on Mauna Kea (Hommon and Ahlo 1983:47; McCoy 1986:6; Ziegler Appendix C) and those who see little or no connection (Cordy 1994:206; Reinman and Schilz 1993, 1994). The earlier doubts of a relationship between the activities occurring in the Mauna Kea Adze Quarry Complex and those lower on the mountain, extending out into the broad expanse of the Humuula Saddle, began to change as the result of more field surveys and sourcing studies.

Welch's survey of a portion of the Saddle Road in 1990 was one of the first studies in the Saddle Region to systematically focus on collecting evidence for linking the adze quarry to sites at PTA. Welch, who formulated a research problem focused on this topic, noted that evidence of adze preforms or flakes in the project area might "indicate routes relating to the transport of Mauna Kea raw material or artifacts to the coastal lowlands" (Welch 1993:37). The source of the basalt at Site 50-10-23-5003, some of which was provisionally identified as coming from the Mauna Kea Adze Quarry Complex on the basis of textural and color characteristics (Welch 1993), was subsequently confirmed using XRF analysis (Sinton and Sinoto 1997; Sinton 1998; Bayman et al. 2001:55).

Some years later Williams submitted 10 basalt artifacts from sites at PTA to the Northwest Research Obsidian Laboratory for XRF analysis. The 10 artifacts included four hammerstones, one adze fragment and five pieces of basalt debitage from five sites (21283, 21492, 21502, and two reference samples from the Mauna Kea Adze Quarry). Two of the four hammerstones were sourced to Mauna Kea, while the other two were from an unknown source. All of the basalt debitage, which came from Sites 21283, 21492 and 21502, matched the reference material from the Mauna Kea Kea Adze Quarry Complex. The one adze blank, from Site 21283, was from an unknown source (Williams 2002: Table 5). The finding that the artifacts from Site 21283 came from multiple sources, including Mauna Kea, is of considerable interest and appears to match what has been found in the sourcing of artifacts from Site 14638.

The relationship, if any, between adze and volcanic glass tool manufacture is still not well understood, but the co-occurrence of the two types of raw material at sites located in the Humu`ula Saddle, close to the northern boundary of the PTA installation, indicate a link between the activities taking place on Mauna Kea and those in the saddle area. Williams noted that of the seven artifacts sourced to the Mauna Kea Adze Quarry Complex, one, a hammerstone found at one of the chill glass quarries, Site 21699, is the same material as most of the hammerstones from the adze quarry [a vesicular basalt] and this constituted the best evidence of the link between the chill glass quarries at PTA and the adze quarry complex on Mauna Kea "since it's possible that the other artifacts sourced to Mauna Kea may have been obtained from the alluvial gravels of Pohakuloa Gulch without the need to ascend to the quarries" (Williams 2002:92).

In a recent paper (McCoy 2011) mention was made that Sites 5003, 14638, 21283, 21492 and 21502, located at PTA, all contain *pōhaku `eho,* as well as basalt adze manufacturing debitage that has been sourced to Mauna Kea (Williams 2002:224; Bayman et al. 2001:55). These same sites also contain avifaunal remains, primarily dark-rumped petrel (*Pterodroma phaeopygia sandwichensis*) that was exploited on a seasonal basis. Though difficult to prove, there is a strong possibility that some of the birds, apparently butchered according to the late Alan Ziegler (1994, 2003), were intended for consumption by the adze makers on Mauna Kea (Hommon and Ahlo 1983; McCoy 1986, 1990; Williams 2002; Ziegler 1994, 2003).

7.3.8 Ritual Practices: A Consecrated Industry of Craft Specialists

In an earlier paper (McCoy 1990:96) the statement was made that the number of shrines and other ritual remains in the Mauna Kea Adze Quarry Complex indicate that work in the quarry, like the building of a Hawaiian canoe, was an "affair of religion" (Malo 1951:126). According to Handy this was true of all of the major crafts throughout Polynesia. Handy (1927:282) used the term "consecrated industry" to highlight the pervasiveness of ritual in Polynesian crafts:

> The main features of all kinds of consecrated enterprise were everywhere fundamentally the same. These were: organization and direction under master craftsmen or adepts, and priests; worship of patron deities, who were commonly deified men, by means of prayer and the presentation of offerings; tapu and purificatory rites designed to insulate the work, the workers, and the product, from evil; the taking of omens relative to the outcome of the enterprise; empowering workers, places, instruments, and the products by using conductors of mana, and endowing them directly with mana through spells; consecrating the finished product by means of ritual; and finally, feasting and general merrymaking to mark the end of the consecrated period, to enjoy the product, and to render thanks to the gods (Handy 1927:282).
>
> Consecrational worship before, during, and after, all labor was regarded as the prerequisite of successful accomplishment...What Malo wrote with regard to the making of canoes in Hawaii was true in ancient times of all industry throughout all Polynesia: "The building of a canoe was an affair of religion" (99, p. 168) (Handy 1927:282).

Information on Hawaiian craft specialization (see Lass 1998 for a useful summary) is on the whole rather meager and for adze manufacture almost non-existent. Malo (1951) noted that adze makers, who were called *po`e ka-koi*, were a "greatly esteemed class" and that "each man worshipped the *akua* that presided over the occupation of profession he followed" (Malo 1951:51). According to Sahlins "craftsmen and priests did not constitute a separate class (contra Malo) or status level. Their position in the social hierarchy was instead determined by their inherited rank which varied along a continuum from low to high" (Sahlins 1958:14). According to Goldman (1970) the common craftsman was known only by his specific occupation--"one who makes adzes, or, if an acknowledged expert, as a "skilled person" (*malalaioa*)" (Goldman 1970:223). It is unclear as to whether or not craftsmen of commoner status were granted the title of *kahuna* after an apprenticeship (like priests of the commoner class), but Goldman's analysis of status led him to conclude that the technical statuses (i.e., craft specialists) were not a shadow aristocracy, but rather an elevated class of commoners (Goldman 1970:537).

Buck noted that “Chiefs, warriors, craftsmen, and commoners had their own particular deities. The commoners conducted their simple ritual without any special setting, but craftsmen made simple shrines upon which to deposit their offerings” (Buck 1957:465). Ethnographic data indicate that amongst groups of craft specialists, one of them assumed the temporary role of a “priest” in conducting ritual activities. According to Goldman (1970:223), “Kahuna, a title for both professional priests and craftsmen, implied in both fields a ritual office. The crafts kahuna was its religious leader.” Handy noted that there were several ways of becoming a craft priest:

> The system of professional craftmanship was such that the adepts or master craftsmen (kahuna, tohunga) may properly be called craft priests. A man who became an adept at some profession through heredity, aptitude and apprenticeship, was not only master of the technique of his profession, but was also master of the ceremonial requirements of his trade, understood the auguries and omens that were significant... Likewise in Hawaii the master canoe-maker presented offerings to the gods of the forest; he uttered the appropriate prayers; and then he himself did the preliminary manual work in trimming the log for the canoe body before it was shaped out (99, p. 168). Under the direction of the adept in charge there always worked a body of consecrated workers, some of them also adepts, others assistants or apprentices (Handy 1927:282-283).

In contrast to everyday work, the places where consecrated work took place had to be purified, as did the people involved in such work. According to the information gathered by Handy:

> Numerous tapu protected consecrated enterprise from evil influences. Those engaged in the work had to be purified before they began their labors in order that they might be freed from evil that had attached itself to them and be made physically pure to work as instruments of mana (Handy 1927:284).
>
> The localities used in connection with sacred labor had to be consecrated, as did the workers. It has already been pointed out that the precincts of the professional fishermen in both Hawaii and the Marquesas were tapu, that is protected against the intrusion of outsiders (Handy 1927:285).

Archaeological evidence of the kinds of consecrational acts described ethnographically have been tentatively identified at several sites on Mauna Kea. There are two sites, both located outside of the quarry proper, that have been interpreted as places where rites of passage may have taken place. One is the Pu`u Kalepeamoa Site (50-10-23-16244), a treeline campsite that on present evidence was occupied by adze makers on the ascent to and descent from the quarry complex (McCoy 1991; McCoy et al. 2009). A piece of chill glass from this site has been recently sourced to either Mauna Loa or Kilauea (Peter Mills, written communication), with the most likely source being the Pohakuloa Chill Glass Quarry Complex in the Pohakuloa Training Area (Williams 2002). This artifact suggests a southerly ascent route, while the presence of adze preforms and manufacturing waste indicate material transported downslope from the quarry. This transitional site contains evidence suggesting that it was the locus of rites of passage involving a change in social status from *noa* to *kapu*, Hawaiian terms that are commonly but, according to Shore (1989), not adequately glossed as sacred and profane. According to Shore, *kapu* and *noa* represent the relations possible between the divine and the human, with *kapu* being "a state of contact with the divine" and *noa*, "an unbounded state of separation from the divine" (Shore 1989:164-165). A variety of artifactual evidence suggests that the Pu`u Kalepeamoa Site point was a logistical support camp occupied by people engaged in a number of different activities.

As noted in a data recovery report on the Pu`u Kalepeamoa Site (McCoy 1991), there is good reason to expect that the ascent and descent phases of the quarry operation were important social occasions based on ethnographic information relating to Hawaiian beliefs and the generalization that "The crossing of frontiers and thresholds is always hedged about with ritual, so also is the transition from one social status to another" (Leach 1976:35). From this it was inferred that the ascent to the quarry must have involved a serious of religious rites in the process of passing through and across the boundaries of a number of different environmental zones perceived in cultural terms as wildernesses and known by the general term *wao* (Malo 1951:17; McCoy 1990:114).

It is highly unlikely that we will never know what kinds of rites were conducted at any of the shrines, the names of the gods that were invoked or the underlying beliefs because of the absence of verbal and written accounts (cf. Trigger1998:18). Trigger (1998) and Davis (1993) are very explicit about the limits of our interpretations:

> I reluctantly conclude that specific beliefs cannot be inferred from material culture alone. To infer the meaning of symbols, it is necessary to have verbal information in the form of written records or oral traditions either from the same culture or from cultures that are historically related to the one being studied (Trigger 1998:18).

> To understand what an image signifies, an interpreter must know exactly in what way the properties of a visual display were produced for seeing-as. Because of the possibility of ambiguity and of fortuitous resemblance, no amount of inspecting the display itself, 'empirically' recording its 'attributes,' can possibly provide this information. The interpreter must have what I called 'archaeological' knowledge about the replication of seeing-as (Davis 1993:129).

The uprights on the larger, more complex shrines (Types 4 and 5), those which are inferred to have been possibly built and used by priests instead of the heads of small family groups, may have possibly functioned in a way similar to that described by Raymond Firth for the stone symbols on the *marae* of Tikopia:

> The material symbols also gave a kind of chart for navigation in ritual behaviour. The ritual of Marae Lasi in Uta had an intricate ground plan, and by reference to the stone symbols of the gods the performers could constantly orient themselves for assembly and individual action. The stones were also of great importance as mnemonics, serving to remind generation after generation of what had to be done, where and for whom (Firth 1970:126).

The epitome of site complexity occurs in two unique compounds of associated shrines and enclosures. One of these is Site 16204, which is located in the Science Reserve, approximately 500 m from the nearest toolstone source. The site consists of five shrines, a small but diverse assemblage of adze manufacturing by-products and number of stone-walled enclosures. The enclosures are arranged in two separate groups that suggests a division based on occupational status and/or group membership at the community or chiefdom level. What we may in fact see here in the site structure is a symbolic linkage and opposition between different communities and/or polities. This site has been interpreted as a place where apprentice adze makers likely went through a series of rites of passage (McCoy 1999b; McCoy and Nees 2010).

The second compound is located on top of the escarpment in the heart of the quarry at Site 16216. A total of 39 enclosures have been identified beneath and adjacent to a massive mound of debitage situated directly below two shrines on the lee side of a prominent ridge (Figure 7.5). One shrine, which is comprised of five and possibly six dispersed uprights positioned on the top of boulders, is believed to be a territorial "map" of the island political organization with each upright symbolizing a district or polity. One possible explanation for the enclosures is that they represent the shelters of a collective labor force comprised of workers from various task groups and sectors of the quarry who assembled during the day to mine and reduce large blocks of material into blanks and preforms, some of which may have been transported back to other camps to be finished. The deliberate burial of these structures with tons of debitage suggests quite a different interpretation, especially when viewed in relation to the evidence of similar "backgrounding" behaviors (Douglas 1975:3) from other contexts in the quarry. The alternative view is that these structures were occupied by a collective labor force that assembled on various occasions to participate in public rituals, perhaps rites of passage marking the change from one "state" to another (Turner 1967:93), such as initiation rites. A short distance away from this compound is a large extraction pit that is partially surrounded with a wall of debitage. There is no obvious utilitarian or pragmatic function for this wall which is thus inferred to represent yet another kind of ritual behavior.

7.3.9 Ascent and Descent Routes

In a cultural landscape made temporarily “sacred” by rites that made adze makers and their work environment *kapu*, there were, as Barrett would argue, a series of paths accessible to some and foreclosed to others (Barrett 2001:159-160). Barrett notes the importance of time or what others would call space-time, in the movement of humans from one place to another:

> Many places are simply passed through, others represent 'stations' where time is consumed. These 'stations' or locales are thus distributed serially and are interspersed by periods which are required by the individual both to separate those locales and to move between them. As a process of constituting social reality, the significance of each locale is determined not only by what takes place there and then, but by what has gone before and what comes after. In other words, it is determined by the memories and the expectations of the participants. Thus an understanding of 'place' depends upon its context within time, a time-context built up from a number of differing trajectories as people meet and then part (Barrett 1994:73-74).

However the isolated scatters, shrines and even possible burials located in the NAR and Science Reserve and elsewhere in the summit region are interpreted, it is clear that at least some adze makers spent some time at “stations” along a route or pathway that is marked by the lithic artifacts they left behind. The occurrence of semi-finished adze preforms outside of the quarry has always presented an interpretive challenge. The issue was discussed in a report on the Pu`u Kalepeamoa Site:

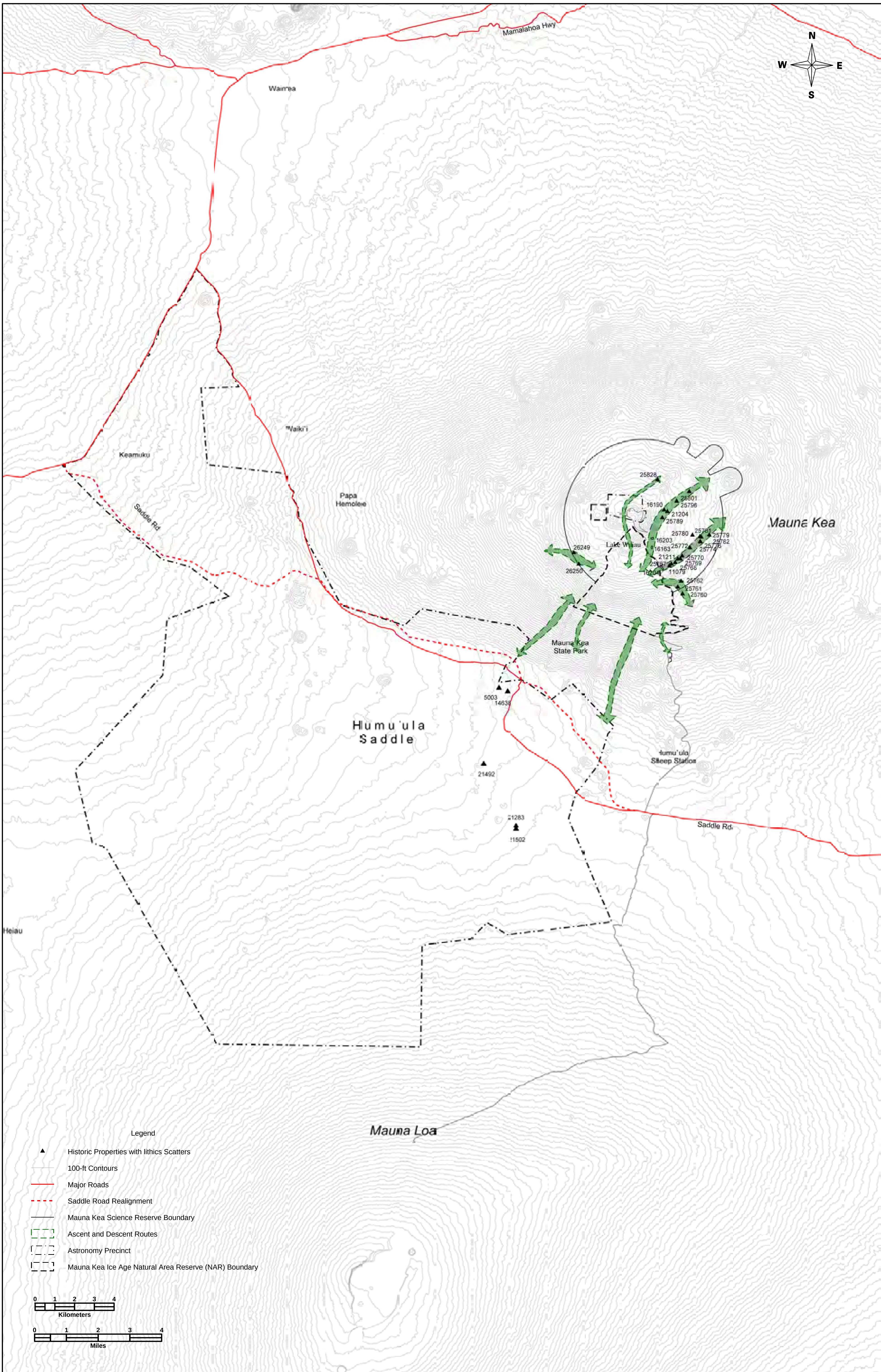
> Hypothesis 1 stated that the predominant activity at this site was the "finishing" of late stage adzes imported from the Mauna Kea Adze Quarry. This hypothesis,

Figure 7.5. Plan View of Site 16216.

> which denotes a major spatio-temporal discontinuity in the manufacturing
>
> process, contradicts earlier assumptions regarding two interrelated aspects of efficiency in this particular quarry industry based on a consideration of its isolated location: (1) the removal from the quarry of adzes ready for grinding and polishing rather than crudely flaked adzes to minimize the discard rate due to breakage and other factors in the resumption of work at a different place and time and (2) the minimization of weight in the transport phase of the manufacturing process (McCoy and Gould 1977). The transport phase is assumed to have been conditioned by a number of factors, the most important of which are two positively correlated variables, bulk properties and distance from the source. If this distance decay model is correct then the relative proportions of cores, early stage tool rejects and large flakes should decrease with distance from the source.
>
> Neither of the two assumptions regarding the removal of unfinished adzes from the quarry has ever been evaluated to determine if the assumptions are indeed warranted or under what conditions there might be predictable exceptions. The Pu'u Kalepeamoa site would seem to be an anomaly or deviation from the predicted behavior, but it is an anomaly only if the underlying premise is correct. In this case I think the underlying efficiency argument is essentially correct, but that the risk minimization and labor-saving aspects of the theory do not provide a completely satisfactory explanation for the existence of this site. The hypothesis of a late stage "finishing" camp is not supported by the various analyses, which point instead to a camp occupied by craftsmen who made a few adzes on small cobbles and flake blanks imported from at least two different source areas. Of particular relevance is the apparent late date of this site and evidence that it was probably occupied only a few times, which means that whatever theory is used to account for this site it must be seen in specifically historical terms rather than in general economic terms (McCoy 1991:169-170).

