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**LITHIC ECONOMIES AND SELF-SUFFICIENCY:  
STONE TOOL PRODUCTION AND CONSUMPTION IN A LATE PREHISTORIC  
COMMUNITY OF MOLOKA'I, HAWAII**

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A thesis submitted in partial fulfilment of the requirements for the degree of Bachelor of Arts  
with Honours in the School of Social Sciences,  
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## **STATEMENT OF ORIGINALITY**

This thesis represents the original research undertaken for the Bachelor of Arts Honours degree at the University of Queensland and was completed during 2006. I declare that the work presented is the result of my own independent research, except where otherwise acknowledged in the bibliography. This material has not been submitted either in whole or in part, for a degree at this or any other university.

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Angela Spitzer  
October 2006

## **SUPERVISOR'S CERTIFICATE OF APPROVAL**

I certify that I have read the final draft of this thesis and that it is ready for submission in accordance with the Thesis Requirements as set out in the School of Social Science Honours Policy documents.

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Dr Marshall Weisler  
October 2006

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## ABSTRACT

This study examines the inter- and intra-site assemblage variability of lithics excavated from six late prehistoric sites in leeward West Moloka'i, Hawaii. Both religious and domestic sites are represented including fishing shrines (*ko'a*) and a high-status house site. A comprehensive technological approach was employed integrating usewear, typology and individual flake attribute analysis to identify production and consumption behaviours. Expedient tool manufacture and use was identified at most sites including the use of amorphous cores for flake tool production.

Of particular significance was the identification of late stage, small-scale adze manufacture within an attached shrine enclosure of a high status house site. The proximity of the debitage to the religious feature is evidence of ritual production. Small-scale adze production in such settings may have enabled individuals and/or households to gain status and wealth through ritual performance and the production of prestige goods. This has implications for the study of the organisation of adze production and craft specialisation and suggests that ritual production is not necessarily an indicator of chiefly control.



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# CHAPTER ONE: INTRODUCTION

Stone tools in Polynesia were used in domestic and ritual contexts and are important for understanding subsistence and political economies (Earle 1997b). High quality stone, favoured to produce formal tools such as adzes, was however not always locally available at Polynesian sites. This contributed to the specialisation of communities (Kirch 1990; Mills 2002; Sahlins 1992:19-20) and the development of exchange networks (cf. Lass 1994; Weisler 1990b, 1997, 1998). The large-scale quarry site at Mauna Kea on Hawai'i<sup>1</sup> island contains more than 100 shrines (Cleghorn 1986; McCoy 1990; Williams 1989). The Hawaiian ethnohistoric literature (Malo 1903:76) indicate that craft specialists and ritual practices played an important role in adze production. However, the production of formal and expedient stone tools also occurred at a small scale in domestic contexts (Kahn 1996), indicating that the 'lithic economy' existed on multiple levels from household self-sufficiency to an almost factory-like scale (Bayman and Moniz-Nakamura 2001). A technological approach to the study of stone artefacts enables the examination of the 'life-cycle' of tools from their production to their use and discard. Considered alongside the contexts of these activities, lithics provide insights into the important aspects of Hawaiian culture and economy including the political organisation of production, craft specialisation and ritual practices.

This thesis examines the inter- and intra-site variability of lithic assemblages collected from six late prehistoric sites from Moloka'i, Hawaii. The assemblages are from religious and domestic contexts including fishing shrines (*ko'a*) and a house site (*kau hale*). These sites are located within the *ahupua'a* of Kaluako'i, the largest traditional land unit of Moloka'i in the leeward west end of the island.

The arid landscape of the leeward region was not permanently settled until the late prehistoric era (Weisler 1989). However ethnohistoric (Kamakau *et al.* 1994:128; Malo 1903:78) and archaeological (Summers 1971; Weisler 1990b; Weisler *et al.* 2006) evidence suggests the Kaluako'i *ahupua'a* played an important role in the lithic economy of Moloka'i as it contained the best sources of adze-quality basalt and volcanic glass on the island.

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<sup>1</sup> Following the convention suggested by Weisler (1997), the name Hawaii refers to the group of islands within the Hawaiian chain. This is distinguished from Hawai'i, which refers to the single island within the archipelago.

Technological analysis of the Kaluako'i tools and debitage revealed both formal and informal stone tool manufacture and use, including the identification of small-scale ritual adze manufacture at a high-status house site. This research highlights the importance of examining different contexts of tool production and use including variation at the intra-site scale. Through analysis of these contexts it is argued that the stone tool assemblages provide material evidence of subsistence practices as well as aspects of ritual activities.

## **Research Question and Aims**

This thesis examines the following research question: *How is the inter- and intra-site assemblage variability of lithics from Kaluako'i, Moloka'i, representative of prehistoric economy and embedded ideology?* To address this, a holistic approach is taken which examines the lithic assemblages on a number of different levels, from individual artefacts viewed as objects of material culture, to social practices represented by the materialisation of ideology. The specific aims of this research are:

- To develop a database of lithic attributes for the description of material culture and the interpretation of social and economic activities;
- To identify activities of informal and formal stone tool production, consumption and maintenance;
- To evaluate the organisation of tool production, in particular the presence or absence of craft specialisation and/or self-sufficiency;
- To examine the spatial distribution of lithics and the extent to which the Hawaiian ideological concepts of *mana* and *kapu*, described in the ethnohistoric literature, may explain spatial patterns of assemblages within their archaeological contexts.

## **Rationale**

This research makes a significant contribution to the regional archaeology of Moloka'i and Hawaii and to understanding the role of stone tools in Polynesian culture. The assemblages examined contain approximately 600 stone artefacts. This sample was constrained by restrictions in the field on the excavation of culturally sensitive religious sites and time limits within the honours degree. However, I demonstrate how the detailed technological analysis and consideration of the archaeological contexts of the assemblages, contributes much to the archaeology of the Kaluako'i lithic economy.

The examined assemblages were collected from six sites, distributed around the west and south coastlines of Kaluako'i. As marginal land, this large *ahupua'a* was not permanently settled until late prehistory (Summers 1971; Weisler 1989; Weisler *et al.* 2006). While these sites are yet to be dated, as permanent settlement features, they were therefore most likely inhabited within a few hundred years of each other and are considered here as contemporaneous. This provides an opportunity to examine the economy at the community scale. The benefits of this perspective have been demonstrated in Polynesia by several studies (Graves and Green 1993; Kolb 1997; Green 1980; Walter 1998). *Ahupua'a* functioned as integrated communities which redistributed resources (Sahlins 1958). Thus the study of the community as a whole, provides a perspective of economy that individual sites cannot alone provide, and one which is sensitive to regional variation associated with group identity (Kirch 1990).

Stone tool analysis has been at the forefront of ancient Hawaiian economic research and has provided insight into the political organisation of production and distribution. The focus of these studies has been adzes, a woodworking tool, and the quarry sites in which these were produced (Cleghorn 1982, 1984, 1986; Lass 1994; Leach 1993; McCoy 1990; Weisler 1990a; Williams 1989). In particular the large-scale quarry of Mauna Kea on Hawai'i island has received intensive analysis and has fuelled a debate about the possible chiefly control of adze production and distribution (Lass 1998; McCoy 1990; Withrow 1990) and the role of ritual (Leach 1993; McCoy 1990, 1999). The focus on this site has led to a notion of adze manufacture as a craft-specialisation, confined to discrete large quarry sites. Only with the analysis of adze production at non-quarry sites has this view been challenged, opening up the possibility that adze manufacture occurred in a number of different contexts and at varying scales (Bayman and Moniz-Nakamura 2001; Kahn 2005). This highlights the importance of looking beyond quarries to other sites of manufacture such as residential sites. Since this thesis examines the association of adze manufacture at a residential shrine, it makes a significant contribution to the debate about ritual production as a marker of elite control.

Informal tools have not received the same attention as adzes, with the exception of volcanic glass artefacts (Barrera and Kirch 1973; Weisler 1990b; Weisler and Haslam 2005; Williams 2004). However, simple flakes and retouched artefacts were important tools for a range of domestic activities (Allen *et al.* 1995; Kahn 1996). Little is understood about the production strategies for informal tools, and it has been assumed that they merely represent utilisation of adze waste material (Deunert 1995; Turner and Bonica 1994). This thesis tests this notion by examining strategies of informal tool production and raw material use.

## **Theoretical Framework**

Economy can be simply defined as the manner in which humans live within the social and natural environment (Polanyi 1957). Economy therefore includes both the exchange of goods and self-sufficiency. This general definition by Polanyi (1957) is the backbone of substantivist economic theory. It has been posited that economy is 'embedded' within broader socio-political institutions including religion, politics and kinship relations (Earle 1997a). While substantivist economics has been criticised for its evolutionary model of economic hierarchy (Halperin 1994:65), it provides a useful definition of economy which can be incorporated into a range of other approaches.

The contextual archaeology paradigm is employed here for the interpretation of the social implications of the production and consumption behaviours observed in Kaluako'i. This post-processual perspective examines artefacts within their cultural contexts in order to understand their relative value and meaning (Hodder 1982a). The symbolic meaning of artefacts communicates and legitimates ideology which provides power to select groups (Hodder 1982b:207). The contextual archaeology of economy incorporates Polanyi's (1957) notion of 'embeddness' and thus argues that the symbolic meaning of objects within the broader socio-political structures can be revealed through an analysis of their contexts of production and use. Technological analysis is then a key tool for situating and understanding the contexts of stone artefacts in Hawaii.

## **Thesis Organisation**

This thesis is presented in six chapters. A critical review of the relevant literature is presented in Chapter Two, and includes a discussion of the ethnographic and ethnohistoric record of Hawaiian political organisation, religion and the use and meaning of stone tools. I review the contribution of archaeology to the understanding of Hawaiian lithic economies including an evidence from sites of adze manufacture for ritual practices, craft specialisation and the organisation of production.

The environmental and archaeological contexts of the stone artefact assemblages examined in this study are described in Chapter Three. A history of archaeological research in Moloka'i and Kaluako'i is presented including the current settlement pattern model. The chapter also includes a description of the field sampling techniques for collecting the lithic assemblages and their influence on data interpretation.

Chapter Four describes the methodology employed in the technological analysis and the procedures implemented for the recording of lithic attributes. It includes a discussion of the experimentally derived models of adze reduction used for the interpretation of the debitage attribute data, and a model for the estimation of productivity. The results of this analysis are presented in Chapter Five.

The concluding chapter presents a discussion of the social implications of the results including the significance of small-scale ritual adze production in a domestic site. Directions for future research are suggested highlighting the need to examine multiple contexts of adze production and use in order to understand the political organisation of resources and labour and the materialisation of ideology.

## CHAPTER TWO: LITERATURE REVIEW

Polynesian stone tools are the subject of a significant body of literature. As one component of the literature, ethnohistoric and ethnographic accounts document the use and ‘meanings’ of artefacts and are essential references for the interpretation of the archaeological record. Since lithics provide tangible evidence of the prehistoric economy and socio-political organisation, their study has stimulated research into the organisation of adze production and distribution. In turn, this has enabled issues such as the role of ritual, craft specialisation and elite control of important stone resources to be examined. Informal stone tools and domestic sites have been generally neglected in these studies, however a review of this work suggests that stone tool production occurred in a range of different contexts, which possibly influenced their value and use in utilitarian and sacred activities.

This chapter reviews the ethnohistoric and archaeological literature relevant to the study of lithic production and consumption within the contexts of Hawaiian society. I firstly broadly examined the social structure of late prehistoric Hawaiian society. This includes a discussion of the importance of the *ahupua'a* (traditional land unit) as the basis of community economy and the *kapu* system of law that communicated and legitimated social hierarchy and ideology. This provides a background for examining the role of stone tools within Hawaiian society. The two major categories of stone artefacts, formal and informal tools, are defined and discussed separately. Ethnohistoric literature is considered, focusing on evidence of ritual adze production and use. Adze production is then examined from a technological perspective, with a review of experimentally derived models of reduction. Finally the contexts of adze manufacture and the organisation of production and distribution are discussed including evidence for craft specialisation. This literature provides the background to this thesis, outlining current understanding of the contexts of stone tool production and use as well as the symbolic significance of these artefacts and behaviours within ideologies of Hawaiian society.

### **Late Prehistoric Hawaiian Society**

Late prehistoric Hawaiian society had a complex hierarchical system of social structure (Cordy 1981; Goldman 1970; Kirch 1985; Sahlins 1958). The archipelago was split between several competing polities ruled by paramount chiefs (*alii nui*). An early adaptationist approach suggested that these chiefs gained power due to a need to redistribute resources



throughout the environmentally diverse landscape (Sahlins 1958; Service 1962). This view has since lost popularity in favour of a political model which posits that power was obtained through the use of ideology and the exchange of prestige goods (Earle 1997a; Kolb 1999; Ladefoged 1998; Sahlins 1976).

Formal rank within the society was inherited, and upheld by religious beliefs and the idea of the chief as the closest link to the gods. Instrumental in this was the ideology of the *kapu* system of law and cosmology (Levin 1968). *Kapu* polarised the ancient Hawaiian world into the sacred and profane and governed daily practices and ceremonies. Closely linked to notions of gender and status, these laws dictated the roles of men and women and forced the separation of those of unequal status or gender during activities such as eating (Seaton 1974; Valeri 1985:214-215). *Kapu* was enforced by the threat of punishment by death (Davenport 1969:3). However it was also perpetuated by its physical expression in the architectural proximities of structures from temples to households (Ladefoged 1998). This has implications for the study of the spatial distribution of artefact such as stone tools, as production and consumption activities were influenced and controlled by this system.

While ideology legitimated chiefly power, economic control was achieved through a complex system of land units called *ahupua'a*. Ideally, *ahupua'a* were radial land segments extending from a mountain to the sea which encompassed most resources and functioned as integrated communities (Handy and Pukui 1972; Hommon 1986; Weisler and Kirch 1985). A local elite (*konohiki*) who acted as a representative for the chief, oversaw the organisation of production within the community and ensured that the required taxes were paid to the chief (Mills 2002; Tuggle 1979:178). As well as paying tribute, the community was expected to be largely self-sufficient and to support the local elites, who assisted on a local level in the redistribution of subsistence goods between the coastal and inland agricultural areas (Earle 1977; Handy and Pukui 1972:6; Sahlins 1958:18).

As archaeological surveys and geochemical sourcing studies have revealed, local self-sufficiency did not necessarily include stone tools (Weisler 1988, 1990b). Indeed, it has been suggested that the well-documented *ahupua'a* boundaries and historic accounts of self-sufficiency may have blinded researchers to the possibility of regular inter-community exchange in what Mills (2002:149) dramatically refers to as 'the tyranny of the *ahupua'a*'. This does not necessarily discredit the central importance of the community. As Williams (1989:47) suggests, *ahupua'a* that did encompass rare resources may have gained economic,

political or social advantage through transactions with outside communities. There is also ethnographic evidence to suggest that *ahupua'a* may have specialised in the production of certain goods such as adzes, fish and canoes (Sahlins 1992:19-20). The *ahupua'a* is thus a key concept in the debate about the organisation of the production and distribution of resources, and the extent to which a centrally controlled economy of prestige items may have occurred. Stone tools which produce clear evidence of production in the form of debitage, and which can be sourced using petrographic and geochemical techniques, are an important class of artefacts in this debate.

### **Stone Tools in Hawaiian Society**

A classification commonly used in the analysis of stone artefacts is that of formal versus informal tools. Formal tools are those that require the greatest effort for production and usually involve retouching, grinding or finishing techniques. They may also conform to discrete morphologies (Andrefsky 1994). These tools are made with the intention of long-term use and are rejuvenated or reworked a number of times (Binford 1979). In Hawaii, adzes were the most common formal tools. Informal stone tools are those that are most often produced for immediate use and require less effort for production than formal tools (Andrefsky 1994). In Hawaii these artefacts are often found at residential sites and may be associated with domestic activities (Weisler and Clague 1998).

### **Informal Stone Tools**

Informal tools are a largely neglected class of artefacts in Hawaiian archaeology, yet contribute a significant percentage of stone tool assemblages. Unlike adzes, they have received little attention in the ethnohistoric literature except where it has been noted that they were used for heavier tasks such as 'carving a dog or pig' tasks impractical for bamboo knives (Brigham 1902:351).

Within informal tools, volcanic glass artefacts have received the most attention. This lithic raw material was used in Hawaii for making what Weisler (1989:16) describes as a "...nondescript class, consisting primarily of unmodified flakes and cores less than 20mm long". A usewear study of these artefact types has suggested their function as scraping or chopping tools (Barrera and Kirch 1973:185). Recent residue analysis of several artefacts including specimens from Moloka'i, have identified their use for cutting plant material and working shell (Weisler and Haslam 2005).

The formation of volcanic glass requires specific geological conditions determined by lava chemistry and cooling history and thus, like fine-grained basalt, this material is heterogeneously distributed in the Hawaiian Islands. Williams' (2004) technological analysis of the Pohakuloa volcanic glass quarry site on Hawai'i Island, identified a level of production that exceeded the local need. A smaller glass source has also been identified at Mauna Kea, an adze quarry complex (McCoy 1990). These sites suggest that at least in some areas, craft specialists may have produced volcanic glass artefacts. This inference is supported by geochemical evidence for the inter-*ahupua'a* and inter-island exchange of volcanic glass material in Moloka'i (Weisler 1990b, Weisler and Clague 1998).

