# VARIABILITY IN POI POUNDERS FROM KAUA‘I ISLAND, HAWAI‘I

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We certify that we have read this thesis and that, in our opinion, it is satisfactory in scope and quality as a thesis for the degree of Master of Arts in Anthropology.

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**ABSTRACT**

Hawaiian poi pounders are unique artifacts which have received inadequate attention from the archaeological community. Three varieties of poi pounders are recognized today: the common knobbed form, ring pounders, and stirrup pounders. These artifacts have never been systematically analyzed, and a great deal of variability exists within the three categories. This research utilizes paradigmatic classification to examine stylistic variability in poi pounder morphology. The seriation method is used to illuminate patterns of interaction and transmission through time and space among Hawaiian groups. Functional analyses are carried out to help explain processes of selection and interaction between poi pounders and the environment. The spatial extent of this research is limited to the island of Kauaʻi, which is historically known for its distinctive poi pounder forms.

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**CHAPTER 1**

# INTRODUCTION

At the turn of the century W.T. Brigham described the poi pounder as “an implement very prominently identified with Polynesian life: one that had its beginnings with the race and which will perhaps be the last of ancient things to fall from the hands of the dying people” (1902:36). Indeed, traditional poi pounders continue to be used in Hawai‘i even today. In fact, they are among the most celebrated Hawaiian antiquities, a symbol of strength in Hawaiian culture (Figure 1.1).

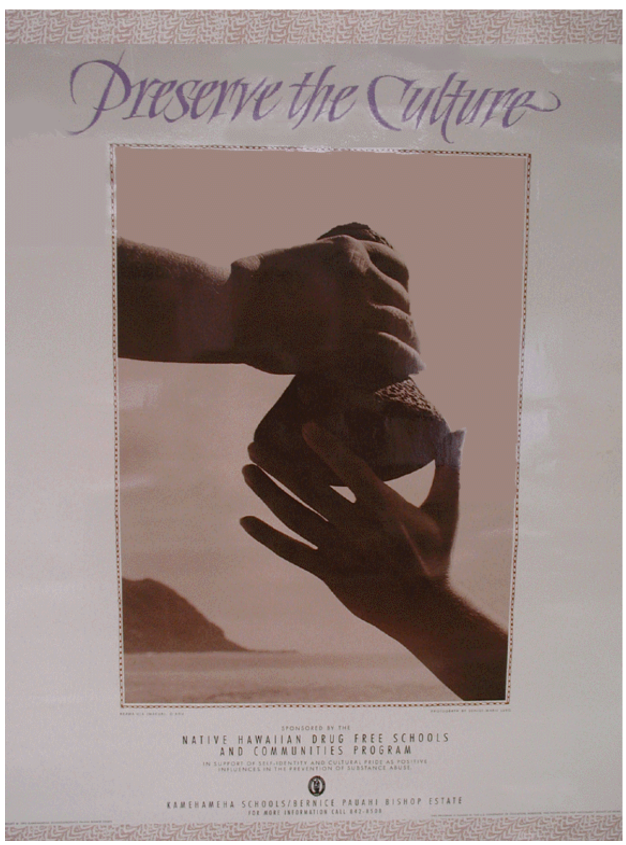



Figure 1.1: Poster Displayed at Kamehameha Elementary Schools Portraying the Continued Importance of Poi Pounders to the Hawaiian Community

Poi pounders, or *pōhaku kuʻi poi*, are used for pounding cooked taro root (*kalo*) into poi, a main staple of the traditional Hawaiian diet. Taro root was steamed in an *imu* (earth oven), peeled with a shell scraper, and placed on a wooden pounding board to be mashed with the stone pounder. The first step in the pounding process was to break each taro corm into pieces. Then water was added and the mixture was mashed until smooth and turned with one hand, with more water being added as needed through the course of the pounding (Handy et al. 1991).

Poi pounders were used throughout Polynesia wherever poi was prepared, but the pounders of the island of Kauaʻi, Hawaiʻi are thought to be the most variable in their morphology (Brigham 1902:40). Most Hawaiian poi pounders were skillfully crafted out of fine basalt and often exhibit elaboration on their handles. No metal tool replaced poi pounders in the way that metal adzes replaced stone adzes, thus stone poi pounders are still in use today. Given the importance of this unique class of artifacts, surprisingly little systematic research has been done on Hawaiian poi pounders.

Studies of Hawaiian material culture have traditionally relied on artifact names and descriptions provided by European visitors and native historians of the late 18th or early 19th centuries. This history poses a number of problems for artifact analysis today (See Field 1996; Graves and Erkelens 1991). Most importantly, ethnographically-derived classifications have limited the ability to examine artifact variability through time and across space. This may be remedied by developing systematic classifications using stylistic and functional attributes capable of measuring variability at various levels and employed in analysis.

Systematic classification may be used as a tool in archaeology to generate and identify cultural variability based on artifact analyses. Being able to measure variability in the analysis and classification of artifacts will greatly enhance our understanding of the archaeological record in key areas of interest, such as cultural interaction, adaptation to the environment or available resources, and spatial and temporal changes in settlement systems. Artifact classification makes the best use of the information potential of the archaeological record by allowing the analyst to track change through time and across space.

Studies of the agricultural landscape in Hawai‘i tend to focus on agricultural features (e.g., terraces) in favor of tools used for food production or preparation (Ladefoged and Graves 2000). As organic materials are rarely preserved in Hawai‘i, food remains are seldom available for study, thus food preparation equipment (e.g., poi pounders) may serve as a proxy indicator for some kinds of agricultural practices. Understanding the way in which food preparation tools changed through time and space can help to account for changes in settlement, technological production and use, and agricultural practices in different areas of an island and through time.

In this paper I use paradigmatic classification to examine stylistic variability in poi pounder morphology. I utilize the seriation method to order this class of tools through time and to illuminate patterns of interaction and transmission among Hawaiian groups on the island of Kaua‘i. I also examine spatial differences in poi pounder variability classified at a finer level and relate these differences to environmental variables. In addition, I carry out functional analyses to help explain processes of selection and interaction between poi pounders and the environment.

The spatial extent of this research is limited to the island of Kauaʻi, which is historically known for its distinctive poi pounder forms.

**Background**

Kauaʻi Island is unique in many respects. It is the oldest, wettest, and most isolated of the eight main Hawaiian Islands. At roughly five million years old, Kauaʻi is geologically older than the other main islands in the Hawaiian chain (Armstrong 1973). This maturity translates to a weathered landscape, with broad plains and deep soils. The Koʻolau and Puna districts of Kauaʻi are composed almost entirely of oxisols, "the most important agricultural soils of the state" (Armstrong 1983:46-47). Oxisols also make up significant portions of the Haleleʻa and Kona districts (Armstrong 1983:46).

Kauaʻi is also noted for high amounts of windward rainfall, and is home to the wettest spot on earth, Mount Waiʻaleʻale (1,569 meters elevation), which averages 1,232 centimeters of rain per year (Morgan 1996:199). However, the leeward (southwest) coast of the island lies in the rain shadow of this peak and portions of it receive less than 51 centimeters of rain per year (Morgan 1996:199).

Situated at the northwestern end of the main Hawaiian chain, Kauaʻi is 116 kilometers from its nearest neighbor, Oʻahu, thus Kauaʻi and its satellite island Niʻihau are the most geographically isolated of the main islands (Morgan 1996:199). Moreover, the marine channel separating Kauaʻi and Niʻihau from Oʻahu is known for rough conditions and likely hindered interaction between these two islands and the rest of the Hawaiian chain.

This isolation has been suggested as the underlying cause for some of the traits of material culture that occur only on Kauaʻi (Bennett 1931:97; Kirch 1985:23, 1990:45). The dressed and fitted stone block architecture seen in the Menehune Ditch ʻ*auwai* (irrigation channel) near the Waimea river rarely occurs outside Kauaʻi (Kirch 1985:104). Block grinders and ring and stirrup poi pounders are thought to be unique to that island as well (Bennett 1931:69; Brigham 1902:44; Hiroa 1964:30-31; Kirch 1985:104, 1990:45). In addition, double-barbed one-piece fishhooks and hematite sinkers are common on Kauaʻi and rare on the other islands (Kirch 1985:104, 106) but this may be a reflection of raw material availability rather than isolation.

The archaeological literature has traditionally focused on entire sites on Kauaʻi (Athens 1981, Griffin 1984), or on structural features such as *heiau* (religious architecture) (Bennett 1931, Williams 1951) or irrigation systems (Earle 1978). Rarely has the focus been on a specific class of artifacts (e.g., poi pounders), and this represents a large gap in the archaeological research of Kauaʻi and to some extent the rest of the Hawaiian Islands [but see Sinoto's work on fishhooks (1962)]. However, poi pounders have been included in a number of syntheses of Hawaiian material culture, and these will be reviewed below.

**Previous Research**

The earliest descriptions of Hawaiian poi pounders come from W.T. Brigham (1902). In his classic *Stone Implements and Stone Work of the Ancient Hawaiians*, Brigham describes these artifacts in striking detail and marvels at the effort put into their manufacture (1902:37). He compares the Hawaiian pounders with those of other areas in the Pacific and concludes that the variation in poi pounder form is greatest in Hawaiʻi (Brigham 1902:40).

Brigham describes three general forms of Hawaiian poi pounders (Figure 1.2), but never defines the attributes that distinguish poi pounders from artifacts of similar morphology, such as mullers, pestles, clubs, and *kapa* pressers (Figure 1.3). His artifact typology is based on "tradition", which he gathered from missionary journals and interviews, conversations with Hawaiian *aliʻi* (royalty) and *makaʻainana* (commoners), and his own observations of traditional Hawaiian villages (Brigham 1902: iii, iv, 41). This approach is problematic in that artifacts are grouped according to their inferred function. Difficulties arise in deciding where to place objects that do not fit neatly into the groupings, artifacts that are similar in appearance but served different functions, or those with no known ethnographic function (See Field 1996; Graves and Erkelens 1991). For example, Brigham includes the same artifact in a group of clubs and a group of pestles (Brigham 1902: Plate XL, Plate XLI).