Evidence in support of a pan-island production system theory (McCoy 1990) includes the isolated lithic sites, some associated with shrines and possible burials, located outside of the adze quarry proper. As discussed in the recently completed archaeological inventory survey report on the Science Reserve (McCoy 2010), the locations of these different sites are arranged in a number of essentially linear pathways or corridors emanating from the quarry and going off in multiple directions are interpreted as ascent-descent routes utilized by adze makers (Figure 7.6). The best defined of these are on the east side of the mountain. There are two and possibly three pathways leading out from the quarry toward the Hāmākua coast. One of these appears to follow the route of the historic Umi Koa trail. A continuation of one of these is suggested by the occurrence of an isolated basalt lithic scatter near Red Hill below Pu`u Mākanaka (Stephanie Nagata, personal communication). The evidence is less clear on the south side of the mountain, but we believe there is reason to believe that Pōhakuloa Gulch and Waikahalulu Gulch were corridors used not only by the elite adze makers working in the quarry, but also their retinue of supporters. We believe that the latter used the Pu`u Kalepeamoa Site and the area around Sites 14638 and 5003 at the bottom of Pōhakuloa Gulch as camps. Isolated sites with basalt sourced to Mauna Kea located further south in PTA suggest other stops and a continuation of the travel back to a home on the Kona coast. Several isolated lithic sites located on the southeastern side of the Science Reserve hint at yet another corridor following a glacial moraine and outwash deposit and perhaps leading to another camp site near Pu`u Kole (McCoy 1991:Figure 2).

Figure 7.6 Adze Quarry Complex Ascent and Descent Routes.



In addition to the isolated artifacts and shrines, it is highly likely that some of the simple piles or stacks of rocks included in the list of “find spots” (Appendix P) because of ambiguities concerning function and age are indeed historic properties. They might be trail markers, boundary markers, or a simple kind of shrine made to propitiate the gods. Ed Stevens (personal communication) mentioned that when he was little and his family decided to hike a forest trail they would erect a pile of three stones with *ti* leaves between. The purpose was to petition the gods to avoid rain during the hike. It is reasonable to think that this kind of practice, which continues even today, would explain the large number of small stacks of rocks widely dispersed throughout the Science Reserve. It is hard to imagine that such features of the most minimalist kind would necessarily mark trails. They would hardly be visible or not at all during misty or foggy weather, for example. It is easy to see how a simple ritual performed to avoid bad weather could have evolved from earlier practices that were aimed at avoiding danger and insuring safe passage.

Thomas Thrum described a common form of propitiation practice involving the construction of a simple *ahu* of three stones in Haleakala”

> It was a recognized custom of Hawaiians to erect stone piles--pile is one meaning of the word ahu--as way marks, memorials of parties traveling or resting, division points of survey, and also guides to most accessible routes of travel. One such marks the safest of three ridges leading from the rim of the crater to the district of Nuu. That some ahu mark burial places is in accord with the present practice in certain districts of Maui and of Hawaii, and perhaps elsewhere. Most, if not all, of the ahus of three stones, one upon the other, are tributes to the deity of the locality and are designed by travelers to assure safety in their journey (Thrum 1921:259).

In a discussion of likely cultural practices in the Mauna Kea summit region McEldowney (1982: A-13) noted that “Such propitiation or petition made to local deities or to those who were personified in natural phenomena (i.e., clouds, mist, rains, winds, falling rocks, stands of trees, etc.) could be made with offerings to “upright stones,” “small platforms,” simple stones and natural landscape features” (Buck 1957:259). Among the early first-hand accounts of propitiation practices are two described by Menzies in 1793 and included in McEldowney’s discussion (1982: A-9 to A-10):

> So bigoted are these people to their religion that here and there on the sides of the path they have little maraes or spots consecrated to their deity, which none of them ever pass without leaving something, let it be ever so trifling, to obtain his good will, and they were highly delighted indeed when we followed their example in throwing a nail, a few beads, or a piece of tapa before their deity, which the women were not allowed to pass without uncovering their breasts and shoulders (Menzies 1920:85).
>
> We observed here and there on the path little maraes, pointed out by taboo sticks stuck in the ground round a bush or under a tree. In passing these places the natives always uttered a prayer or hymn, and made some offerings as they said, to their akua, by leaving a piece of fruit, vegetable or something of other at these consecrated spots (Menzies 1920:156-157).

The Rev. William Ellis observed similar practices aimed at ensuring safe passage at dangerous places along paths or trails, especially those that went up and over cliffs.

His account, dating to his travels through the islands in 1823, mentions stone gods at such dangerous places.

> Within a few yards of the upper edge of the pass, under the shade of the surrounding bushes and trees, two rude and shapeless stone idols are fixed, one on each side of the path, which the natives call *Akua no ka Pari*, gods of the precipice; they are usually covered with pieces of white tapa, native cloth; and every native who passes by to the precipice, if he intends to descend, lays a green bough before these idols, encircles them with a garland of flowers, or wraps a piece of tapa round them, to render them propitious to his descent; all who ascend from the opposite side make a similar acknowledgment for the supposed protection of the deities, whom they imagine to preside over the fearful pass. This practice appears universal, for in our travels among the islands, we have seldom passed any steep or dangerous paths, as the commencement or termination of which we have not seen these images, with heaps of offerings lying before them. Until very recently, it is evident the influence of superstition was strong in the minds of the great mass of the people; for although the natives who accompanied us in our excursions, either from a conviction of the absurdity of the notions of their countrymen, or from mere wantoness, usually overturned the idols, battered them with stones, or rolled them down the precipice or passage which they were supposed to defend; yet on passing the same path only a very short time afterwards, we have invariably found them replaced, or, if broken, their places supplied by fresh ones. The conduct of our native companions was never the consequence of our directions, and seldom received our approbation, for we were not ambitious to become Iconoclasts....(Ellis 1979:15-16).

Eduard Arning, who was collecting ethnographic specimens in the Hawaiian Islands in the 1880s, witnessed a variation of same practice as that described earlier by Ellis, on Molokai and Oahu, indicating that what many people today would call superstitious beliefs, continued well after European contact. Instead of tapa and flowers, Arning describes the offerings as stones:

> Stone Offerings: In crossing the pali between Kalawao and Waikolo (Molokai) the natives deposited oval lava stones on the dangerous hills. This custom was, during my stay, still rigidly observed. I took such a lava piece (1,20) from one of the rocks; it measures 9 cm. long and 7 cm. wide. Also at the end of a narrow gorge famous for its picturesque waterfall near Punaluu on Oahu (photo 1, 232 and 1, 233) behind the temple of the fish god is Kalaupoko the natives deposited stone offerings. They hoped that these offerings would protect them from falling stones, and they deposited these every four or five steps in little heaps and covered them with leaves of dracaena or Eugenia. They hoped by these tokens of attention to propitiate the gods. They always entered the valley only timidly and with shyness. Here, I was told, the god Kameepua fled from the angry Pele and in sliding down the mountain caused the stripes of erosion beside the waterfall (Arning 1931:79).

Safe passage is the reason for the scene that Tyerman and Bennett (1831:432) described:

> As we proceeded towards an adjacent village, we had to cross, with great difficulty and some peril, a range of black rocks which overhung the dashing surges with precipices of giddy elevation. The path being exceeding rough, there were placed, at intervals small heaps of stones with a large block set upright in

> the centre of each. The latter, in fact, was a local divinity, tufts of grass and wreaths of leaves being devoutly laid around these sanctuaries by passengers, who thus propitiated his favour that they might be protected from slips and falls by the way…On the summit of this stupendous range, we found a perfect pandemonium, consisting of multitudes of these dumb, shapeless fragments of the rock on which we were treading, set up to receive the honours due to God alone. These seemed to be of a superior order, entitled to inhabit a higher region, than those on the declivities; for, in addition to the grass and leaves that strewed their respective shrines, their tops were wrapped round with native cloth. The savage aspect of nature in this scene of utter loneliness and desolation—where not a tree or plant grew among the innumerable crags, loose or fixed, that lay like the ruins of a mountain shattered to pieces around and below where we stood—was well calculated to affect with superstitious awe an ignorant people (quoted in McAllister 1933:19-20).

A preliminary examination of the locations of the numerous stacked and piled stone *ahu* in the NAR and Science Reserve suggests that the placement of many of them occur along or near what we believe were ascent and descent routes as indicated by flake scatters and/or shrines with adze manufacturing by product offerings. Though more analysis is needed, what we seem to be seeing is a patterned relationship between different kinds of material evidence of pathways and propitiation practices performed most probably on the ascent of, for example, a steep glacial moraine, but also possibly on the way down the mountain during bad weather when safety became a major concern.

7.3.10 Relevance to Selected Topics and Issues in Hawaiian Archaeology

The study of isolated, so-called "special purpose" sites and site complexes located outside of the permanently occupied coastal-inland zone, such as the Mauna Kea Adze Quarry Complex and the ritual landscape located in the summit region of Mauna Kea, hold great potential to contribute to an understanding of cultural process at the regional level. Such site complexes and landscapes also require a regional perspective if they are to be properly understood in terms of their various relationships, which are fundamentally political, socio-economic and religious, rather than purely technological in the case of the adze quarry.

In talking about social action in non-Western societies it is important to remember that:

> ...any social action is simultaneously economic, political, and religious, although not necessarily to an interesting extent...If religion, politics, and economics are analytical rather than empirical categories, it follows that the vexed question of causal relations or determinism among them is a theoretical one, a function of the way in which these entities are conceived. Social science has not yet produced a generally accepted theoretical statement of these relations because the three categories themselves are not logically necessary but merely emanations of the organization of Western society into church, state and market (MacGaffey 1986:2-3).

7.3.10.1 Craft Specialization, Social Complexity and the Related Issues of Trade and Exchange

It is now widely accepted that the emergence of craft specialization is not correlated with social complexity, at least with social complexity viewed as a linear series of evolutionary stages (e.g., tribe to chiefdom to state). Goldschmidt noted, for example, that the Nomlaki, a tribe located in Northern California, had a number of specialists, including two specialists involved in the heat-treatment of “flint” and another in the reduction of pieces of heat-treated “flint” (Goldschmidt 1951:331-332).

The discussion of Keanakāko`i as the locus of a consecrated tool manufacturing “industry” has already introduced the concept of craft specialization. Based on ethnographic evidence, the consecrated industries of Polynesia were all forms of craft specialization (Handy 1927). The discussions that follow consider the origins of Polynesian craft specialization and archaeological approaches to studying it.

7.3.10.1.1 Ethnographic Perspectives on the Origins of Polynesian Craft Specialization

The origins of craft specialization and its relationship to social complexity in Polynesia has been a subject of interest to both ethnographers and archaeologists. Goldman presented an interesting and insightful theory on the origins of specialization in Polynesia:

> The significance of specialization lies in its role of diversifying the economy, giving it more interactive agents and more complexity with respect both to the organization of production and the system of exchange. General economic theory holds specialization to be a by-product of high productivity, on the one hand, and of the diversification of social needs, on the other. The assumption is logical enough that an economy will not have specialists until it can afford them and wants them, but since the theory does not claim that specialization <u>must</u> arise with an economic "surplus," it is uninformative on the very question of greatest interest, namely: how does specialization arise? With its wide range of forms of specialization, Polynesia can illuminate some of the factors in their evolution. In the history of specialization, Polynesia is not at the lowest level. All share in the common respect for the expert, the tohunga. Respect for skill is surely a basic human trait. But the Polynesian concept of tohunga is more than general respect. By conferring the title, the Polynesians have converted a general human concept into a specific system of status, drawing the expert into the orbit of aristocracy. Thus, viewing the forms of variation and the historical elaboration of specialization from the perspective of Polynesia, we see in the honoring of the expert the source of the whole development. The concept of expertness does have its roots in the actual nature of skills, as in the exceptional skill required to fashion a seaworthy canoe. It is the elaboration of the system of skills, the formation of professions, of guilds, and the incorporation of the tohunga into the order of statuses--in short, the growth of specialization--that we must attribute to the basic concept of honoring the expert. This, however, remains to be proven (Goldman 1970:491-492).

The importance of skill and knowledge is repeatedly emphasized in the ethnographic literature. Shore elaborates on their interrelationship and why craft specialization was universally regarded as a *tapu* activity:

> Knowledge and skill have frequently been pointed to as exemplifying *mana*. Those with specialized skill and knowledge, who Polynesians variously call *tohunga* (Maori), *tufuga* (Samoan), *kahuna* (Hawaiian), and *tahu`a* (Tahitian), among others exhibit *mana*...What all of these specialists share is the capacity to to externalize intellectual power (knowledge) as concrete, coherent products such as boats, houses, victory in warfare,

> and healed bodies. Knowledge embodied in organized, generative activity, whether words or deeds, replicates the work of the gods for Polynesians, and is thus *tapu* activity (Shore 1989:149-150).

Just how important the gods were to craftsmen was noted by Malo (1951) and others. The role that ancestral spirits and deities played in traditional crafts was summarized by McEldowney (1982: A-14) who noted that “Numerous ancestral spirits and deities who were attributes of other gods presided over occupational groups and individual professions in every aspect of their work. Craftsmen relied on these religious entities to provide inspiration, to enhance skills, and to insure the quality and availability of material used” (Malo 1951:81; Barrere 1962:23).

7.3.10.2 Archaeological Approaches to the Study of Craft Specialization and the Importance of Quarries

Torrence noted some years ago that "Craft specialization and control over resources both present very knotty problems for archaeology because the terms embrace such a wide variety of different types of behaviour whose relationship to exchange do not appear to be necessarily straightforward" (Torrence 1986:233). Questions of resource ownership, access, and control, on which the interpretations of tool acquisition (direct access or exchange) are based, are especially difficult to investigate, however, as Torrence herself discovered in her investigations of Bronze Age obsidian exchange on the Aegean island of Melos (Torrence 1984, 1986).

One of the problems in studying craft specialization is related to the matter of variability in the forms and levels of production and the different terms used to characterize this variability. Costin (1991) and Clark (1995) provide a good summary of the problem:

> For example, the term “attached specialization,” as first suggested by Earle [1981] and then developed by him and others [Brumfiel and Earle 1987; Costin 1986; Gero 1983; Hagstrum 1985, 1989; Russell 1988], was defined as production on command for elites and the social and political institutions they control. The key was the reference to a situation in which elites sponsor the productive process in order to control the distribution and consumption of high-value, high-status goods…This has implications for explanation, since central to Earle’s work is the theme that attached specialization develops as part of a political processes, while independent specialization evolves to meet utilitarian, economic needs [Brumfiel and Earle 1987] (Costin 1991:7).

> Recognition of different types of specialized craft production sent investigators scrambling to devise typologies of craft specialization and to determine the archaeological signature of each type (see Costin 1991 for a summary)...The current confusion of categories makes comparative analysis difficult (cf. Halperin 1994:1-11) and calls into question the usefulness of craft specialization as a descriptive, analytical, or explanatory category (Clark 1995:270).

According to Torrence (1984:50; 1986:164), quarries should assume a privileged position in the study of stone tool production and exchange systems because of the direct link to consumers. A well designed analysis should make it possible, for example, to determine whether tools were obtained by what Colin Renfrew (1975:43) has called “direct access,” or through some form of exchange. In the latter case, quarries should theoretically provide a better indication of the kind of exchange than settlement sites, where inferences based on the study of consumption patterns are always faced with equifinality problems caused by such factors as tool reuse or recycling, variable discard patterns, and post-depositional processes. In practice, stone tool quarries are not easily interpreted in social terms, however.

In Hawai`i, the Mauna Kea Adze Quarry Complex has assumed a special place in an on-going dialogue regarding the origins and antiquity of craft specialization. One reason for the focus on Mauna Kea, discussed elsewhere (McCoy 1990:110), is that Mauna Kea is the only known tool-quality basalt source in the Hawaiian Islands with the inherent potential to sustain over a period of more than perhaps a few centuries an institutional practice such as the legitimation of chiefly authority and power based on the production for exchange by a group of attached specialists (Brumfiel and Earle 1987:5-6).

Following on the 1975-76 research project there have been efforts to identify craft specialization in the Mauna Kea Adze Quarry Complex based on: (1) the scale of production (McCoy 1977, 1981, 1990); (2) standardization of adze forms (Cleghorn 1982; Kirch 1990); (3) standardization of manufacturing techniques and indications of apprenticeship based on measures of differential skill (Cleghorn 1982, 1986), and the degree of ritual investment in the manufacturing process (McCoy 1977, 1981, 1990, 1991). A brief review of some of the key arguments is presented below.

In the neo-evolutionary writings that are part of the increasingly diversified literature on Hawaiian archaeology (e.g., Kirch 1984, Hommon 1986) there are explicit and implicit references to the "evolution" of tool types and the appearance of craft specialization as an index of social complexity. Kirch provides a good illustration of this viewpoint:

> In contrast to the early adze variation, for example, later Hawaiian basalt adzes display a *monotonous* uniformity…..The increasing standardization of portable artifact morphology in the Expansion and especially Proto-Historic Periods thus implies increasing craft specialization, as well as the control of certain raw material resources (e.g. adz quarry sites) by particular social groups. Elite control of unevenly distributed resources (such as fine-grained basalt for adzes, pearly shell for fishhooks, or large *Acacia koa* trees for canoes) would imply some form of exchange between sociopolitical units (Kirch 1990a:327, our emphasis).

McCoy (1990:100-101) has criticized the normative view linking craft specialization to standardization. He has challenged the conclusions of Cleghorn and others (e.g., Arnold 1987; Kirch 1990) who use standardization of tool form and manufacturing procedures as unambiguous signatures of craft specialization. While quadrangular cross-section adze blades are the most common "type" in the quarry and in collections of finished adzes (Emory 1968: 162-164; Kirch 1990), there is also evidence for a multiplicity of reduction strategies and tool forms throughout the history of the quarry complex (McCoy 1990:101) and, indeed, at other Hawaiian quarries as well (Dye et al. 1985; Weisler 1990:35-36). Some of the variability is undoubtedly due to predictable failures and departures from norms, which are to be expected in quarry sites (Isaac 1977:9, footnote 1) despite the level of skill that is evidenced in the debitage and unfinished adze blades.

Some of the diversity of adze forms in the Mauna Kea Adze Quarry Complex and other Hawaiian adze quarries (e.g., Dye et al. 1985; McCoy et al. 1993; Weisler 1990) is related to variability in raw material properties. Mauna Kea is unlike any other Hawaiian adze quarry in the presence of massive bedrock exposures, unconsolidated glacial drift deposits containing rounded cobbles and boulders, and an abundance of thick tabular slabs of minimally weathered basalt resting on the surface or embedded in a lava flow. Indeed, the thick tabular slabs facilitate the manufacture of quadrangular-sectioned adze blades and probably contribute to the predominance of these types in the complex. In contrast to the areas containing bedrock exposures and slabs, where there is a preponderance of larger and thicker quadrangular adze preforms, smaller, more diverse adze forms are found more commonly in the glacial drift deposits.

The predominance of thick rectangular and square cross-sectioned blanks preforms (Cleghorn 1982, this report) supports the unstated assumption that a higher value was placed on tabular material, which is virtually localized to the escarpment and nearby flows. It is here that the vast majority of the larger adzes used in felling trees for canoes and land clearance would have been made. Maximization of raw material form is obvious, yet there is also clear evidence throughout the history of the quarry of multiple reduction strategies in the manufacture of a range of adze types and sizes from core blanks and flake blanks (McCoy 1977, 1981, 1986; Cleghorn 1982).