The majority of non-glass informal stone tools in Hawaii are made from basalt. Without incorporating usewear analysis into technological studies it can be difficult to distinguish between basalt adze debitage and unmodified flake tools. Therefore it is likely that many artefacts have been misidentified (Allen et al. 1995:285). While there has been some examination of residues and usewear on a small number of basalt flakes to indicate tool function (Allen et al. 1995; Deunert 1995), strategies of basalt flake-tool production have not been fully explored. It has been assumed by several researchers that informal stone tools were simply utilised adze debitage (Buck 1957; Deunert 1995; Turner and Bonica 1994). While pig residues on a polished adze flake suggest adze debris was a source of material for informal stone tools (Allen et al. 1995:291), there is no reason to suggest that expedient tool production did not occur independently of adze production, especially at habitation sites (Bayman and Moniz-Nakamura 2001; Kahn 1996). Such practices may be indicated by the presence of multi-directional cores and the utilisation of coarse-grained material less suitable for adze manufacture. Strategies of informal stone tool production are explicitly examined in this study both separate from, and associated with adze manufacture, in order to assess this behaviour.

### **Adzes as Material Culture**

Adzes are frequently referred to in the ethnohistoric and ethnographic accounts from Hawaii and greater Polynesia (Cleghorn 1984). They were one of the first items of Pacific material culture observed by Captain Cook and his crew, who replicated their design in iron in order to barter with the Islanders (Bayman 2003:99) These rich accounts provide glimpses of the use and meaning of these artefacts, and are a valuable resource for interpreting the archaeological record, enabling an insight into cultural practices and symbolism.

There were a number of different types of Hawaiian adzes (*ko`i*), which were used for different functions. Primarily a woodworking tool, they were used for canoe building, house building, land clearing and the carving of religious sculptures (Kamakau and Barrere 1976:122; Malo 1903:76-77). Certain adzes also had a ritual function as part of elaborate ceremonies and were considered prestige items. These objects may have functioned as symbols rather than practical tools and were probably never used for woodworking. Such objects were the possessions of priests rather than craftsmen (Valeri 1985:273, see Firth 1967 for similar references for Tikopia).

Adze makers are recorded as being craft specialists (Kamakau and Barrere 1976:122) and "...a greatly esteemed class in Hawaii..." (Malo 1903:76). However, there is no indication that they were necessarily attached to, or sponsored by, a chiefly elite who controlled distribution. In fact the mechanisms of exchange described by Malo (1951:51) would suggest otherwise, as an adze "...became an object of barter with this and that one and thus came into the hands of the canoe maker".

In Hawaiian society, even utilitarian adzes were associated with the god Kane, also linked to woodworking, men, and fishing (Handy 1927:101). The religious concept of *mana* appears to have been very important to the meaning and manufacture of adzes (Leach 1993). *Mana* loosely translates to power, prestige, strength or luck. Both people and objects could embody this power and there were a number of rituals in which this could be obtained (Valeri 1985). Adzes could also have *mana*, however they were at their most potent when used by a powerful person. In the wrong hands, an adze could even be spiritually dangerous (Handy 1927:26,32).

Most activities associated with woodworking were linked to the gods. However certain tasks such as carving religious figures appear to have required certain rituals for the adzes. These could involve the services of a priest and shrines or temples (Valeri 1985:264). Malo (1903:237) describes a ceremony in which adzes used for carving religious figures of the war god Luakini, were laid overnight at a religious site, also referred to as *Mana*.

There is also some indication from the ethnohistoric literature that ritual may have also played a role during the production of adzes. It is mentioned that adze makers used a 'liquor' made from *pala* fern juice and *kukui* nuts to soften the stone (Malo 1903:77). The technological literature has cast doubt on the mechanical functionality of this practice (Cleghorn 1984:400).

If this substance did not make knapping easier, then it is likely that at least in part it had a ritual function. In a combined usewear and residue analysis of Hawaiian stone tools, a single adze which displayed no edge damage or striations indicative of use, tested positive to fern antiserum (Allen *et al.* 1995:292). While the authors did not consider it, this may be the first physical evidence for the use of this substance. Unfortunately no other residue studies of Hawaiian adzes, blanks or preforms without usewear have been conducted to test this suggestion. However if this liquor was used, as Malo (1903) suggests, analysis of the ingredients described give some indication of its meaning.

It is significant to note that ferns, like adzes were associated with the god Kane (Beckwith 1977:53). Both fern juice and *kukui* nuts were used as pigments. Pala fern juice was used to colour gourds grey in Oahu (Handy and Handy 1972:217) and black *kukui* shell ash was used in tattooing (Handy and Handy 1972:237). This indicates that it may have functioned as a darkening agent if applied to a rock. Colours played an important role in Hawaiian religion as symbols of the gods and there are several references to the importance of the colour of adzes in Pacific cultures. This is clearly documented in Papua New Guinea where certain coloured stones were favoured for their symbolic value and specifically sought for adze/axe manufacture (Strathern 1965; Vial 1940). There is also ethnographic evidence from this region of the painting of sacred adzes (Davies 1969:128,139). In the Marquesas Islands a certain black rock was the most highly valued and reserved for the manufacture of a boy's first adze (Linton 1923:321). In Hawaiian religion black was one of the colours associated with Kane (Valeri 1985:264). While it would be inappropriate to make a definitive statement of the use or purpose of the liquor, it may not be coincidental that so many aspects of it are linked to Kane, the patron god of adze makers (Handy 1927:101). Future residue and experimental studies may assist in the testing of this hypothesis.

This literature highlights the importance of ritual in ancient Hawaiian society as embedded within everyday activities, including the production and use of adzes. This is further explored later in this chapter with a discussion of archaeological evidence of ritual adze production. These ethnohistoric accounts have significance for the interpretation the Kaluako'i stone artefact assemblages as many were from religious sites.

### **Adze Technology**

Technological analyses of adzes have focused on interpreting the sequence of reduction from raw material to finished tool. Adzes are ground and polished stone tools and therefore waste flakes, blanks and preforms are more useful for the study of production than finished tools

(Cleghorn 1982:7; McCoy 1977:225). Several replication experiments have provided models of the sequence of adze production and the characteristics of the debitage produced (Cleghorn 1982; Deunert 1995; Turner and Bonica 1994). All these models define discrete stages throughout the production sequence. In practice, adze reduction existed as a continuum and adzes could be rejected at any point during the sequence (Lass 1994:36). However there is value in defining generalised stages as they facilitate interpretation and comparison of sites. Williams' (1989) interpretation of Cleghorn's (1982) experimental assemblage provides the most universally applicable sequence of adze reduction, and involves five stages. A comparison of available experimental studies reveals that there is only minor variation in the attributes of debitage recorded at each of these stages. Synthesising this data within the framework of reduction provided by Williams (1989) reveals the following model:

#### Stage 1: Raw Material Procurement

Basalt was collected from outcrops (Cleghorn 1982; 1986; McCoy 1990; Weisler 1990b) or water-worn cobbles from gulches or beaches (Bayman *et al.* 2001; Cleghorn 1984; Kamakau and Barrere 1976:122). Fine-grained, dense rock, without vesicles or phenocrysts was preferred as well as that which naturally formed in blocky pieces in outcrops (Cleghorn 1982:342).

#### Stage 2: Primary Reduction (formation of adze blank)

An adze blank is an unfinished tool with an undetermined cross-sectional form (Weisler 1990b:34). Stages 2, 3 and 5 of adze production involved the use of free-hand percussion or bipolar percussion using an anvil (Cleghorn 1982; Williams 1989). According to ethnohistoric accounts, adze makers may have had a whole tool kit of different shaped hammerstones for this task (Malo 1903:77). The waste flakes produced at this stage exhibit low numbers of dorsal scars (0-2) and many contain cortex surfaces (Kahn 2005:343; Turner and Bonica 1994; Williams 1989).

#### Stage 3: Secondary Reduction (formation of adze preform)

An adze preform is an unfinished tool with a determined cross-sectional form (Weisler 1990b:34). Waste flakes produced at this stage rarely contain cortex and exhibit variable numbers of dorsal scars (Kahn 1996; Turner and Bonica 1994; Williams 1989).

#### Stage 4: Grinding and Polishing

A sandstone grindstone was used to smooth the surface of the adze. This process generally erased most of the evidence of the previous steps of manufacture and produced a polished finish (Cleghorn 1986:7)

#### Stage 5: Maintenance/Reworking

Adzes are reworked to rejuvenate broken or blunt tools, producing a new product that is smaller than the original tool. This is an act of curation, which indicates that the adze or the material is highly valued (Binford 1979). Waste flakes produced at this stage exhibit similar characteristics to that from Stage 2 production (Williams 1989). Approximately half of these flakes may also contain polished surfaces (Turner and Bonica 1994).

Debitage size and weight are commonly used for the interpretation of reduction stage (Deunert 1995; Kahn 2005:343; Turner and Bonica 1994). However these variables have not been utilised in all reduction models due to anomalous data reported by Cleghorn (1982: 348), which found no size/weight patterning. Turner and Bonica's (1994) experiments revealed that debitage under 2g is the most common weight category throughout all stages of manufacture. The pattern of reduction therefore is not as simple as an overall decrease in the size/weight of debitage throughout the process of manufacture as is the case for biface production (Andrefsky 1998:109). However, it is modelled that if these flakes under 2g are excluded from the analysis, the remaining dominant class of debitage produced will decrease in weight throughout reduction. The production of larger adzes will also produce heavier debitage flakes, and therefore the weight of debitage is an important variable for the determination of the types of adzes produced as well as the stage of reduction present (Turner and Bonica 1994).

A useful by-product of many experimental lithic reduction studies has been the development of models for the estimation of productivity (Brantingham and Kuhn 2001; Cleghorn 1982; Eren *et al.* 2005; Hiscock and Clarkson 2005; Kuhn 1990). Scale of production is an important factor for the interpretation of craft specialisation (Brumfiel and Earle 1978; Costin 1991; Yerkes 2003), and these models have important implications for analysis of the organisation of production and inter-site comparison. Cleghorn (1982:338) proposes one such model for the estimation of the number of adzes produced from a debitage assemblage. He suggests that for every 10g of debitage, 5g of adze blanks/preforms will be produced. The

utility of this model is that it accounts for the varying amount of debitage produced in the manufacture of different sized tools. Turner and Bonica's (1994) experiments produced a similar pattern with the suggestion that the production of larger adzes will create heavier debitage.

With one exception (Lass 1994), Cleghorn's (1982) reduction model has not been incorporated into the general analysis of Polynesian adze production sites. This is perhaps due to a number of flaws, which prevent its universal application. First, it does not make any distinction between adze blanks and preforms despite the significant difference in the amount of debitage that is produced between these two forms. Second, it is only suitable for application at sites where the entire sequence of reduction occurs. It is therefore inappropriate for analysis of workshops and residential sites where secondary reduction mainly occurs (cf. Kahn 1996; Turner and Bonica 1994). While this model cannot be universally applied to adze production sites, it highlights the potential of such calculations for the inter-site comparison of production scale and craft specialisation. This thesis develops and utilises a similar model to that by Cleghorn (1982) for the estimation of adze productivity. This is developed with consideration of the stage of adze reduction present and thus is more appropriate for residential debitage assemblages. This enables the examination of the scale of production and thus the presence and form of craft specialisation.

### **Organisation of Adze Production**

The relevance of adze studies in Polynesia lies in their ability to provide insight into the organisation of economy. For this reason, significant research has focused on the organisation of adze production and the presence and nature of craft specialisation. Adze production in Polynesia occurred in a range of different contexts including quarries, habitation sites and workshops. It is important to examine these different types of sites as adzes were often transported between locales throughout their reduction sequence. There is also evidence that the context of production may have influenced the value and/or function of the adzes produced (Leach 1993). Analysis of the differences and similarities between these contexts suggests that adze production in Hawaii and Polynesia existed as a continuum from self-sufficiency to attached specialisation (Bayman and Moniz-Nakamura 2001:249). The following case studies provide evidence for this variability and highlight archaeological signatures for craft specialisation that may be relevant for the interpretation of the Kaluako'i assemblages examined in this study.



By definition, craft specialisation is the production of goods for exchange (Brumfiel and Earle 1978:5). Thus, in general, the number of adzes made should exceed the requirements of an individual or household. Specialisation is best viewed as a multidimensional interplay of the degree of elite control and the scale and intensity of production (Costin 1991). An analysis of debitage and adze rejects is the best approach for determining production scale and intensity and there are models which have been applied for the estimation of output levels, standardisation and success rates (Cleghorn 1982:339-240; Lass 1994:45).

The degree of attachment or sponsorship of craft specialists is somewhat more difficult to gauge from the archaeological record (Earle 1991). Economy is embedded in the social and political systems of a culture (Earle 1997a; Polanyi 1957; Trigger 1974), and the organisation of production represents its intention. At one extreme, production may be simply for satisfying commoner demand for subsistence items. At the other, access to goods is restricted to an elite minority for the accumulation of wealth and power (Earle 1997b). In practice, however, this distinction exists as a continuum, as elite sponsorship may take place in the short-term for the production of special goods for individual projects or events (Lass 1998). In the archaeological record, elite control of production may be indicated by evidence for resource control and a high degree of labour organisation (Costin 1991). Thus the context of production is of equal importance as the products themselves for determining the scale and nature of craft specialisation.

Mauna Kea on Hawai'i Island is the largest adze quarry complex in Polynesia, and is perhaps the best example of craft specialist production of adzes in Hawaii. This site has received intense interest (Cleghorn 1982; McCoy 1977, 1990, 1999; Williams 1989) that has been the catalyst for a debate about the possible centralised control of adze production and distribution (Cleghorn 1986; Lass 1994; Leach 1993; McCoy 1990; Withrow 1990). While fine-grained basalt is often viewed as an exception to other resources (Earle 1987), Mauna Kea is in many regards a battle-ground for adaptationist (Sahlins 1958; Service 1962) and political philosophies (Earle 1997a).

The quarry is situated on the Mauna Kea volcano where a fine-grained prismatic basalt was exploited. The site extends over an area of twenty square kilometres and includes outcrops, workshops, rockshelters and over 100 shrines, many with evidence of long-term use (Cleghorn 1986; McCoy 1990). Access to the quarry could be easily regulated by its

remoteness from permanent settlement. Several walls and shrines may also be symbolic markers of resource control (McCoy 1990).

Substantial piles of debitage and adze rejects litter the site, evidence for the large scale of production and a high level of labour organisation. The spatial distribution of this material was interpreted as representing several 'chipping stations' each with two craftsmen working as a team (Cleghorn 1982:342). Different stages of the production sequence appear to have taken place in various areas of the site evidenced by variation in the amount of primary and secondary debitage (Cleghorn 1986; Williams 1989). While this behaviour has been suggested as an adaptation to the harsh alpine environment (McCoy 1990), activity pattern differentiation is also an indicator of specialisation within a site and can accompany increased production levels (Dixon *et al.* 1994:15).

The high level of labour organisation is also indicated by the possible presence of apprentice training. By examining the quality of the raw material and calculating the degree of success of each work station, Cleghorn's (1982; 1986) technological analysis of the waste flakes suggest that there was a differential level of skill at the site and that the lesser-quality material may have been used for training purposes. This particular evidence however, should be considered with caution as raw material quality greatly influences debitage attributes (Kahn 1996:22; Jones 1979). Thus skill levels should not be interpreted for areas of variable rock quality. However, there is other evidence for apprentice craftsmen at Mauna Kea. On the fringes of the quarry, a religious feature was interpreted as an initiation site. McCoy (1999) used a phenomenological approach to examine the site within the landscape and interpreted its isolation from the quarry as symbolic of the transitional nature of the initiates. This study argues that the ritualisation of adze production is not only an indication of craft specialisation, but also of elite sponsorship.

Ritual adze production is also a feature of the main quarry area. Numerous shrines demonstrate the religious significance of the site. Several of these have debitage and adze reject offerings (McCoy 1990:98; 1999:28). It has also been suggested that the waste flakes in a rockshelter may represent a ritual fill (Williams 1989). Large religious features were generally constructed by request of the chiefs (Handy 1927; Valeri 1985). McCoy (1990) therefore suggests that adze production at the Mauna Kea quarry may have been under centralised control by elites. However this hypothesis is not without criticism. Lass (1998) emphasises household shrines as evidence for the participation of non-elites in religion and

ritual and thus rejects McCoy's (1990) interpretation of the centralised control of Mauna Kea. However this has not been fully explored as household adze production has been generally neglected from study in Hawaii. Thus this thesis contributes to this debate through the analysis of lithics from religious and residential contexts.