Figure 1.2: Examples of Traditional Poi Pounder Forms
Left to Right: Knobbed (Also Known as Conical), Ring, Stirrup

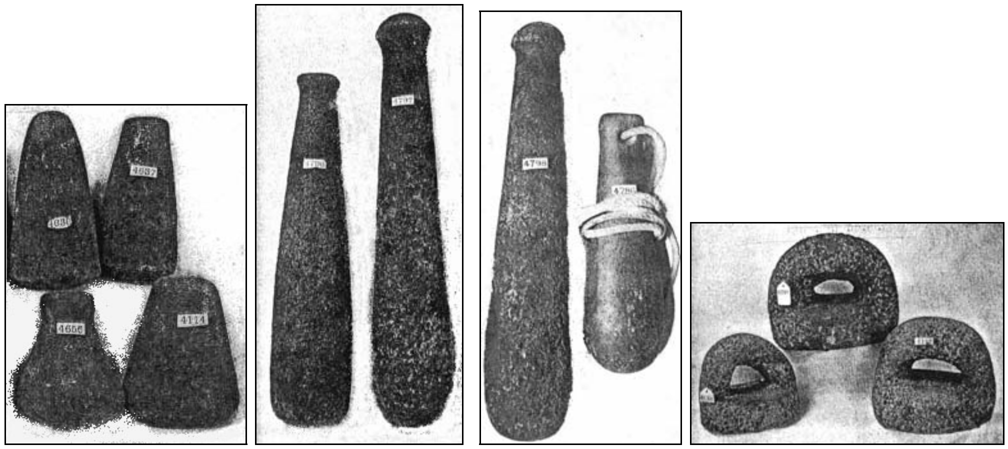


Figure 1.3: Examples of Functional Types
Left to Right: Mullers, Pestles, Clubs, *Kapa* Pressers (Brigham 1902: 32, Plate XLI, Plate XL, 51)

Brigham noted the occurrence of three types of poi pounders. The classic (also known as knobbed or conical) pounders were the most common, while the ring and stirrup forms were found only on Kaua‘i. Knobbed pounders were operated with one hand, while the stirrup forms were thought to require the use of both hands. The use of hands for ring pounders varied, with one hand used for pounding or two hands for grinding (Brigham 1902:49).

Regarding the ring and stirrup pounders, Brigham regrettably notes “When I first visited that island [Kaua‘i] in 1864 they were already obsolete and were shown as curiosities” (1902:46). Thus Brigham believes the ring and stirrup forms to be very old. Brigham gives the traditional names *pōhaku ku‘i puka* and *pōhaku puka* for the ring pounders, but does not provide a Hawaiian name for the stirrup form.

T.R. Hiroa’s (1964:27-33) early 20$^{th}$ century accounts of poi pounders are notable as well. Published posthumously in 1964, *Arts and Crafts of Hawaii* presents a wealth of information on Hawaiian material culture described by Hiroa in the early 1900s. Like Brigham, Hiroa identifies three types of poi pounders: the classic knobbed form, ring pounders, and stirrup forms (Hiroa 1964:27). Hiroa identifies a number of variations within the knobbed grouping, distinguishing the common rounded-knob form from those with mushroom-shaped knobs, and those with flat tops (Hiroa 1964:28). He grouped the knobbed pounders according to size, with three categories: small, medium, and large. He distinguished poi pounders from similarly formed pestles and mullers by the distinctive flare at the base of the knobbed pounder.

Hiroa provides a slight variation to the Hawaiian name for the ring pounder, referring to it as *pohaku puka ku'i poi*, and like Brigham he does not know of a Hawaiian name for the stirrup pounder. Hiroa also maintains that the ring and stirrup forms are limited in distribution to Kaua'i (1964:30-31). As with his examination of the knobbed pounders, Hiroa recognized variability within the ring and stirrup forms, noting differences in the shape of the pounding surface in the former and in the upper end treatment of the latter. He even characterized stirrup pounder tops as convex, concave, or straight (1964:31).

W.C. Bennett provides further analysis of Kaua'i poi pounders in his 1931 classic *Archaeology of Kauai*. Based largely on fieldwork conducted in 1928-1929, this volume provides a valuable record of the material culture of Kaua'i for the purpose of documenting the vanishing archaeological treasures of that island.

Bennett recognizes nothing distinctive about the conical pounders of Kaua'i but puzzles over the enigmatic ring and stirrup forms. He posits that the ring and stirrup pounders were used for grinding rather than pounding and that these implements were intended for use by women (1931:69). Whereas men were the sole producers of poi on the main Hawaiian Islands, both sexes were allowed to pound poi on Kauaʻi and Niʻihau (Bennett 1931:69, 96). Bennett even relates that the ring pounders were referred to as "*wahine* pounders" by Kauaʻi residents in the late 1920s (1931:69).

Bennett proposes that the stirrup forms are the oldest of the Kauaʻi pounders, the ring pounders intermediate in age, and the conical forms most recent (1931:69, 70, 96). His comments on the distribution of poi pounder forms in the late 1920s support this hypothesis: "The conical forms are still in use to-day [sic] by Hawaiians and Chinese for pounding poi. The ring pounders, unused, are still to be found about the homes of the Hawaiians. The stirrup forms are found in the deserted archaeological sites" (Bennett 1931:69). Bennett points to isolation as the major causal factor for the unique material culture found on Kauaʻi (1931:97).

More recent reviews of Hawaiian material culture also include poi pounders but fail to go beyond description and ethnography. In *Feathered Gods and Fishhooks,* Kirch includes a brief description of the Hawaiian poi pounder (1985:189). He calls it a "characteristic Hawaiian artifact" and notes the occurrence of three major forms, the conical pounder, which is most common, and the ring and stirrup forms that are restricted to Kauaʻi (Kirch 1985:189). Kirch suggests that the limited distribution of these latter forms indicates that Kauaʻi was more isolated than the other main islands in pre-contact times.

Kirch returns to the enigma of the Kauaʻi poi pounders in a later paper entitled "Regional Variation in Hawaiian Prehistory" (1990:45-46). He identifies the ring and stirrup pounders as "the best-known examples of geographic style in Hawaiian artifact classes" and puzzles over why these functionally equivalent yet stylistically distinct artifacts were retained only on Kauaʻi Island (Kirch 1990:45). Kirch challenges traditional explanations that see the ring and stirrup pounders as "archaic survivals of an earlier period of Hawaiian culture" because these forms are not found in other areas of the Pacific (1990:45). Instead he suggests that the three forms of Kauaʻi poi pounders represent local styles that may have been linked to status differentiation in prehistory (Kirch 1990:45-46), suggesting that they were used contemporaneously. However, Sinoto (1970) has recovered two artifacts from the Marquesas which he believes are incipient forms of stirrup pounders; these are the only examples of these forms outside of Hawaiʻi.

The final notable mention of poi pounders in the literature comes from Summers' *Material Culture: The J.S. Emerson Collection of Hawaiian Artifacts* (1999:3-4). In this volume, Summers describes the artifacts that Emerson amassed in the late 19$^{th}$ century from the Hawaiian Islands. Among these are 15 knobbed pounders and six ring pounders, for which Summers provides careful measurements and fascinating ethnographic information. For example, one of the smaller-sized knobbed pounders was used to pound poi in secrecy at a time when *aliʻi,* or chiefs, were known to confiscate food from the *makaʻainana*, or commoners (Summers 1999:3-4).

To summarize the literature, three basic forms of poi pounders are identified, but the distinguishing features of these forms are not clearly defined. All sources relate that two of the three poi pounder forms (i.e., the ring and stirrup forms) are known only to Kauaʻi, yet we know nothing of their distribution across the landscape of that island or through time. I will attempt to address these issues herein.

**Research Questions**

The goal of this paper is to examine variability in poi pounders across space and through time on the island of Kauaʻi. This involves addressing four research questions:

1) Do poi pounders vary stylistically through time, and if so in what ways do they change?
2) Are poi pounders stylistically variable across space? At what scale do they vary? What is the maximal geographic scale at which the transmission of information regarding poi pounder style occurred?
3) How do poi pounders vary by functional or technological attributes? How does function or technology affect the distribution of stylistic variants of these artifacts across space and through time? Are there discernable performance-related features linking the form of poi pounders to metrical values?
4) How might environmental structure affect the distribution of poi pounders in terms of style, function, and technology?

Paradigmatic classification is used as a tool to answer questions 1 and 2. This method utilizes dimensions and modes to systematically identify artifact variability.

The classification used here focuses on the handle region of the artifact, as variations in this area are likely stylistic rather than functional. Stylistic traits are appropriate to use here because they have no selective value, thus their distribution across space and through time can be attributed to “direct cultural transmission” (Dunnell 1978a:120). Paradigmatic classes are used to examine stylistic variability across space and through time on Kauaʻi Island.

The seriation method is also utilized to address research questions 1 and 2. Paradigmatic classes are used to order groups of poi pounders to develop a relative chronology for these artifacts on Kauaʻi Island. Seriations are performed at multiple scales of analysis to identify the maximal geographic unit at which information was shared on Kauaʻi.

Research question 3 deals with functional characteristics of poi pounders. Functional traits directly affect the fitness of an artifact; thus they inform on processes of selection and interaction between an artifact and the environment (Dunnell 1978a). Stylistic traits can be sorted by functional traits affected by selection. Weight, base diameter, base height, overall height, and material type are likely functional traits, as they directly affect artifact performance. Metric measurements were taken on all available artifacts and material type was estimated based on color, texture, and the percentage of pore space in basalt. The distribution of these traits are displayed in space and time (based on stylistic traits) to identify patterned variability in poi pounder function.

Rainfall data and information on soil quality will be used to address research question 4 (How might environmental structure affect the distribution of poi pounders in terms of style, function, and technology?). These data will be assessed against the distribution of stylistic and functional traits of poi pounders across the windward and leeward regions of Kauaʻi.

# CHAPTER 2

# METHODS

## Sample

I examined a total of 173 poi pounders from Kaua‘i (Table 2.1). Forty-four (25.4%) of these were housed at the Grove Farm Museum in Līhu‘e and 88 (50.9%) were located at the Bishop Museum in Honolulu, where I was able to physically examine them (Table 2.1). Ten of the Bishop Museum poi pounders were from archaeological contexts while the remainder were donated to the ethnographic collection. In addition, I gathered information from photographs and measurements of 41 (23.7%) ethnographic pounders recorded in the Bishop Museum archives, cross-referencing weights and photos to ensure that these were not poi pounders I had already physically measured. These artifacts were weighed and measured by museum staff and volunteers between 1964 and 1970. It is assumed for the purpose of this paper that these measurements were taken in a consistent and replicable fashion and thus are comparable across objects. All other measurements were taken by myself.

Table 2.1: Database for Study (nb. sample size for each analysis varies according to different sampling criteria)

| Collection | Number Employed: Spatial & Temporal Analyses | Number Employed: Functional Analyses | Overall Total |
|---|---|---|---|
| Grove Farm Ethnographic Collections | 1 (1%) | 44 (29.5%) | 44 (25.4%) |
| Bishop Museum Ethnographic Collections | 47 (48%) | 73 (49%) | 78 (45.1%) |
| Bishop Museum Archaeological Collections | 9 (9.2%) | 10 (6.7%) | 10 (5.8%) |
| Bishop Museum Archives | 41 (41.8%) | 22 (14.8%) | 41 (23.7%) |
| | | | |
| Totals | 98 | 149 | 173 |

A universal method of identifying a poi pounder based on physical characteristics did not exist when I selected the artifacts for my sample, thus I began by selecting artifacts previously identified as pounders by museum staff. It became apparent that poi pounders are highly variable in morphology, but can be distinguished from pestles and clubs because of their wide bases and hence the ability to stand upright unsupported (See Figure 1.3 for illustrations of pestles and clubs). Ring pounders and *kapa* pressers differ in that *kapa* pressers have a half-circle shaped perforation, while the perforation of a ring pounder more closely approximates a full circle (See Figures 1.2 and 1.3). The distinction between mullers and pounders remains unclear (See Figure 1.3) therefore this sample may include mullers not indicated as such by museum staff.