7.3.10.3 Variability in Hawaiian Stone Adze Manufacture: Different Forms of Craft Specialization and Scales of Production

Lass, who agrees that standardization of Hawaiian adze forms is a problematical marker of craft specialization (Lass 1998:25), has challenged the view that the adze makers on Mauna Kea were “attached specialists” rather than “independent specialists” as defined by Brumfiel and Earle (1987:5-6). Lass believes that the quarry complex was used on an occasional basis by “independent specialists,” defined by her as specialists that were neither sponsored nor supported by chiefs (Lass 1994:47). This conclusion is at odds with the ethnographic record. According to Sahlins, craftsmen were engaged and subsidized by high chiefs and local leaders of intermediate status (Sahlins 1958:15-16).

Bayman and Moniz (2000), who are in agreement with McCoy regarding a high degree of specialization and elite sponsorship in the Mauna Kea Adze Quarry Complex, have presented a different interpretation of three isolated adze manufacturing sites located near the bottom of Pōhakuloa Gulch. In their view the assemblage of lithic artifacts from Sites 5003, 12251, and 14638 represent an expedient form of adze production on a smaller scale than what is evidenced higher on Mauna Kea in the quarry proper. While providing yet another demonstration of variability in Hawaiian adze manufacture, they came to the questionable conclusion that manufacture at the Pōhakuloa sites was “non-specialized” and “outside of the direct purview of elite control” (Bayman and Moniz 2000:249):

> Expedient adze production at Pohakuloa and Pololu was on a much smaller scale, it was non-specialized, and it was outside the direct purview of elite control. The adze rejects on the interior saddle were evidently intended for different functions than the larger ones made on Mauna Kea (Bayman and Moniz 2000:249).
>
> Detailed study of the Pohakuloa adze production system also revealed that it was markedly different in terms of its organization than the main quarry at Mauna Kea. Simply put, there is strong evidence that adze production (and use) at Pohakuloa was embedded in a broader economy of resource extraction that included bird catching and other activities. Moreover, this system of adze production operated independently of the highly specialized, large-scale

> production that was practiced at the main quarry of Mauna Kea. These findings have important implications for general models (e.g., Kirch 2000) of traditional Hawaiian economic organization (Bayman et al. 2004:85).

The conclusion that adze production at Pōhakuloa was embedded in a broader economy of resource extraction and operated independently of the highly specialized adze manufacturing industry higher on Mauna Kea is similar in some respects to the Lass model discussed above. The Bayman and Moniz-Nakamura model is based on several unfounded assumptions, including: (1) that the Pōhakuloa sites were occupied by a different group of adze makers than those working in the adze quarry and the sites therefore were not a part of the quarry industry or production system; (2) that manufacture was expedient, and (3) that the adzes made at this site, which they claim are smaller than those found in the quarry probably had a different intended function.

One problem with both Lass' (1988) and especially Bayman and Moniz's (2000) interpretation of independent specialists, is the underlying assumption that specialists of this class were manufacturing a tool to meet strictly utilitarian, economic needs in contrast to the attached specialists who were part of a political process because of chiefly sponsorship. This is the Brumfiel and Earle model (1987:5), which fails to take into consideration a point emphasized by Kirch based on an earlier remark by Goldman:

> Polynesian political systems cannot be understood separately from cosmology and religion, nor for that matter can their economic systems be divorced from their political and ritual contexts. As Goldman put it, 'whether we start with politics to explain the economy or with economics to explain the polity, we are involved in the same equation' (1970:509) (Kirch 1984:37).

The idea that the smaller adzes found at the Pōhakuloa sites might have been used for different purposes than the larger adze preforms found wherever the raw material form allows them to be made is a commonsense kind of argument, but it is difficult to apply for reasons noted by Sahlins:

> In order to frame an answer, to give a cultural account of production, it is critical to note that the social meaning of an object that makes it useful to a certain category of persons is no more apparent from its physical properties than is the value it may be assigned in exchange. Use-value is not less symbolic or less arbitrary than commodity-value. For "utility" is not a quality of the object but a significance of the objective qualities" (Sahlins 1976:169).

Based on evidence from a number of adze manufacturing sites on the south flank of Mauna Kea, we believe that the authors have misinterpreted the Pōhakuloa sites and because of this reached spurious conclusions regarding the scale of production and sponsorship. The artifact assemblage at Site 14638 resembles the Pu`u Kalepeamoa Site assemblage in the presence of bird cooking stones, small adze preforms, small flake debitage, volcanic glass nodules, abrading tools, and utilized basalt flakes (Bayman and Moniz 2000:243-244). The similarities between the two site assemblages suggest that a variety of activities took place at both sites. In our view the two sites were logistical support camps for the adze makers working in the quarry.

Use of the term “expedient” to characterize the discarded, unfinished adze preforms at the Pōhakuloa sites does not purport with the widely accepted definition of expedient tools and technology:

> In a continuum of production effort formal tools are at one end and informal tools are at the opposite end. Informal tools may be viewed as unstandardized or casual with regard to form. They include expediently manufactured tools that are made, used, and discarded over a relatively short period of time. Binford (1979) characterizes such tools at situational gear, or gear that is put to use in response to conditions rather than in anticipation of events or situations. This kind of technology is wasteful with regard to lithic raw materials: it tends to produce tools that are simpler and have less formal patterning, shape, or design (Andresfky 1998:213).

The illustrated adze preforms from the three Pōhakuloa sites (Bayman and Moniz 2000: Figure 4) indicate that more than a little effort was expended in their manufacture and that unlike the utilized basalt and volcanic glass flakes at these sites, the adze makers must have had some form in mind. Another description of the contrast between formal and informal tools emphasizes the differences between the two:

> Formal tools are defined as artifacts that require energy and skill to manufacture, such as endblades, sideblades, burins, microblades, and bifaces (Andresfky 1994b, 1998). They are tools in standardized form, shaped for hafting, which require a preconception, or a “mental template” prior to manufacture. They are distinguished from “expedient” tools, such as flake knives and retouched flakes, which can be manufactured spontaneously with minimal preparation (Wenzel and Shelley 2001:115).

Part of the effort required in making any stone tool is obtaining the raw material. Even if tool-quality basalt occurred nearby in the glacial outwash deposits at the bottom of Pōhakuloa Gulch (Porter 1979a, 1987; McCoy 1991:Figure 3; see Figure 7.1), the effort in finding, testing and transporting a partially reduced cobble or other piece of material is inconsistent with the notion of an expedient technology.

In a discussion of the volcanic glass quarry complex at PTA Williams cautions against the unqualified use of such terms as simple and expedient in describing stone tool manufacture:

> Using the term “simple” or “expedient” to describe a reduction technology often has unfortunate negative connotations to it, as few technologies are ever really “simple.” The definition of expedient as ‘suitable for achieving a particular end’ is appropriate to describe the volcanic glass reduction technology at PTA: sharp edges suitable for unhafted cutting tools were produced from multi-platform, multi-directional cores (Williams 2002:95).

When the adze preforms from the Pōhakuloa sites are compared to those from Hopukani Springs and the Pu`u Kalepeamoa Site there are notable similarities in size and cross-section frequencies (McCoy 1991; Bayman et al. 2001; Bayman and Moniz 2000). The Pu`u Kalepeamoa site adze rejects appear to be more similar to those from other lower elevation sites, such as the Waikahalulu and the two Hopukani rockshelters , than to those from the higher elevation sites in terms of the relative proportions of flake and core blanks, small size, and cross-section category frequencies (McCoy 1986). The typological variability that is evident in the Hopukani Springs sites, the Waikahalulu Rockshelter, and the Pu`u Kalepeamoa Site assemblages assumes major importance with regard to several research problems. This is yet one more instance from the Mauna

Kea Adze Quarry of significant typological diversity refuting (1) frequent assertions of typological monotony in late prehistoric Hawaiian adzes (Kirch 1985, 1990) and (2) the putative link between craft specialization and standardization/homogeneity (Cleghorn 1982, 1986; Kirch 1990; McCoy 1981, 1986, 1990).

With regard to the importance that Bayman and Moniz give to differences in preform size as an indicator of a different mode and scale of production, it is true that large preforms are comparatively rare in many Hawaiian adze quarries (McCoy et al. 1993; Weisler 1990; Dye et al. 1985). There are several possible explanations. Helen Leach, in an important study of New Zealand adzes, concluded that thick quadrangular and large triangular adzes were underrepresented in the surviving sample because of two factors: (1) a higher success rate compared to other types, and (2) the purposeful reworking of broken specimens, [which is not generally possible in the case of thin adzes made on blades or flakes] (Leach 1984:113).

The discussion of production strategies noted the effect of raw material form on preform size and how this is related to the different kinds of sources. With regard to the question of preform type representation raised by Leach, there are at least two possible, but not necessarily mutually exclusive, explanations for the large number of semi-finished preforms in the Mauna Kea Adze Quarry. One is the abundance of raw material which would suggest that the adze makers could afford to discard performs at a higher rate than would have been possible at many other quarries where there were limited quantities of source material. A more likely explanation is that, as craft specialists working in area of special cultural significance (the *piko* of the island) there was a higher standard of performance and valuation of the final product. This is yet one more another example of the importance of context in archaeological interpretation.

It is perhaps not too farfetched to think that if a particular adze was intended to be used in carving a wooden deity to be placed on a *heiau* that any small defect may have led to its abandonment of the in the quarry, although it might have been technically possible to correct the error. In contrast to everyday life, an error made by a craftsman working under a *kapu* and in a *kapu* environment would have been a serious matter and could have resulted in large numbers of discarded adzes, some with only minor or perceptible flaws, over time:

> Errors in craftmanship were likewise indicative of the presence of maleficent influences, or foreboded evil. In Tahiti in ancient times a small technical error might lead to the abandonment of the work in hand; while in Hawaii a diviner might point out some defect in the construction of a house, predicting misfortune for its inmates if the error was not corrected (54, Vol. VI, p. 82). In the Marquesas the ancient craftsmen discarded defective products as worthless. Obviously there is a point of view arising out of religious concepts, which must have had very far reaching practical effects in producing painstaking and accurate craftmanship, such as was typical of ancient Polynesia (Handy 1927:287).

In summary, the quarry evidence, while agreeing with the results of Lass' adze sourcing study that there was no centralized redistribution of adzes on the island of Hawaii, presents a wholly different perspective on this issue that also raises questions about some of her supporting data. The evidence is at odds, for example, with her view that the Mauna Kea quarry was exploited on an occasional basis by independent craft specialists.

The Pu`u Moiwi Adze Quarry on Kaho`olawe has also assumed importance in the debates over standardization in Hawaiian adze manufacture, beginning with the observations of Hommon (1979) at Site 108. Hommon was struck with how different the types of adze rejects at this site were compared to the finished adzes found on sites elsewhere on the island which were quadrangular in cross-section. This led Hommon to develop three working hypotheses:

> 1) The non-quadrangular adzes may have been earlier forms, produced before the quadrangular form achieved its later overwhelming popularity. This would suggest that site 108 was abandoned before such a shift took place.
>
> 2) The non-quadrangular adz may have been introduced from outside Hawaii. Alternately, the quadrangular adz may have been the introduced form. (The latter statement could be combined with number 1 above).
>
> 3) The non-quadrangular adzes may have been manufactured for export to Maui or some other island (Hommon 1979).

In developing these hypotheses Hommon was careful to note that "none of the arguments can be supported with solid evidence and further research is clearly needed" (Hommon 1979).

Hommon's hypotheses regarding the seemingly anomalous typological characteristics of the site 108 adze rejects and the possibility that the non-quadrangular adzes were produced for exchange were re-evaluated based on data collected in a preliminary re-survey of the Pu`u Moiwi Adze Quarry in 1992. Hommon's (1979) and others' (e.g., Kirch 1990) statements regarding the predominance of the quadrangular form in Hawaii is supported by the results of an important study by Emory (1968) who examined a sample of 265 Hawaiian adzes [165 from various localities in the Bishop Museum collection and 100 from Maui in the Wong collection]. Emory concluded that:

> No place in East Polynesia exhibits such a steadfast adherence to one form of adz as Hawaii. Hawaiian adzes are usually quadrangular (or rectangular) in cross-section, and except for some small specimens and a few of medium size, are tanged. They range from wide and thin to narrow and thick with most of them of intermediate proportions. In profile the great majority are curved longitudinally along the base and the butt meets the blade at an angle. None show shaping by pecking (Emory 1968:162-163).
>
> Our study of Hawaiian adzes has revealed the early existence of an islandwide uniformity in adzes. There is no reason to believe that there ever was a time in Hawaiian history when the tanged, quadrangular adz was not known. Therefore, the first settlers introduced this adz form. They may also have brought the plano-convex, the triangular, and reversed triangular at the same time, but only the quadrangular form survived (Emory 1968:164).

When Emory's data on the frequency of Hawaiian adze types is examined (Emory 1968: Table 6) one of the first things that is noticed is that there are no trapezoidal or reversed trapezoidal adzes. The Pu`u Moiwi assemblages thus appear to be anomalous in the presence of a new and previously unknown adze type in Hawaii. Once known, Emory would probably have argued that the assemblages exemplified an evolutionary sequence which he had already described. He wrote that "The reversed trapezoidal tanged adz marks a transition in form from the quadrangular tanged adz to the reversed triangular" (Emory 1968:159).

The Pu`u Moiwi assemblages do not appear anomalous given what we now know of other quarry assemblages, but there are several questions that are raised in interpreting the meaning of the reversed trapezoidal adze. First, the comparison of quarry types and finished tool types from non-quarry contexts raises questions about the representativeness or bias in quarry assemblages because quarry assemblages are comprised of intended and unintended by-products. It is natural to expect more variety or diversity in a quarry context because of predictable failures and departures from norms. Isaac (1977:9, footnote 1) noted that quarry sites commonly deviate from what he called "regional-phase norms." Second, it is highly likely that a significant proportion of the reversed trapezoidal rejects are early stage rectangular adzes (see Cleghorn 1982). Third, given the occurrence of this adze type in habitation sites from other islands (e.g., Kirch 1975), it is necessary to assume that some proportion of the reversed trapezoidal rejects were intentional and/or acceptable tool types.

Emory's conclusion that only the quadrangular form survived to the end of the Hawaiian cultural sequence implies that all of the non-quadrangular adzes must date to the settlement period. A similar conclusion was drawn by Kirch based on Cleghorn's earlier conclusions regarding the evidence for craft specialization in the form of standardization in adze forms and the manufacturing technology as a whole:

> A temporal pattern of some significance is the morphological variability evident in various artifact classes from assemblages dating to the Colonization and Developmental Periods. This is especially notable in basalt adzes, but also in fishhooks and various ornaments. In part, such variability reflects attempts to adapt technomic artifacts to local environmental constraints and conditions. Equally important, however, such variability may signal an early lack of technical specialization (Kirch 1990a:327).

Emory's and Kirch's conclusions regarding the homogeneity of late Hawaiian adzes is contradicted by recent evidence from several different sites. The one relatively early radiocarbon date from the Pu`u Moiwi quarry of ca. AD 1250-1400 is in line with existing arguments regarding the antiquity of non-quadrangular adze types (e.g., Kirch 1985), but the reversed trapezoidal and reversed triangular types are known to have been made over a much longer time period at the Mauna Kea adze quarry (McCoy 1986, 1991) and probably elsewhere (Dye et al. 1985). It is doubtful that the manufacture of non-quadrangular adzes was restricted to just the early part of the Pu`u Moiwi quarry sequence.

If Kirch's claims have any truth value to them it seems odd that while adzes were becoming increasingly standardized other items were beginning to exhibit significant regional variability in style (Kirch 1990b). The literature indicates that Hawaiian adzes, though predominantly quadrangular in cross-section, were not all alike and hardly *monotonous*, although Kirch would probably claim that such matters are in the eye of the beholder. Brigham's and Bennett's descriptions of Hawaiian adzes are instructive in pointing to other aspects of variability that have been largely overlooked because of the preoccupation with cross-section:

> The Hawaiian peculiarity consists in the parallel sides and angular tang, but it is not to one definite shape that all Hawaiian adzes conform. For instance, the plates show that parallelism of the sides is not constant and in the larger specimens there is a wide departure, but all the while there is a strong family resemblance among them all (Brigham 1902:74-75).

> As shown by Emory...tanged adzes fall into three main classes...1. Broad, heavy adzes, with the width of the cutting edge more than 25 per cent of the length and the tang at a marked angle to the blade. 2. Narrow, heavy adzes, with the width of the cutting edge less than 25 per cent of the length. 3. Thin bladed adzes with tang at a slight angle. In class 1 the sides diverge towards the cutting edge, in class 2 they are parallel, or converge, and in 3 they diverge markedly. In Kauai thick bladed adzes, classes 1 and 2, are far more numerous than the thin bladed, or class 3 (Bennett 1931:58).

What is clearly in need of clarification in the study of Hawaiian craft specialization in stone tool manufacture is the concept of standardization and its putative relationship to social complexity. Cowgill's discussion of the various issues surrounding standardization and its misuse is worth quoting at length:

> Finally, I offer some suggestions about further concepts related to diversity...First, of course, is *richness*, the number of categories present. Second, is *evenness*, which expresses the extent to which the categories are represented by similar quantities of objects. A third concept is *range*, by which I mean the amount of difference between the most different categories...A fourth concept is *standardization*. This has been used too loosely, to mean several different things, including relatively low richness. I suggest that we distinguish between richness and standardization, and use the latter term to refer to low variation within categories. Fifthly, since some categories in a data set may show high standardization while other categories show low standardization, it seem worth defining *uniformity of standardization* as the extent to which some categories are more standardized than others (Cowgill 1989b:135).
>
> Low standardization, in contrast, as I urge we define it, means that there is considerable variation between different examples of a given category. There are at least three plausible reasons for low standardization. One is that there is simply little value placed on standardization by the culture. A second is relatively low skill, and/or conditions not conducive to uniformity of products or raw materials. A third is relatively high skill and control over techniques, which can be taken advantage of to vary monotony. Greater skill and greater control over materials and techniques doubtless appear when producers spend a higher proportion of their time in making ceramics (or lithics, or whatever), but low standardization, *per se*, may reflect low skill, high skill, or have little to do with skill. Even distinguishing richness and range from standardization is not enough. Studies of artifact production must take explicit account of more than this, such as sensitive indicators of skill. Unfortunately, many attempts to deal with craft production and specialization...have been seriously flawed by vagueness about some of the distinctions I have discussed (Cowgill 1989b:135).

Some of the problems that Cowgill has identified in attempts to interpret skill are evident in Kirch's characterization of the temporal changes in Hawaiian adze morphology. In saying that low standardization may signal the lack of technical specialization he is implying the lack of knowledge of local materials and requisite skill to control and thus "dominate" the raw material. Thus, for the first roughly 1,100 years of Hawaiian prehistory [Kirch's Colonization and Developmental Periods] adze makers were dominated by the material and unable to produce standardized forms. One of the difficulties with this adaptationist argument is the underlying assumption that the raw material used for adze manufacture in Hawai'i was significantly different from that in the homeland to require a millennium of experimentation.

Instead of increasing homogeneity through time--the evolutionist hypothesis linking craft specialization to standardization (Kirch 1985, 1990)--there is instead evidence for more diversity and, thus, meaningful variability at group and individual levels, the latter of which is left out of account in the generalizing or evolutionist interpretations. What distinguishes the individual and collective site assemblages as the work of specialists in the Mauna Kea Adze Quarry Complex is not the quality of the work or, more specifically, the skill and success rate alone --a variable that is too contingent--but rather the degree of embellishment in the ritual dimension of production (McCoy 1991). As Cowgill noted, low standardization may have little or nothing to do with skill. Conversely, craft specialization is too complex an institution to be explained or identified archaeologically in terms of skill alone.