Standardisation in procedure and adze form is also posited as evidence of the high degree of specialisation at the site (Cleghorn 1982:342). However, it has since been shown that other sites of adze manufacture in Hawaii have similar levels of standardisation (Bayman and Moniz-Nakamura 2001; Weisler 1990a). This has led to the criticism of the centralised control hypothesis as a model of production at Mauna Kea and the suggestion that all adze makers were independent specialists or even non-specialists (Lass 1994:48). However, such suggestions do not take into consideration other indicators of organisation such as apprentice training, and the evidence of resource control that is evident at Mauna Kea. There is also nothing to suggest that craft specialisation requires standardisation. Greater skill may be demonstrated by flexibility in style and methods to adapt to variations in materials and circumstances (McCoy 1990:100). Variation may in fact be more highly valued within the political economy as it may distinguish the symbolic products of the elites from those of utilitarian value (Costin 1991:34). There is evidence that adzes produced at Mauna Kea were larger in size than those from other Hawaiian quarries. Larger adzes are more frequently represented in burial caches (Weisler 1988) and thus along with the evidence for ritual production at the site, it is argued that some of the adzes from Mauna Kea may have had a ritual function (Leach 1993:39).

Several other adze production sites have been examined in Hawai'i, which have highlighted the uniqueness of Mauna Kea and the diversity of the lithic economy. The quarry sites of Pololu on Hawai'i Island (Lass 1994) and Kapohakau on Lana'i (Weisler 1990b) featured adze production on a much smaller scale. Unlike Mauna Kea, these sites represented a flake blank industry for adze manufacture. This however does not necessarily represent variation in skill or style as the preforms were not morphologically different from those at Mauna Kea. The variation in technique is instead attributed to the different form of raw material, as cobbles rather than prismatic outcrops were exploited at these quarries (Lass 1994:38). There is however, a significant difference in the size of adzes produced at these sites. The adzes from Kapohakau are believed to be the smallest in Hawaii and it is suggested these may have had utilitarian value for household activities rather than for rituals and canoe and house building which would have required larger tools (Weisler 1990b:46).

Apart from one possible religious feature at Kapokakau (Weisler 1990b), there is no evidence of ritual production at either of these quarries. Although not explicitly examined, there also does not appear to be any activity differentiation within the sites, or restricted access to the raw material. This suggests that while Kapohakau and Pololu were probably exploited by craft specialists, these were independent (Lass 1994:68) and catered to the domestic, commoner market (Weisler 1990b:46).

A manufacturing site at Pohakuloa on Hawai'i Island (several kilometres from the Mauna Kea site) demonstrates utilisation of material from Mauna Kea in a different context (Bayman and Moniz-Nakamura 2001). While the adzes produced at this site appeared no less standardised than at Mauna Kea, production was on a much smaller scale and was accompanied by other unrelated activities including bird catching and butchering and informal tool production. An analysis of the lithic assemblages at the site indicated that the entire sequence of adze reduction, finishing and use took place at this location. This is in contrast to other workshop sites in Hawaii where only part of the sequence of production occurred (Dixon *et al.* 1994). Its small scale, less formally organised production, and the association of the site with other activities lead to its interpretation as a non-specialist site of adze manufacture.

A quarry site and associated workshops within the Kamaka'ipo Gulch of West Moloka'i provides another context for adze production and craft specialisation (Dixon *et al.* 1994). This study dated the sites to examine change in the organisation of production over time. During the initial exploitation of the quarry, only temporary habitation sites/workshops were used. However around the 15<sup>th</sup> century AD, a permanent house-site was constructed as well as an associated agricultural terrace. This was interpreted as an intensification of adze production which may have corresponded with the up-scaling of agricultural activities on the windward side of the island (Kirch and Kelly 1975). Land clearing associated with agriculture may have created a greater demand for adzes on Moloka'i. Arguably the permanent settlement of the site may have also allowed greater control of access to the quarry. Thus, this is possible evidence for the centralised control of adze production at Kamaka'ipo (Dixon *et al.* 1994:15). If the increased organisation of adze production at the quarry was in response to demand in the windward areas, this represents an adze economy that extended beyond *ahupua'a* boundaries. This does not mean that adze production was controlled by a chief. Rather, as ethnohistoric evidence suggests (Sahlins 1992:19-20), Kamaka'ipo may represent the strategic specialisation of the community which gained economic or social advantage from

inter-*ahupua'a* exchange (Williams 1989:19-20). The organisation of production may thus have occurred at the community level, perhaps by the land manager. This site has particular relevance for this study as Kamaka'ipo Gulch is within the Kaluako'i *ahupua'a*, the region of focus for this thesis.

The Kamaka'ipo Gulch sites are also important as they demonstrate clear activity differentiation and the movement of adze material throughout the production sequence. As no evidence of grinding stones or polished debris is found at adze quarries in Hawaii, it has been hypothesised that adzes were transported from quarries as preforms or blanks and that further working and finishing was conducted within residential sites (Cleghorn 1982:40; Kahn 1996:35). This pattern is confirmed by the inter-site comparison of the debitage at the Kamaka'ipo Gulch. A higher percentage of primary production material was present at the quarry, while debris characteristic of late stage manufacture was concentrated in the workshops/habitation sites. This pattern suggests the organised transportation of adze blanks from the quarry to the workshops where finished preforms were produced (Dixon *et al.* 1994). A similar pattern of production has been noted in New Zealand (Turner and Bonica 1994) and a habitation site in the Marquesas had evidence of late stage production including the grinding and polishing of adzes (Kahn 1996).

These studies raise questions about the nature of the household production of adzes. As late stage debitage predominates at these types of sites, the question arises as to whether residential sites were simply one loci of manufacture within an organised production chain, independent specialists or perhaps self-sufficient units. Only a few examples of household adze production have been observed in Polynesia. However these suggest that a small-scale industry of independent adze production occurred at these sites.

At residential complexes in the Halawa Valley in Moloka'i, the expedient manufacture of adzes from local, coarse-grained material was observed (Kirch and Kelly 1975). These artefacts were probably not exchanged as they would not have been of the same quality as those produced from the adze quarries in the west of the island (cf. Dixon *et al.* 1994; Cleghorn *et al.* 1985) and therefore most likely represent a level of production which enabled the self-sufficiency of the residents. A study of households in the 'Opunohu Valley of the Society Islands examined debitage from house sites of differential status (Kahn 2005). This revealed that adze production was confined to high status house sites where the entire sequence of adze manufacture was present. It was argued that this adze production would

have been highly visible within the community and thus was a symbolic statement of wealth and status (Kahn 2003:359). Ideology therefore may have been an equal driving factor for the production of adzes in domestic contexts along with subsistence need or economic gain.

Within the Polynesian system of hierarchy determined by genealogy, small-scale craft specialisation may have enabled individuals within the commoner class to gain status within the community through a demonstration of specialist knowledge (Spielmann 1998).

The variability in the production behaviours observed at these different sites suggest that adze manufacture in ancient Hawaii occurred in a number of different contexts. While these differences were sometimes reflected in the production of a different type of adze, as appears to be the case for Kapohaku (Weisler 1990b), this was not always the situation. The general standardisation of the techniques of adze manufacture, and the ethnohistoric literature seems to indicate that most adze makers were craft-specialists. Therefore the symbolic 'meaning' of the adze, whether it had power, or *mana*, may have been partially derived from its context of manufacture as well as the power of the craftsman himself (Handy 1927:32).

A dual economy of adze production has been advanced by several researchers who have compared large adze quarries with smaller-scale production sites (Bayman and Moniz-Nakamura 2001, Weisler 1988, 1990a). The primary function of Mauna Kea may have been to produce large ritual adzes, whereas sites such as Kapohaku may have produced tools for more utilitarian use. However, this interpretation may be overly simplistic and the adze economy may be better explained as a spectrum of different production strategies that fulfilled various social and material needs (Leach 1993). The adze manufacture site examined in this thesis provides an opportunity to test this model by the examination of household production.

### **Exchange**

Exchange is an important aspect of economy and is embedded within the concept of craft specialisation (Costin 1991). Petrographic and geochemical techniques enable the sourcing of lithics to their geological origin (Cleghorn *et al.* 1985; Ward 1977; Weisler 1998; Weisler and Clague 1998). These methods have been extensively applied in the Pacific to map inter-island interaction (Best *et al.* 1992; Rollet 2002; Weisler 1997, 1998) and inter-*ahupua'a* exchange (Lass 1994; Weisler 1990b). Lithic sourcing analysis is beyond the scope of the research conducted for this thesis, however these techniques have been utilised in the literature to examine adze distribution. This is relevant for the interpretation of the centralised control of adze production.

Lass (1994) used petrographic analysis to source basalt adzes on Hawai'i. She tested the hypothesis of Sahlins (1958) and Service (1962), who suggest that adzes, along with other resources, were centrally redistributed. Examining the distribution of the adzes in reference with their source site, Lass found no pattern of distribution, which she argued disproved the centralised redistribution hypothesis.

While groundbreaking for its time in its use of sourcing analysis to interpret more than merely the presence or absence of interaction, there were a number of problems with this study. Firstly, the pattern of adze distribution did not conform to the 'fall-off' frequency versus distance model. As no change in this distribution was detected over time, any organization in the distribution of adzes was discounted. Lass may be correct in the rejection of the presence of centralised redistribution of adzes. However, she considered adze production as a single homogenous economy, without considering either the context of the sites in which the adzes were found, or the contexts of the adze's production. It is important to consider the sites in which the adzes were found, as particular types of adzes may have been concentrated in certain types of sites such as temples or residences. Therefore even if there had been some pattern in the distribution of adzes, due to centralised redistribution or otherwise, the research strategy employed by Lass would not have been sufficient to detect it.

## **Summary**

Stone tools played an important role in prehistoric Polynesian society as both subsistence and wealth items. With the exception of volcanic glass artefacts, informal stone tools have been generally neglected from the archaeological literature. Adze studies, particularly those focused on production sites, have dominated lithic studies in Hawaii. The quarry site of Mauna Kea in Hawai'i has been intensively researched for a number of years, and has significantly influenced the understanding of the organisation of adze production and distribution. Large scale of production at this site as well as its association with religious features suggests that a high level of organisation occurred that perhaps involved centralised control by elites. Comparison of production strategies at Mauna Kea with several other sites of adze production including quarries, workshops and house sites revealed that adze production occurred in a range of different contexts with varying degrees of craft specialisation. The context and organisation of production may have contributed to the determination of the type of adze produced and its symbolic meaning. This suggestion is

supported by ethnohistoric accounts of the rituals associated with adze manufacture, which contributed to the *mana* of the tool.

These case studies highlight the benefits of a contextual analysis of adze manufacture. This review has revealed the possibility that adze manufacture alone existed as ‘multiple lithic economies’ in Hawaiian prehistory. The case study of Kaluako’i presented in this thesis contributes to this notion as well as providing much needed insight into informal lithic economies and household adze manufacture.



## CHAPTER THREE: THE RESEARCH AREA AND MATERIAL COLLECTION

This chapter places the lithic assemblages examined in this thesis within their environmental and archaeological contexts. Previous archaeological research on Moloka'i and in the *ahupua'a* of Kaluako'i is discussed and descriptions of the sites involved in this study are presented. The methods of collection and the influence of these sampling strategies for the interpretation of the lithic economy are also described.

### Background

The Hawaiian chain is a group of volcanic islands located in Eastern Polynesia (see Figure 1). The fifth largest island, Moloka'i is a volcanic doublet primarily composed of tholeiitic basalt with localised secondary deposits of alkali basalt (Sterns and MacDonald 1947).

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**Figure 1.** Map of Oceania. The Hawaiian islands are located in Eastern Polynesia, at the northern apex of the 'Polynesian triangle' (Kirch 2000:6).

Moloka'i has not received the same amount of archaeological attention as other Hawaiian islands such as Maui and Hawai'i. However, Summers (1971) compiled an inventory of

prehistoric sites on Moloka'i. Most of these sites have not been studied in much detail, and many more sites since this survey have since been discovered, suggesting that the island is a rich area for archaeological research. The projects which have been conducted on the island have focused on agriculture (Dixon *et al.* 1994; McCoy 2005), fishing strategies and fishponds (Summers 1964; Weisler and Walter 2002), exchange (Weisler 1990b), early excavations in west end rockshelters (Bonk 1954), and settlement patterns (Kirch and Kelly 1975; Weisler and Kirch 1985).

Kaluako'i is the largest *ahupua'a* of the island at approximately 20 000 hectares. It is situated in the leeward, western third of the island, encompassing the extinct volcano Mauna Loa (see Figure 2). Translated from native Hawaiian, Kaluako'i means 'the adze pit' which is perhaps testament to its fine-grained basalt quarries which were prehistorically exploited for the production of adzes (Summers 1971:39). Ethnohistoric literature also mentions Kaluako'i as an important centre for adze production (Kamakau *et al.* 1994:128; Malo 1903:78).

As a leeward *ahupua'a*, Kaluako'i has an arid environment. Early archaeological surveys suggested it prehistorically supported no permanent settlements (Bonk 1954:139; Stokes 1909). However it is now understood that Moloka'i followed a similar history of settlement pattern to other Hawaiian islands with the temporary settlement of leeward regions in the early expansion period (AD 1100-1400), followed by occupation on a permanent basis in the late prehistoric era (Weisler 1989). Recent Thorium-230 dating of coral from settlements at Mo'omomi, places the permanent occupation of Kaluako'i in the 15<sup>th</sup> century AD (Weisler *et al.* 2006).

The general settlement pattern of the west end during the late prehistoric era was characterised by the concentration of household clusters around the coastline and the utilisation of inland areas for dry-land cultivation of sweet potato and adze quarrying activities (Dixon *et al.* 1994:4; Handy and Handy 1972:514; Weisler 1989). Fishing was an important subsistence activity, and fishing shrines (*ko'a*) are one of the most common types of sites in the region (Summers 1971:40). Ellis (1917) describes *ko'a* as being positioned on almost every point of land which projected into the sea. As well as having religious functions in the late prehistoric era when the west end became permanently settled, they may have also served as markers of fishing territories (Weisler *et al.* 2006:274).

While fishing and dry-land agriculture provided for the subsistence needs of the prehistoric Hawaiians living in arid Kalukao'i, archaeological evidence suggests this community may have played an important role as a provider of stone artefacts and raw material for the rest of the island. Kaluako'i, has seven currently recorded prehistoric adze quarries and several volcanic glass sources, the only sites of this type on the island. These have been characterised using petrography and geochemical techniques (Cleghorn *et al.* 1985; Weisler 1990b). This has enabled several artefacts from other communities of Moloka'i to be sourced to these quarries, indicating the presence of inter-community interaction and exchange (Weisler 1988, 1990b). Preliminary evidence from several adze workshop sites in south-western Kalukako'i suggests that there may have been an increase in adze production around the fifteenth century AD. This has been interpreted as a response to the intensification of agriculture in windward Moloka'i, a pursuit that presumably required adzes for land clearing (Dixon *et al.* 1994).

## **The Sites**

The lithic assemblages examined in this thesis were excavated from four coastal sites within Kaluako'i during the 2005 University of Queensland field season directed by Dr Marshall Weisler. Several surface collections were also made from sites nearby the excavations (see Figure 2). The following is a description of the archaeological contexts of the lithic assemblages and the methods employed for their collection.

### **MO-B6-66 (Site 66)**

Located behind the bay at Kaupoa, site 66 is a rectangular high-walled enclosure approximately 10m<sup>2</sup> which has been interpreted as a *hale mua* or men's house (Weisler and Walter 2002:48). Inside the enclosure is an altar and upright godstone near which coral and fish offerings were placed. Four 0.5m<sup>2</sup> units were excavated inside the enclosure producing a number of fish remains, several bone fishhook fragments, shell, pig bone and lithics. Stone artefacts were also collected from the surface around the site.

### **MO-B6-35 (Site 35) – Kawaku Iki**

Kawaku Iki is a *ko'a* located on a narrow cliff point between two bays. It consists of a low platform and upright godstone. It is directly *makai* (seaward) of two small residential sites (60-60-01-1614 (Site 1614) and 50-60-01-1613 (Site 1613)) Four 0.5m<sup>2</sup> units were excavated within the structure and while numerous fish and shark bones were collected, significantly no

stone artefacts were found. Several lithics were collected from outside the structure, however many of these were from locations closer to the residential sites than site 35 itself.