I was not able to obtain a complete set of information for every artifact (e.g., some lacked precise provenience information, while others lacked weight data), thus not all 173 artifacts were used for each analysis (See Table 2.1). For the spatial and temporal analyses I utilized 98 (56.6% of the total sample) of the poi pounders that had provenience information to the scale of district or better and for which the dimensions of my classification could be clearly identified (Appendix A). One was from the Grove Farm Museum and 56 from the Bishop Museum. Forty-eight of these were from the ethnographic collections and nine were from archaeological contexts. Forty-one ethnographic pounders from the Bishop Museum archives were used in the spatial and temporal analyses as well.

As so few of these artifacts are from archaeological contexts (9.2%), there are obvious questions regarding the temporal assignment of the poi pounders in this sample (i.e., few pounders have dates associated with them). In addition, poi pounders require a great deal of effort to manufacture, thus these artifacts would have long use-lives, being kept in families over many generations. Therefore, the dates associated with the locations where archaeological pounders were found represent discard and not necessarily manufacture. However, the relative dates produced by seriation do represent manufacture (i.e., when the attributes measured by the seriation came into being).

For the functional analyses I utilized 149 (86.1%) of the pounders that had weight, height, and base diameter data available (Appendix B). Forty-four of these were from the Grove Farm Museum, 73 from the Bishop Museum ethnographic collection, 10 from archaeological contexts, and 22 from data derived from records in the Bishop Museum archives. I was able to ascertain the material type of 132 of these artifacts.

**Recording Methods**

For the pounders that I was able to physically examine, I took digital photographs and used these to obtain precise measurements to characterize the morphology of each artifact. Digitally measuring these highly variable artifacts proved advantageous in that the exact location of each measurement could be documented for future replication. The diameter of the poi pounder base was measured as the widest portion of the artifact, base height was measured from the center of the base diameter to the bottom of the artifact, and overall height was taken as the greatest vertical measure of the poi pounder (Figure 2.1). Using a form gauge,

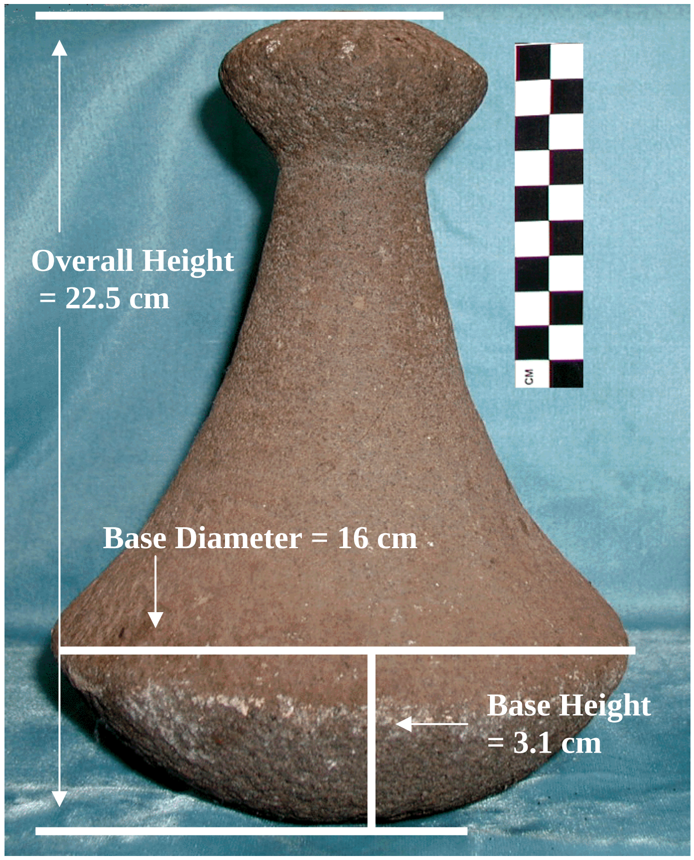



Figure 2.1: Base Diameter, Base Height, and Overall Height Measures

I drew cross-section profiles of each pounder to characterize the depth of the perforation. I also recorded the weight and material type of each artifact. Density of the basalt artifacts was calculated through visual inspection with reference to illustrations designed for estimating the percentage composition of rock (Terry and Chilingar 1955).

Based on this information, I devised a simple paradigmatic classification (sensu Dunnell 1970) for poi pounders (Table 2.2). Paradigmatic classification is based on the intersection of attributes and dimensions. A dimension is a set of mutually exclusive features of artifacts and modes are the different attribute states of

Table 2.2: Paradigmatic Classification for Poi Pounders

| | |
|---|---|
| Dimension: Top | |
| Mode: | 1) Convex |
| | 2) Concave |
| | 3) Flat |
| | 4) Multiple |
| Dimension: Upper Sides | |
| Mode: | 1) Angled In |
| | 2) Angled Out |
| | 3) Straight |
| | 4) Multiple |
| Dimension: Perforation | |
| Mode: | 1) Present |
| | 2) Absent |
| | 3) Partial |

a dimension. For example, the inner edge of a fishhook head is a dimension, while flat or stepped would be modes of that dimension.

Paradigmatic classification is an important tool for archaeologists because classes are explicitly defined in terms of the modes within each dimension and every mode is explicitly defined (Dunnell 1970). This way modes can be identified again not only by the analyst, but by anyone who wishes to replicate the work. Dimensions are not weighted; all dimensions and all modes are of the same importance. All classes are comparable to all other classes in the classification because they are all defined by a common set of attributes. Every dimension and every mode contributes to a class definition, thus paradigmatic classifications theoretically track all variability that we recognize; not just that which the analyst thinks is important. Any mode can co-occur with any other mode so unexpected variability can be recognized. New modes may be added freely without affecting the structure of the classification so assemblages can be compared across a large area.

Scholars in Hawai‘i are beginning to appreciate the value of paradigmatic classification in archaeological research (e.g., Allen 1992, Field 1996, Moniz et al. 1996). In an analysis of fishhooks, Allen asserts that “Paradigmatic classifications provide systematic information on variability, distributions, and abundances and lay a firm foundation for comparative studies” (1992:101).

The classification used here focuses on the handle region of the artifact, as this is the most promising area in which to identify stylistic variability. It includes three dimensions: 1) the morphology of the top, 2) the morphology of the upper sides, and 3) the presence/absence of perforation (See Table 2.2). The first two dimensions have four modes and the last has three, therefore this classification produces 48 classes (4x4x3) (Table 2.3).

Table 2.3: List of Possible Stylistic Classes

| | | | |
|---|---|---|---|
| 111 | 211 | 311 | 411 |
| 112 | 212 | 312 | 412 |
| 113 | 213 | 313 | 413 |
| 121 | 221 | 321 | 421 |
| 122 | 222 | 322 | 422 |
| 123 | 223 | 323 | 423 |
| 131 | 231 | 331 | 431 |
| 132 | 232 | 332 | 432 |
| 133 | 233 | 333 | 433 |
| 141 | 241 | 341 | 441 |
| 142 | 242 | 342 | 442 |
| 143 | 243 | 343 | 443 |

For example, a poi pounder with a convex top, upper sides angled in and partial perforation is a class 113 artifact, while one with a concave top, straight sides, and no perforation would fall into class 232 (See Table 2.2). These classes are clearly capable of tracking variability at a finer scale than the traditional three-group classification of poi pounders (knobbed, ring, and stirrup).

**Dimension Definitions**

The definitions of the top and upper sides follow Shepard's analysis of pottery form (1956:225-227). Shepard utilizes a geometric approach that focuses on the contour of each artifact. Contour is characterized by points of inflection, which can be identified by "moving a straight edge as tangent along the contour of a vessel profile" (Shepard 1956:226). The lines created by the straight edge will change direction at the contours, and inflection points are located at the intersection of two lines (Figure 2.2). Shepard asserts that the inflection point is critical to characterizing the shape of a pottery vessel because "its position is definitive and it marks a fixed division of the vessel" (1956:226). The utility of the inflection point can be easily extended to the analysis of poi pounders, where such points mark different divisions of the tool (Figure 2.3).

The first dimension, top, is defined as the region above the uppermost points of inflection on the sides of an artifact (Figure 2.4). There are four modes that characterize the shape of this dimension: 1) convex, 2) concave, 3) flat, and 4) multiple. Figure 2.5 illustrates examples of each mode. The convex mode has a surface that curves upward, while a concave surface curves down toward the base of

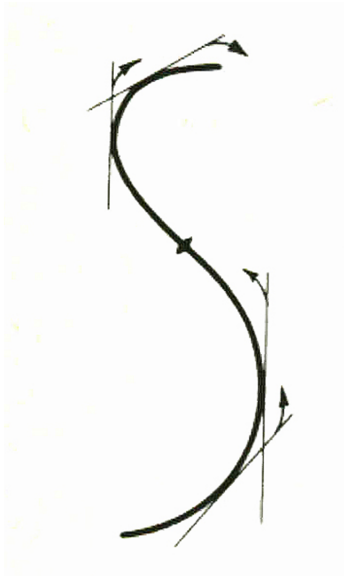


Figure 2.2: Points of Inflection
(Adopted from Shepard 1956:226)

Figure 2.3: Example of Points of
Inflection on a Poi Pounder

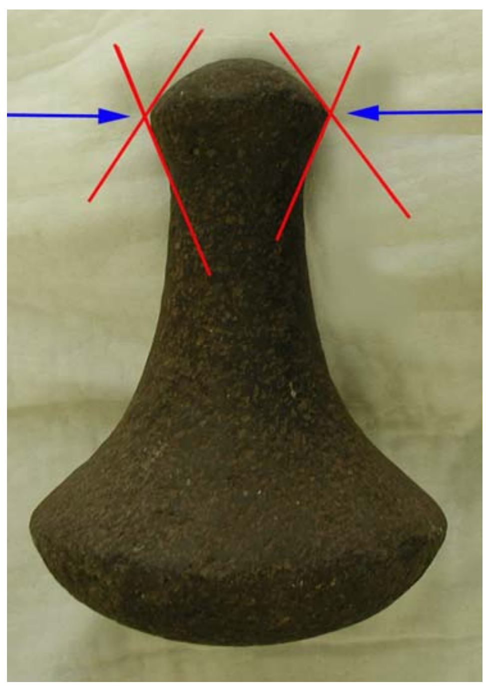


Figure 2.4: Definition of Poi Pounder Top
Arrows indicate uppermost points of inflection on the sides of an artifact.
Dimension 1 (top) is defined as the region above these points.