7.3.10.2 Socio-political Processes at the Regional Level

With a few notable exceptions (e.g., Cordy 1994) there is a common tendency in Hawaiian archaeology to take the boundaries of the community, the *ahupua`a*, as the main focus of study, but in so-called "complex" societies it is readily apparent that many of the most important cultural processes transcend a specific locale or community. One result of the narrow focus on the *ahupua`a* is that many of the most important questions regarding socio-economic and political processes are yet to be addressed with empirical data. This is fundamentally a problem of research perspectives and theoretical orientation, more particularly of not having a regional research design. At the present time archaeological data are largely conceptualized as relevant to the boundaries of sites and communities rather than larger territories. A second result of the narrow focus on the community is the proclivity to accept it as a self-sufficient socio-economic unit which is clearly not true or universally true. This normative view reduces the community to a redundant unit wherein variability within and between communities is minimized.

When the research on the quarry began, in 1975, it was assumed that the scale of production was a clear indication of production for trade or exchange, and that the prevailing and widely accepted ethnographic model of Hawaiian land tenure, with its emphasis on proprietary rights to resources within the boundaries of the community territory (*the ahupua`a*) was applicable (McCoy 1977). The large volume of material available for exchange implied wide-ranging political and social relationships with a number of communities. As the research progressed the initial assumptions began to be questioned. There was the realization, for example, that although there was a potentially large quantity of adzes available for exchange, something other than exchange value or economics per se was involved. As Sahlins noted, "an economic basis" is a symbolic scheme of practical activity not just the practical scheme in symbolic activity. “It is the realization of a given meaningful order in the relations and finalities of production, in valuations of goods and determinations of resources” (Sahlins 1976:371).

There is accumulating evidence that the Mauna Kea Adze Quarry Complex had developed at some point in its long history into a pan-island production center exploited by small groups of attached craft specialists from all six of the political districts on the island of Hawai`i (McCoy 1990). The evidence includes, but is not limited to, a constellation of upright stones in the Pu`u Ko`oko`olau area of the adze quarry area that is interpreted as a “territorial map” of the island political organization, and rockshelter base camps/workshops characterized by roof-top shrines and large debitage mounds interpreted as district level work centers. This interpretation of the quarry socio-political structure has a number of important implications. It suggests, for example, that the prevailing and generally accepted ethnographic model of Hawaiian land tenure, in which a community had exclusive rights to the resources within its territorial boundaries, does not apply. The added implication is that because more than one community had direct access to the quarry there was no monopoly of the raw material source and, thus, no production for trade or exchange as the ethnographic model would suggest and is commonly concluded for such large quarries where production clearly exceeded local needs (Kirch 1979; Williams 1994). Mills and his colleagues (2011) have recently demonstrated through the use of non-destructive sourcing techniques, using a sample of basalt adze debitage from a habitation site in Kahalu`u, Kona, that less than 70% of the debitage came from local sources. This is important evidence against the widely held view of ahupua`a self-sufficiency held by Earle (1977, 1978) and others, who do acknowledge, however, the existence of exchange of certain goods (Earle 2002:92; cf. commentary on this issue in Kirch 1985: 2; McCoy 1990: 110-112; Lass 1994:11).

The quarry sequence spans the putative transformation/change in the 15th and 16th centuries from what Hommon (1986:58) has termed the archaic *maka`ainana* society of multi-community non-egalitarian corporate kinship groups to the economically and socially self-sufficient communities comprised of ego-based bilateral kindreds called *ahupua`a* that displayed strong tendencies toward endogamy. According to Hommon, this transformation was accompanied by or resulted in the erosion of kinship ties between communities coeval with the growth of even more status levels amongst the chiefly class. If this is true then it raises questions about the relationship between the rise of supposed self-sufficient communities and the death of kinship ties amongst the commoners. It seems to us that the recruitment of lower level chiefs to organize and supervise production at the community level is a contradiction, that there is instead good evidence for the maintenance of inter-community ties through large scale enterprises involving labor recruitment and circulation of a surplus to support the so-called public economy.

Evidence in support of the pan-island production system theory includes the isolated lithic sites, some associated with shrines and possible burials, located outside of the adze quarry proper discussed above in Section 7.3.9 on ascent and descent routes.

7.3.10.3 Territoriality and Property Rights/Use Rights

The number and location of the subalpine forest “outlier sites” is a subject of great interest with regard to the social relations of production, what Wolf (1990:587) later called structural power which was defined as “the power to deploy and allocate social labor”. These sites, which include the Pu`u Kalepeamoa site, the Pu`u Kole site and sites located near what is now an old section of the Saddle Road (Welch 1991) were clearly occupied on the descent from the quarry and are thus inferred to mark routes back home for one or more leeward groups. More specifically, these sites are interpreted as evidence that the quarry was a "common resource" exploited by groups from every region and political district on the island from at least AD 1400 on (McCoy 1990). Supporting evidence for the "common resource" hypothesis and attached as opposed to independent specialists (cf. Earle 1982; Clark and Parry 1990; Withrow 1991) is presented elsewhere (McCoy 1990).

In the traditional Hawaiian system of land tenure, individuals did not own resources. Rather they had use rights to property and resources which were expropriated from the gods. When the quarry research first began it was assumed that the scale of production was a clear indication of production for exchange or trade and that the ethnographic model of Hawaiian land with its emphasis on proprietary rights to resources within the boundaries of the *ahupua'a* was applicable (McCoy 1977). Some fundamental problems with this long-held assumption (see also Withrow 1990, 1991), were noted after the 1975-76 fieldwork in the quarry, leading to an alternative view, that the Mauna Kea quarry, like Kamoku in the Hāmākua District, was a *common resource* exploited by all of the chiefdoms on the island (McCoy 1990:112, 1992; for other views on this matter see Withrow 1990, 1991). Unlike the *ahupua'a*, where there were proprietary rights to resources, "common lands" were open to exploitation by the masses. This alternative system of land tenure does not necessarily imply uncontrolled access or the lack of competition and conflict over access to the best quality material.

7.3.10.4 Non-agricultural Production Systems

Polynesian archaeology evinces an understandable preoccupation with food production and agricultural systems in particular. In contrast to the long history of research on food production relatively little attention has been given to the study of non-agricultural production systems, such as stone tool manufacture, which tend to be viewed in purely technological terms rather than production systems in their own right (Kirch 1984, 1989, 1990).

One consequence of this bias is a partial understanding of life as fully constituted and lived in time and space. In the case of more so-called "complex" societies, such as Hawaii, there is, moreover, a general lack of knowledge regarding the "other economy"--the so-called "political" or "public" economy -- that supported social institutions larger than the family (Sahlins 1972:101) and involved the management and mobilization of resources, such as food surpluses and labor, for economic and political purposes--honor, prestige, legitimation, and domination. Just how little is known of this other economy and more particularly of the interaction between chiefs and commoners prior to European contact, is clear in some of the overviews of Hawaiian prehistory (Cordy 1981; Hommon 1976, 1986; Kirch 1984, 1985, 1990).

As noted elsewhere, non-agricultural production systems, such as the Mauna Kea adze quarry industry, were an integral part of the social construction of reality (McCoy 1990:114). There is, perhaps, no other single archaeological site complex in Hawaii that holds such great potential for understanding how that reality was actually made and changed over time than the Mauna Kea Adze Quarry.

7.3.10.5 Annual Subsistence Region

Because of the existence of agriculture Hawaiian settlement was fundamentally permanent and sedentary, although there was obviously some movement between coastal and more upland areas. The exploitation of land beyond the limits of agriculture and, thus, permanent habitation, in pre-contact Hawai'i constituted the functional equivalent of an annual range in mobile hunter-gatherer societies.

The evidence relating to the quarry and other upland activities suggest that this annual range was to a large extent a polity catchment area or territorial range that was for the most part economic, but also frequently included "sacred" lands on the highest mountains above treeline (McCoy 1990). In this view there was both an annual economic range and a non-economic territory. The treeline location of the Pu'u Kalepeamoa site provides the first real opportunity to investigate the sociocultural significance of this natural boundary and its place in the hierarchy of Hawaiian wilderness zones (Malo 1951:17; Handy and Pukui 1972:22; McCoy 1990:114).

7.4 THE SHRINES OF THE MAUNA KEA SUMMIT REGION: LINGUISTIC, ARCHITECTURAL, AND TEMPORAL RELATIONSHIPS TO RELIGIOUS STRUCTURES ELSEWHERE IN HAWAI`I AND EAST POLYNESIA

The linguistic, architectural, and temporal relationships of the Mauna Kea shrines to religious structures elsewhere in Hawaii and East Polynesia were discussed in the archaeological inventory survey report on the Mauna Kea Science Reserve (McCoy and Nees 2010). The discussion that follows is a continuation of the earlier analysis. It incorporates the shrine data from the NAR and briefly compares the data sets from the Science Reserve and NAR that together comprise what we have referred to as the Mauna Kea summit region.

Soon after his trip to Mauna Kea, in 1937, Emory published several papers in which he noted both linguistic affinities and architectural similarities to religious structures elsewhere in Hawaii and East Polynesia (Emory 1938, 1947, 1970). Emory's pioneering effort was, of course, in many ways limited. In some cases the comparisons were based on incomplete data and unwarranted assumptions of uniformity. In the absence of absolute dates Emory, Buck and others working in 1920s-1940s, were forced to make a number of assumptions based on architectural characteristics.

The discussion that follows summarizes some of Emory's comparisons and presents a critique of some of the conclusions he made regarding the antiquity of what were assumed to be archaic forms and their probable replacement by more advanced or complex structures. Because the subject matter is religious structures, we have included a brief and far from complete synopsis of what is covered under the rubric of religion. Not long ago it was common practice to define religion as involving a belief in supernatural beings. Katherine Luomala, who summarized some of the most important characteristics of traditional Hawaiian religion, including the existence of major gods and another class of gods called *`aumakua*, used the term supernatural beings:

> Believing the supernatural forces filled sea, sky, and earth, the Hawaiians personified them in countless named and individualized deities, who controlled nature and mankind through their *mana*, or supernatural power. The people retained cosmogonic gods from the homeland, such as Kane, Kanaloa, Ku, Lono, and Wakea, and goddesses like Hina, Papa, Haumea, but they added aspects of these gods and included the deified dead, beings like the volcano goddess Pele, and touchy local spirits in their pantheon of supernatural beings. This pantheon provided the inherited or acquired guardian gods, or aumakuas, of each individual, family, occupation, and profession (Luomala 1987:215).

Over time, some anthropologists, such as Mary Douglas, refrained from using the term supernatural in recognition of the fact that in many cultures gods were part of nature, not above or outside of it. Oral traditions indicate that this was definitely the case in pre-contact Hawaii.

Guthrie developed what he believes is a new theory of religion based on a closer analysis of the concept of anthropomorphism (Guthrie1993). He has continued to elaborate his theory (2007a, 2007b) thusly:

> In the case of the term religion, for example, cognitive science supports defining it, broadly yet substantively, as a system of thought and action for interpreting and influencing the world, built on anthropomorphic premises. Anthropomorphism, in turn, may be theorized as the inevitable consequence of a

> strategy of perception for an ambiguous world: namely, guess first at what matters most (Guthrie 2007b:58).

Guthrie employs to good effect the concept of “family resemblances” made famous by the philosopher Ludwig Wittgenstein:

> Religion’, for example, may be used to corral a particular family of human ideas and actions. One such family appears cross-culturally, though it is, like other families (Wittgenstein 1974), not bounded but open-ended. Specifically, the family I have in mind is one of ideas and actions relating to (among other things) important, often-invisible, human-like agents—‘spirits’, for example—who have interests in and influence on human affairs, and with whom humans can interact symbolically (as by prayer and offerings) (Guthrie 2007b:59).

The term “family resemblances” is in our opinion an apropos term for our purposes. While it denotes obvious similarities in, for example, the form of a structure and the placement of upright stones, it does not assume direct contact between the people who built the shrines on Mauna Kea and a group of people in the Tuamotus, Tahiti, Tongareva, or wherever the same or similar trait is found. One obstacle to establishing direct links is the absence of a firm chronology for the shrines on Mauna Kea and the religious structures with which they are being compared.

7.4.1 Linguistic Affinities

Kenneth Emory, as previously noted, was the first archaeologist to describe the shrines on Mauna Kea and note their East Polynesian affinities. Emory made the following comments about the shrines he saw during his brief visit in 1937:

> The adze makers, clinging to the ancient form of shrine at which to approach their patron gods, have preserved a most important link with their ancestral home. Each upright stone at a shrine probably stood for a separate god. The Hawaiian dictionary describes `*eho* as "a collection of stone gods" and this is the term which the Tuamotuans, the neighbors of the Tahitians, used to designate the alignment of upright stones on the low and narrow platform at their maraes, or sacred places (Emory 1938:22).

As Emory pointed out, the word `*eho* is *keho* and possibly *aho* in various parts of East Polynesia:

> The upright stone slabs on the ahu and out on the court are called *pohatu* at Vahitahi and Napuka and probably many other islands. At Anaa, Fagatau, Fakahina, Tatakoto, Reao, and undoubtedly at other islands they are called *keho*. *Keho* in the Marquesas is a term applied to a “basalt column planted in the ground to serve as a backrest” (32, p. 351). In the Society Islands an *aho* (`*aho?*) is a certain stone set up in a marae where the priest set up his *tapa`au* (coconut leaf twisted to represent a man). Henry (13, pp. 134, 399) records that these *aho* of Tahiti were only certain small uprights in the rear part of the court. It is probable, however, that the word *aho* is related to the Marquesan and Tuamotuan word *keho*, meaning a backrest in the Marquesas and a marae memorial stone or backrest in the Tuamotus. In Hawaii, `*eho* means a stone god representing Lonokaeho, a collection of stone gods, or a stone pillar set up as a monument (Emory 1934:10).

The word *keho* is also found in the language of Rapa Nui (Easter Island) where it is may have also referred at one time to ancestral god-stones predating the famous statues called *moai* (McCoy 1993).

Emory's saw similarities in the design of religious structures throughout East Polynesia and presented evidence indicating that in several island groups they were probably called *ahu* in the beginning, prior to the appearance of the word *marae*:

> In New Zealand the *tu-ahu* with a row of upright stones planted across one end of the open space is apparently the Tahitian inland marae reduced to its simplest in form and function (24). The name itself carries with it memory of the most conspicuous feature of a Society Island marae. Elsewhere (p. 41) I have given facts which indicate that in the Society Islands and in the Tuamotus the ancient maraes were once called "ahu" (Emory 1933:51).

The word `*eho* has various other meanings, some of which point to the need to exercise some caution in assuming that all upright stones were shrines. According to Mary Kawena Pukui and Samuel H. Elbert (1971:35) `*eho* is a term for a single stone image as well as a stone pile, particularly of the kind used to mark land boundaries. The latter information may have come from Samuel M. Kamakau, who noted that "Boundary markers (*kukulu `eho`eho*) of tall stones (*oeoe pohaku*) were set up to identify the boundaries" (Kamakau 1976:7). The use of a stone to represent a god and mark a land boundary are not necessarily incompatible, however, since the construction of religious structures in Polynesia was a common way of making a claim to a piece of land (Handy 1927; Emory 1947:10). Handy described examples from the Society Islands and New Zealand:

> Another instance of the use of stones as mediums of mana is exhibited in the custom typical of the Society Islands and New Zealand, and doubtbless of other islands also, of employing them as signs of ownership of land. In the Society Islands the limits of land belonging to families were marked by corner stones, small upright columns of rock some of which were dressed and some rough, set up at the corners of the property. These markers, which have been in the ground from ancestral times, are regarded as very sacred even today...In New Zealand the same practice is exhibited in the "boundary stones" (*pou-paenga*) which were set up to mark the limits of the plantations...Now, it is evident that this ceremonial use of stones to seal a land claim is closely related to the building of stone marae for the purpose, among others, of establishing land rights (Handy 1927:180).
>
> The maraes, as the property of kindred, were material symbols of them, and formed a visible connection with the past. Always standing on the land occupied by the kindred, observable by any who might pass, they came to be a seal of ownership. They bound the ancestral spirits and gods of the kindred to the land, putting it under their eternal guardianship (Emory 1947:10).

7.4.2 Architectural Design (Type) Comparisons

The shrines of the Mauna Kea summit region are morphologically both similar to and different from most of the religious structures found in the main Hawaiian Islands. The single upright shrines most closely resemble the small family shrines called *Pohaku o Kane* ("Stone of Kane"), the defining characteristic of which was a single upright stone that symbolized the male organ. There are numerous descriptions of the Pohaku o

Kane and their uses (Kamakau 1964:32; Luomala 1987:216; Beckwith 1970). The description that follows is from Beckwith:

> A family altar called Pohaku-o-Kane (Stone of Kane) was set up to Kane in the shape of a single conical stone from a foot to eight feet in height, plain or with slight carving, and planted about with ti plant, where members of a family went to pray to their aumakua and ask forgiveness for the broken tapu to which they ascribed any trouble that had come upon them. Here they sought protection from their family god with offerings and prayer. They came early in the morning, chewed awa while a pig was baking, and, when all was ready, ate under tapu, leaving no remnants and clearing away all rubbish. The place for setting up the stone and the offering to be made were revealed in a dream to the kahuna they consulted. The stone itself was sprinkled with water or with coconut oil and covered with a piece of bark cloth during the ceremony. It is possible, since the Kane stone is generally regarded as an emblem of the male organ of generation, that this covering is similar to the reported practice, before worshipping an image in which sex organs were displayed, of covering those parts with tapa cloth (Beckwith 1970:46-47).

Though similar, it is doubtful because of the context in which they are found that the single upright shrines on Mauna Kea were Pohaku o Kane, or at the very least, functioned in the same way.

One of the first comparisons Emory made that included the Mauna Kea shrines was in a paper published in 1943. Without giving any details, Emory interpreted the Mauna Kea structures as “crude replicas” of the Necker structures which he called *marae*:

> The Necker maraes, with their continuous row of uprights along the back of the platform, are most like the maraes of the more isolated eastern end of the vast Tuamotuan Archipelago. Although Necker was unknown to the historic Hawaiians, its ancient visitors certainly came from the main Hawaiian group, as the squid-lure sinkers and adzes found on the island are Hawaiian. Crude replicas of the Necker maraes were discovered by the writer in 1937 at the quarries of the adze-makers on the 12,500 foot contour of Mauna Kea, the highest mountain on the island of Hawaii. At Puu o Umi on the slopes of neighboring Mauna Loa, a low, narrow platform, bearing uprights similar to the Necker marae has been photographed (See pl. V, fig. 1). But the Necker type of marae has been all but obliterated in Hawaii (Emory 1943:13).

Though Emory saw obvious similarities in widely dispersed religious structures in the Hawaiian Island, the Necker marae as described by him were in some ways distinctive. Emory noted, for example, a pattern of odd numbers of uprights and alternation between flat and pointed shapes:

> The central rear upright, that is, the upright having an equal number of uprights on each side, is conspicuously larger than the others in 7 out of the 12 maraes where it could be noted. In the remaining 5 maraes it is of equal size or even smaller. In Marae 26 and Marae 34, the central rear upright, which measures 4 feet high, 2 feet wide, and 2 feet thick, shows a deep front-to-back groove at the top, possibly an artificial notch (fig. 26). Of the other central rear uprights as many are almost flat on top as are definitely pointed (Emory 1928:63).