#### **MO-B6-38 (Site 38) – Kawaku Nui**

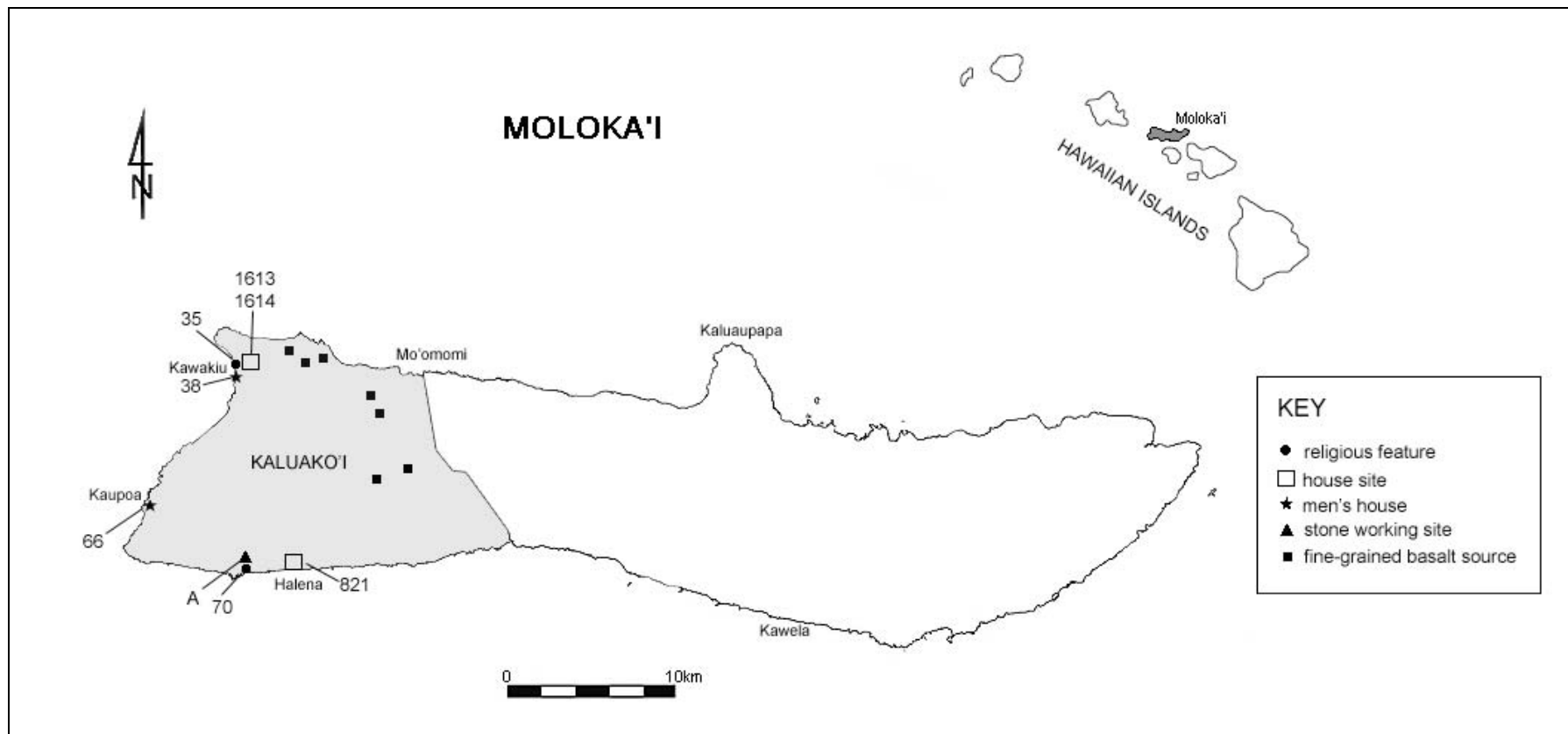
Located south of Site 35, Kawaku Nui is a rectangular, high-walled enclosure approximately 10m x 11m in size. Interpreted as a *hale mua* (men's house) similar to Site 66 at Kaupoa, this feature was the focus of an excavation in 1978 which revealed human remains, adze preforms, grindstones, retouched flakes and a large assemblage of fishhooks and fish bone (Weisler and Walter 2002). This site was not excavated in the 2005 field season, however several lithics were collected from the surface outside the enclosure.

#### **50-60-01-70 (Site 70)**

Located near Hale o Lono hill, this feature is a raised platform approximately 4.5m x 6m in size, incorporating two large basalt boulders. There are a number of coral offerings at the site and this has led to its interpretation as a *ko'a* (Summers 1971:60). A total of 1.5m<sup>2</sup> units were excavated in 2005 beside the platform, producing a number of lithics, shell, coral abraders and faunal remains including pig, fish and bird.

#### **Site A**

This site is located upslope of Site 70, on top of Hale o Lono hill. This site was first discovered during the 2005 field season, so is yet to receive a Hawaiian state site number. A site of stone working, and perhaps other craft activities, there are no built structures visible, however a lithic surface scatter including volcanic glass and basalt artefacts was observed. Several coral abrader fragments were also present. A small sample of these artefacts were collected from the surface.

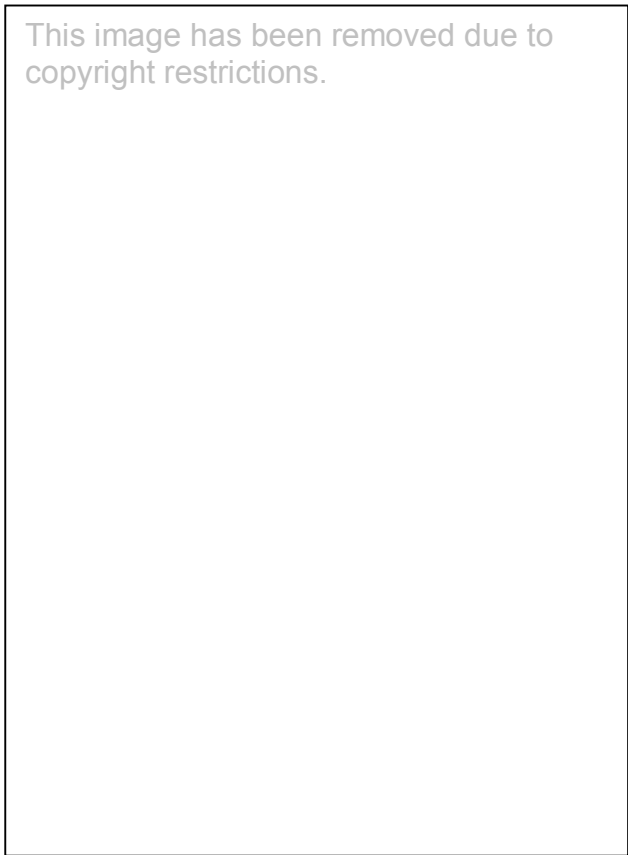


**Figure 2.** Map of Moloka'i showing location of Kaluako'i *ahupua'a*, known adze quarries (from Weisler 1988) and sites discussed.

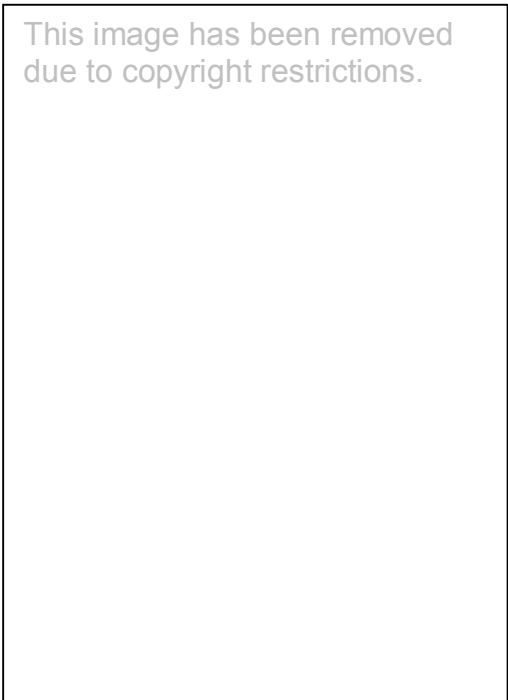
### **50-60-01-821 (Site 821)**

This is a large, high-walled residential site with a separate, associated oven feature outside to the southwest (See Figure 3). Preliminary analysis of this site, in particular its comparison with other residential sites in Moloka'i (Weisler and Kirch 1985), suggest this is a late prehistoric high-status house site. This is indicated by the permanence of the structure and the complex segregation of activity areas, in particular the presence of a fully enclosed shrine. Inspection of the wall structure suggests that this shrine was contemporaneous with the rest of the house, and was not a later addition. The shrine of 821 is unusual because it is located to the west of the house, rather than the eastern side as at Kawela (Weisler and Kirch 1985) and Mo'omomi (Weisler *et al.* 2006).

Within the major house area, four 1m<sup>2</sup> units were excavated on a grid. In unit S1W6, a hearth feature indicated by a rock alignment and abundant charcoal contained several lithics, fish bone and shell. Lithics and faunal remains were also excavated from units N1W2, N4W2 and N4W6. In addition, two 1m<sup>2</sup> units were excavated within the shrine. These were placed at the northern end where numerous coral offerings and several large basalt cores were found on the surface. Excavation of the shrine revealed the presence of a stone platform on which coral and faunal remains appear to have been placed (see Figure 4). Directly in front of this altar, within the cultural deposit, numerous fine-grained basalt lithics were found. This area, and in particular the shrine excavation, contributed the bulk of the stone artefacts examined in this study. Material was also collected from two lithic surface scatters near the house. Collection Area A was located 23.5m south-west of the house site near the oven feature and Collection Area B was 70m south-west of the site. Only a small sample of the surface artefacts was removed from these locations.



**Figure 3.** Map of House Site 821, mapped in 1987, with locations of excavation units(Courtesy of Marshall Weisler)



**Figure 4.** Photograph of excavation of shrine with altar shown.

## **Sampling Strategies**

The majority of lithic material examined in this study was collected during site excavation. All excavated material was wet-sieved using 6mm and 3mm screens, which enabled the collection of small pieces of debitage that may otherwise have been lost. These assemblages are therefore effectively 100% of the stone artefact population within the excavation units. Surface collection as a sampling method is far less controlled than excavation and the resulting assemblages may not be representative of the artefact population at a site (Hester *et al.* 1997:35). In order to preserve the sites for future study, not all artefacts on the ground surface were collected. While conscious effort was made to sample artefacts with a range of artefact and material types, there was no formal randomisation procedure implemented. For this reason, the lithic assemblages sampled by surface collection are examined separately from the excavated material.



## **CHAPTER FOUR: METHODOLOGY AND METHODS**

Lithics are a diverse class of artefacts that contains formal and expedient tools, and their waste products resulting from manufacture. The study of lithic technology involves the classification of these objects and the definition of their attributes in order to address a range of questions (Odell 2004:viii). Precise classification facilitates understanding the production and use of lithics.

The technological analysis of the Kaluako'i lithic assemblages focuses on describing the material culture represented and identifying production and consumption of formal and informal stone tools. This study aims to distinguish between adze and expedient tool production and to identify the stage and scale of reduction. Strategies of raw material procurement are also examined through an analysis of the physical quality of the material. This research also examines the inter- and intra-site variability of the lithic characteristics and inferred behaviours.

A typological approach to the classification of the lithics was used for both formal and morphological classes. Individual flake attribute analysis (IFA) and mass analysis (MA) were then employed to collect data for a range of lithic attributes. These attributes were chosen with reference to the predicted characteristics of assemblages associated with adze and informal tool production, consumption and maintenance. This chapter reviews these methods and describes the procedures implemented for this project.

### **Identifying the Production and Consumption of Adzes and Informal Tools**

Experimental archaeology provides the necessary link, through middle-range theory, to transform descriptive information about assemblage characteristics into interpretations of the behaviours they represent (Binford 1981; Schiffer 1976; Trigger 1995). Models of lithic reduction provide a means for interpreting the archaeological record and highlights the characteristics of the assemblages, which best distinguish the production and consumption of formal and informal stone tools.

In Polynesia adze production is primarily identified by the presence of large quantities of debitage, particularly flakes under 5cm in size (Kahn 1996:44-45). Several experimental studies have been conducted which provide models of adze reduction and maintenance

(Cleghorn 1982; Deunert 1995; Turner and Bonica 1994). Review of these models suggests a number of debitage attributes are most useful for identifying the stage of adze reduction. These are presence or absence of cortex, dorsal scarring, and debitage weight. The adze reduction model used for interpreting the Kaluako'i assemblages for this study is an integration of the characteristics defined by Cleghorn (1982) and Turner and Bonica (1994) and is similar to the interpretation by Kahn (2005:343) and Williams (1989). It is summarised in Tables 1 and 2.

Informal tool production is primarily identified and distinguished from adze manufacture by the presence of amorphous cores (Kahn 2005:347). Flake tools may also be a secondary product of adze manufacture (Deunert 1995; Turner and Bonica 1994). Flake tool consumption is identified by usewear analysis.

**Table 1.** Model of adze reduction

<b>Stage of Reduction/Activity</b>	<b>End Product</b>	<b>Associated Lithics</b>	<b>Debitage Characteristics</b>
Primary Reduction	Adze Blank	Hammerstones Debitage Anvils (if using bipolar percussion)	Low numbers of dorsal scars (0-2), high numbers of flakes with dorsal cortex (Kahn 2005:343; Williams 1989). Size 1-4 debitage characteristic (Turner and Bonica 1994:7)
Secondary Reduction	Adze Preform	Hammerstones Debitage	Variable numbers of dorsal scars, flakes with cortex rare (Kahn 1996; Williams 1989; Turner and Bonica 1994). Size 5-6 debitage characteristic (Turner and Bonica 1994:7)
Grinding and Polishing	Finished, Polished Adze	Grindstones Polishing stones	No debitage produced
Maintenance/Reworking	Variable	Hammerstones Debitage	Similar characteristics to primary reduction debitage (Williams 1989). Up to half of debitage produced may contain polished surfaces (Turner and Bonica 1994).

**Table 2.** Turner and Bonica's (1994:7) weight categories of debitage

<b>Class</b>	<b>Weight Range</b>	<b>Reduction Stage/Activity</b>	<b>End Product</b>
1	>300g	Primary Reduction	Adze blanks > 2500g
2	201-300g	Primary Reduction	Adze blanks > 2500g
3	101-200g	Primary Reduction	Adze blanks > 2000g
4	51-100g	Primary Reduction	Adze blanks < 2000g
5	21-50g	Secondary Reduction	Adze preforms
6	3-20g	Secondary Reduction	Adze preforms
7	<3g	Most common size at all stages of reduction, particularly during fine trimming.	Various

### **Artefact Classification**

A typological approach was employed to classify the lithic material into artefact classes. While morphological characteristics were used to define these classes, many contain implications of artefact function and future intent (such as the suggestion that an adze blank would be further worked into a finished adze). These implications of the typological approach have received recent criticism (Hiscock in press). The materialist alternative separates production from consumption and removes connotations of artefact function from classes (Hiscock in press). Many of the issues raised by materialists are no longer relevant with the application of usewear analysis (Holdaway and Stern 2004:154), as is utilised for this study. There is significant ethnographic evidence (cf. Malo 1903, Buck 1957:255-256) to support adzes as a morphological and functional class recognised by the Hawaiians themselves. Therefore it is argued that a typological approach incorporating usewear analysis is appropriate for this study and is compatible with decades of Polynesian lithic research (Cleghorn 1984). The following classes were used for classifying of the Kaluako'i lithics:

### **Cores**

Cores are defined morphologically as stone artefacts lacking a ventral surface with one or more negative scars produced from the removal of flakes (Holdaway and Stern 2004:37). This category of artefacts includes tools and the nodules that were the source of flake tools. While artefacts could potentially have both functions, core tools are separated from non-tool cores through usewear analysis. In Hawaii there is evidence of adze manufacture from core technology, particularly where raw material outcrops in a prismatic form (Cleghorn 1982).

Therefore the morphology of all Kaluako'i cores was recorded in order to identify the material that may have represented the preliminary stages of manufacture. Adze manufacture from cores usually results in prismatic forms containing right angles through control of directions of flake removal. In contrast, amorphous cores are usually the product of expedient flake tool manufacture (Kahn 2005:347). Core form was categorised according to the idealised classes described by Odell (2004:63). The raw material form and cortex type and were also recorded for cores as an indicator of material procurement strategies.

### **Hammerstones**

Hammerstones are rocks which display impact damage from use as a percussor for the manufacture of stone tools (Andrefsky 1998:xxii). The presence of hammerstones indicates lithic production behaviours.

### **Adze Material**

This class of artefacts includes all adzes, adze blanks, preforms and polished adze flakes. Adze blanks do not have their cross-sectional shape determined. Cross-sectional shape is apparent in adze preforms (Weisler 1990a). Adze flakes exhibit polish on their dorsal surface and are during the reworking or sharpening of finished, polished adzes. Adze material within the Kaluako'i assemblages was defined using these categories. Their presence is an important indicator of site activities. All adze material was weighed and the raw material recorded. Illustrations of representative these artefacts were made.

### **Debitage, Used Flakes and Retouched Flakes**

Classification and analysis of these artefacts types are crucial to the identification of consumption and production activities. Identification of these artefacts was achieved through analysis of usewear and retouch. Debitage is the waste products of lithic tool production. While finished tools are usually removed from their contexts of production,debitage often remains in situ, leaving a signature of production activities and the manufacture process (Andrefsky 2001). In contrast, used flakes and retouched flakes are tools. Used flakes are defined as unmodified flakes that exhibit usewear. Retouched flakes are tools that have been intentionally modified.

There are a number of different forms of retouch including flake removal, grinding and polishing. Flake removal retouch is used to both modify the edge of a tool to perform a particular function and/or to change the overall shape of the artefact. Retouch and usewear is formed from distinct processes. However, in practice their separation is difficult, which has lead some researchers to make no distinction between used and retouched artefacts, merely

describing the modification (cf. Holdaway 2004). This approach is unsuitable for studies that aim to identify production, consumption and maintenance activities. Therefore for the purposes of this study, flake removal retouch is defined as scars greater or equal to 3mm in length. Scars smaller than this measurement are considered unintentional and therefore not retouch. This is adopted in response to experimental studies which suggest that usewear scars are almost always under 2mm while retouch exceeds 3mm (Richards 1988:134).