Figure 2.5: Examples of Dimension 1 (Top) Modes
Clockwise from top left: 1) Convex, 2) Concave, 3) Flat, 4) Multiple

the artifact. The flat mode has a surface that is relatively level, and the multiple mode is a combination of any number of the above modes.

The next dimension characterizes the morphology of the upper sides of the poi pounder. The upper side is measured down from the highest point of inflection on the side of an artifact. There are four modes for this dimension: 1) angled in, 2) angled out, 3) straight, and 4) multiple (Figure 2.6). When measured against a horizontal

Figure 2.6: Examples of Dimension 2 (Upper Sides) Modes
Left to right: Angled In, Angled Out, Straight

line, upper sides that are angled in exhibit an acute angle, while sides that are angled out exhibit an obtuse angle, and straight sides are roughly perpendicular to the horizontal line (Figure 2.7). The multiple mode accounts for artifacts whose left and right sides differ, although I did not observe any examples of this.

The final dimension characterizes perforation, which refers to the presence or absence of a puncture through the artifact. This dimension includes three modes: 1) present, 2) absent, and 3) partial. Present refers to an artifact with a complete puncture while absent indicates an artifact whose front or back surface is not indented at all. Partially perforated refers to an instance in which a cavity is present that did not completely puncture the artifact. Ring pounders are an example of a perforated poi pounder, the classic knobbed pounder is an example in which perforation is absent, and many stirrup pounders are partially perforated (Figure 2.8).

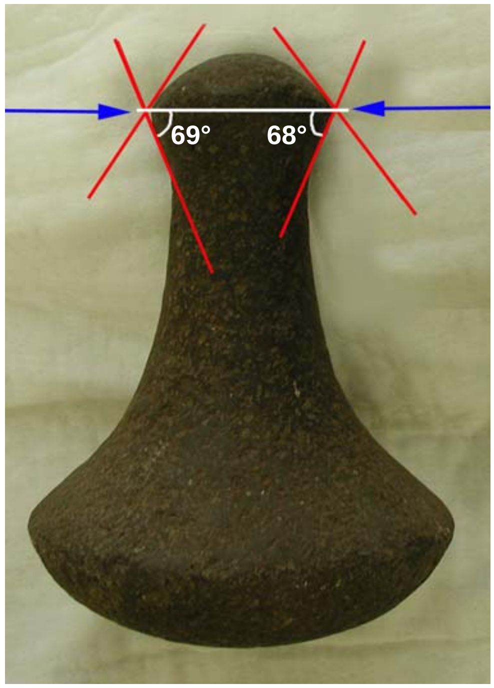



Figure 2.7: Measurement of Dimension 2 (Upper Sides)
Arrows identify uppermost points of inflection. Measurement is taken from horizontal line. In this example angles are acute, thus upper sides are angled in.


Figure 2.8: Examples of Dimension 3 (Perforation) Modes
Left to Right: Present, Absent, Partial

# CHAPTER 3

# STYLISTIC ANALYSES

For the temporal and spatial analyses I used 98 poi pounders (56% of the total sample) that had provenience information to the scale of the district (See Table 2.1). Temporal analyses suggest a change from variability to homogeneity through time, with stirrup pounders oldest, ring forms intermediate in age, and knobbed pounders most recent. Earlier occupation of the windward side of the island is also suggested. Spatial analyses indicate that poi pounders were most variable in form in the windward districts of Halele‘a and Ko‘olau and least variable in the Kona district on the leeward side of the island. In addition, the classic knobbed pounders were common in the leeward region, while the windward pounders were more diverse.

## Temporal Analysis

An attempt to apply seriation to poi pounders adds to our understanding of interaction and transmission through time among Hawaiian groups on Kaua‘i. Seriation is a method that uses classes to order groups by recording the distribution of combinations of artifact attributes (Dunnell 1970:308). To infer chronology, the artifacts used in seriation must meet the following conditions: groups must be of comparable duration, they must come from the same cultural tradition, and they must come from the same local area (Dunnell 1970:305). In addition, artifacts must be of comparable function and classes must be historical, beginning with a low frequency, increasing in numbers, then declining in frequency.

The dimensions of the paradigmatic classification were used to array the individual pounders at different geographic scales of analysis to track variation in poi pounder form across space and possibly through time. Here I use occurrence seriation based on the presence or absence of a given mode of the three dimensions defined in the classification: 1) a convex top, 2) upper sides angled out, and 3) perforation (partial or complete).

One shortcoming of the seriation method is that the orderings do not specify which end is most recent and which is oldest. This must be derived from independent evidence. Ethnographic evidence consistently points to the knobbed pounders as the most recent form (Bennett 1931:69, 70, 96, Brigham 1902:46) and for this study, that will be the basis for determining the temporal direction of the poi pounder seriations.

Poi pounders were seriated at the scale of the site, district, region (windward or leeward), and the entire island. Ninety-three poi pounders had provenience information to the scale of site. Of these only the sites that contained six or more artifacts were seriated. These were Hanalei, the area between Keālia and Kīlauea, Keālia proper, Līhuʻe, Hanapēpē, Kōloa, Waimea, Nuʻalolo, and Kalalau. Sixty-six artifacts were found in these nine sites.

All sites except Kōloa seriated flawlessly, with the youngest pounders exhibiting convex tops, sides not angled out, and no perforation (i.e., knobbed) (Table 3.1). The ring pounders (convex tops, sides angled out, perforated) were intermediate in age, and the diverse stirrup forms usually occurred at the bottom of each seriation. The only exception was the Nuʻalolo site, where stirrup forms occurred at both ends of the seriation, but this likely reflects the absence of knobbed pounders at that site.

Table 3.1: Occurrence Seriation by Site (shaded row indicates gap)

| District | Site | Convex Top | Upper Sides Angled Out | Part/Full Perforation | Classes |
|---|---|---|---|---|---|
| Halele‘a | Hanalei | + | | | 112,132 |
| | Hanalei | + | + | + | 121,123 |
| | Hanalei | | + | + | 223 |
| Ko‘olau | Keālia-Kīlauea | + | + | + | 123 |
| | Keālia-Kīlauea | | + | + | 223,423 |
| | Keālia-Kīlauea | | | + | 213 |
| | Keālia-Kīlauea | | | | 312,212 |
| Puna | Keālia | + | + | + | 121,123 |
| | Keālia | | + | + | 223,423 |
| | Keālia | | | | 412 |
| Puna | Līhu‘e | + | | | 112 |
| | Līhu‘e | + | + | + | 121,123 |
| | Līhu‘e | | + | + | 223,323 |
| Kona | Hanapēpē | + | + | + | 121,123 |
| | Hanapēpē | | + | + | 223 |
| | Hanapēpē | | | + | 213 |
| Kona | Kōloa | + | | | 112 |
| | Kōloa | + | + | + | 121 |
| | Kōloa | | + | | 422 |
| | Kōloa | | | + | 413 |
| Kona | Waimea | + | | | 112 |
| | Waimea | + | + | + | 121 |
| | Waimea | | | + | 413 |
| | Nu‘alolo | + | + | | 122 |
| Kona | Nu‘alolo | + | + | + | 121 |
| | Nu‘alolo | | + | + | 323,423 |
| | Nu‘alolo | | + | | 322 |
| Nā Pali | Kalalau | + | | | 112 |
| | Kalalau | + | + | + | 123 |
| | Kalalau | | + | + | 223 |

The seriations performed at the level of district produced results similar to those at the level of site (Table 3.2). The five *moku‘āina* districts of Halele‘a, Ko‘olau, Puna, Kona, and Nā Pali were used for this scale of analysis, with all 97 poi pounders included in the seriation. Ten poi pounders came from Halele‘a district, 11 from Ko‘olau, 27 from Puna, 42 from Kona, and 8 from Nā Pali. The artifacts seriated quite well at this scale, with only two gaps – one in Puna and another in Kona.

Table 3.2: Occurrence Seriation by District (shaded rows indicate gaps)

| District | Convex Top | Upper Sides Angled Out | Part/Full Perforation | Classes |
|---|---|---|---|---|
| Halele‘a | + | | | 112,132 |
| Halele‘a | + | + | + | 121,123 |
| Halele‘a | | + | + | 223 |
| Halele‘a | | | | 412 |
| Ko‘olau | + | + | + | 121,123 |
| Ko‘olau | | + | + | 211,223,423 |
| Ko‘olau | | | + | 213 |
| Ko‘olau | | | | 212,312 |
| Puna | + | | | 112 |
| Puna | + | + | + | 121,123 |
| Puna | | + | + | 223,323,423 |
| Puna | | + | | 322 |
| Puna | | | + | 413 |
| Puna | | | | 312,332,412 |
| Kona | + | | | 112 |
| Kona | + | + | | 122 |
| Kona | + | + | + | 121,123 |
| Kona | | + | + | 223,323,423 |
| Kona | | + | | 322,422 |
| Kona | | | + | 213,413 |
| Nā Pali | + | | | 112 |
| Nā Pali | + | + | + | 123 |
| Nā Pali | | + | + | 223 |

The knobbed pounders once again appeared at the top of each seriation (i.e., they are most recent), the ring pounders in the middle (intermediate in age), and the stirrup pounders on the bottom (oldest). Koʻolau district, which lacked the knobbed form, was an exception, with stirrup forms appearing on both ends of the seriation. Kona district slightly deviated from the pattern as well, with one form of stirrup pounder (convex top, sides angled out, no perforation) appearing younger than the ring forms.

A similar ordering was produced at the scale of windward and leeward regions (Table 3.3). Sample size is more comparable at this scale of analysis, with the Haleleʻa, Koʻolau, and Puna districts combining to form the windward region (n=47) and the Kona and Nā Pali districts forming the leeward region (n=50). Knobbed pounders occurred at the upper end and stirrup pounders at the lower end of the seriations for both regions. The ring pounders occurred directly after the knobbed form in the windward region, while one of the stirrup forms (convex top, sides angled out, no perforation) occurred between the knobbed and ring pounders in the leeward region. The seriations again produced two gaps, one in each region.

The seriation for the entire island exhibited the same patterns as those seen in smaller scales of analysis (Table 3.4). Knobbed pounders were again situated at the top (as the youngest) and most stirrup pounders were placed at the bottom (as the oldest). Ring pounders were intermediate, with one form of stirrup pounder between the ring and knobbed forms. Only one gap was produced, and this occurred near the lower end of the seriation.