Emory did not comment on what the pointed and flat shapes might mean. The senior author has suggested on the basis of ethnographic evidence (Beckwith 1970; Luomala 1987) that the two shapes represent male and female (McCoy 1999b). East Polynesian societies, such as Hawaii, where there is a clear indication of sexual symbolism in pointed and flat stones.

Emory's description of the Necker marae suggests that as a group they are more homogeneous than the Mauna Kea shrines in terms of the presence of a substantial platform and associated terrace or "court"; the regularity in the occurrence of odd numbers of uprights on the platform, and the frequent occurrence of uprights on the court. There are undoubtedly a number of different reasons for these differences even if we assume that the Necker and Mauna Kea structures are of the same cultural origin. There are social and environmental factors as well as regional variation in design and construction that would have to be considered.

> The marae ruins of Necker belong to one fixed type from which only 5 out of the 33 maraes vary in any noteworthy degree. The type form is a low, narrow, rectangular platform which faces on a paved rectangular terrace (fig. 25). Along the full length of the rear of the platform an odd number of upright slabs which average 2 1/2 feet in height, 1 1/2 feet in width, and 8 inches in thickness, are set at equal intervals. On the front of the platform a smaller upright stands opposite the central upright. Directly in line with these two, a pair of small uprights are planted on the pavement of the terrace and against the platform, at their base a flat slab. Opposite this pair of uprights another pair, or a single upright, stands on the front of the pavement. All these uprights face parallel to the platform.
>
> Viewed from the front, one, two, or three small uprights stand near the right corner of the pavement. Near the left edge of the terrace, about one-third of the way from the platform to the front edge of the pavement, stand one or two small uprights. The right and left terrace uprights face parallel the platform or at right angles to it (Emory 1928:60-61).

There are some fairly striking similarities between the Necker marae and some of the Mauna Kea shrines in, for example, the locations of court uprights, but the number of sites on Mauna Kea that exhibit these characteristics are very limited in number. One site that exhibits a similar pattern of court uprights is Site 16168 in the Science Reserve (Figure 7.7).

In noting that the Mauna Kea shrines exhibited similarities to other rarely found forms in Hawaii, such as those he had recorded on Necker, Emory was assuming or perhaps simply implying that the Mauna Kea shrines were of a single type. It is true that the shrines on Mauna Kea are on the whole more homogeneous in design compared to Hawaiian *heiau*, but what Stokes had to say on the matter of *heiau* plans applies equally well to the Mauna Kea shrines:

> After examining about 150 *heaiu* sites on the island of Hawai`i, about 70 on Moloka`i, and several on the islands of Kaua`i, O`ahu, and Kaho`olawe, it seems to me that a man would be very unwise to attempt to draw a plan of *the* Hawaiian *heiau* (Stokes 1991:21).

Mauna Kea has one of the largest concentrations of shrines known anywhere in Polynesia to our knowledge, far more than what anyone might have predicted even after

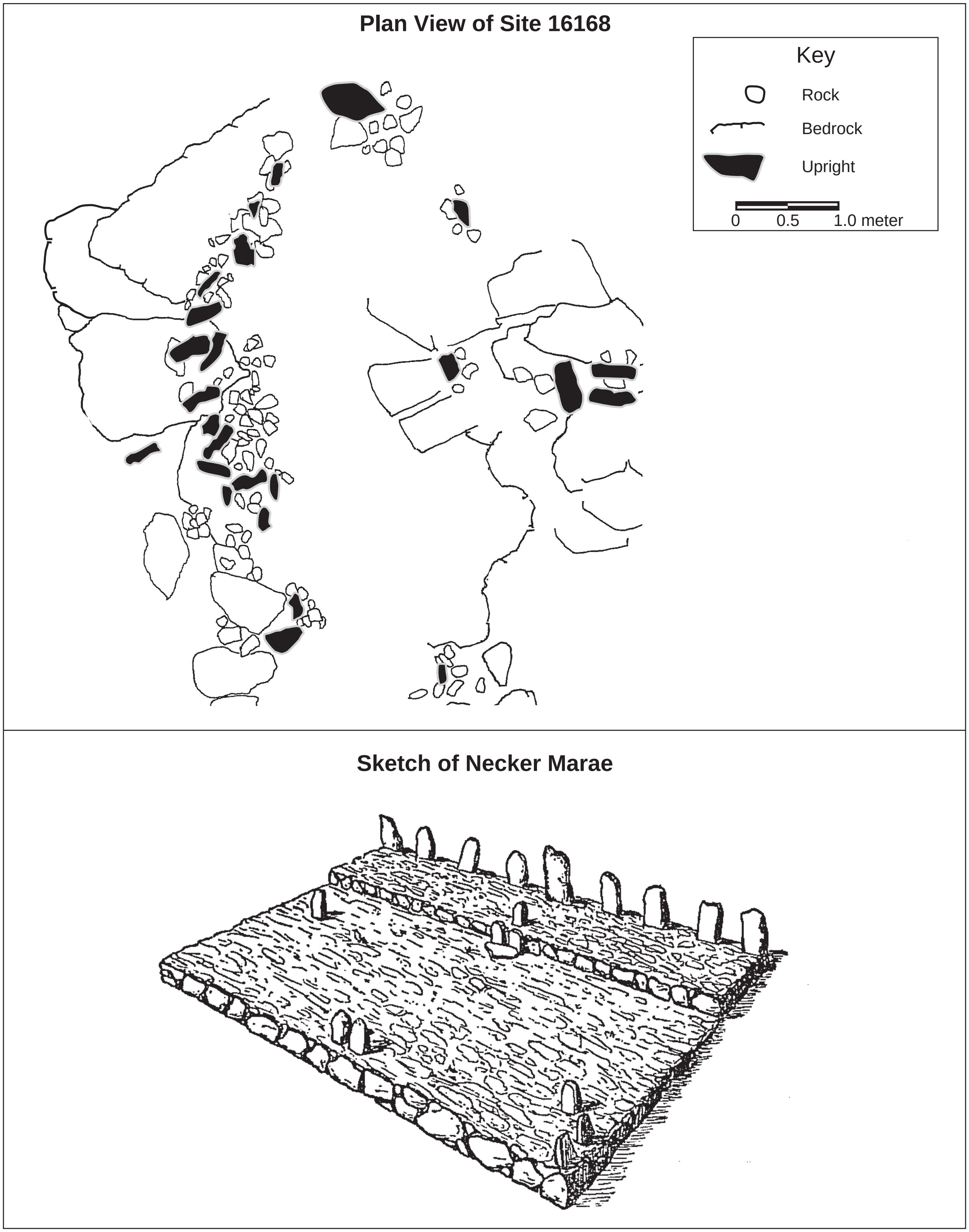


Figure 7.7. Necker Island Marae and Mauna Kea Shrine (Site 16168) (after Emory 1928).

the work in the adze quarry in the mid-1970s and the first survey on the summit and north flank in 1982 (McCoy 1982; McEldowney 1982). As a whole, the shrines display a number of common traits, but as demonstrated in the analysis of shrine planviews in Section 6, what Stokes had to say about *heiau* also applies to the shrines on Mauna Kea: there is no such thing as *the Mauna Kea shrine*.

The shrine data for the NAR obviously invite comparison with the data from the Science Reserve. There are any number of comparisons that could be made, of course, but for this report we have selected shrine type as defined in this report and in the archaeological inventory survey report on the Science Reserve (McCoy and Nees 2010). The frequency of shrine types in the two areas is compared in Table 7.2 and Figure 7.8.

Table 7.2. Number and Percent Total of Shrine Types in the NAR and the Science Reserve.

Shrine Types in the NAR.

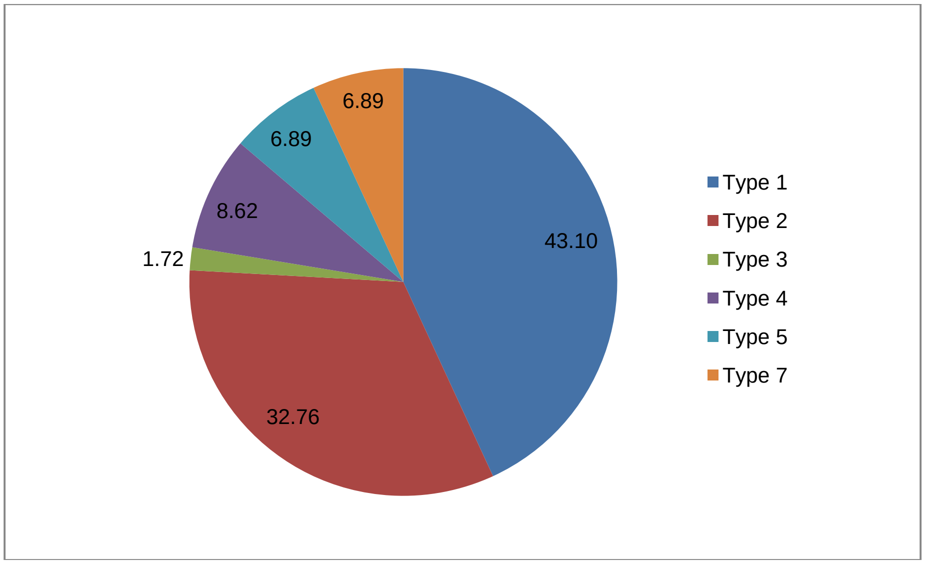
Type	Defining Characteristics	No.	% Total
1	Single upright	25	43.10
2	Row of juxtaposed uprights	19	32.76
3	Row of separated uprights	1	1.72
4	Row of uprights and off-set uprights	5	8.62
5	Multiple uprights with a pavement and defined court	4	6.89
6	Multiple rows of uprights	0	0.00
7	Group of dispersed, non-aligned uprights	4	6.89
Unclassified		0	
TOTAL		**58**	**100%**

Shrine Types in the Mauna Kea Science Reserve.

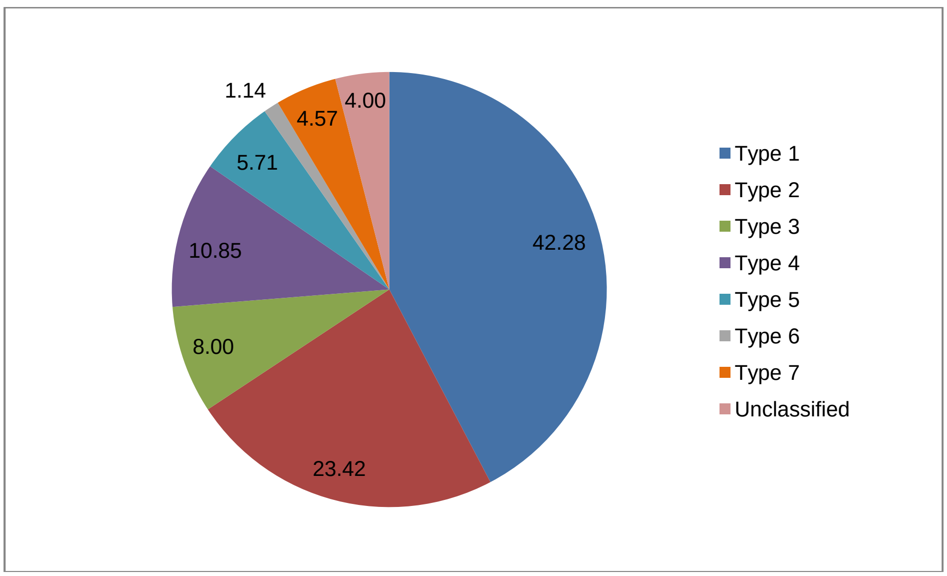
Type	Defining Characteristics	No.	% Total
1	Single upright	74	42.28
2	Row of juxtaposed uprights	41	23.70
3	Row of separated uprights	14	8.00
4	Row of uprights and off-set uprights	19	10.85
5	Multiple uprights with a pavement and defined court	10	5.71
6	Multiple rows of uprights	2	1.14
7	Group of dispersed, non-aligned uprights	8	4,57
Unclassified		7	4.00
TOTAL		**175**	**100%**

There are clearly many similarities between the two study areas in terms of the relative percentage of shrine types, with the single upright shrine (Type 1) being the most similar. The one difference that stands out is the lack of any Type 6 shrines in the NAR. Apart from that, the frequency of each type is remarkably similar.

Emory's comparative studies were, of course, not limited to Hawaiian structures, but also included Tahitian and Tuamotuan *marae.* Emory (1933, 1947) saw both



Natural Area Reserve [NAR] (n=58)



Science Reserve (n=175)

Figure 7.8. Relative Abundances of Shrine Types in the NAR (above) and the Science Reserve (below).

similarities and differences in the Necker *marae* and the *marae* he had seen and recorded in Tahiti and the Tuamotus:

> What the *marae* of Necker have in common with Tahitian and Tuamotuan is a long narrow, raised platform facing on a rectangular court. Along the back of the platform stand an uneven number of stone uprights, and on the court there is an arrangement of uprights, including one, or a pair centrally placed against the platform and another single or pair away from the platform (Fig. 13). In some *marae*, as in the Society Islands, the platform is absent, and the uprights at the head of the court are planted directly in the pavement. A tiny platform abuts the

> central or pair of uprights against the platform. Such were seen as many of the Tuamotuan *marae* (Emory 1970:87).
>
> Where the Necker *marae* depart from the Tahitian-Tuamotuan type, is the increase in number of uprights on the platform. Instead of three, theirs ranged from 5 to 21, but always an uneven number (Emory 1970:87).

The Type 4 shrines---a row with additional or supplementary uprights to one side--- are similar to central and western Tuamotuan *marae*. In contrast to the Type 5 shrine, the off-set uprights define the court area which is normally unpaved and unenclosed. Figure 7.9 shows several examples of Tuamotuan *marae* that resemble some of the Mauna Kea shrines. Many of the Tahitian *marae* that Emory recorded are considerably more elaborate than any known religious structures on Mauna Kea (Figure 7.10).

The large number of uprights that characterize the Necker *marae* is something seen in some of the Mauna Kea shrines, but only rarely. Emory's observations on the uneven number of uprights on the Necker *marae* are of great interest in terms of the uniformity, which would suggest strict adherence to a rule or code. This same pattern is not found on Mauna Kea, although there are a number of shrines with odd numbers of uprights.

7.4.3 Functional Variability

One of the puzzling characteristics of the Mauna Kea shrines, except for a number in the adze quarry, is the rarity or complete absence of anything that could be readily interpreted as an offering. An account of a shrine dedicated to Pele at a place called Pu`u o `Umi (on some USGS maps it is marked as `Umi Caverns/Alika Cone) at the roughly 7,800 ft elevation on Mauna Loa (see Emory 1943, 1970) indicates that the uprights themselves should perhaps be considered offerings:

> An old road of Umi's from his heiau between the mountains in Kona to Kau, is mentioned in the article "Ahua a Umi" in the 1917 Annual. A most interesting discovery of another section of this road was made by Professor Jaggar on visiting the source of the 1919 lava low. Near the source of the flow were many small horse-shoe shaped stone shelters at different parts of the trail, and one large stone platform with long stones erected at the back, and further along a smaller stone platform. It has been learned from the Hawaiians that these platforms were for the priests, and the upright stones were offerings erected whenever there was a flow in this especially Pele-ridden section of Mauna Loa, to avert disaster. The shelters were against the prevailing wind, and would hold from one to several men, sheltering quite a company in all (Baker 1920:85).

It may never be possible to corroborate all of the details in this account, but the idea that a stone erected for the purpose of averting a disaster was regarded as an offering to the god Pele makes sense and is not inconsistent with the generally accepted view that uprights and other material objects were places for the gods to inhabit when they were needed. The alleged function is also consistent with the wealth of ethnohistoric accounts of rituals aimed at avoiding danger. If a new upright was placed on the platform each time there was a crisis this would indicate an accretional history, as opposed to a single event structure with many uprights placed all at once.

The Mauna Loa site, which consists of a shrine and temporary shelters occupied according to available information by priests, has no known counterpart on Mauna Kea.

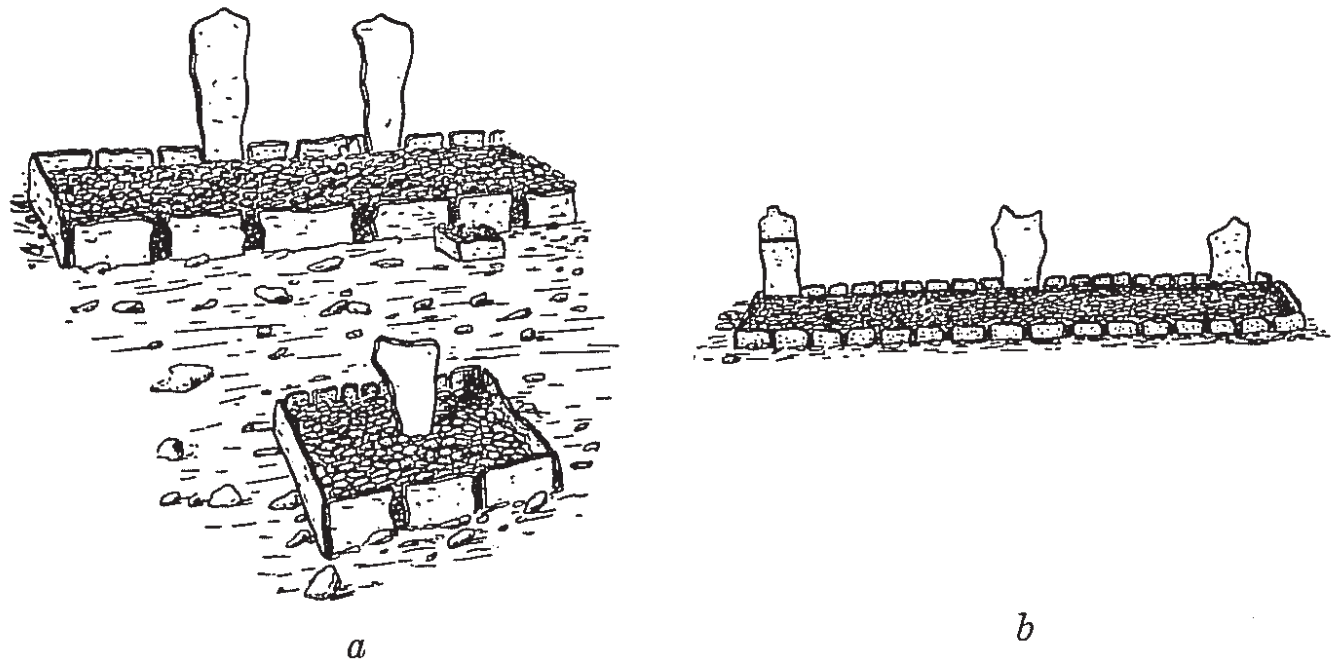


FIGURE 69.—Sketches of maraes in the Tuamotu archipelago: *a*, one end of the Marae Katipa, Fakahina Island, showing the sacred stone uprights, a small altar before one of the uprights, and a small platform supporting an upright; *b*, Marae Ramapohia, Fagatau Island, Tuamotu archipelago, platform about 3 feet wide, 60 feet long, the upright slabs of limestone about 6 feet high, the carving on left slab representing the human form is called *ofai tiki* or representation of a deity.

(Reproduced by permission from a drawing by Seurat.)

Figure 7.9. Examples of Tuamotuan Marae (after Emory 1928).