### **Attribute Analysis**

Individual Flake Attribute Analysis (IFA) and Mass Analysis (MA) methods were used for this study. IFA involves the measurement and recording of attributes of individual lithic specimens. It is suitable for a range of flake characteristics (Andrefsky 1998:110). This method was used for the analysis of dorsal scarring, flake weight, cortex, raw material and retouch.

Cortex presence or absence, dorsal scarring and flake weight were chosen as attributes, as they were identified as useful characteristics for the interpretation of adze reduction stages in experimental replication models (see Table 1). Adze reduction is primarily interpreted from debitage characteristics. There is some contention in the literature as to the origin of expedient tools in contexts of adze manufacture. Turner and Bonica (1994) have suggested that informal tools were produced from the waste products of adze debris. In contrast, Jones (1984) suggests that informal tools were produced intentionally in separate activities and even used different raw material than for adze manufacture. Whilst the results of these studies are clearly site-specific, they highlight the value of comparing tool and debitage attributes. Where flake tools may have been initially produced as adze debitage, examining tool attributes can reveal patterns of preference for certain flake attributes (Deunert 1995; Turner and Bonica 1994). Where attributes of informal tools and debitage differ greatly, separation of debitage produced from adze manufacture and other informal tool production may be possible (Jones 1984; Kahn 1996:44-49). Therefore for this study, the same attributes were recorded for retouched flakes, used flakes and debitage.

Raw material type and texture were also recorded using IFA for all lithic material. This qualitative data was used to examine the strategies of material procurement and the differential use of raw material. Raw material texture (including the presence of phenocrysts, vesicles and grain size) is important for assessing the relative quality of lithic material. Cortex

texture (whether water-rounded or characteristic of dyke material) is some indication of the types of locations from which material may have been obtained.

Although all artefacts were examined on an individual basis and their weights recorded, the use of Tuner and Bonica's (1994) weight classes to interpret the stage of adze reduction represented in debitage assemblages required the additional use of Weight Increment Analysis (WIA). This method of analysis is a form of Mass Analysis (MA), however it differs significantly from the nested screen approach commonly associated with this technique (cf. Ahler 1986) and avoids much of its criticism (Andrefsky in press). MA by definition is the application of typology, grouping artefacts with common characteristics within defined boundaries of variation (Odell 2004:130-132). Artefact weight is directly related to a flake's size dimensions and is a reliable and time-efficient attribute of measurement useful for the determination of tool reduction (Andrefsky 1998:96; Shott 1994:75; Turner and Bonica 1994). WIA was used to group debitage into the weight classes defined by Tuner and Bonica (1994) (see Table 2). These classes represent defined phases of adze reduction. There has been criticism of the MA approach for its lack of accounting for variation in blank size (Andrefsky in press, page 4), however Turner and Bonica's experimentally derived model clearly defines size grades associated with specific adze blank weights.

The following describes the procedures implemented for the collection of attribute data. Appendix 1 and 2 supplement these descriptions with a diagram of flake anatomy and the coding protocol adopted for the recording of lithic attributes.

### **Flake Completeness**

An adaptation of Sullivan and Rosen's (1985) free-standing debitage typology was used for recording flake completeness. This typology described in Clarkson and O'Connor (2006:194) includes not only proximal, medial and distal fragments, but also left and right fragments of these sections orientated from the ventral surface (see Figure 5). Fragments which lack an identifiable ventral surface are classified as debris (Sullivan and Rozen 1985). This variable is used for the calculation of the minimum number (MN) of artefacts (Shott 2000).

This image has been removed due to copyright restrictions.

**Figure 5.** Classification of flake fragments  
(Clarkson and O'Connor 2006:194)

### **Raw Material**

There are two major rock-types represented in Hawaiian stone tool assemblages. Basalt, a fine-grained mafic volcanic rock is characterised by relatively low silica and abundant plagioclase and pyroxene minerals. It also commonly contains olivine (Blatt and Tracy 2000:506). Volcanic glass is a non-crystalline aphanitic rock-type. While it is defined texturally, Hawaiian glass is usually basaltic in composition (Weisler and Clague 1998:104). The rock-type of all stone artefacts was recorded, as well as textural characteristics including relative grain-size, phenocrysts, vesicles and flow banding. A hand-lens was used to identify phenocrysts.

### **Cortex**

Cortex is the weathered outer layer of outcrops and artefacts. Experimental results by Dribble and colleagues (2005), suggest dorsal cortex percentages may not reveal any more additional information than the gross measurement of presence versus absence for the interpretation of

tool reduction. In response to this study, and also with the goal of time *management*, cortex was measured as presence or absence for both the dorsal surface and striking platform. Where present, the texture of cortex was also recorded. Water-rounded cortex was identified by its relative smoothness and/or rounding of the surface. Dyke cortex in contrast has a spongy texture.

### **Degree of Dorsal Scarring**

The degree of dorsal scarring is a reliable indicator of reduction stage (Shott 1994). The number of dorsal scars was counted as: 0, 1, 2, 3, 4 and 4+. Scars resulting from retouch, usewear or platform failure scars originating from the striking platform were excluded from this count (after Kahn 1996, 2005).

### **Weight**

All lithics were weighed in grams using an electronic scale (with 0.1g accuracy). Debitage which was too small to register on these scales was recorded as weighing 0.1g (after Kahn 2005). Artefacts were then assigned to weight classes (see Table 2) based on these values.

### **Retouch**

Retouch was also recorded using IFA. The location of retouch as well as whether it was bifacial or unifacial was noted.

### **Usewear Analysis**

Fundamental to the typological approach developed for the Kaluako'i assemblages was the separation of flake tools fromdebitage. This was accomplished through usewear analysis. Usewear is the damage produced on tool edges and surfaces by their use (Fullagar 2006:208). Usewear analysis of stone tools relies on the results of experimental studies (eg. Odell and Odell-Vereecken 1980; Richards 1988; Tringham *et al.* 1974) which have identified a number of types of wear including edge rounding, edge fracturing, striation and polish (see Robertson 2005:48 for definitions).

The expression of usewear on lithic artefacts is significantly influenced by the raw material of the tool (Lerner *et al.* in press). Several replication experiments have examined basalt stone artefacts (Deunert 1995; Kahn 1996; Odell 1980; Price-Beggerly 1976; Richards 1988). Early experiments failed to detect usewear on basalt tools (Price-Beggerly 1976), however more recent analysis has suggested that edge fracture usewear, recognizable with low-powered microscopy, will form on almost all basalt artefacts used for common domestic tasks (Deunert



1995; Odell 1980). Unfortunately, the coarseness of the raw material may prevent determination of tool function or contact material (Richards 1988:147; Turner *et al.* 2001:64). Thus while usewear analysis may be unsuitable for functional studies of basalt stone artefacts, it provides a reliable attribute for the separation of debitage from utilised flakes.

Trampling and bagwear can cause edge damage which mimics the wear produced during the intentional use of stone artefacts (Shea and Klenck 1993). For this reason, all artefacts were packaged separately in the field. All artefacts including flakes and cores were examined for usewear. During the initial categorisation of the lithics, a hand lens was used to examine all surfaces and edges. Artefacts that displayed preliminary evidence of any of the usewear types were then examined under a low-powered Orion stereo-microscope (magnification range 0.65x – 4.5x) for verification. Usewear was recorded as present or absent.

### **Sampling Strategy**

All lithic artefacts collected during the 2005 field season were examined for this thesis. However due to the methods of sampling conducted in the field, not all assemblages are comparable. Several assemblages were collected from the surface, separate from excavated units. Many of the artefacts from the surface collections are unique and are therefore important for the description of material culture and activities of site use. However these surface collections did not represent the entire population of lithics within the area of collection, and sampling in the field was not well controlled. Biases introduced with this sampling strategy are in addition to those naturally caused by post-depositional processes (Hester *et al.* 1997:35). In particular smaller debitage may be underrepresented or absent. Thus lithic density and debitage attribute are only examined for excavated assemblages.

## CHAPTER FIVE: RESULTS

Using the typology outlined in Chapter Four and debitage attribute analysis, a database of artefacts and their attributes was constructed. A variety of artefact types are represented including debitage, cores and formal and informal tools. This chapter examines and compares assemblages at the inter- and intra-site level. Lithics collected from sites 66, 35, 38 and 70 are studied on the scale of the whole site. Units excavated within Site 821 were located within spatially separate areas of the house indicated by the rock alignments and high wall dividing the shrine from the main enclosure (see Figure 3). The lithics from these units, as well as those collected from the surface outside the house, were assessed as separate assemblages in order to consider variability on the intra-site scale. This chapter presents the analysis of the composition of assemblages and their attributes for the description of the material culture, stone tool production and consumption activities and the interpretation of adze reduction and productivity.

### Composition of Assemblages

There is a marked variability in the composition of assemblages and the quantity of artefacts excavated from the sites/units. To account for variation in the sampled area, the density of lithics is examined as an indicator of lithic production and consumption activities (see Table 3). The artefact types represented in the assemblages are provided in Tables 4 and 5.

**Table 3.** Quantity and density of excavated lithic material

Site	Context	Total # Artefacts	Total Weight (g)	Mean Weight (g)	Density (#/m <sup>2</sup> )	Density (g/m <sup>2</sup> )
66	-	27	3680.2	136.3	27	3680.2
70	-	41	655.8	16.0	27.3	437.2
821	N1W2	18	149.0	8.3	18	149.0
821	N4W2	54	1127.3	20.9	54	127.3
821	N4W6	6	119.8	20.0	6	119.8
821	S1W6	11	45.8	4.2	11	45.8
821	Shrine 1	178	5804.2	32.6	178	15804.2
821	Shrine 2	134	9648.8	72.0	134	9648.8
821	Shrine Total	312	15452.8	49.5	156	7726.4
821	Site Total	401	16894.7	42.2	66.8	2815.8

**Table 4.** Composition of assemblages from Sites 66, 35, 38, 70, A and 821

<b>Artefact type</b>	<b>Site 66 Excavated</b>		<b>Site 66 Surface</b>		<b>Site 35 Surface</b>		<b>Site 38 Surface</b>		<b>Site 70 Excavated</b>		<b>Site A Surface</b>		<b>Site 821 Total</b>	
	<i>N</i>	<i>MN</i>	<i>N</i>	<i>MN</i>	<i>N</i>	<i>MN</i>	<i>N</i>	<i>MN</i>	<i>N</i>	<i>MN</i>	<i>N</i>	<i>MN</i>	<i>N</i>	<i>MN</i>
Debitage	17	16	10	10	23	21	7	6	32	25	7	6	360	267
Cores	1	1	-	-	2	2	3	3	-	-	1	1	13	13
Hammerstones	1	1	-	-	-	-	-	-	-	-	-	-	2	2
Hammerstone Flakes	3	3	-	-	-	-	-	-	-	-	-	-	-	-
Core Tools	-	-	-	-	1	1	-	-	-	-	-	-	1	1
Utilised Flakes	5	5	7	6	2	2	-	-	5	5	5	4	29	26
Unused Retouched Flakes	-	-	-	-	-	-	2	2	-	-	2	2	3	3
Utilised Retouched Flakes	-	-	1	1	5	5	7	7	4	4	2	2	10	10
Adze Blank Fragments	-	-	1	1	-	-	-	-	-	-	-	-	-	-
Adze Preforms	-	-	-	-	-	-	-	-	-	-	-	-	1	1
Adze Flakes	-	-	-	-	-	-	-	-	-	-	1	1	1	1
Other Adze Fragments	-	-	-	-	-	-	-	-	-	-	-	-	1	1
<b>TOTAL</b>	<b>27</b>	<b>26</b>	<b>19</b>	<b>18</b>	<b>33</b>	<b>31</b>	<b>19</b>	<b>18</b>	<b>41</b>	<b>34</b>	<b>18</b>	<b>16</b>	<b>421</b>	<b>325</b>



**Table 5.** Composition of assemblages from Site 821 and associated areas

<b>Artefact type</b>	<b>N1W2</b>		<b>N4W2</b>		<b>N4W6</b>		<b>S1W6</b>		<b>SHRINE</b>		<b>Surface Collection Area A</b>		<b>Surface Collection Area B</b>		<b>40m West of Site 821</b>	
	<i>N</i>	<i>MN</i>	<i>N</i>	<i>MN</i>	<i>N</i>	<i>MN</i>	<i>N</i>	<i>MN</i>	<i>N</i>	<i>MN</i>	<i>N</i>	<i>MN</i>	<i>N</i>	<i>MN</i>	<i>N</i>	<i>MN</i>
Debitage	12	10	46	35	4	3	7	7	281	204	8	6	2	2	-	-
Cores	1	1	-	-	-	-	-	-	9	9	2	2	1	1	-	-
Hammerstones	-	-	1	1	-	-	-	-	1	1	-	-	-	-	-	-
Hammerstone	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Flakes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Core Tools	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-
Utilised Flakes	5	4	5	4	1	1	4	3	11	11	1	1	2	2	-	-
Unused Retouched Flakes	-	-	-	-	1	1	-	-	2	2	-	-	-	-	-	-
Utilised Retouched Flakes	-	-	2	2	-	-	-	-	5	5	2	2	1	1	-	-
Adze Blank Fragments	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Adze Preforms	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1
Adze Flakes	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-
Other Adze Fragments	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-
<b>TOTAL</b>	18	15	54	42	6	5	11	10	311	234	14	12	6	6	1	1



Site 821 has the highest density of lithics. These are concentrated in the units excavated from the two Shrine contexts (note that the term ‘Shrine’ is capitalised when referring to the overall site, but not when discussing the actual archaeological feature). While an area above the altar was included in the Shrine 2 context, all the lithics were recovered from directly in front of the altar. For the purposes of interpretation, the material excavated from these two units is considered a single assemblage that is dominated by debitage, the bi-product of adze production activities. Debitage was found at all other sites and units, however at much lower densities.

### **Hammerstones and Hammerstone Flakes**

A spheroid, water-rounded vesicular basalt hammerstone with bipolar impact scars was found at Site 66. This and the presence of three hammerstone flakes suggests that there were stone tool production activities occurring in situ at the site. Similar water-rounded hammerstones were also found in Unit N4W2 and the Shrine of Site 821, although these had impact scars on only one end.

### **Cores**

A total of twenty cores were identified across the assemblages. All of these are amorphous in morphology indicating that they were associated with informal tool production rather than adze manufacture. These were found at Site 66, 35, 38, A at N1W2, the Shrine and the Surface Collection Areas A and B of Site 821.

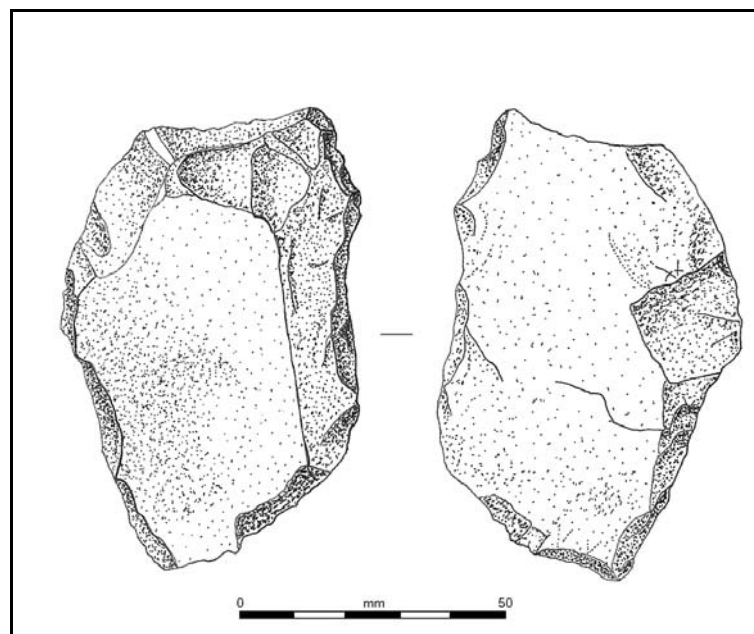
### **Utilised Flakes, Retouched Flakes and Core Tools**

Core tools are a rare artefact type within the assemblages. Only two were found at Site 38 and the Shrine of 821. These were amorphous in form suggesting that they represented the expedient use of a core which had previously been the source of flake tools. Used flakes were found at all sites except site 38 and represent the most common tool type within the assemblages (57% of tools are unmodified flake tools). Retouched flakes were also identified at all sites and contributed 35% of the tools within the assemblages. The majority of these had unifacial modification although a small number were bifacial (See Table 6 and Figure 6). Seven lithics within the retouched flake class are awls. Awls are artefacts that have invasive retouch along the flake margins that form one or more points (see Figure 7), and are interpreted as piercing or drilling tools (Clark 1979). These artefacts were found at Sites 38, 70, A and the Shrine at 821. Usewear analysis of the artefacts indicated that several retouched

artefacts lacked usewear; this suggests they were unused and therefore possibly produced at the locales at which they were found. The two awls from Site A, as well as two retouched artefacts from Site 38, one from N4W6 and three from the Shrine of Site 821 lacked usewear.