When the gaps are traced back through the different scales of analysis it becomes apparent that they result from four distinct artifacts (Table 3.5). These artifacts all exhibit non-convex tops with upper sides angled out and no perforation, falling into classes 322 and 422. There are a number of possible explanations as to why these artifacts do not fit

Table 3.3: Occurrence Seriation by Region (shaded rows indicate gaps)

| Region | Convex Top | Upper Sides Angled Out | Part/Full Perforation | Classes |
|---|---|---|---|---|
| Windward | + | | | 112,132 |
| Windward | + | + | + | 121,123 |
| Windward | | + | + | 223,323,423 |
| Windward | | + | | 222,322 |
| Windward | | | + | 211,213,413 |
| Windward | | | | 212,312,332,412 |
| Leeward | + | | | 112 |
| Leeward | + | + | | 122 |
| Leeward | + | + | + | 121,123 |
| Leeward | | + | + | 223,323,423 |
| Leeward | | + | | 322 |
| Leeward | | | + | 213,413 |

Table 3.4: Occurrence Seriation for Entire Island (shaded row indicates gap)

| Scale | Convex Top | Upper Sides Angled Out | Part/Full Perforation | Classes |
|---|---|---|---|---|
| Island | + | | | 112,132 |
| Island | + | + | | 122 |
| Island | + | + | + | 121,123 |
| Island | | + | + | 223,323,423 |
| Island | | + | | 222,322 |
| Island | | | + | 211,213,413 |
| Island | | | | 212,312,332,412 |

Table 3.5: Aberrant Pounders

| Artifact # | Provenience | District | Class | Archaeological | Depth (in) |
|---|---|---|---|---|---|
| C.1651 | Nu‘alolo | Kona | 322 | No | |
| Ka120 | Koloa Caves | Kona | 322 | Yes | 0 (Surface) |
| 1927.124.02 | Wailua | Puna | 322 | No | |
| 447 | Nu‘alolo Kai | Kona | 422 | Yes | 44 |

into the seriations: 1) they are of a different functional class (they were not used for pounding poi), 2) they were left in a stage of manufacture in which they were not completed, or 3) they were assigned incorrect provenance information (i.e., they derive from a different district or island).

The four aberrant pounders are illustrated in Figure 3.1. Artifacts C.1651 and KA120 appear to be unfinished. Both are very roughly shaped and asymmetrical. The base of pounder C.1651 slants to one side, rendering it unsuitable for pounding poi (Figure 3.2). Artifacts 447 and 1927.124.02 may not be poi pounders. Artifact 447 lacks a gripping device and a flare at the base, more closely fitting the ethnographic descriptions of a muller (Brigham 1902:30,32,41,42) or a pestle (Hiroa 1964:28). Artifact 1927.124.02 is starkly different in profile from the other stirrup pounders (Figure 3.2) and was classified by Bennett as a block grinder (1931:65-68). Bennett describes block grinders as oblong implements with surfaces meeting at right angles (1931:66). These artifacts lack a gripping device, thus Bennett speculates that they were hafted (1931:66). Most block grinders exhibit heavy wear on their bases and were likely used for rubbing or grinding activities (Bennett 1931:66).

When these four aberrant pounders are omitted, the seriations are perfect at all scales of analysis (Tables 3.6-3.8, Figure 3.3), and this provides clear evidence for transmission processes involving the production of poi pounders that spanned the entire island as a single local group.

The seriations also illustrate a hypothetical chronology for poi pounder form on the island of Kauaʻi (Figure 3.3). The knobbed pounders (convex top, sides angled out, no perforation) were most recent, ring forms (convex top, sides angled out, perforated)


C.1651 Ka120 1927.124.02 447

Figure 3.1: Illustrations of Aberrant Pounders

Figure 3.2: Side View of Pounders C.1651 and 1927.124.02

intermediate in age, and most of the stirrup forms were oldest. The stirrup class with a convex top, sides angled out and no perforation (class 122) appeared intermediate in age between the knobbed and ring pounders. This class of artifacts was found only in the Kona district and may have been a specialized form in that area.

Each row in the seriation can be considered a temporal unit (TU), with TU 1 most recent and TU 5 oldest (Figure 3.3). TU 1 consists of the knobbed pounders (class 112) and a single artifact of class 132. TU 2 is made up of the stirrup class that may have been a specialized form in Kona (class 122), the ring pounders (class 121), and a stirrup form similar in morphology to the ring pounders but lacking complete perforation (class 123).

Table 3.6: Occurrence Seriation by Site with Aberrant Artifacts Removed

| District | Site | Convex Top | Upper Sides Angled Out | Part/Full Perforation | Classes |
|---|---|---|---|---|---|
| Halele‘a | Hanalei | + | | | 112,132 |
| | Hanalei | + | + | + | 121,123 |
| | Hanalei | | + | + | 223 |
| Ko‘olau | Keālia-Kīlauea | + | + | + | 123 |
| | Keālia-Kīlauea | | + | + | 223,423 |
| | Keālia-Kīlauea | | | + | 213 |
| | Keālia-Kīlauea | | | | 312,212 |
| Puna | Keālia | + | + | + | 121,123 |
| | Keālia | | + | + | 223,423 |
| | Keālia | | | | 412 |
| Puna | Līhu‘e | + | | | 112 |
| | Līhu‘e | + | + | + | 121,123 |
| | Līhu‘e | | + | + | 223,323 |
| Kona | Hanapēpē | + | + | + | 121,123 |
| | Hanapēpē | | + | + | 223 |
| | Hanapēpē | | | + | 213 |
| Kona | Kōloa | + | | | 112 |
| | Kōloa | + | + | + | 121 |
| | Kōloa | | | + | 413 |
| Kona | Waimea | + | | | 112 |
| | Waimea | + | + | + | 121 |
| | Waimea | | | + | 413 |
| | Nu‘alolo | + | + | | 122 |
| Kona | Nu‘alolo | + | + | + | 121 |
| | Nu‘alolo | | + | + | 323,423 |
| Nā Pali | Kalalau | + | | | 112 |
| | Kalalau | + | + | + | 123 |
| | Kalalau | | + | + | 223 |

Table 3.7: Occurrence Seriation by District with Aberrant Artifacts Removed

| District | Convex Top | Upper Sides Angled Out | Part/Full Perforation | Classes |
|---|---|---|---|---|
| Halele‘a | + | | | 112,132 |
| Halele‘a | + | + | + | 121,123 |
| Halele‘a | | + | + | 223 |
| Halele‘a | | | | 412 |
| Ko‘olau | + | + | + | 121,123 |
| Ko‘olau | | + | + | 223,423 |
| Ko‘olau | | | + | 211,213 |
| Ko‘olau | | | | 212,312 |
| Puna | + | | | 112 |
| Puna | + | + | + | 121,123 |
| Puna | | + | + | 223,323,423 |
| Puna | | | + | 413 |
| Puna | | | | 312,332,412 |
| Kona | + | | | 112 |
| Kona | + | + | | 122 |
| Kona | + | + | + | 121,123 |
| Kona | | + | + | 223,323,423 |
| Kona | | | + | 213,413 |
| Nā Pali | + | | | 112 |
| Nā Pali | + | + | + | 123 |
| Nā Pali | | + | + | 223 |

Table 3.8: Occurrence Seriation by Region with Aberrant Artifacts Removed

| Region | Convex Top | Upper Sides Angled Out | Part/Full Perforation | Classes |
|---|---|---|---|---|
| Windward | + | | | 112,132 |
| Windward | + | + | + | 121,123 |
| Windward | | + | + | 223,323,423 |
| Windward | | | + | 211,213,413 |
| Windward | | | | 212,312,332,412 |
| Leeward | + | | | 112 |
| Leeward | + | + | | 122 |
| Leeward | + | + | + | 121,123 |
| Leeward | | + | + | 223,323,423 |
| Leeward | | | + | 213,413 |

| Temporal Unit | Scale | Convex Top | Upper Sides Angled out | Part/Full Perforation | Classes |
|---|---|---|---|---|---|
| 1 | Island | + | | | 112,132 |
| 2 | Island | + | + | | 122 |
| 2 | Island | + | + | + | 121,123 |
| 3 | Island | | + | + | 223,323,423 |
| 4 | Island | | | + | 211,213,413 |
| 5 | Island | | | | 212,312,332, 412 |

Figure 3.3: Occurrence Seriation For Entire Island with Aberrant Artifacts Removed

This temporal unit combined two seriation rows because of the limited distribution of class 122 and the similar morphology of these artifacts to those in classes 121 and 123. TU 3 consists of three stirrup forms with sides angled out and partial perforation (classes 223, 323, and 423). TU 4 is made up of two stirrup forms with sides angled in and partial perforation (classes 213 and 413) and a single artifact which appears to be an intermediate form in the transition from stirrup to ring (class 211). The oldest temporal unit (TU 5) consists of four stirrup forms lacking perforation (classes 212, 312, 332, and 412).

From this it is apparent that pounders with convex tops are most recent (TU 1-2) while those with concave, straight or multiple tops are older (TU 3-5). In addition, pounders with upper sides angled out are more recent (TU 1-3) and those with upper sides that are straight or angled in are older (TU 4-5). It appears that poi pounders were more variable in the distant past and became more homogenous through time.

The temporal units can be used to attempt frequency seriations at different scales of analysis. Whereas occurrence seriation utilizes the presence or absence of traits to order groups, frequency seriation uses artifact class frequencies to order groups. The principle is equal unimodal class distribution. Each “x” in these seriations represents 5% of a given temporal unit. Frequency seriations were performed at the scale of district and region.

The frequency seriation by district worked well for all districts (Table 3.9) but may have been affected by small sample sizes for TU 4 (n=8) and TU 5 (n=7). Nevertheless, the high frequency of TU 1 pounders from Nā Pali suggests that this district was occupied most recently. Halele‘a, Ko‘olau, and Puna districts appear to have been occupied earlier, exhibiting few pounders from TU 1-3 and many from TU 4 and 5.

Table 3.9: Frequency Seriation by District

| TU | Halele‘a | Ko‘olau | Puna | Kona | Nā Pali | Sample Size |
|---|---|---|---|---|---|---|
| 1 | xxx | | x | xxxxxxxxx | xxxxxxxx | 16 |
| 2 | xx | xx | xxxxxx | xxxxxxxxxx | x | 40 |
| 3 | x | xxx | xxxxxxxx | xxxxxxx | x | 23 |
| 4 | | xxxxxxxxx | xxx | xxxxxxxxxx | | 8 |
| 5 | xxxxxx | xxxxxx | xxxxxxxxx | | | 7 |

The frequency seriation by region may have been affected by the same problem of small sample size for TU 4 (Table 3.10). A larger sample for TU 4 is likely to produce a greater percentage of these artifacts on the windward side of the island. Note that

Table 3.10: Frequency Seriation by Region

| TU | Windward | Leeward | Sample Size |
|---|---|---|---|
| 1 | xxxx | xxxxxxxxxxxxxxxx | 16 |
| 2 | xxxxxxxxxx | xxxxxxxxxx | 40 |
| 3 | xxxxxxxxxxxx | xxxxxxxx | 23 |
| 4 | xxxxxxxxxx | xxxxxxxxxx | 8 |
| 5 | xxxxxxxxxxxxxxxxxxxx | | 7 |

there are only two columns in this seriation, thus the frequency of one column is determined by the other (e.g., if the windward side of the island has 100% of the pounders for TU 5, then the leeward side must have 0% of the TU 5 pounders). This seriation illustrates that the pounders from the windward region are older than those from the leeward side of the island. TU 1 is largely comprised of leeward pounders, while TU 5 is comprised solely of pounders from the windward region. This suggests earlier occupation of the windward side of the island, and later occupation of the more marginal leeward area.