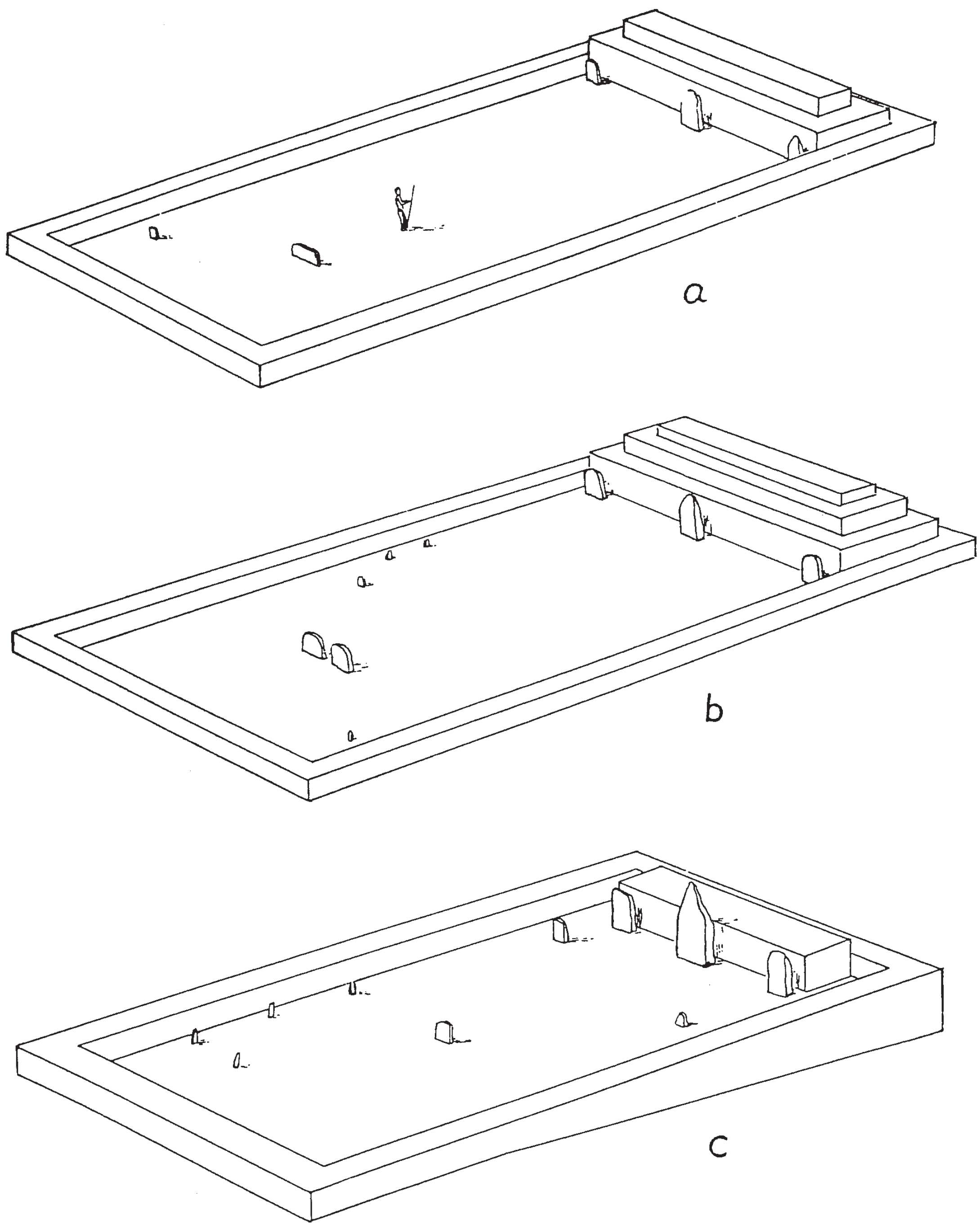


Figure 2. Tahitian *marae*: *a*, coastal type with *ahu* of two inner and three outer steps, sketch based on *marae* in Hitiaa; *b*, coastal type with *ahu* of three inner and four outer steps, sketch based on *marae* Arahurahu, Paea; *c*, intermediate between inland and coastal types, sketch based on *marae* Teroro inland at Afareaitu, Moorea.

Figure 7.10. Examples of Tahitian *Marae* (after Emory 1970: Figure 2).

It is possible that the priests had a retinue of followers or helpers who constructed the shelters. The absence of such shelters at some of the larger shrines on Mauna Kea is hard to explain if, based on our earlier assumption, that priests were involved in the construction and use of the larger, more complex shrines.

There are a number of places on the island of Hawaii that are attached to Umi, including one described by Beckwith:

> On the slope of the mountain just back of the hill Hale-pohaha were to be seen, before the lava flows of 1887 and 1907 covered them, the stone structures of "Umi's camp." Seventy-five huts were counted, all facing away from the wind and built of three slabs of pahoehoe lava rock, two set together at an angle and a third forming the back, each hut large enough to hold two men. Larger huts, perhaps designed for chiefs, were supported by slabs within and built up outside with stone walls shaped into a dome. The place on Kauiki is still pointed out where the image stood which was later commemorated by Kamehameha as the god Kawalaki`i (Beckwith1970:391-392).

Shrines exhibiting family resemblances to those on Mauna Kea have also been found in the Pohakuloa Training Area. Some are large platforms with one or more upright stones. Others are low structures like Site 21289 (Figure 7.11). The uprights at this site consist of a single row of fairly evenly spaced stones of variable shapes. A profile drawing of the uprights shows what appear to be pointed, flat-topped, mesial notched and corner-notched forms (Figure 7.11). The plan is similar in some respects to the Type 3 and Type 4 shrines on Mauna Kea.

7.4.4 Upright Shape Similarities and Differences

Reference was made earlier to the fact that several of the pioneers in Polynesian archaeology and anthropology, such as Emory and Buck, had noted the existence on *marae* throughout Central and East Polynesia of unusual forms of uprights, with such distinguishing characteristics as flanges, notches and grooves. Some uprights were described as exhibiting human or animal forms (e.g., Emory 1947:29). In the Tuamotus these were distinguished by the name *tiki* (Emory 1947:13-14). Though sometimes identified as a human or anthropomorphic characteristic, the tendency was to dismiss flanges, notches, grooves and other apparently unsual characteristics as nothing more than “ornamentation” or “embellishment.” The following descriptions give some idea of how these odd or unusual uprights were regarded by Emory and Buck:

> Montiton (35, p. 366) and others assumed that the great upright slabs on the marae platform, a few of which were shaped crudely in semblance of the human form, were “idols,” but this shaping is little more than embellishment and the uprights themselves simply mark the place of the gods when they were thought to be at the marae (Emory 1947:29).
>
> Presumably, therefore, the slabs along the back of the ahu functioned to mark the position of ancestral gods attending the service. These stones did not serve as material embodiments of their ancestral gods, although the ones which in shape suggested the human form were called *tiki* (that is, shaped in human or animal form), a term which we are likely to associate with the representation of a god. Montiton calls them “idols” (35, p. 366). Some of the backrests on the court were also shaped in the same way, and this shaping can hardly be other than embellishment (Emory 1947:13-14).

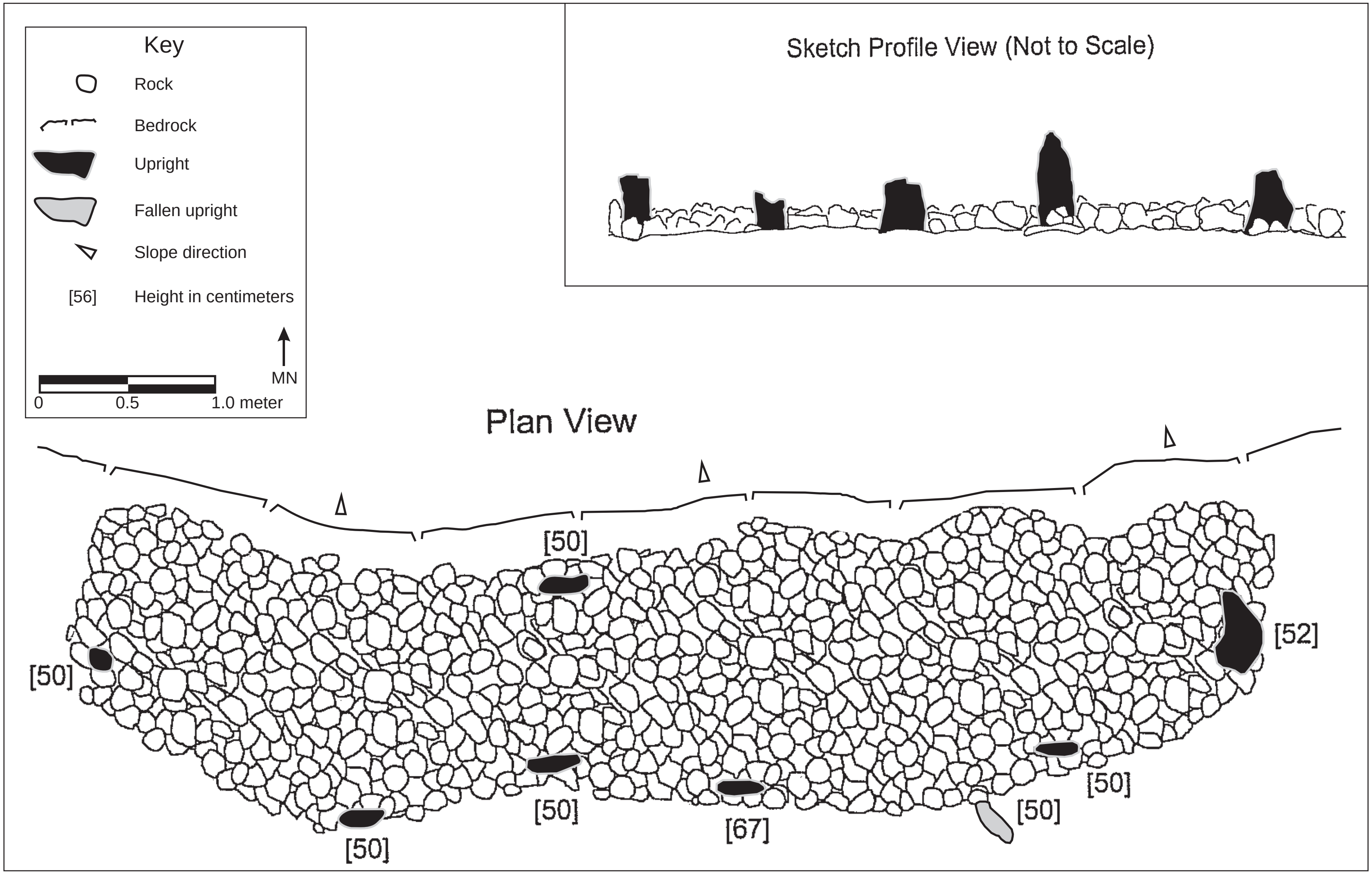


Figure 7.11. Plan View and Profile of Shrine (Site 21289) in the Pohakuloa Training Area. (Modified from Williams, 2002, Figure III-12)

> These Tongarevan *marae* share in common with Tuamotuan and Society Island *marae* a raised platform at one end of a quadrangular court and uprights along the back of this platform. In the Tuamotus, at Fagatau, Fakahina, and Tatakoto we saw the same kind of flange and notched ornamentation on *marae* uprights (Emory 1934a: fig. 5) (Emory 1970:80).
>
> A few of the slabs were ornamented at the top by horizontal flanges or by lateral notches (Buck 1932:155, fig. 22). Buck considered all the slabs on Tongareva *marae* as purely ornamental "placed there to add dignity and impressiveness to the structure" (Buck 1932:179) (Emory 1970:80).

A comparison of the uprights found on the shrines in the Mauna Kea summit region to the examples described above indicates commonalities in the presence of small numbers of slabs with flanges, side-notches and mesial notches. Though there is a difference in raw materials (limestone vs. basalt) and the limestone slabs were often shaped as opposed to the natural forms on Mauna Kea, the occurrence of similar forms is of interest, even if we cannot rule out chance and the fact that it may be only a case of fortuitous resemblance. Buck (1932:153) noted in the case of Tongareva that the sides of the limestone slabs were also shaped. He noted that though the Tongarevan slabs are generally rectangular, the widths at the top and bottom varied. Buck illustrated examples of what we have called "divergent: and "convergent" sided uprights with flat tops (Buck 1932: Figure 21). Examples of Tongarevan marae uprights are illustrated in Figures 7.12 and 7.13.

While Emory consistently dismissed unusual upright shapes as nothing more than ornamentation, he did recognize, however, how such forms could have evolved over time into images:

> It can readily be seen that if these slabs were set up originally as back-rests for the gods, they might easily be taken to represent the gods as much as images would. At the island of Fagatau and Tatakoto in the Tuamotus some slabs were shaped crudely in the outline of the human form. While the object of this was embellishment, as indicated by the fact that the chief's leaning slab was similarly shaped, it does illustrate how a back-rest reserved for a departed ancestor might converted into a representation of him. In the *heiau* on Kauai in the Hawaiian Islands, sketched by Captain Cook's artist, the wooden slabs which are arranged after the fashion of the stone slabs of Necker maraes are carved with a human face. On the island of Hawaii, in place of the straight lines of slab images, we have descriptions of a semi-circle of wooden images in the round placed at one end of the court. The transition of the upright slabs of the early Polynesian marae into images seems actually to have taken place whatever their original intent (Emory 1943:17).

What Emory, Buck and others failed to appreciate is that material culture is meaningfully constituted, which means "there are ideas and concepts embedded in social life which influence the way material culture is used, embellished and discarded" (Hodder 1992:12). Embellishment can denote different things. In a paper on different kinds of value in the Eastern Solomon Islands, Davenport, noted, for example, that " aesthetically embellished objects signal ritual contexts and ritual utilization" and "An embellished object is separated from the economic domain of purchase and exchange" (Davenport 1986:106-107).

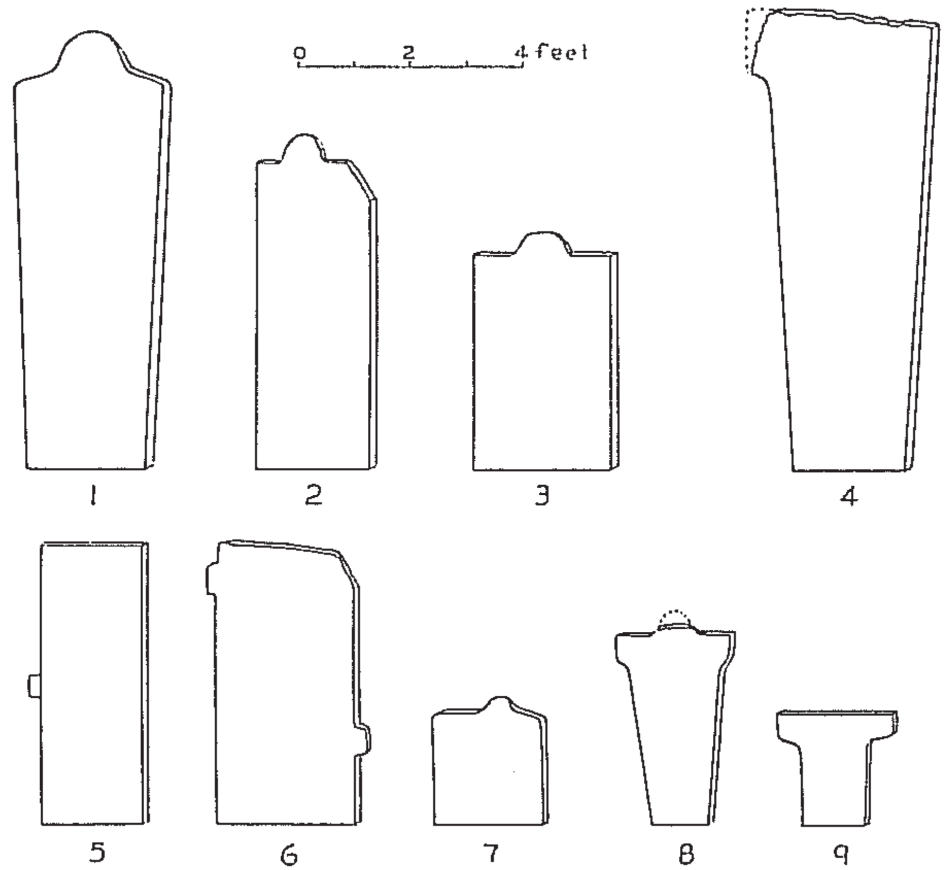


FIGURE 5.—Limestone marae uprights: 1-5, from marae Ramapohia, Fagatau: 3, a court upright; 5, a lateral *ahu* upright; the others *ahu* uprights; 6, *ahu* upright from marae Punakau, Tatakoto; 7, court upright from marae Ahutu, Fagatau; 8, upright from marae Katipa, Fakahina; 9, court upright from marae Ahutu, Tatakoto.

Figure 7.12. Tuamotuan *Marae* Upright Forms (after Emory 1934: Figure 5).

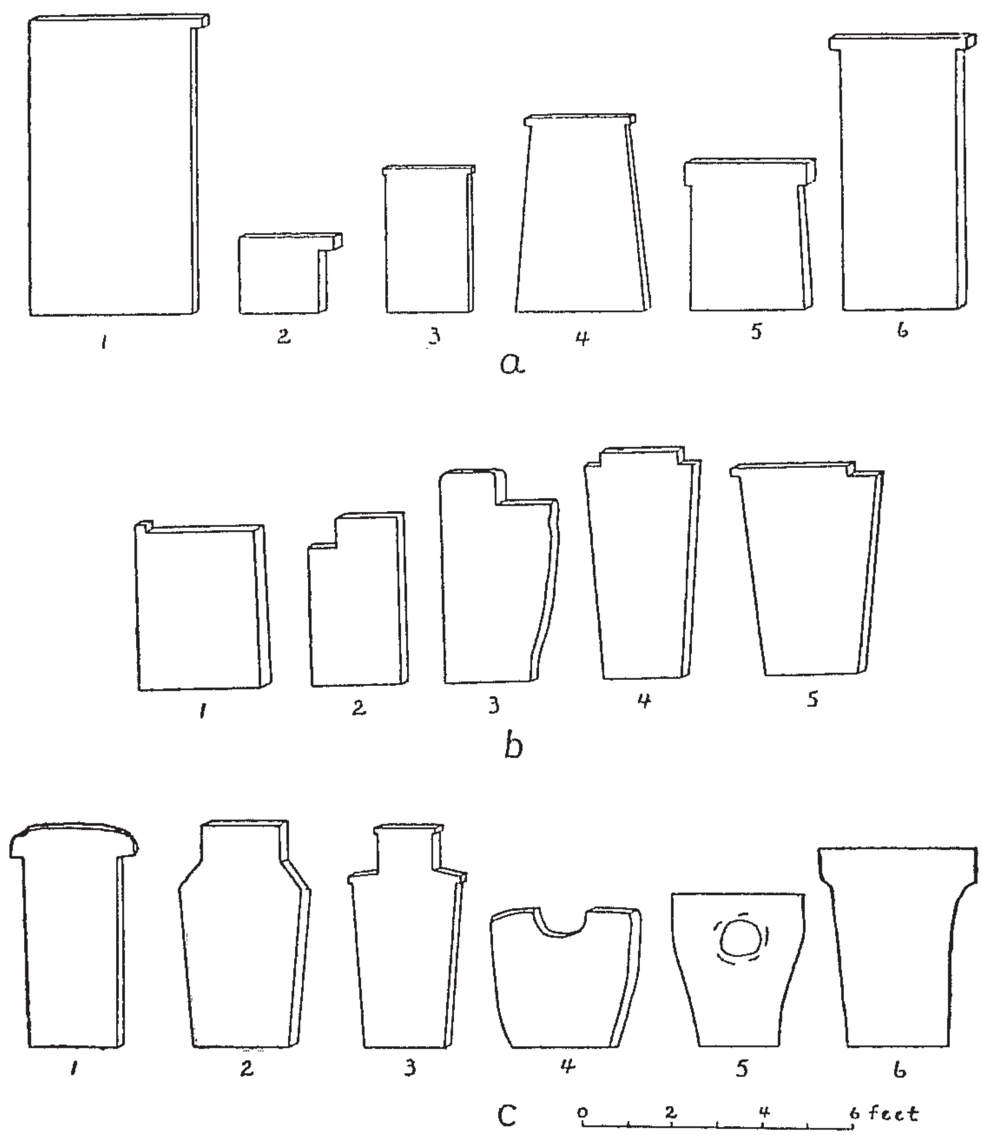


FIGURE 22. Marae pillars. *a*, pillars with horizontal flanges: 1, 2, unilateral flanges; 3-6, bilateral flanges. 1, Rauhara pillar from back line; 2, Te Reinga, right line; 3, Rakahanga, front line; 4, Rakahanga, left line; 5, Rauhara, right line; 6, Te Tohi, back line. *b*, pillars with corner notches: 1-4, back line pillars; 5, pillar of left line. 1, Te Tohi pillar with vertical flange; 2, Te Reinga, even unilateral notch; 3, Te Reinga, deep unilateral notch; 4, Te Tohi, bilateral notches; 5, Rakahanga, shallow notch and flange. *c*, worked pillars: 1, Mahue pillar from back line, bilateral projections; 2, Rakahanga, left, two sloping shoulders; 3, Rakahanga, left, bilateral squared shoulders and bilateral horizontal flanges at shoulders and top; 4, Te Reinga, left, mesial curved notch; 5, Te Reinga, right, perforation evidently a natural flaw and not worked; 6, Te Hara, back, bilateral projections or deep flanges.