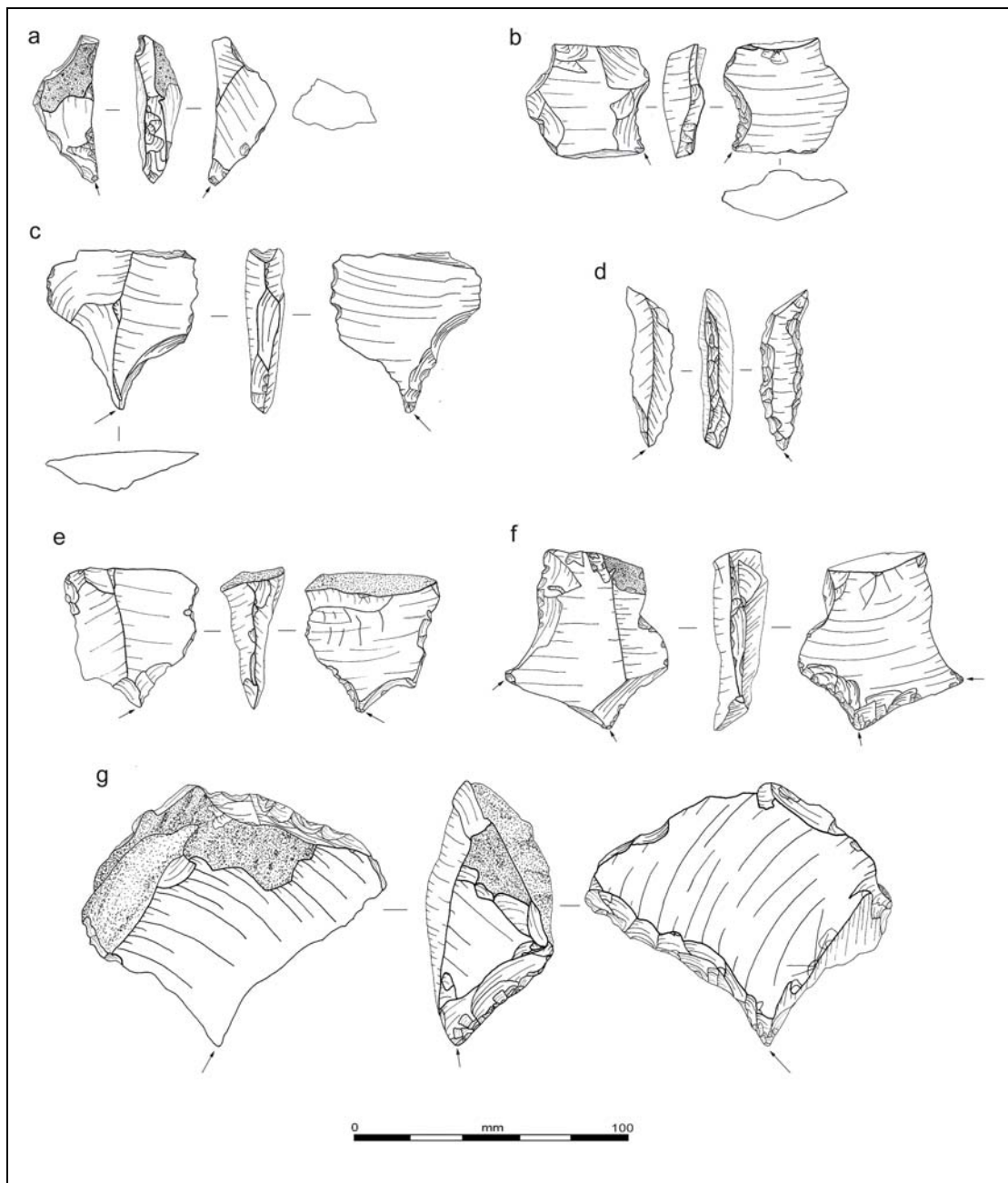
**Table 6.** Type of Retouch on Artefacts

Context	Total #	Bifacial		Unifacial	
		N	N%	N	N%
Site 66	1	-	-	1	100.0
Site 35	5	1	20.0	4	80.0
Site 38	9	-	-	9	100.0
Site 70	4	1	25.0	3	75.0
Site A	4	-	-	4	100
N4W2	2	1	50.0	1	50.0
N4W6	1	-	-	1	100.0
Shrine	7	-	-	7	100.0
Surface Collection Areas A&B	3	2	66.7	1	33.3
<b>TOTAL</b>	<b>36</b>	<b>17</b>	<b>47.3</b>	<b>19</b>	<b>52.7</b>



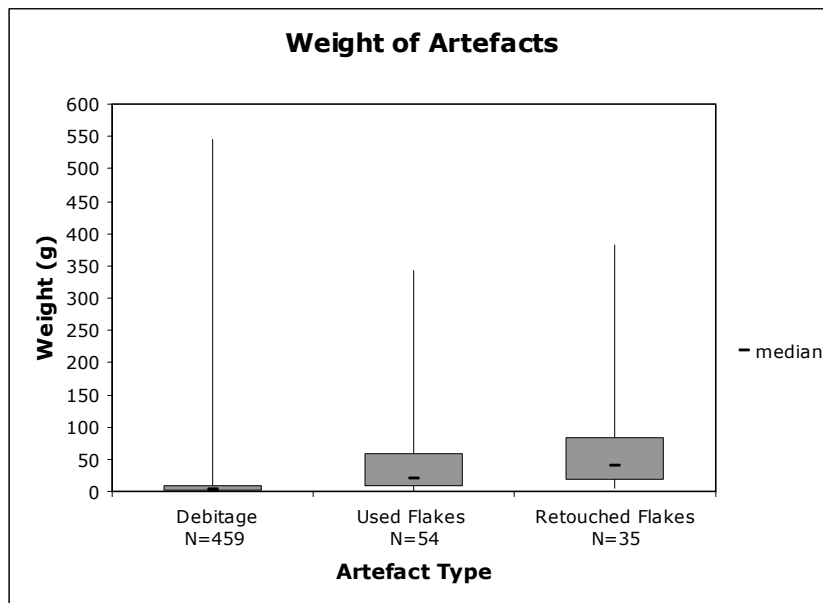
**Figure 6.** Artefact C.443, bifacial tool, Surface Area Collection A, Site 821





**Figure 7.** Illustrations of all awls in assemblages. a) Artefact C.109 from Site 70. b) Artefact C.62 from Site 38. c) Artefact C.130 from Site A. d) Artefact C.126 from Site A. e) Artefact C.370 from Shrine, Site 821. f) Artefact C.386 from Shrine, Site 821. g) Artefact C.322 from Shrine, Site 821. Arrows indicate awl point.

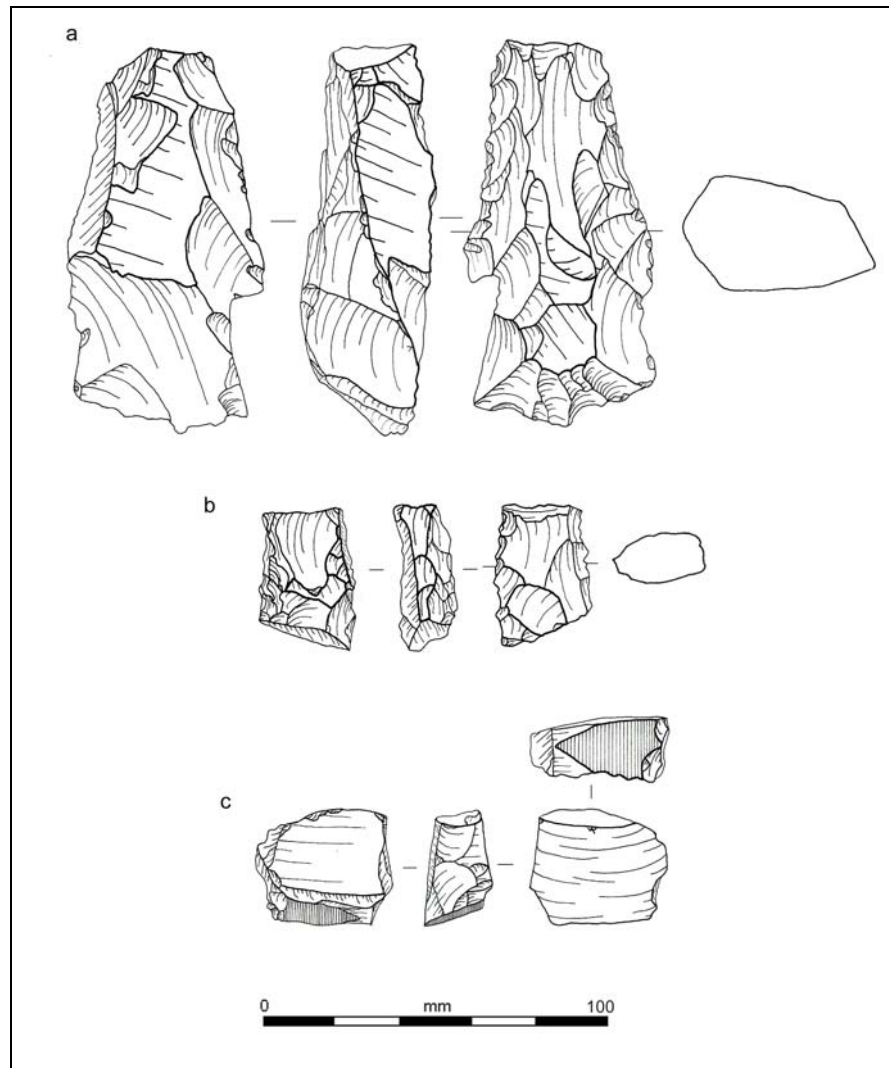
A comparison of the weight distribution of debitage, retouched flakes and used flakes suggests that flake tools are statistically heavier than debitage. Figure 8 demonstrates that the majority of debitage is lighter than the flake tools and retouched flakes. However the weight range of debitage is far greater, suggesting that the largest pieces of debitage could have been selected for use as flake tools.



**Figure 8.** Weight distribution of debitage, used flakes and retouched flakes

### **Adze Material**

Adze flakes, preforms and blanks are all represented in the lithic assemblages. An adze preform was found 40m west of Site 821 (see Figure 9a). This artefact is a trapezoidal, untanged adze, a relatively common form in Hawaii (Cleghorn 1992). While a bevel has been formed, more working of this artefact would have been necessary before it could have been ground and polished. It appears to have been discarded due to difficulties in removing a large lump on the front face. An adze preform/blank fragment was also excavated from the Shrine of Site 821. This fragment, along with the high density of debitage in this area of the site, is evidence for adze manufacture. A small adze blank fragment was also collected from the surface near Site 66 (see Figure 9b). A single polished adze flake was found at both the Surface Collection Area A of Site 821 and Site A. These suggest that adze maintenance activities were conducted at these sites or areas.



**Figure 9.** Illustration of adze material. a) Artefact C.455 adze preform reject, collected 40m west of Site 821. b) Artefact C.145 adze blank fragment, surface collection, Site 66. c) Artefact C.131 polished adze flake from Site A.

### **Ratio of Production to Consumption Elements**

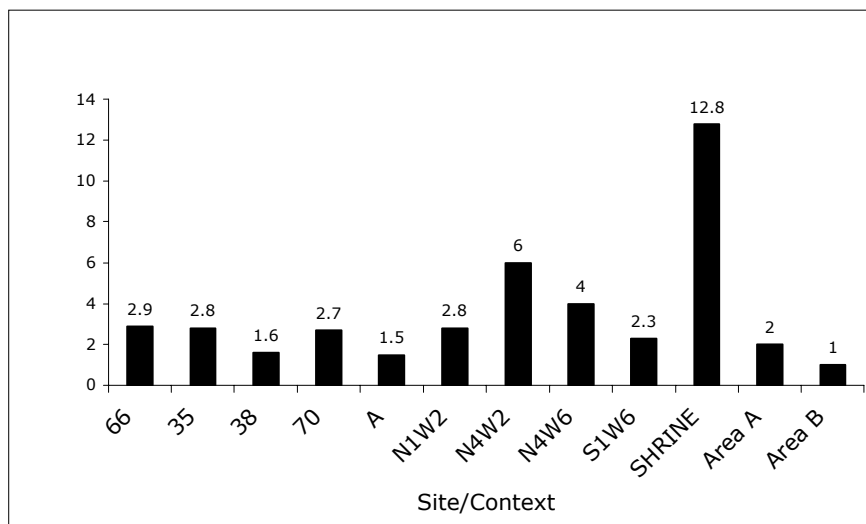
The ratio of production to consumption elements is a useful indicator of site activities which accounts for the variability in the sampled area of sites (Costin 1991:21-23). This quantitative analysis enables the examination of whole assemblages and provides a numerical measure for inter-site/unit comparison.

Artefacts were assigned as either production or consumption elements (see Table 7). For this analysis production is defined as the primary manufacture of tools. In this context, polished adze flakes associated with adze maintenance are considered consumption elements. This distinction is not easily made for debitage that may be produced during both adze manufacture and maintenance. However, a greater quantity of debitage is produced during production than maintenance activities. Only two polished adze flakes were found, suggesting

adze maintenance was not a major activity at most sites, and thus should not greatly influence the quantitative analysis. The results of this analysis are presented in Figure 10.

**Table 7.** Production and consumption elements analysed

Production Elements	Consumption Elements
Debitage	Used Flakes
Hammerstones	Used Retouched Flakes
Hammerstone Flakes	Polished Adze Flakes
Cores	
Adze Preforms/Blanks	



**Figure 10.** Ratio of minimum number (MN) of production elements to consumption elements for each assemblage.

Sites and units with high values in Figure 10 are those with a greater numbers of production elements. The Shrine of Site 821 has a significantly higher value than other units/sites. This supports the interpretation that this is a locale of adze manufacture. A moderate value was also recorded for Unit N4W2 suggesting that this area was also involved in tool production of some form. All other sites/units had relatively lower values, indicating that they were more likely associated with lithic consumption activities.

## Raw Material

Characteristics of the lithic raw material were recorded in order to examine procurement strategies and patterns of use. The majority of material examined was basalt, although volcanic glass was also present in small quantities at Site A (see Table 8). In general, finer-grained material is better quality for flake tool production than coarse-grained and vesicular basalt. The raw material represented in the assemblages is both an indicator of material availability (obtained from the local sources or through exchange) and use.

**Table 8.** Summary of lithic raw material by number and weight percentage

Site / Context	CG Basalt		FG Basalt		VFG Basalt		Vesicular Basalt		Volcanic Glass	
	<i>N</i>	<i>Wt %</i>	<i>N</i>	<i>Wt %</i>	<i>N</i>	<i>Wt %</i>	<i>N</i>	<i>Wt %</i>	<i>N</i>	<i>Wt %</i>
66	11	16.5	9	25.6	13	4.8	13	53.1	-	-
35	12	35.4	12	51.8	8	10.7	1	2.1	-	-
38	11	72.0	4	12.2	3	15.8	-	-	-	-
70	3	18.8	10	48.0	28	33.2	-	-	-	-
A	-	-	-	-	11	97.5	-	-	7	2.5
821 – N1W2	-	-	7	17.9	11	82.1	-	-	-	-
821 – N4W2	-	-	11	77.4	40	12.3	3	10.3	-	-
821 – N4W6	-	-	5	28.1	1	71.9	-	-	-	-
821 – S1W6	-	-	5	57.2	6	42.8	-	-	-	-
821 – Shrine	-	-	98	40.2	197	33.2	17	26.6	-	-
821 – Area A	-	-	4	2.5	10	97.5	-	-	-	-
821 – Area B	-	-	1	1.0	5	99.0	-	-	-	-
821 - Total	-	-	131	29.6	207	53.6	20	16.8	-	-
<b>TOTAL</b>	<b>48</b>	<b>6.9</b>	<b>175</b>	<b>29.8</b>	<b>346</b>	<b>42.8</b>	<b>67</b>	<b>20.4</b>	<b>7</b>	<b>&lt; 0.1</b>

Table 8 shows the number of artefacts of each raw-material type within the assemblages as well as their weight percentage. Site 66 has the highest weight percentage of vesicular basalt (53.1%) of any assemblage. However, this is due to the presence of a single heavy hammerstone of this material. In general sites 66, 35 and 38 have a lower weight percentage of very-fine grained (VFG) material than Site 70, A and 821 and more coarse-grained (CG) stone. This trend, when considered with the geographical location of the sites (see Figure 2), suggests this variation may be due to local availability. It is interpreted that a fine-grained

(FG) to VFG basalt was readily available in the south of Kaluako'i, which was exploited at Sites 70, A and 821 for the production of formal and expedient tools.