**Poi Pounders from Archaeological Contexts**

The small sample of nine archaeological pounders showed no clear patterns through time, although most were from the historic period (Table 3.11). They were all found in the large Kona district – eight from Nu‘alolo Kai and one from Koloa Caves. Two of the Nu‘alolo Kai pounders lacked any depth information.

The dearth of poi pounders in archaeological assemblages may reflect the long use-lives of these artifacts. Many pounders continue to be used today in the processing of taro into poi. As poi pounders require a great investment of time to manufacture, they would have been kept in families for many generations, likely being utilized until they were broken. The number of broken poi pounders from archaeological

Table 3.11: Depth Information for Archaeological Poi Pounders

| Artifact # | Provenience | District | Depth Below Surface (in) | Date | Class |
|---|---|---|---|---|---|
| Ka-120 | Koloa Caves | Kona | 0 (Surface) | No Date | 322 |
| 281 | Nuʻalolo Kai K3 G16 | Kona | 6 | >1750 | 113 |
| 276 | Nuʻalolo Kai K3 F7 | Kona | 8 | >1750 | 423 |
| 280 | Nuʻalolo Kai K3 D12 | Kona | 12 | >1750 | 122 |
| 446 | Nuʻalolo Kai K5 J17 | Kona | 14-18 | >1750 | 122 |
| 447 | Nuʻalolo Kai K5 I15 | Kona | 44 | 1500-1750 | 322 |
| 452 | Nuʻalolo Kai K3 G17 | Kona | 37-54 | 1450-1750 | 122 |
| 827 | Nuʻalolo Kai K3 G8 | Kona | No Depth Information | No Date | 122 |
| 277 | Nuʻalolo Kai K3 E9 | Kona | No Depth Information | No Date | 121 |

contexts is unclear, as I only included pounders for which the dimensions of the paradigmatic classification could be clearly identified (i.e., those with intact upper portions). Another explanation for the scarcity of archaeological pounders is that they were taken from their original contexts by collectors. This is highly plausible, as poi pounders are prized antiquities and are commonly sought after by professional and amateur collectors.

The archaeological pounders were classified according to the more inclusive paradigmatic classification described earlier (See Table 2.2). Artifacts of the same class (322) were found on the surface of Koloa Caves and 44 inches below the surface at

Nu‘alolo Kai, and artifacts of this class were quite rare overall, comprising only 4% of the total sample. However, neither of these implements fit in with the seriations, as the pounder from Koloa Caves may be unfinished, and the one from Nu‘alolo Kai may not be a poi pounder (See Figure 3.1). None of the classic knobbed pounders (class 112) were observed in the archaeological sample, and this may be a product of small sample size, or may reflect a later age for the knobbed pounders.

**Spatial Analysis by Class**

For the spatial analysis I grouped the 98 artifacts according to ancient *moku‘āina*, or district boundaries (Armstrong 1983:95, Spriggs and Tanaka 1988:xiv) and by windward and leeward regions. The island of Kaua‘i consists of five *moku‘āina* districts: Halele‘a, Ko‘olau, Puna, Kona, and Nā Pali (Figure 3.4). The Kona and Nā Pali districts together make up the leeward region while the remaining three districts comprise the windward division.

Archaeologists often use districts as units of analysis in Hawai‘i, as material culture is known to vary at this scale (Cordy and Kaschko 1980, Earle 1978, Graves and Abad 1996, Kirch 1990, Kikiloi 2002). Because they were often ruled by distinct paramounts, district boundaries may constrain interaction, thus greater similarity between forms in a given district is expected. Likewise, artifacts of the same functional class are expected to differ across district boundaries in terms of style.

Ten (10.2%) poi pounders came from Halele‘a district, 11 (11.2%) from Ko‘olau, 27 (27.6%) from Puna, 42 (42.8%) from Kona, and 8 (8.2%) from Nā Pali. Stretching from Nu‘alolo to Hanapepe, the Kona district is by far the largest, and fittingly includes

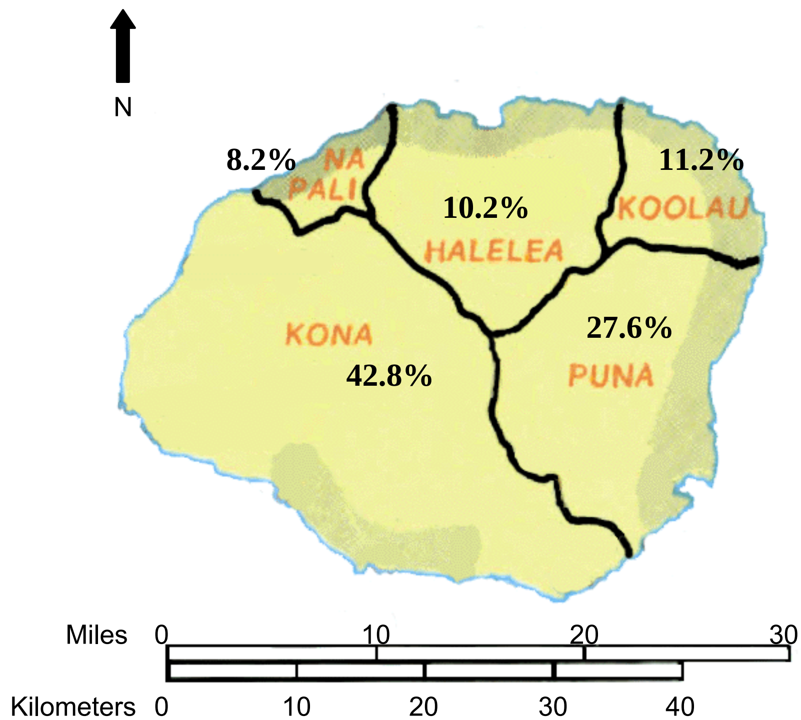



Figure 3.4: Map of Kaua'i Depicting *Moku'āina* Districts (adopted from Armstrong 1983:95)

the largest number of artifacts. Correspondingly, Nā Pali, the smallest district, includes the fewest number of artifacts. Note that the prolific archaeological site of Nu'alolo Kai lies within the Kona district, thus the Nā Pali artifacts are comprised solely of poi pounders from Kalalau Valley. Class size is more comparable when the artifacts are grouped according to the windward and leeward divisions, with 48 poi pounders (49%) from the windward side and 50 (51%) from the leeward.

Seventeen of the 48 potential classes produced by the three dimensional classification were realized. Figure 3.5 and Table 3.12 show the distribution of artifacts in these classes. The most common classes were class 121 with 26 artifacts (27%), and

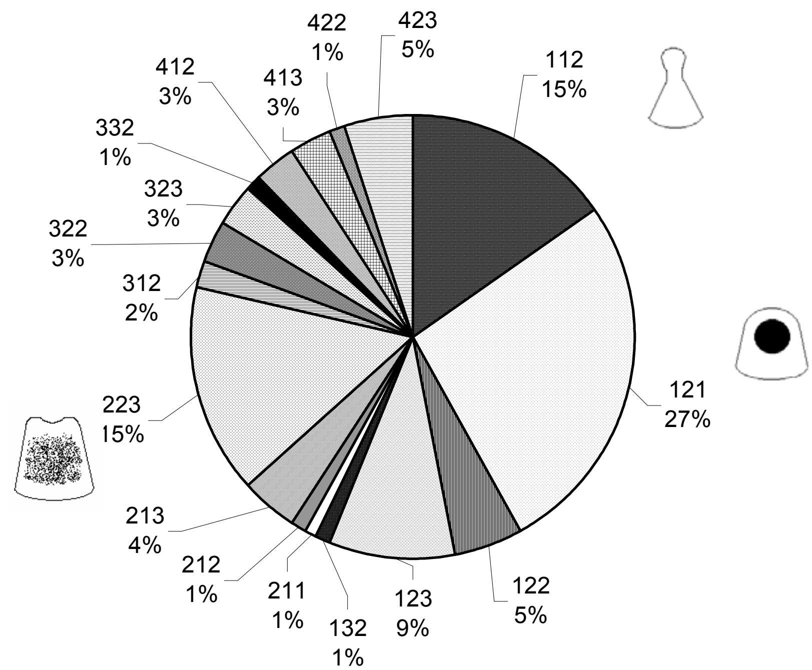



Figure 3.5: Frequency of Realized Classes

Table 3.12: Data for Realized Classes

| Class | Description of Class | Number of Artifacts | Percent of Total |
|---|---|---|---|
| 112 | Convex Top, Sides Angled in, No Perforation | 15 | 15% |
| 121 | Convex Top, Sides Angled Out, Full Perforation | 26 | 27% |
| 122 | Convex Top, Sides Angled Out, No Perforation | 5 | 5% |
| 123 | Convex Top, Sides Angled Out, Partial Perforation | 9 | 9% |
| 132 | Convex Top, Straight Sides, No Perforation | 1 | 1% |
| 211 | Concave Top, Sides Angled In, Full Perforation | 1 | 1% |
| 212 | Concave Top, Sides Angled In, No Perforation | 1 | 1% |
| 213 | Concave Top, Sides Angled In, Partial Perforation | 4 | 4% |
| 223 | Concave Top, Sides Angled Out, Partial Perforation | 15 | 15% |
| 312 | Flat Top, Sides Angled In, No Perforation | 2 | 2% |
| 322 | Flat Top, Sides Angled Out, No Perforation | 3 | 3% |
| 323 | Flat Top, Sides Angled Out, Partial Perforation | 3 | 3% |
| 332 | Flat Top, Straight Sides, No Perforation | 1 | 1% |
| 412 | Multiple Top, Sides Angled In, No Perforation | 3 | 3% |
| 413 | Multiple Top, Sides Angled In, Partial Perforation | 3 | 3% |
| 422 | Multiple Top, Sides Angled Out, No Perforation | 1 | 1% |
| 423 | Multiple Top, Sides Angled Out, Partial Perforation | 5 | 5% |