Figure 7.13. Tongarevan Marae Upright Forms (after Buck 1932: Figure 22).

7.4.5 A Re-Assessment of the Form and Meaning of East Polynesian God-Stones

As remarked earlier, the conventional view of Polynesian 'god-stones' is that they were 'vehicles', 'places for the gods to inhabit,' abodes of the gods,' or 'temporary shrines' as opposed to icons or actual representations of the gods. While there is no reason to question the function of most of these stones, the whole matter of 'representation' is badly in need of re-examination. For example, are uprights embodiments of gods or simply mediums for communication—i.e., a vehicle as commonly described? Differences in form and repeated forms argue for something more meaningful.

The ability of the gods to take different forms appears to have been widespread in Polynesia. Handy noted that "Most of the gods who received actual worship and those who figured in the myths and legends were thought of usually as having human form. It must be remembered, however, that gods were accredited with the power of assuming various forms at their pleasure. All through Polynesia there are legends which recount the exploits of the mythical hero gods who were regarded as embodying and expressing all the attributes of human beings, but at the same time possessing godlike powers and qualities" (Handy 1927:90-91).

The Maori, who did not engage in the construction of large religious structures of stone like other groups in East Polynesia, did manufacture small god sticks of variable forms to represent different gods:

> Some of the diminutive Maori "god sticks," called *toko*, show an interesting symbolism. A set described by White (156, Vol. I, p. 2) consisted of small sticks only a few inches high, each with a knob on top, and each having a characteristic shape of shaft. The stick representing Tu, the war god, was straight, standing erect "as Tu did at the deluge." The symbol representing Tawhiri, the god of the tempest, was "not unlike a corkscrew, to represent the whirling of the winds and clouds when Rangi attached Tu at the time of the deluge." The lord of the sea, Tangaroa, was symbolized by "a zigzag form, not unlike the teeth of a saw, to represent the waves of the sea." The stick representing Tane, the forest lord, "had a semicircular bend at half its length, on either side of which it was straight. This bend represented the swelling and growth of bulbs, shrubs and trees." The stick of Rongo, the god of the sweet potato, "was in rounded wave-lines along its whole length, to represent the growth of the tuberous *kumara* as it raised the earth in little mounds." Lastly, the *toko* (stick) of Haumia, the god of the fern root "had three half-circles bending in one direction" which represented the "irregular and twisted form of the fern-root when newly dug up" (Handy 1927:124).

The Maori god stick figures suggests that in addition to or, perhaps, in place of the commonplace male/female dichotomy there are physical characteristics of the uprights that are specific to one god or goddess or class of gods or personal spirits. In the Maori example, it is interesting that it was the shape of the shaft, which is equivalent to what we are calling the body of the upright that was the distinguishing characteristic.

There were obviously many different forms of representation in Polynesian god-stones and wooden images and this is the problem for analysts and interpreters. The stone uprights on Mauna Kea are an example of what Gell called 'aniconic representations':

> Meanwhile, there are indexes which refer to other entities (such as gods, again) which (*a*) are visible, but which (*b*) do not permit abductions as to the visual appearance of the entity (god) because they lack any visual recognition cues. Sometimes gods are 'represented' by stones, but the god does not 'look like' a

> stone in anybody's estimation, believer or non-believer alike. The anthropology of art has to consider such instances of 'aniconic' representation, as well as the ones involving more or less overt visual cues as to the appearance of the entity being represented. There are many forms of 'representation' in other words, only one of which is the representation of *visual form*. Approximately, the aniconic image of the god in the form of a stone is an index of the god's spatio-temporal presence, but not his appearance. But in this case, the spatial location of the god is not 'arbitrarily' or 'conventionally' associated with the spatial location of the god; the stone functions as a 'natural sign' of the god's location just as smoke is a natural sign of the spatial location of fire (Gell 1998:26).

The problem with Gell's formulation, with the simple dichotomous distinction between 'iconic representations' and 'aniconic representations", is that while it may be true that natural stones do not represent the appearance of the god (the Hawaiians did not know what the gods looked like) 'god-stones' of the kind widely found throughout Polynesia can or did represent some quality or aspect of a god or class of gods, who were in many instances indistinguishable from humans (Sahlins 1995; Valeri 1985). Sahlins describes the similarities and overlap:

> In the event, all sorts of resemblances and differences, temporalities, and contiguities connect features of nature and elements of culture to one or another of the great *akua*. As previously noted, the hawk, the dog, and certain game fish are bodies of Ku, since this god is the ideal male and these species evoke the warrior's qualities. Plants used in men's technical activities are likewise particularlizations of Ku, such as the *koa* tree, from which canoes are made. Forest birds whose feathers adorn warriors and chiefs' capes are again realizations of Ku. Ku: the term also means 'straight' or 'erect,' hence things high and straight in nature are manifestations of Ku's virility. The coconut tree is a kino of Ku; it is a man with his head in the ground and his testicles in the air (Sahlins 1995:168-169).

The uprights on the larger, more complex shrines in the adze quarry (Types 4 and 5), those which are inferred to have been possibly built and used by priests or possibly the heads of craft guilds instead of individual adze makers or the the heads of small work groups, may have possibly functioned in a way similar to that described by Raymond Firth for the stone symbols on the *marae* of Tikopia:

> The material symbols also gave a kind of chart for navigation in ritual behaviour. The ritual of Marae Lasi in Uta had an intricate ground plan, and by reference to the stone symbols of the gods the performers could constantly orient themselves for assembly and individual action. The stones were also of great importance as mnemonics, serving to remind generation after generation of what had to be done, where and for whom (Firth 1970:126).

7.4.6 Cultural Origins and Chronology: A Review of the Replacement and Cultural Survivals Theory

Not long after they were first described in 1938, Emory compared the Mauna Kea shrines to the *marae* on Necker and to a platform with uprights on the slopes of Mauna Loa. Emory expressed a commonly held opinion of the time—that simple shrines with East Polynesian architectural and iconic characteristics were once common throughout the main Hawaiian Islands, but had been replaced by the *heiau* just about everywhere except for Necker and other isolated localities such as higher elevation slopes of Mauna

Kea and Mauna Loa. This viewpoint, which is a classic example of the “archaic survival theory,” was a prevalent theory in anthropology at the time Emory and Buck were working. Another example of such thinking is found in Buck’s description of the introduction of a new form of religious structure with Paao. Buck wrote that “He [Paao] introduced the form of temple then vogue in Tahiti, and it was adopted either peacefully or after hostilities. The new form based on the later Tahitian type was locally named heiau instead of marae. The early temples were destroyed or altered in all the inhabited islands, but a few escaped destruction in isolated localities such as the mountain slopes of Mauna Kea and Mauna Loa on Hawaii ” (Buck 1957:531). One important aspect of the diffusionist model was left out of account—the origin of the term *heiau* which to our knowledge has never been adequately explained (conversation with Julie Taomia). If Paao did in fact introduce a new form of *marae* to Hawaii, why didn’t the term *marae* follow?

The cultural survivals theory was untenable even at the time Emory and Buck were writing on the subject of Polynesian religious structure variety and change. The *ahu* of Easter Island, which Emory compared to Tuamotuan *marae*, and the *tuahu* in New Zealand clearly indicate an early widespread form of a "primitive" or "archaic" type. The validity of the assumptions underlying the “replacement and survivals theory” have been questioned before (McCoy 1999b). The view that the shrines on Mauna Kea and in other remote places in Hawai`i must necessarily be “early” because of their “archaic” form is an old idea, which I think is still mistakenly held to by some archaeologists even today. This appears to be a classic example of the fallacy of reading antiquity into simple forms (i.e., of wrongly inferring age based on formal and spatial attributes).

Until recently none of the shrines on Mauna Kea had been dated and it appeared unlikely that the age of any would ever be determined, except by comparison to the shrines in the adze quarry where similar forms are found in association with workshops and dated rockshelters (McCoy 1999a). It was believed that some of the shrines might be potentially quite early based on the assumption that pilgrimages to the snow-topped may have occurred soon after human colonization of the Hawaiian Islands. Two shrines in the NAR were recently dated using the ^{230}Thorium method. The first shrine, which was destroyed and not recognized until a few years ago, is located above the entrance to Keanakāko`i (literally “cave of the adze”).  Keanakāko`i is a habitation rockshelter (Bishop Museum site no. 50-Ha-G28-2-R2; State of Hawaii site no. 50-10-23-16205) with a large mound of debitage in front of the entrance located at the ca. 3,780 m elevation on a modern section of the Humu`ula Trail. The dated sample, which was collected from the surface of the debitage mound below the remains of the shrine, yielded an age-determination of AD 1398 $\pm$ 13. The second sample, which has a secure provenance, is from a shrine (Bishop Museum Site No. 50-Ha-G28-3-S1; State Site No. 50-10-23-16206) located at the ca. 3,675 m elevation, approximately 500 m south of Keanakāko`i. This shrine, which is one, if not the most elaborate of all the shrines on Mauna Kea was dated to AD 1441 $\pm$ 3 (McCoy et al. 2009).

While a few shrines could date to perhaps as early as AD 800-1000, most were probably constructed at a later time, coinciding with the rise in population and intensification of adze manufacture in the adze quarry circa AD 1400-1600. It is important to note in this regard that the shrines in the Science Reserve and those in the adze quarry are stylistically indistinguishable. A good number of shrines are therefore probably coeval with the quarry industry, which is roughly dated to circa AD 1100 to AD 1800 (McCoy 1990).

It is clear from ethnographic accounts and recent archaeological dating that simple forms of Hawaiian shrines, such as *the Pohaku o Kane* and *koa*, and more elaborate religious structures (*heiau*) were coeval. In the case of Tahiti, Emory was cognizant of the fact that a variety of forms, both simple and complex, existed at the time of European contact:

> The types, from the simplest to the most elaborate apparently were in use at the time of European contact, so that on form alone one cannot say that any given ruin is earlier than another. But we are fully justified in regarding the stepped-*ahu marae* and those embellished with dressed stone, as well as the *ahu* faced with megalithic slabs, as belonging to the final period of Tahitian culture and as evolving from the smaller, simpler types of *marae* (Emory 1970:77).

7.4.7 Life Histories of Shrines: The Cycle of Respect and Disrespect

One of the newer concepts borrowed by archaeologists from anthropology, is the “life history” concept. The basic argument is that objects, like people, have a “life history” and that an understanding of life histories provides a richer account of material culture items which often tend to be interpreted in strictly utilitarian or functionalist terms.

The life history of uprights obviously started with the selection of particular stones within a “field” of stones that in some cases would number in the thousands and exhibit a bewildering variety of shapes. In Section 6 it was argued that uprights have a “deliberative history” based on some conceptual scheme or belief system in their selection.

Ethnographic data indicate that the relation between man and his gods is a form of accountability in the sense that both are dependent on one another. Durkheim noted in this regard that "The gods also have need of man; without offerings and sacrifice they would die" (Durkheim 1965:53; quoted in Murphy 1971:149).

The consecration of a shrine was not a once in a life-time event. They had to be renewed or re-consecrated. Victor Turner had an apt phrase for this- "the seemingly fixed is really the continuously renewed” (Turner 1985:155). Handy described the process as follows:

> Such representations of deity were for the most part, merely temporary shrines into which gods could be induced to enter when their services were required for purposes of divination or for dispensing mana. At such times these objects or instruments were made new or refurbished, and consecrated, as were the places of worship. They were revered with all the awe that the visible presence of the god himself would have inspired but at other times the only sanctity accorded to the object was that which pertained to any paraphernalia devoted to the service of the gods (Handy 1927:122).

Sahlins (1995: 271) noted the same pattern or cycle of respect and disrespect:

> It is true that such images were receptacles of the gods. But then, they would be so when and as they were ritually consecrated, a condition that would not obtain during the Makahiki, as ordinary rites were then in abeyance. Hence the indifference to images reported as a general rule by Lieutenant King in his resume of observations at Hawaii (Cook and King 1784, 3:160). Samwell had remarked the like in his own journal:
>
> Tho’ they look upon these idols as their Gods they pay no great reverence to them, for when any of us laughed at them & treated with Contempt even those

> we supposed the most sacred among them, the Indians instead of being offended, would join with us in ridiculing them & seemed to think as lightly of them as we did, and there was none of them they would not sell even for trifles (Beaglehole 1967:1185; n.b.: the last was not true of the Ku image).

The cycle of respect and disrespect that Capt. Cook's party observed is evident on some of the shrines in the Science Reserve. The life-history of some shrines ended with what can only be characterized as deliberative destruction of some of the god-stones. There is no way to date this kind of event. Some of the destruction is undoubtedly post-contact and even recent. In other cases, such as Sites 16189 (Figure 7.14) and Site 16163 (Figure 7.15), many of uprights at these sites were not just knocked over; they were deliberately broken. In the case of Site 16189, some of the broken pieces are 10 cm or so thick. The breaks, moreover, are clean and the fragments, which must weigh 100 lbs or more, are found several meters below where they originally stood (see Figure 7.14).

It is interesting to note that as late as the late 19th century on Easter Island (Rapa Nui), when all of the stone statues (*moai*) had been toppled; those that were still intact were viewed as still alive while those that had been broken were dead. Wilhelm Geiseler collected the following information in the 1880:

> The honoring of the idols must have been wide spread because even today every older Rapanui man knows well the name of each of the many statues, regardless whether these are still standing or have already fallen down, and displays great respect toward them. Even though present inhabitants claim to be Christians, the idols are still considered to have some special attributes and to possess great powers. Furthermore, they view the tipped over statues as being still alive; only the broken idols are thought of as dead and without any powers whatsoever (Geiseler 1995, trans. by Ayres and Ayres).

This same belief system might explain the deliberate breakage of some uprights. The breaking of objects appears to be a widespread practice in traditional cultures (e.g., the breaking of mortars and pestles, which was called "killing" amongst various Native American Groups. The idea that different statuses or ranks can pollute one another is part of the complex Hawaiian ideology of pollution beliefs (Valeri 1985), and the Maori of New Zealand as well. There are descriptions of Maori chiefs in the early contact period breaking tea cups after the beverage had been consumed, much to the consternation of their European visitors. The reason "was to ensure that their tapu, which had entered the cup by contact with their lips, spread no further to the possible detriment of both themselves and any future user" (Hanson and Hanson 1983:53).

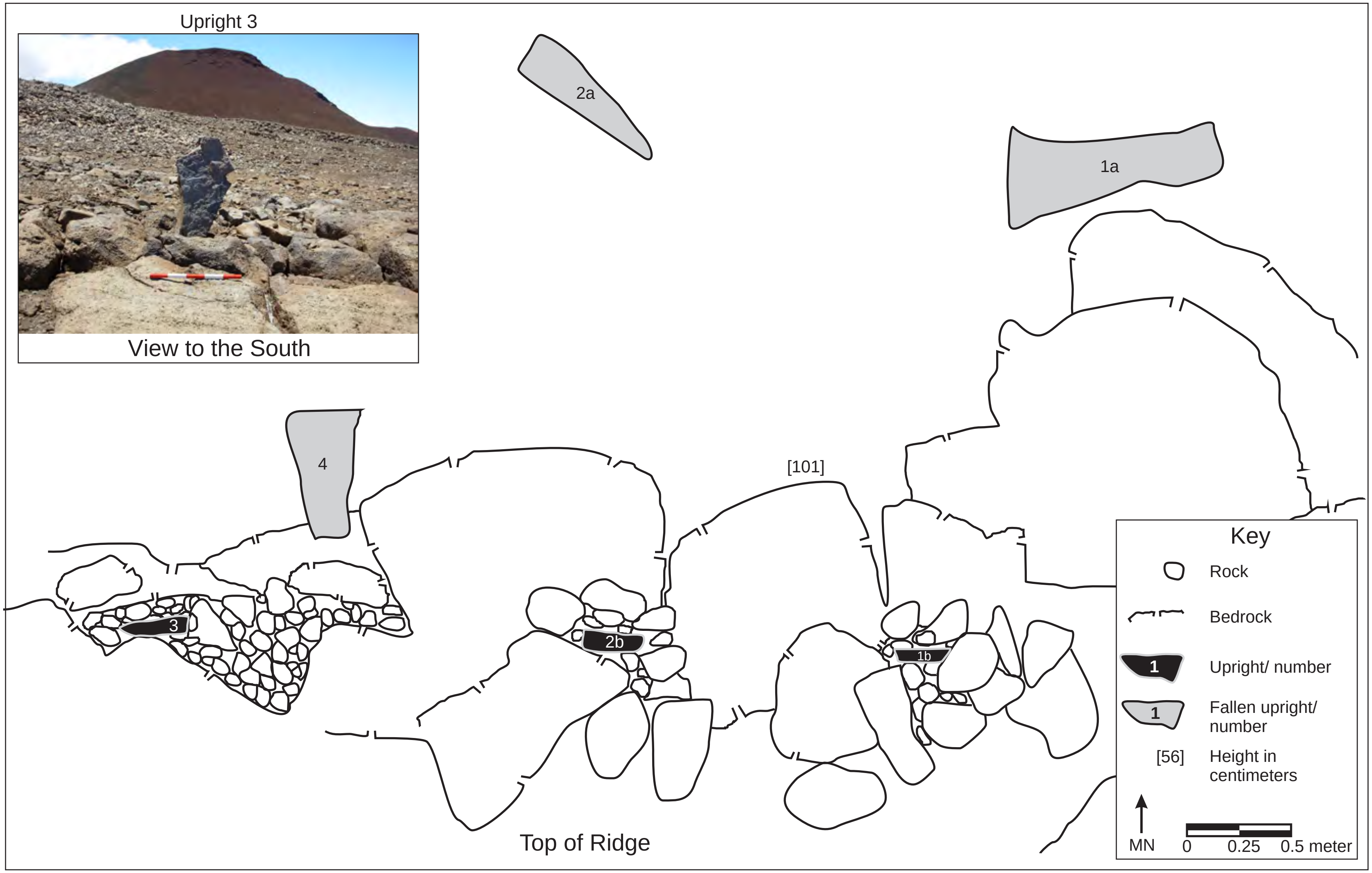


Figure 7.14. Deliberately Broken and Displaced Uprights at Site 16189, Plan View and Photograph.