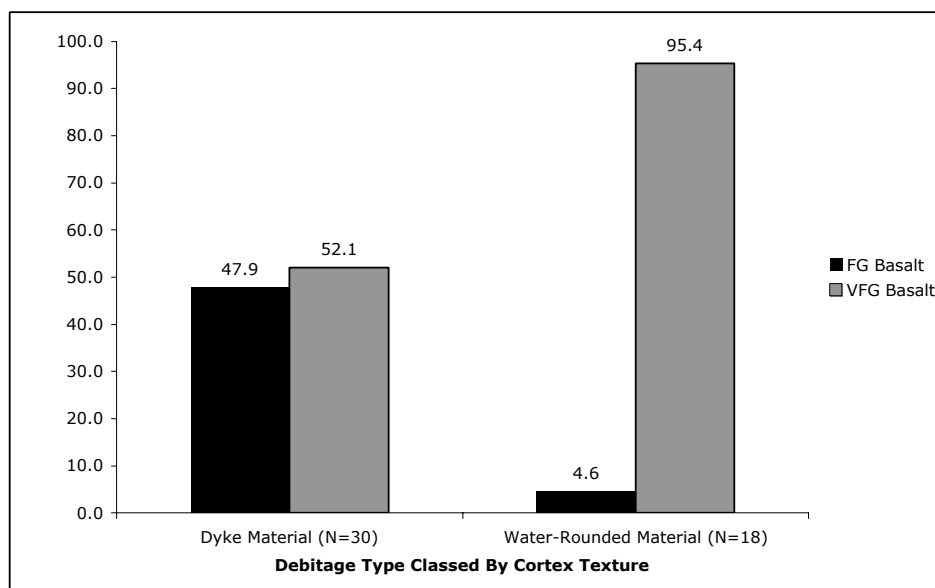
**Table 9.** Summary of cortex type present on debitage, cores and tools

Site/Context	Water Rounded		Dyke		Ambiguous	
	<i>N</i>	<i>Wt%</i>	<i>N</i>	<i>Wt%</i>	<i>N</i>	<i>Wt%</i>
66	15	89.2	-	-	4	10.8
35	14	76.0	3	15.4	1	8.6
38	5	100.0	-	-	-	-
70	2	49.2	5	50.8	-	-
A	-	-	-	-	-	-
821 – N1W2	2	94.4	1	1.3	1	4.3
821 – N4W2	7	85.8	3	14.1	1	0.1
821 – N4W6	1	7.9	1	92.1	-	-
821 – S1W6	-	-	3	100.0	-	-
821 – Shrine	18	21.4	30	72.8	5	5.8
821 – Area A	1	2.6	3	96.8	1	0.6
821 – Area B	-	-	2	100.0	-	-
821 – Total	29	20.6	55	74.9	8	4.5

Examination of the cortex type present in assemblages (summarised in Table 9) gives further indication of the strategies of raw material procurement and use. In general, most cortex has a water-rounded surface. This suggests that raw material for stone tools may have been collected from the beach and/or from gulches where water-rounded cobbles are present; outcrops do not appear to be a significance source of raw material. Beach and/or gulch areas provided the dominant material type for Sites 66, 35 and 38. Cortex characteristic of dyke material is present in relatively high quantities at site 70 and 821, however water-rounded material is also present. On the intra-site scale, the Shrine assemblage is clearly dominated by dyke material, whilst water-rounded material is in higher quantities in the assemblages from the main house area. This may indicate that different raw material was used for different activities.

Analysis of the quality of these cortical flakes, suggest that water-rounded material is more frequently finer grained than the dyke material (see Figure 11). Dyke rock, which is naturally prismatic in form, is ideal for adze manufacture (Cleghorn 1986). Thus the dominance of this material at the Shrine may suggest a raw material selection strategy that prioritised raw

material form over quality. This is a similar behaviour to that observed at the adze quarry at Mauna Kea (Cleghorn 1982: 342).



**Figure 11.** Percentage of raw material texture and form of cortical debitage flakes from Shrine, Site 821.

### **Debitage Attribute Analysis**

The high density and quantity of debitage at the Site 821 shrine suggests the presence of adze production activities. Attribute analysis of this material was conducted in order to assess the stage/s of reduction present. This analysis is particularly important for the interpretation of the site, as no adze rejects (except for one preform 40m west of the site) were found. Debitage from the other sites and units was also examined, however these assemblages are generally too small for an effective analysis of reduction.

### **Cortex Presence and Location**

Some 15.7% of the debitage within the Shrine assemblage exhibited dorsal cortex. This is a relatively low frequency compared to that modelled for sites with the full range of reduction, where values between 26.2 and 90% are predicted (Kahn 2005:400). This suggests reduction was at the secondary stage and that adze material was brought to the site already partially reduced. Sites interpreted as locations for late stage preform finishing (final trimming) typically report cortical material frequencies of less than 10% (Kahn 1996:232; 2005:400). The percentage of cortical flakes at the Shrine is slightly higher than this, which suggests working of adze material began at an early stage during secondary reduction, perhaps from adze blanks.

**Table 10.** Cortex presence and location on debitage

Site / Context	Absent		SP Only		Dorsal Only		SP and Dorsal		Missing Data	
	<i>N</i>	<i>N %</i>	<i>N</i>	<i>N %</i>	<i>N</i>	<i>N %</i>	<i>N</i>	<i>N %</i>	<i>N</i>	<i>N %</i>
66	9	52.9	1	5.9	4	23.5	2	11.8	1	5.9
70	27	84.4	3	9.4	1	3.1	1	3.1	-	-
821 – N1W2	10	83.3	1	8.35	1	8.35	-	-	-	-
821 – N4W2	36	78.2	-	-	9	19.6	-	-	1	2.2
821 – N4W6	3	75.0	-	-	-	-	-	-	1	25.0
821 – S1W6	3	42.9	-	-	1	14.2	-	-	3	42.9
821 – Shrine	227	81.1	-	-	34	12.1	10	3.6	9	3.2

**Number of Dorsal Scars**

The number of dorsal scars is important for understanding the reduction stage represented by an assemblage of debitage. The Shrine assemblage includes debitage with both high and low dorsal scar numbers. It is dominated by debitage with two or less dorsal scars (68.6%). This frequency is lower than that modelled for assemblages produced during the entire reduction sequence (72-82%)(Kahn 2005:409). This supports the interpretation of the cortex frequency data for this assemblage as representative of secondary stage adze reduction. With the exception of Site 66, the Shrine assemblage has a greater percentage of debitage with high numbers of dorsal scars. However, all these assemblages have sufficient frequency of debitage with three or more dorsal scars to be within the modelled range for late stage preform trimming (Kahn 2005:409).

**Table 11.** Number of dorsal scars on debitage

Site / Context	0		1		2		3		4		4+	
	<i>N</i>	<i>N %</i>	<i>N</i>	<i>N %</i>	<i>N</i>	<i>N %</i>	<i>N</i>	<i>N %</i>	<i>N</i>	<i>N %</i>	<i>N</i>	<i>N %</i>
66	0	0	1	5.9	2	11.8	9	52.9	1	5.9	4	23.5
70	0	0	20	62.5	5	15.6	4	12.5	3	9.4	0	0
821 – N1W2	0	0	4	33.3	6	50.0	1	8.35	1	8.35	0	0
821 – N4W2	3	6.5	17	37.0	14	30.4	4	4.3	2	4.3	1	2.2
821 – N4W6	0	0	0	0	3	75.0	1	25.0	0	0	0	0
821 – S1W6	0	0	1	14.3	5	71.4	0	0	1	14.3	0	0
821 – Shrine	8	3.0	90	32.8	90	32.8	55	20.1	19	6.9	12	4.4



## Weight

Debitage was classed according to the weight categories defined by Turner and Bonica (1994:7; see Table 12). Class 7 debitage (<3g) is the most frequent at all sites/contexts except Site 66 and Unit N4W6. This weight class is common to all adze reduction stages and thus is not a diagnostic category for determining the adze reduction stage (Turner and Bonica 1994). However the large amount of this class of debitage at the Shrine, particularly flakes 0.1g and under (which represented 24% of the debitage assemblage), indicate that adze manufacture was occurring in situ. If debitage had been produced elsewhere and brought to the shrine, these small flakes would not have been included in the assemblage (Healan 1995). This negates the possibility that this debitage was a ‘ritual fill’ or offering as has been suggested for a rockshelter site at Mauna Kea (Williams 1989).

Discounting the smallest weight class, the Shrine assemblage is dominated by Class 5 and 6 debitage. This is characteristic of secondary stage adze reduction (blank to preform) and supports the interpretation of the cortex and dorsal scar data. Class 6 (3-20g) debitage was also present in the Site 70 and the other Site 821 assemblages. While the small sample size of the debitage makes interpretation tentative, these assemblages are also characteristic of secondary adze reduction, although the general lack of Class 5 debitage suggests that this would be only the late stage of preform trimming. The absence of Class 7 debitage from the Site 66 assemblage confirms that the excavated area of this site was not used for adze production activities.

**Table 12.** Weight class of debitage

Site/Context	1		2		3		4		5		6		7	
	<i>N</i>	<i>N%</i>	<i>N</i>	<i>N%</i>	<i>N</i>	<i>N%</i>	<i>N</i>	<i>N%</i>	<i>N</i>	<i>N%</i>	<i>N</i>	<i>N%</i>	<i>N</i>	<i>N%</i>
66	2	11.8	-	-	3	17.6	-	-	4	23.5	8	47.1	-	-
70	-	-	-	-	-	-	2	6.2	1	3.1	6	18.8	23	71.9
821 – N1W2	-	-	-	-	-	-	-	-	-	-	2	16.7	10	83.3
821 – N4W2	-	-	-	-	-	-	1	2.2	3	6.5	12	26.1	30	65.2
821 – N4W6	-	-	-	-	-	-	-	-	-	-	3	75.0	1	25.0
821 – S1W6	-	-	-	-	-	-	-	-	-	-	2	28.6	5	71.4
821 – Shrine	2	0.7	1	0.4	5	1.8	13	4.6	22	7.9	55	19.6	182	65.0

## Estimation of Production Scale

Production scale is an important factor for the analysis of the presence and form of craft specialization (Costin 1991). In order to estimate the number of adzes produced at the Shrine of Site 821 a model was used that calculates productivity from the total weight of debitage. A similar model was proposed by Cleghorn (1982:338) that examines debitage from the entire reduction sequence; however, as the flake attribute analysis of the Shrine debitage indicates that secondary reduction predominated, Cleghorn's model was unsuitable. Therefore it was necessary to develop a new model which accounts for the weight of debitage produced between the adze blank and preform stages. Experimentally derived data from an adze replication study (Cleghorn 1982:182) was used to produce the following relationship (see Appendix 3 for mathematical justification):

$$\frac{D_s}{1.7P} = N_p$$

Where:

$D_s$  = weight of debitage

$P$  = weight of average preform

$N_p$  = estimated number of preforms produced

A single adze preform weighing 287.5g was found 40m west of Site 821 (see Figure 9a). A total of 3996.1g of debitage material was excavated from the Shrine. Therefore if the adze preform was representative of those produced at this locale, approximately eight preforms may have been produced.

It is acknowledged that there are unknown factors not accounted for in this calculation that may have influenced the result. Firstly adze preforms of a number of different sizes may have been produced at this locale, so that the preform used for the calculation may not have been a true average of all adzes produced. Secondly, the debitage weight may be influenced by material produced by activities other than adze reduction, such as the manufacture of informal stone tools. Therefore it is not suggested that eight preforms represents the actual number of tools produced, but rather an estimate that gives some indication of the relative scale of production.

## Summary

Analysis of the composition and attributes of the Kaluako'i lithic assemblages revealed that informal tool production and consumption was the dominant lithic activity at most sites. This is indicated by the presence of amorphous cores and flake tools. Analysis of raw material quality and cortex form demonstrates that water-rounded stone, most likely collected from beaches or gulches was utilised at all sites. In addition a fine-grained dyke stone was present at the southern sites in the region (Site 70, A, 821).

The high density of debitage, and the presence of a hammerstone at the Shrine of Site 821, indicates that adze production took place at this locale. An attribute analysis of this material suggests that it represents secondary stage adze reduction (blank to preform). The frequency of small debitage ( $\leq 1$ g), and its incorporation within the cultural layer of the site, indicates that this was in situ production, rather than an offering or ritual fill. The higher frequency of dyke rock at the Shrine compared to other areas of the site suggests that this material was strategically selected for adze reduction over water-rounded material. Analysis of the raw material quality of cortical flakes at the Shrine indicated that dyke rock was more frequently of lower quality than water-rounded material. This demonstrates that, similar to the Mauna Kea quarry (Cleghorn 1982:342), the form of raw material rather than texture, was the most important factor for raw material selection. The attributes of debitage from the other units of Site 821 were also examined. While these assemblages were quite small, which makes analysis of reduction difficult, the debitage attributes conform to the modelled characteristics of late stage adze preform trimming. If such activities did occur at these areas of Site 821, it was only on a very small scale, so that the focus of adze production was within the attached shrine enclosure.

## CHAPTER SIX: DISCUSSION AND CONCLUSIONS

The results obtained through a technological analysis of the Kaluako'i lithics reveal clear variability in the form and scale of lithic activities at the six sites examined. This chapter reviews these findings and examines the assemblages within their archaeological contexts in order to interpret behaviour both of a subsistence and ritual nature. The implications of this research for Hawaiian archaeology and in particular the study of adze economy are examined and future research directions suggested. In particular the importance of considering the context of lithic activities for the interpretation of the organisation of production and consumption is discussed.

### **Interpretation of Site Activities**

The six sites examined represent both residential and religious contexts. Site function is an important consideration for any interpretation of behaviour. The following is a summary of the stone tool assemblages at each site with an interpretation of their function from contextual data.

#### **Sites 66 and 38**

These sites have been previously interpreted as men's houses (*hale mua*) (Weisler and Walter 2002). These sites demonstrate clear evidence of informal stone tool production through the presence of amorphous cores, low levels of debitage and a hammerstone at Site 66. Informal tool consumption is also evident from the presence of utilised flakes (both unmodified and retouched) at the sites, including a possible awl with evidence of usewear. These expedient tools, manufactured predominantly from coarse to fine-grained water rounded basalt, most likely fulfilled a range of domestic tasks.

There is also some evidence of late stage adze production at these sites. Outside the enclosure of Site 66 an adze blank fragment was found. The 1978 excavation of Site 38 revealed at least one adze preform and a grinding stone, indicating that adzes may have been finished at this location (Weisler and Walter 2002:47). The presence of numerous fishhooks at Site 38 (Weisler and Walter 2002) and its proximity to the *ko'a* Site 35, link this site to fishing activities. Likewise Site 66 also contained several fishhooks and is associated with several *ko'a* and possible canoe sheds (Dixon and Major 1993). While adzes had a variety of functions, contextual evidence would suggest that these tools they were most likely used for canoe building. This supports the suggestion that many canoe makers may have produced

their own adzes (Lass 1998:24). The association of adze making with *hale mua* also supports the hypothesis that it was a male dominated craft (Lass 1998:24).

### **Site 35**

Significantly, no lithics were excavated from this *ko'a*. Several stone artefacts were however collected from the surface around the site. These are interpreted as being associated with the residential features nearby (Sites 1614 and 1613). Informal stone tool production and consumption were identified, including exploitation of a coarse to fine-grained water-rounded basalt. No evidence of adze production or consumption was found, indicating that at this site the stone tools were predominantly used for domestic tasks.

### **Site 70**

The presence of coral offerings at this site lead to its previous interpretation as a *ko'a* (Summers 1971:33). However, this feature is significantly different from Site 35 in its architecture, position in the landscape and excavated assemblage (see Chapter Three). Unlike Site 35, Site 70 was located at some distance from the sea and was associated with a variety of faunal remains beyond fish including pig and bird. Also different was the presence of several stone artefacts, including an utilised awl and coral abraders suggesting craft activity. This is in addition to informal tool production and consumption. Future analysis of the faunal and non-stone artefactual remains may assist in the further interpretation of this site, however this preliminary analysis suggests that it might have had broader significance, religious or otherwise, than simply as a fishing shrine.

### **Site A**

An artefact surface scatter with no visible architectural features, the surface collection of material from this site included volcanic glass artefacts, two awls and a polished adze flake. Analysis of the number of production versus consumption elements within the assemblage suggests that the site is best characterised as a consumption locale. The polished adze flake is evidence of adze maintenance and thus the small amount of debitage collected may also be associated with this activity. The stone tool assemblage and the presence of coral abraders suggests the practice of a variety of craft activities may have taken place, which may have include woodworking as evidenced by the association with adze maintenance.

### **Site 821**

This house site contributed the greatest number of lithic artefacts from several distinct areas, which enabled the intra-site comparison of excavated and surface collected assemblages. The most significant activity identified was the production of adzes within the attached shrine area. This produced a high density of debitage that was characteristic of secondary-stage adze reduction (blank to preform). Whilst a very-fine grained water-rounded material was present throughout the site, a fine to very-fine grained dyke rock dominated the Shrine assemblage, indicating a raw material selection strategy that prioritised form over texture. It is noteworthy that adze manufacture at Site 821 was focused at the shrine enclosure. This is interpreted as evidence for ritual production. The significance of this activity for the interpretation of craft specialisation and ideology is explored later in this chapter.

The Shrine assemblage also contained amorphous cores, two unused retouched artefacts and utilised flake tools demonstrating that informal tool production and consumption also occurred at this locale. It is hypothesised that informal stone tools may have been used to prepare food offerings that were laid on the shrine altar.