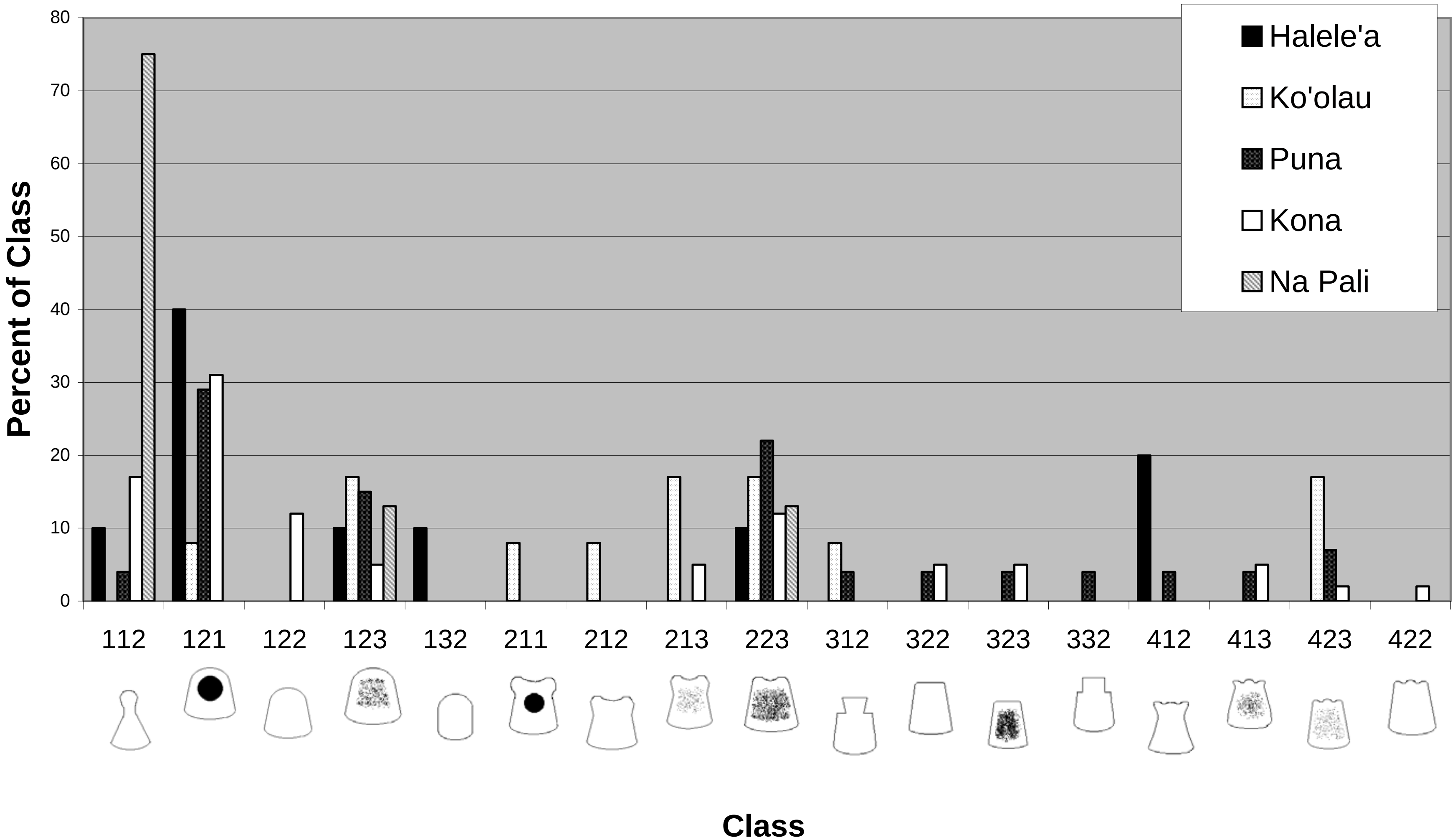
classes 112 and 223 with 15 artifacts each (15%). Thus over 55% of the artifacts fell into just three of the 17 classes (121, 112, and 223). These three classes roughly conform to the traditional knobbed, ring, and stirrup types (See Figure 3.5). The remaining pounders were distributed across 14 classes.

Figure 3.6 illustrates the relative diversity of classes by district. As expected, the Nā Pali district with the fewest number of artifacts (8 pounders) yielded the fewest realized classes (3 classes). However, the 11 poi pounders from the Koʻolau district were spread across eight different classes, while Kona district's 42 pounders were distributed among only 11 different classes. Haleleʻa district included 10 artifacts spread across six classes, while Puna district's 27 pounders were distributed among 11 classes.

The four aberrant artifacts that were removed from the temporal analysis were either unfinished or may not be poi pounders (Table 3.5, Figures 3.1 & 3.2). Thus to examine spatial variability in poi pounder style, these artifacts must be removed from the spatial analysis as well. The remaining spatial analyses will not include these artifacts, therefore sample size will be reduced to 94, with 10 pounders from Haleleʻa, 11 from Koʻolau, 26 from Puna, 39 from Kona, and 8 from Nā Pali. The regional sample sizes are now equal, with 47 poi pounders from each region.

Figure 3.7 illustrates the distribution of realized classes with the aberrant artifacts removed. Classes 322 and 422 are eliminated, leaving only 15 realized classes. Over 60% of the poi pounders fall into the three largest classes (121, 112, and 223). Figure 3.8 shows the distribution of classes by district with the aberrant artifacts removed. Again classes 322 and 422 are eliminated, reducing the number of classes in Kona to nine and

## Figure 3.6: Distribution of Classes by District



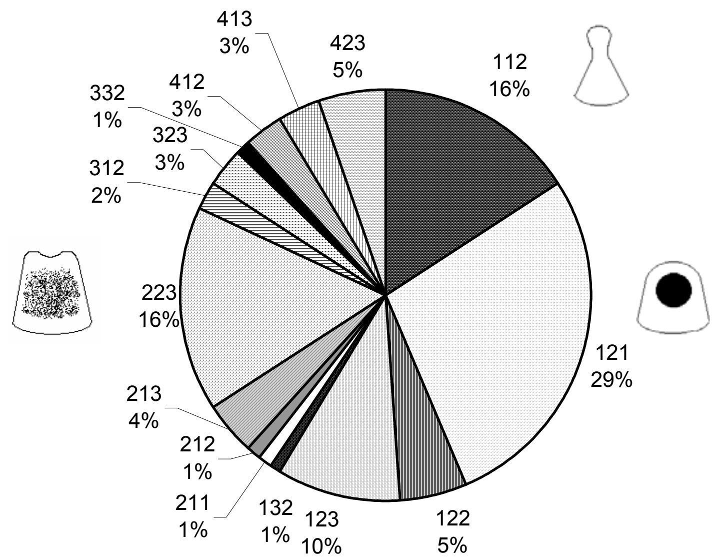
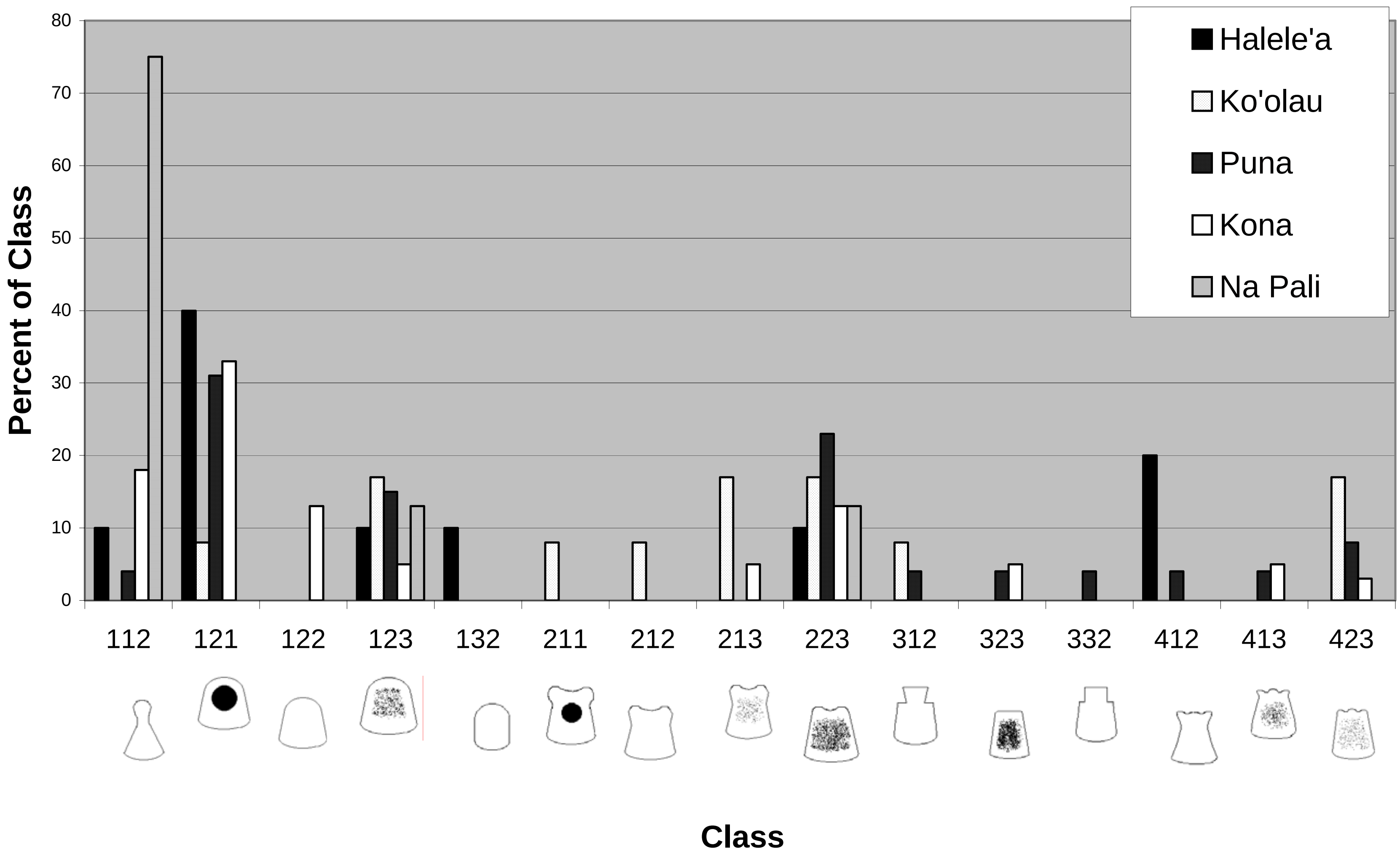



Figure 3.7: Frequency of Realized Classes with Aberrant Artifacts Removed

Puna to ten. The other districts remained the same, with three classes from Nā Pali, six from Halele‘a and eight from Ko‘olau.

Although the district samples are small, it appears that the poi pounders from Halele‘a and Ko‘olau are the most variable in form and those from Kona are the least variable. In fact, Ko‘olau district’s eight classes are all represented by fewer than two artifacts each. The greater diversity in Halele‘a and Ko‘olau may relate to a greater importance of poi in these districts, a longer period of occupation in these areas, or both. Differences in variability may also be explained by social factors, with areas under tighter political control or areas with fewer artifact manufacturers exhibiting more homogenous pounders.