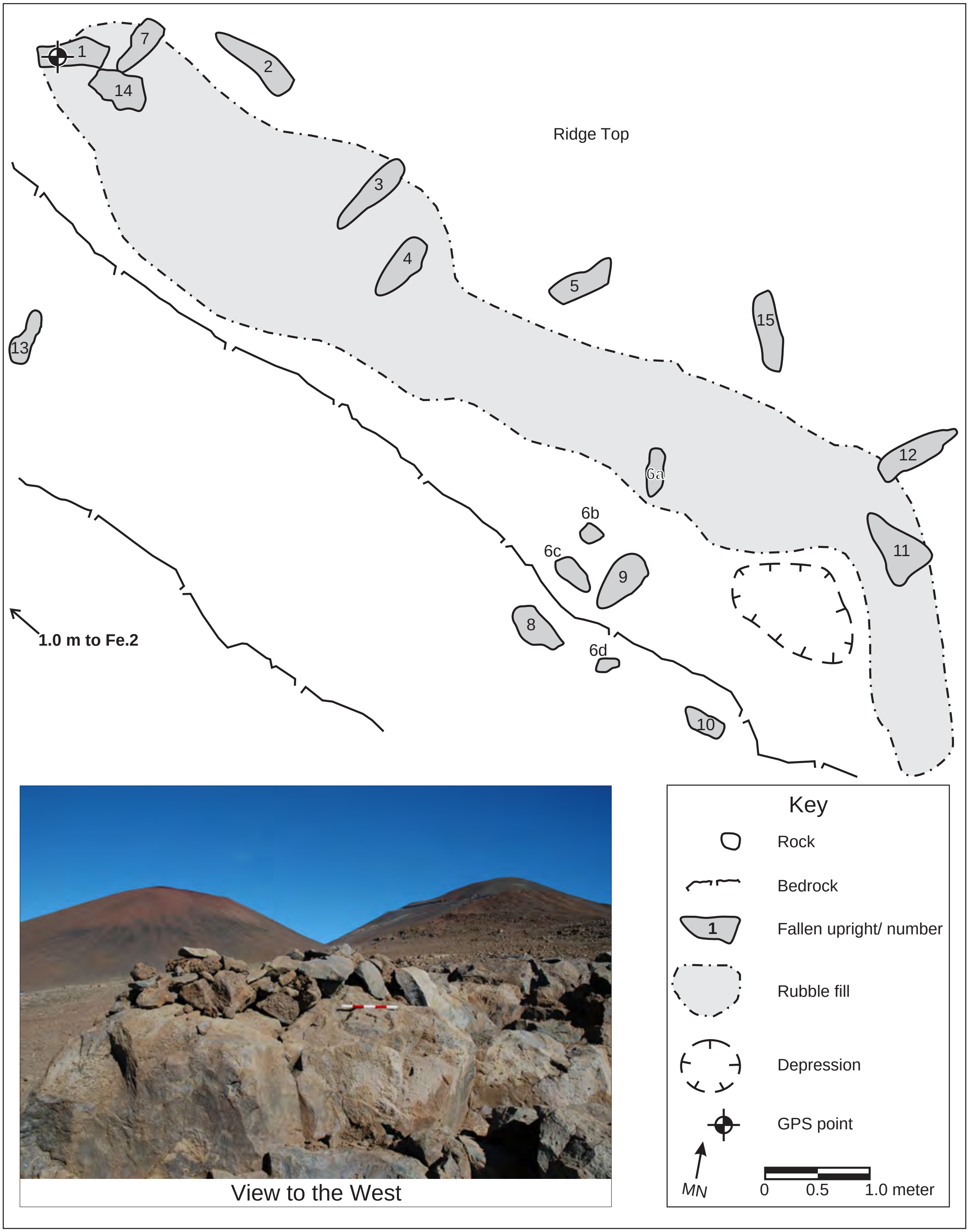


Figure 7.15. Deliberately Broken and Displaced Uprights at Site16163, Feature 1, Plan View and Photograph.

7.5 CONCLUDING REMARKS

The recent history of archaeological research in the summit region of Mauna Kea is a classic example of the emergence of new and different questions as well as new perspectives that are gained in a multi-stage research program carried out over a period of time. The recent work in both the NAR and Science Reserve provided ample opportunity to re-assess earlier ideas and conclusions and to revise or formulate new ones. As an example, one long-standing research question concerned the function and meaning of Site 16204 which is located outside of the adze quarry proper because of the absence of locally available tool-quality basalt, but is regarded as a part of the quarry in terms of the social and religious processes that were an integral part of the production process. The most recent interpretation of this site (McCoy 1999b) differs greatly from ideas held only a few years earlier as a result of the opportunity to go back to this site again and again.

During the survey and even before, in the 1975-76 research project, we came to the conclusion that the site oriented approach to recording and interpreting the archaeological landscape of a quarry complex like that on Mauna Kea presents a number of problems and is in many ways unworkable. A better approach is to view the quarry as a cultural landscape comprised of diverse kinds of activity remains, all related to work and livelihood and probably the burial of esteemed adze makers in the quarry. There is, moreover, no basis for thinking that however the Mauna Kea Adze Quarry Complex is perceived and recorded that the same approach could be extended automatically to other Hawaiian adze quarries.

The Mauna Kea Adze Quarry Complex should not be viewed as a monolithic whole in comparative studies. Generalizations about preform types, reduction sequences, craft specialization, standardization, etc. are not only unwarranted, they often lead to spurious conclusions, such as the conclusion that flake blanks are the predominant blank type in the Mauna Kea Adze Quarry Complex and cobble blanks in the minority (Mintmier 2007: Figure 5).

Comparisons with other adze quarries in Hawai`i need to specify what part of the quarry complex or what specific site assemblages are being used in the comparison. They also need to take into account that while there are commonalities between Hawaiian adze quarries, in for example the manufacturing technology and resultant by-products, the organization or social structure (Hodder 1982:150) of the quarry operation on Mauna Kea exhibits characteristics that on present evidence are believed to be local and particular.

There are also conceptual problems, such as Streck's failure to recognize that what he called mid-slope workshops, as opposed to the quarry, are part of the quarry—that what differs in the form of the raw material or toolstone (Streck 1992).

Finally, we hope to have demonstrated that the isolated lithic assemblages and artifacts in the Science Reserve, though small and seemingly insignificant compared to the massive debitage deposits in the adze quarry, assume a special kind of importance in archaeological practice. They demonstrate that “work” and more precisely, consecrated work, is a far broader, more elusive phenomenon than is generally recognized, thus pointing to the need to continue developing appropriate theory and methods for interpreting the residues of work, such as adze manufacture.

8.0 SIGNIFICANCE EVALUATIONS

Evaluating the significance of sites or historic properties is a requirement for state projects under Chapter 6E-8 and its implementing regulation (Chapter §13-275-6). Site significance in American archaeology tends to be evaluated using standard criteria, such as those set out in the National Park Service's National Register regulations at 36CFR 60.4. Significant historic properties, using the National Register criteria, are those:

> a) That are associated with events that have made a significant contribution to the broad patterns of our history; or
>
> b) That are associated with the lives of persons significant in our past; or
>
> c) That embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or possess high artistic values, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
>
> d) That have yielded, or may be likely to yield, information important in prehistory or history.

One other criteria (e) has been added to the list in Hawai`i. Historic properties evaluated as significant under Criterion "e":

> Have an important value to the native Hawaiian people or other another ethnic group with cultural practices once carried out, or still carried out, at the property or due to associations with traditional beliefs, events or oral accounts—these associations being important to the group's history and cultural identity (Chapter §13-275-6).

Site significance tends to be viewed as fixed and unchanging, but in reality it is "both dynamic and relative" (Moratto and Kelly 1978:2). Bowdler (1977:2) and others have noted how archaeological significance is anything but static. Charles McGimsey and Hester Davis emphasize the importance of having a frame of reference in making significance evaluations and why they are always at the minimum relative:

> The fact that archaeological sites and the information they contain are our only clues to much of human life in the past makes every site potentially significant. It is generally recognized, however, that defining significance implies some frame of reference, problem orientation, geographic, temporal or other context, against which an archaeological phenomenon is to be evaluated. A site is therefore more or less significant relative to some criterion or criteria (McGimsey and Davis 1977:31).

Though frequently ignored, National Register Bulletin 36, *Guidelines for Evaluating and Registering Archaeological Properties*, requires a description of "the research interests and theoretical orientation of the archaeologist" or others involved in the preparation of historic contexts which are directly related to site significance (Little et. al. 2000:14). Bulletin 36 states:

> All archaeological sites have some potential to convey information about the past, however, not all of that information may be important to to our understanding of the pre and post-contact periods of our history. The nature of

important information is linked to the theories or paradigms that drive the study of past societies. It is important to realize that historic contexts, and therefore site significance, should be updated and changed to keep pace with current work in the discipline (Little et. Al. 2000:15)

Bulletin 36 goes on to cite a statement by Nicholas Honerkamp (1988:5):

We ignore theory at our peril…It is very easy to become scientifically and/or humanistically superfluous if we do not continually redefine what is important and why it is important. If as archaeologists we can identifyf questions that matter and explain why they matter, a number of things then begin to fall into place. For instance, field methodologies and analysis routines become driven by solid research designs instead of existing in a theoretical vacuum and being applied in a mechanistic fashion; in the cultural resource management context, the "significance" concept becomes better defined and less slippery in its application…

As indicated in the inclusion of a whole section of this report (Section 4) devoted to a discussion, albeit a short and incomplete one, to methodological and theoretical issues, we believe that Bulletin 36 needs to be applied more stringently in the evaluation of site signficance.

As noted earlier in this report, during the preparation of the Master Plan, in 1999, SHPD proposed that the cultural landscape on the top of Mauna Kea be recognized as the Mauna Kea Summit Region Historic District. The historic district proposal was summarized in the cultural impact assessment for the Master Plan (PHRI 1999:30-32) and discussed in more depth in the early planning process for the proposed Keck Outrigger project (Hibbard 1999; NASA 2005). The IfA, NASA, and other parties agreed that the proposed district, which on current thinking would include all of the Science Reserve, the Natural Area Reserve, and additional areas at selected locations lower on the mountain, meets the eligibility criteria for inclusion on the National Register of Historic Places. The district is now listed in the Statewide Inventory of Historic Places as Site 50-10-23-26869.

With the recognition of the Mauna Kea Summit Region Historic District as eligible for the National Register there is now a single frame of reference that can be used in evaluating site significance for all of the historic properties in the summit region. All of the sites in the NAR are contained within the proposed boundaries of the Historic District. They are considered to be contributing properties in the National Register.

A **contributing** building, site, structure or object adds to the historic architectural qualities, historic associations, or archaeological values for which a property is significant because a) it was present during the period of significance, and possesses historic integrity reflecting its character at that time or is capable of yielding important information about the period, or b) it independently meets the National Register criteria (National Register Bulletin 24:45).

The historic district is significant under all four National Register criteria and criterion "e" of the Hawaii Administrative Rules, Chapter §13-275-6. The district is significant under criterion "a" because of the presence of the Mauna Kea Adze Quarry Complex (a National Historic Landmark), which was used over a period of 500 years or more and the hundreds of shrines in and outside of the quarry. Both the quarry and the shrines are associated with broad patterns and events in Hawaiian prehistory. The district is significant under criterion "b" because of the association with several gods who may have been deified ancestors. These include Kūkahau`ula, Līlīnoe and Waiau. The district is also significant under criterion “b” because of the association with important persons, including Queen Emma and, perhaps, infamous people like Eben Low or “Rawhide Ben.” The sites in the adze quarry and many of the shrines embody distinctive characteristics of traditional Hawaiian stone tool manufacture by craft specialists and a distinctive type of shrine construction found in only a few other places in the Hawaiian Islands. These make the district significant under criterion “c.” Studies of the Mauna Kea Adze Quarry Complex and the on-going archaeological survey of the Mauna Kea Science Reserve have already made a significant contribution to our understanding of Hawaiian prehistory and history, and hold the potential to make even more contributions. The district is thus significant under criterion “d.” Finally, the district is significant under criterion “e” because of the presence of numerous burials and the hundreds of shrines which have been interpreted as evidence of a previously unknown land use practice in the form of pilgrimages to the summit of Mauna Kea to worship the gods and goddesses. As noted earlier**,** Pu`u Kūkahalu`ula, Pu`u Waiau and Pu`u Līlīnoe were deemed Traditional Cultural Properties (TCPs) by SHPD in 1999 based on legendary information and continuity of cultural practices (Hibbard 1999; SHPD 2000). There are people, both Hawaiian and non-Hawaiian, who believe that more of the mountain, if not the entire mountain, is sacred and should be recognized as one large TCP.

SECTION 9.0: RECOMMENDATIONS

As noted in the Introduction to this report, the archaeological inventory survey of the Mauna Kea Ice Age Natural Area Reserve, unlike most archaeological surveys in Hawai`i, was not triggered by a proposed action that would automatically require compliance with Chapter 6E rules and regulations. Rather, the project was developed in response to recommendations in a 2005 Legislative Audit of the Department of Land and Natural Resources to complete a cultural resources management plan for the Mauna Kea Ice Age Natural Area Reserve (Office of the Auditor Report No. 05-13:32). Like the Mauna Kea Science Reserve, which was the subject of the same audit, an archaeological inventory survey was argued to be a prerequisite to developing a management plan based on the commonsense notion that protective measures and other management actions cannot be developed without first knowing what resources exist.

With the completion of the archaeological inventory survey of the NAR there is now a baseline that can be used in developing a cultural resource management plan (CRMP). One of the things that the CRMP will have to address are inherited, existing and possible future management problems. Some of the more notable problems that the CRMP will need to address are outlined below. Two specific recommendations to manage and protect the cultural resources of the NAR are presented here. These and other management proposals will, of course, be developed more fully in the CRMP.

9.1 Inherited, Existing, and Possible Future Management Problems

A number of cultural resource management problems were inherited when the Mauna Kea Ice Age Natural Area Reserve was created in 1981. For example, in the 1970s and 80s the jeep roads that led to within a few feet of the shoreline at Lake Waiau became a cause for concern because of: (1) accumulating rubbish; (2) the scarring of the rim of Pu`u Waiau by ATV's, and (3) the vandalism and theft of the Eben Low memorial plaque. Closure of the roads leading to the lake in 1980s was both an appropriate and necessary management action. Unfortunately, the road closures have not prevented alterations of archaeological features and a change in the cultural landscape as a whole. The surveys undertaken between 2007 and 2009 identified several areas that have been adversely affected by recent activities. The impacts include the alteration of historic properties, and the creation of new features on or near historic properties. The areas that have changed most dramatically are the east side of the Lake Waiau and the east-southeast rim of Pu`u Waiau.

Other cultural resource management problems that were inherited when the NAR was established include:

(1) Scarring of a portion of the Mauna Kea Adze Quarry Complex landscape during the initial construction of the summit road in the 1960s; a bulldozer track, which was terminated at the margin of Site 16205, can still be seen.

(2) Realignment of a portion of the Humu`ula Trail in the 1930s which created a new trail that runs through the quarry toward Lake Waiau and passes within a few feet of the habitation rockshelter and large debitage mound known as Keanakako`i and where there is a bunch of spray-painted graffiti from earlier hikers

(3) The presence of a feral animal population, that though having a more deleterious effect on the local vegetation communities, has also resulted in the disturbance of rockshelter floor deposits

(4) Uncontrolled public access, including the use of ORV's, prior to the development of administrative rules

A more recent impact on the cultural landscape of the NAR occurred in the mid-1980s with installation of an underground fiber optic line that was done without the benefit of input from SHPD to determine the possible adverse effect on the adze quarry and the potential need for additional survey and/or archaeological monitoring.

Changes to the traditional cultural landscape of the NAR are on-going and reflect increased use of the summit region by both visitors and native Hawaiian practitioners. There is evidence, for example, of cremations being interred in the NAR. One of the latest in a series of what many would call acts of desecration occurred during the summer solstice in 2008. A number of stacked pancake-like stone features (Figure 9.1) were constructed at the lake as part of the ceremonies. They were discovered after the fact by one of the OMKM rangers, who promptly took them down after documenting them with digital photographs. A number of similar features were found along the lower part of the Humu`ula Trail in 2008.

9.2 Development of Protocols for Cultural Practices

Lake Waiau has also become in recent years a central place for a new generation of Hawaiian practitioners as evidenced by the increase in the number of new *lele* (altars) and less formal piles of stones without obvious offerings. While Native Hawaiians have the right to engage in cultural practices, the appearance in recent years of such things as crystals, carved wooden objects, and bleached chunks of coral on boulders in the Science Reserve, and a Native American spirit catcher at the lake, point to the need to develop a set of protocols regarding what kinds of activities are culturally acceptable to the native Hawaiian community and which are not and should be discouraged or, perhaps, banned altogether.

There are those who will undoubtedly be opposed to any kind of restrictions, but the development of protocols as a management tool is not antithetical to how sacred places in general are conceived and used. As "places apart" sacred areas by definition have restrictions:

> To say that a specific place is a sacred place is not simply to describe a piece of land, or just locate it in a certain position in the landscape. What is known as a sacred site carries with it a whole range of rules and regulations regarding people's behaviour in relation to it, and implies a set of beliefs to do with the non-empirical world, often in relation to the spirits of the ancestors, as well as more remote or powerful gods or spirits (Carmichael et al. 1994:3).

Figure 9.1. Photograph of Solstice Find Spot at Lake Waiau.

Given NAR's mandate to protect and preserve cultural resources and assuming that the Hawaiian community believes that the sanctity of Lake Waiau should be preserved then we would recommend that NAR begin consulting with the Hawaiian community to develop protective measures, especially for the features believed to be burials. A set of protocols could be developed with the assistance of the Kahu Ku Mauna Council, the Hawaiian advisory group to OMKM, since protocols for cultural practices are also needed for the UH management areas on Mauna Kea.

9.3 Test Excavations of Threatened Areas

In addition to protocols for cultural practices, we believe that some serious thought needs to be given to conducting test excavations in areas of the NAR that are under threat of being damaged. One such area is a rockshelter located above the north side of Lake Waiau that was examined in the 2007 survey, but not given a site number in the absence of surface indications of use in the recent past. The rockshelter, one of the largest known natural shelters in the summit region, may contain buried cultural deposits. Recently constructed stone walls and what appeared to be a recent deposit of introduced cinder, presumably for a sleeping surface, indicate that the floor area may not remain undisturbed much longer.

Another site that is potentially threatened is located right on a lower section of the Humu`ula Trail. Site 28673, an isolated rockshelter and workshop, could be easily disturbed, even inadvertently, by people seeking a temporary shelter during inclement weather.

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