The presence of amorphous cores is significant as it indicates that whilst adze debris was present in large quantities, intentional separation of production of informal stone tools from cores took place. This is in contrast with the strategies of informal stone tool production proposed for several other adze production sites, where informal stone tools were produced from adze debris (Deunert 1995; Turner and Bonica 1994). This suggests that the adze debris produced at the Shrine did not have the characteristics preferred for flake tools. This may relate to flake size, as secondary-stage adze debitage is typically quite small (see Table 2).

Within the main area of the house enclosure, utilised flake tools were common. These artefacts were likely used for domestic tasks. The attribute analysis of the debitage present within these units indicated that they were characteristic of late stage adze reduction (final trimming). However this would have only been a minor activity as the density of debitage was quite low. This debitage material is possibly the result of informal tool production. An amorphous core in Unit N1W2 indicates that such activity occurred in the main house area. Similar cores were also found outside the house at both surface collection areas.

Significantly, no polishing or grinding stones were found within or near the house site. Either adze grinding and polishing occurred elsewhere, or these artefact types were missed due to

the relatively small area excavated. Likewise no finished adzes were found at the house site. The only evidence of adze maintenance and therefore possible use of adzes at Site 821 was a single polished flake found outside the house at Surface Collection Area A. This notable absence is possible evidence that the adzes produced at the Shrine were exchanged rather than used at the site and thus, this has implications for the interpretation of craft specialisation.

### **The Organisation of Lithic Production in Kaluako'i**

Substantial archaeological research in Hawaii has focused on the characterisation of the lithic economy as an indicator of political structure and subsistence practices (cf. Bayman and Moniz-Nakamura 2001; Lass 1994; McCoy 1990). Central to this discourse are the concepts of craft specialisation and self-sufficiency (Brumfiel and Earle 1978; Costin 1991; Lass 1998). Only one context of adze manufacture has been previously examined in Kaluako'i *ahupua'a*. This was the quarry and workshops of Kamaka'ipo Gulch where a high level of organisation and a reasonable scale of production indicated the presence of adze production by craft specialists, possibly under some form of community-level control (Dixon *et al.* 1994). The assemblages examined in the present study provide another perspective on the community lithic economy.

Informal stone tool production and consumption was ubiquitous at most of the sites examined. These activities occurred at levels that suggest for these tool types that these sites were self-sufficient. Similar observations have been made at other residential sites in Polynesia (Bayman and Moniz-Nakamura 2001; Kahn 1996).

Analysis of the macroscopic properties of the lithic raw material suggests that sites 70, A and 821 shared a basalt dyke rock source. While this is only a preliminary result that will be tested with future geochemical sourcing, this is not an unreasonable suggestion given that these sites are located only a few kilometres from each other. The location of the source is unknown, although it is near the sites. It was this material that was utilised for adze manufacture at Site 821. This suggests that access to this raw material was unrestricted, and not monopolised by any one site in the area.

Adze production at the Shrine of Site 821 was of a low-scale. Using a model for the estimation of productivity, it was interpreted that for the debitage excavated, approximately eight preforms may have been produced. However only 2m<sup>2</sup> of the 12m<sup>2</sup> shrine enclosure

were excavated. While it is probable that adze manufacture focused on the area nearest to the altar (see below for further discussion of this), if the entire area was utilised at similar levels to those excavated, up to forty-eight preforms may have been produced. There is yet to be any dating of this site to indicate the time over which it was inhabited. Therefore the intensity of adze production at the shrine cannot be assessed, although this site stands out as an adze producing locale for the nearby region.

There are several other factors that can be considered which may give some indication of the nature of adze production activities at the Shrine. As has been previously noted, there is no evidence of grinding and polishing of adze preforms. Likewise, evidence of adze use and maintenance is confined to a single polished flake found outside the house area. Thus adze consumption does not appear to be a dominant activity at the site, suggesting that even with the low level of production present, it may have exceeded the household requirements.

In specialised communities it has been ethnographically observed that excess production at the household level does not need to be large in order to contribute to a large community-scale surplus for inter-regional exchange (Spielmann 2002:198). As the only source of fine-grained basalt suitable for adze manufacture in Moloka'i, there is a strong possibility that Kaluako'i specialised in adze production. This is supported by ethnohistoric records of this community as a centre for adze manufacture (Kamakau *et al.* 1994; Malo 1903:78).

An important factor for the interpretation of craft specialisation is the context of production (Costin 1991:25). Adze manufacture at Site 821 was occurring within the attached shrine enclosure. Debitage was located directly in front of the altar. This is interpreted as in situ ritual production and thus is subtly different to the shrines at Mauna Kea, wheredebitage and adze rejects were offerings and thus artefacts removed from their original production location (McCoy 1990, 1999).

Ritual adze production has not been observed at any other residential site in Hawaii. Site 821 is significant therefore for the analysis of the organisation of adze production, and enables a reassessment of the characteristics of attached specialisation. Site 821 was a house site and thus it is unlikely that elite sponsorship occurred. Certainly the small scale of production and the lack of raw material control within the area would support this notion. However, ritual production associated with shrine features is commonly cited as evidence for the centralised control of adze production at Mauna Kea (Leach 1993; McCoy 1990, 1999). While there were



more than 100 shrines at Mauna Kea, this may reflect a difference in the type of site rather than a greater emphasis on ritual production. In criticism of the interpretation of ritual as evidence for elite control, Lass (1994:48) specifically cited domestic shrines as evidence that religious features were not all sponsored by chiefs. In doing so she appears to have foreshadowed the results of Site 821. This is not to suggest that the Mauna Kea quarry site was not elite controlled, as there are other indicators for this level of organization from the evidence of apprentice training, resource control and the scale of production. However, this research supports Lass's (1994; 1998) suggestion that ritual production is not definitive evidence of attached specialisation.

### **Site Proxemics, Ritual Production and Ideology**

On one level, functionalism and environmentalism may explain the presence of stone tool production and consumption at the Kaluako'i sites. Late prehistoric settlement was permanent, therefore expedient tools produced from local materials were the most energy efficient technology for domestic tasks (Andrefsky 1994; Torrence 1989). This may explain the ubiquity of amorphous cores and flake tools at most sites. Adze production required the use of high quality basalt that was heterogeneously distributed throughout the islands. The location of adze manufacture sites was in part determined by the local geology, and thus influenced the position of Site 821 in the landscape. However, these paradigms are unable to explain the intra-site variability in the spatial distribution of lithics at Site 821 and the symbolic meaning of the artefacts and behaviours. For this analysis, a contextual approach (Hodder 1978) is more appropriate.

Analysis of the proxemics of Site 821 suggest that it generally conformed in structure to other late prehistoric permanent high status house sites in Moloka'i (Weisler and Kirch 1985). Architecturally, there is a clear separation between the religious feature and the main house area. This is interpreted as a physical reflection of the *kapu* system, which separated the sacred from the profane (Ladefoged 1998; Levin 1968; Weisler and Kirch 1985:154).

The technological analysis of the debitage indicated that in situ adze production took place within the shrine enclosure, in front of the altar. The association of adze production with this religious feature is clearly significant. There is no clear functional explanation for the intentional confining of this activity in the shrine enclosure. Rather the limited space may have caused physical difficulties for adze production and other activities, particularly as

debris accumulated. This activity could have occurred within the main house as there is evidence of informal tool production within this more spacious area. Therefore it is interpreted that the intentional focus of adze production activities within the shrine enclosure had symbolic meaning as a ritual practice.

Ethnohistoric evidence suggests that the concept of *mana* may be important for the meaning of adzes (Leach 1993; Malo 1903; Valeri 1985). This includes evidence that the association of adzes with religious sites could influence their value (Malo 1903:237). It is interpreted that the debitage at the shrine was created by in situ adze manufacture rather than as offerings of debris produced elsewhere. This indicates that act of adze production was in itself a ritual performance. This ritual may have imbued *mana* in the object, thus increasing its value for certain functions.

While adzes were not usually the possessions of chiefs (Lass 1998:24), they were considered prestige items (Firth 1967; Handy 1927:26,32; Valeri 1985:27) and thus symbols of wealth and status (Kahn 2003). In ancient Hawaiian society where membership in social classes was hereditarily defined (Sahlins 1958), craft specialisation enabled commoners to gain status and wealth. (Malo 1903:51). Ritual production legitimised this power through its association with the gods (Lass 1998:28). Thus like chiefs (Earle 1997a), non-elites utilised the materialisation of ideology as a means for gaining wealth and power (DeMarrais *et al.* 1996; Spielmann 1998). Adze manufacture at the shrine may have also served this function, and it is significant that it was occurring at a high-status house site. In many societies ritual knowledge is considered wealth (Spielmann 1998:157). Thus it is the performance of this knowledge, rather than the products themselves, that enable the building of status. This may explain the small scale of adze production at the shrine.

### **Suggested Directions for Future Research**

Several questions have been raised concerning the sites examined in this project. Crucial for the interpretation of craft specialisation at Site 821 is the identification of the intensity of adze production at the shrine. This shrine had numerous coral offerings both on and beside the altar, and it is therefore suggested that future research date this site using high resolution thorium-230 coral dating (Weisler *et al.* 2006). This may identify the period of time over which adze production occurred and enable a reinterpretation the intensity of adze production.

The attribute analysis of debitage from the shrine suggests that lithic material was brought into the site in the form of adze blanks. It is most likely that adze rejects would have remained at the source site. Therefore, identification of the source of this adze material may test this hypothesis and in turn assess the accuracy of the reduction models employed.

Kaluako'i as a region holds great potential for the investigation of the organisation of adze production and distribution. This project is the second technological analysis of lithics from this *ahupua'a* (Dixon *et al.* 1994), however only a small number of sites have been examined. It is suggested that future research focus on examining adze production and distribution from the perspective of the community, including a technological analysis of the eight quarry sites (Sinton and Sinoto 1997; Weisler 1988) as well as other contexts of production including workshops and households. This project has identified the importance of context for the interpretation of craft specialisation and ritual. It is suggested that future research adopt a similar approach, including examination of intra-site variability.

The focus of this study has been stone tool production and consumption, however exchange is also an important component of the lithic economy. Future research in Kaluako'i should utilise geochemical sourcing techniques to provenance stone artefacts to reveal patterns of exchange and interaction, both inter- and intra-*ahupua'a*.

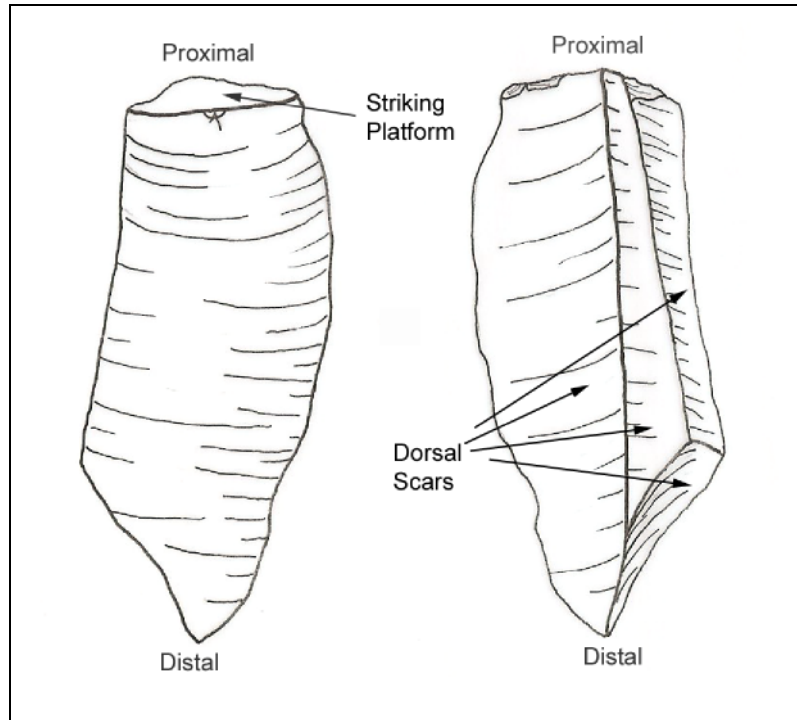
## **Conclusion**

This project identified informal and formal stone tool production and consumption at six late prehistoric sites within the Kaluako'i *ahupua'a* of West Moloka'i. Informal tool production and consumption were identified at these sites from the presence of amorphous cores and used flake tools. It was concluded that these tools represent a self-sufficient subsistence economy associated with residential sites. Small-scale adze production was identified at an attached shrine of a high status house site. Debitage attribute analysis indicated that this was late stage reduction. Whilst both water-rounded and dyke basalt was utilised at the site, dyke rock was favoured for adze manufacture. However, this material in general was coarser than the water-rounded material, indicating a selection strategy that favoured raw material form over texture.

The focus on adze making at the shrine suggests that it represents ritual production. This may have functioned to imbue *mana* in the tool, increasing its value for certain tasks and also to increase the status of the craftsmen through the symbolic display of ritual performance. As

there was no evidence for chiefly control, this research has significant implications for sites such as Mauna Kea, where ritual production has been cited as evidence of centralised control (McCoy 1990). Clearly ritual production occurred at different levels of the adze economy, including small-scale household production. This research supports the notion of the lithic economy as multicentric (Bayman and Moniz-Nakamura 2001) and highlights the importance of a consideration of site contexts for the analysis of craft specialisation and the materialisation of ideology.

# APPENDIX 1: FLAKE ANATOMY



## APPENDIX 2: LITHIC ATTRIBUTES

### Attributes recorded for all artefacts:

#### **1. Artefact Class**

Debitage -	Flake or flake fragment without usewear or retouch.
Used Flake -	Flake or flake fragment with edge fractures less than 3mm in size.
Retouched Flake -	Flake or flake fragment with retouch.
Awl -	A Subclass of retouched flake. A flake with invasive retouch along one or more margins that forms a point.
Core -	Stone artefact lacking a ventral surface with one or more negative flake scar. Also Lacking usewear
Core Tool -	Core with usewear
Hammerstone -	Rock displaying impact damage from use as a percussor.
Hammerstone Flake -	Cortical flake with evidence of impact damage on dorsal surface.
Adze Blank -	Adze precursor where the cross-sectional form is yet to be determined (after Weisler 1990a).
Adze Preform -	Adze precursor with determined cross-sectional form (Weiser 1990a).
Adze flake -	Flake with polish on dorsal or striking platform surface.

#### **2. Weight**

Measured in grams ( 0.1 accuracy).

#### **3. Rock Type**

Basalt -	volcanic rock with non-glassy texture
Volcanic Glass -	volcanic rock with glassy texture

#### **4. Raw Material Texture**

This refers to the texture of the lithic material on flaked surfaces. Only one of the following categories were given:

Coarse Grained -	matrix grains visible with the naked eye (CG)
Fine Grained -	matrix grains only visible with low-powered microscope or hand-lense. (FG)
Very-Fine Grained -	matrix grains not visible with low-powered microscope (VFG)

Vesicular-	lithic material containing at least 5% vesicles
Aphanitic -	Glassy texture, applicable for volcanic glass

### **5. Cortex Texture**

NA –	No cortex on artefact
WR –	Water rounded cortex
Dyke –	‘Spongy’ texture to cortex.
A –	Ambiguous cortex, patina covered.

### **6. Usewear**

Observed with hand lens and low powered Orion stereo-microscope (0.65-4.5x magnification)

Present –	either edge fracturing, edge rounding, striations or polish. For positive identification of edge fracturing, damage must be patterned with 3 or more scars within single area of an artefact edge.
Absent -	No usewear observed using low-powered techniques

### Additional Attributes Recorded For Used Flakes, Debitage and Retouched Artefacts:

### **7. Completeness**

Complete Flake –	flake with intact margins and proximal and distal ends.
Flake Fragment -	See Figure 5 – for fragment types.
Debris –	Flake fragment lacking identifiable ventral surface (after Sullivan and Rozen 1985).

### **8. Number of Dorsal Scars**

The number scars on the dorsal surface were counted and recorded as: 1, 2, 3, 4, 4+. Retouch and platform preparation scars were not included in this count (after Kahn 2005).

### **9. Striking Platform Cortex**

Present
Absent

## **10. Dorsal Cortex**

Present

Absent

## **11. Weight Class**

Artefacts were categorised according to Turner and Bonica's (1994:7) weight classes:

Class 1 - >300g

Class 2 - 201 – 300g

Class 3 - 101- 200g

Class 4 - 51-100g

Class 5 - 21-50g

Class 6 - 3-20g

Class 7 - <3g



### APPENDIX 3: ADZE PRODUCTIVITY MODEL

The following is a model for the estimation of the number of adze preforms produced at a site of secondary reduction (adze blank to adze preform). It was developed utilizing mean weight data from an experimental replication study (Cleghorn 1982:182):

Mean weight of experimental blanks = 2406.3g

Mean weight of experimental preforms = 890.2g

If the average blank were to produce the average preform the ratio of blank weight to preform weight is:

$$2406.3 : 897.2 = 2.7 : 1$$

Since  $D + P = B$

And  $B = 2.7P$

Then  $D + P = 2.7P$

If  $\frac{D_s}{D} = N_p$

Then  $\frac{D_s}{1.7P} = N_p$

Where:

$D$  = weight of debitage produced in manufacture of a preform from a blank

$P$  = weight of preform

$B$  = weight of blank

$D_s$  = weight of debitage excavated from unit

$N_p$  = number of preforms produced within unit area



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