**Figure 3.8: Distribution of Classes by District with Aberrant Artifacts Removed**

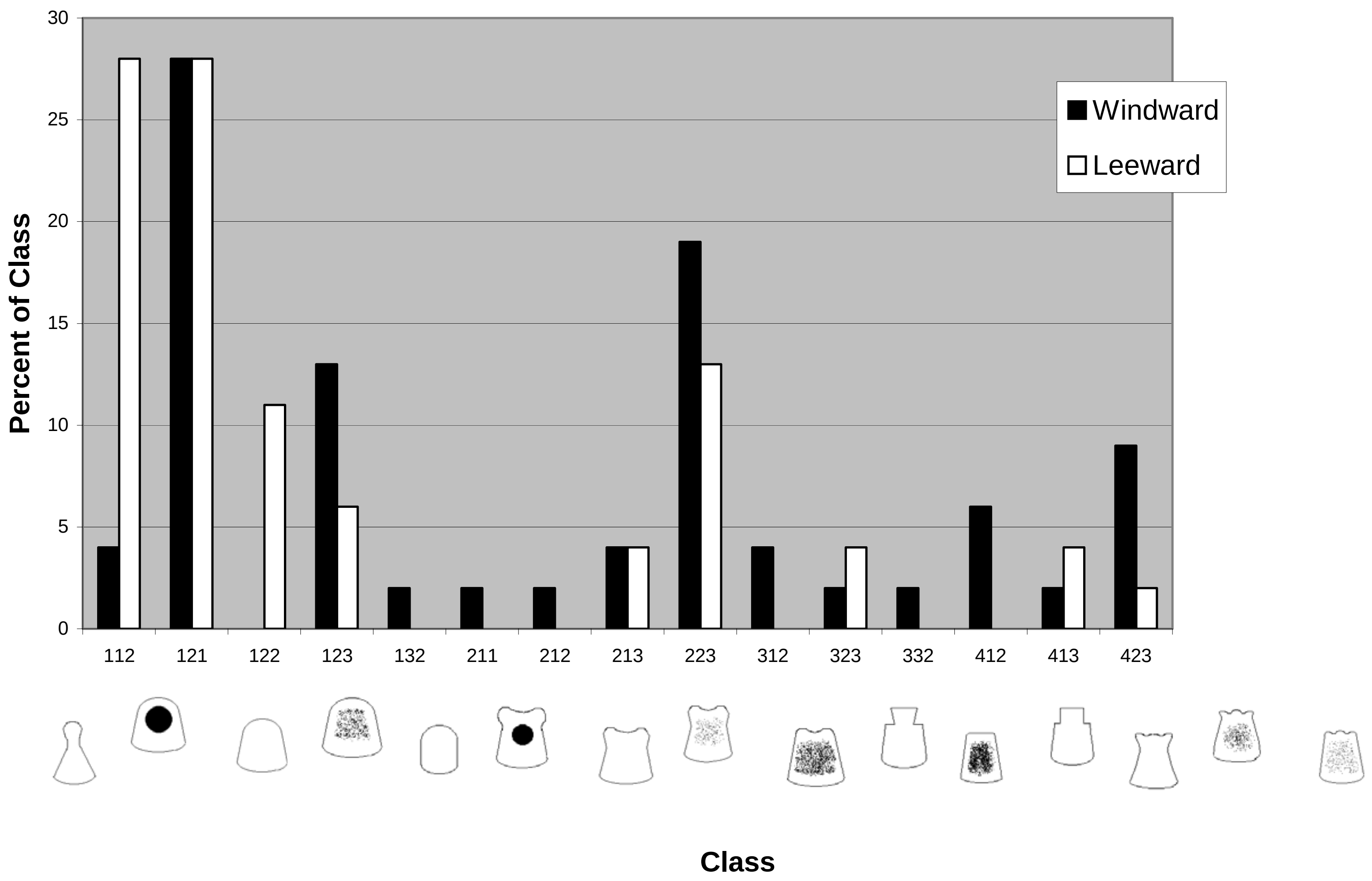


Five artifact classes were found in a single district. These are 122 from Kona, 132 from Halele‘a, 211 and 212 from Ko‘olau, and 332 from Puna. All of these classes are represented by only one artifact each, except class 122, which contained five artifacts all from the Kona district. These distributions may be a product of sampling, or may represent distinct personal or geographic styles.

Figure 3.9 illustrates the distribution of classes by the windward and leeward divisions. The classic knobbed form represented by class 112 is predominantly a leeward phenomenon, while the ring pounders (class 121) were equally distributed on both sides of the island. The more variable stirrup forms were more common on the windward side. As the stirrup pounders are thought to be earlier, this suggests a shift through time in the location where poi pounders were manufactured and used.

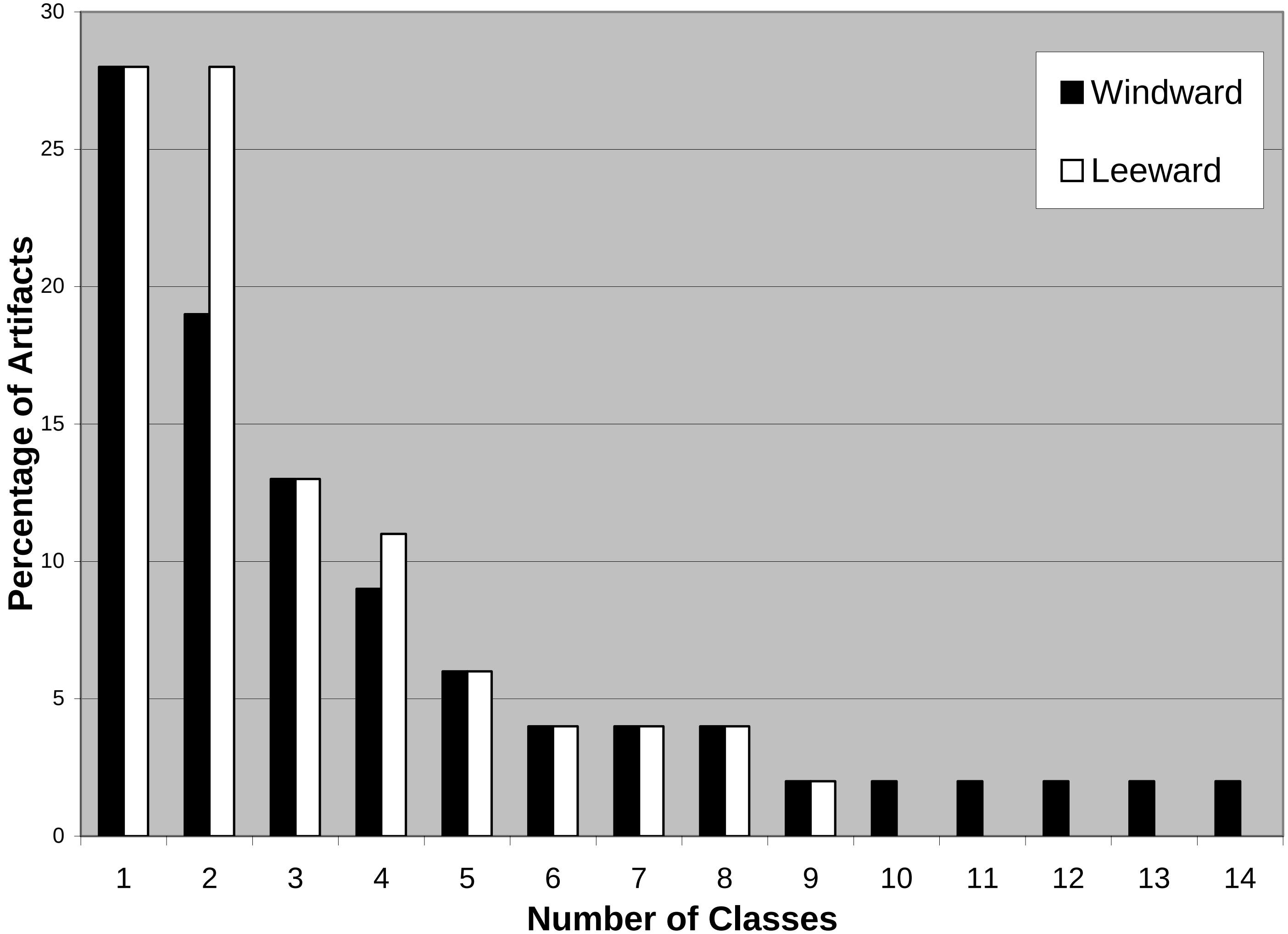
The windward poi pounders exhibited greater diversity overall, with 47 artifacts spread across 14 classes. By contrast, leeward’s 47 poi pounders were distributed among only 9 classes. Class evenness and richness are illustrated in Figure 3.10. The evenness of classes across the two regions was fairly similar (y axis), except for the unusually high number of knobbed pounders (class 112) from the leeward region (column 2 of the histogram). There were also more classes in the windward division, indicating a higher degree of class richness in this region (x axis). The differences in evenness and richness in the windward and leeward regions may be explained by the same factors suggested for district diversity. The greater variability in windward pounders may be attributed to a greater importance of poi in the wet windward region or a longer period of occupation on the windward side of the island, or both. The degree of political control and the number of artifact manufacturers may have played a role as well.

## Figure 3.9: Distribution of Classes by Region




47

Figure 3.10: Percent Distribution of Classes by Region (Evenness)



## Spatial Analysis by Dimension

Finer patterns may be visible by examining the spatial distributions of each dimension. Figure 3.11 portrays the division of artifacts by the first dimension, top. Of the four modes for this dimension, convex was the most common (58%), followed by concave (22%), multiple (11%), and flat (9%). Pounders with convex tops were the most variable, represented by five different classes, while artifacts with flat or multiple-shaped tops were least variable, each spanning only three different classes (See Figure 3.8).

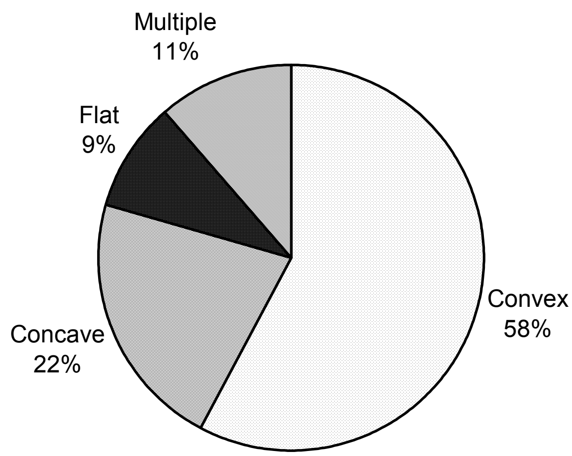
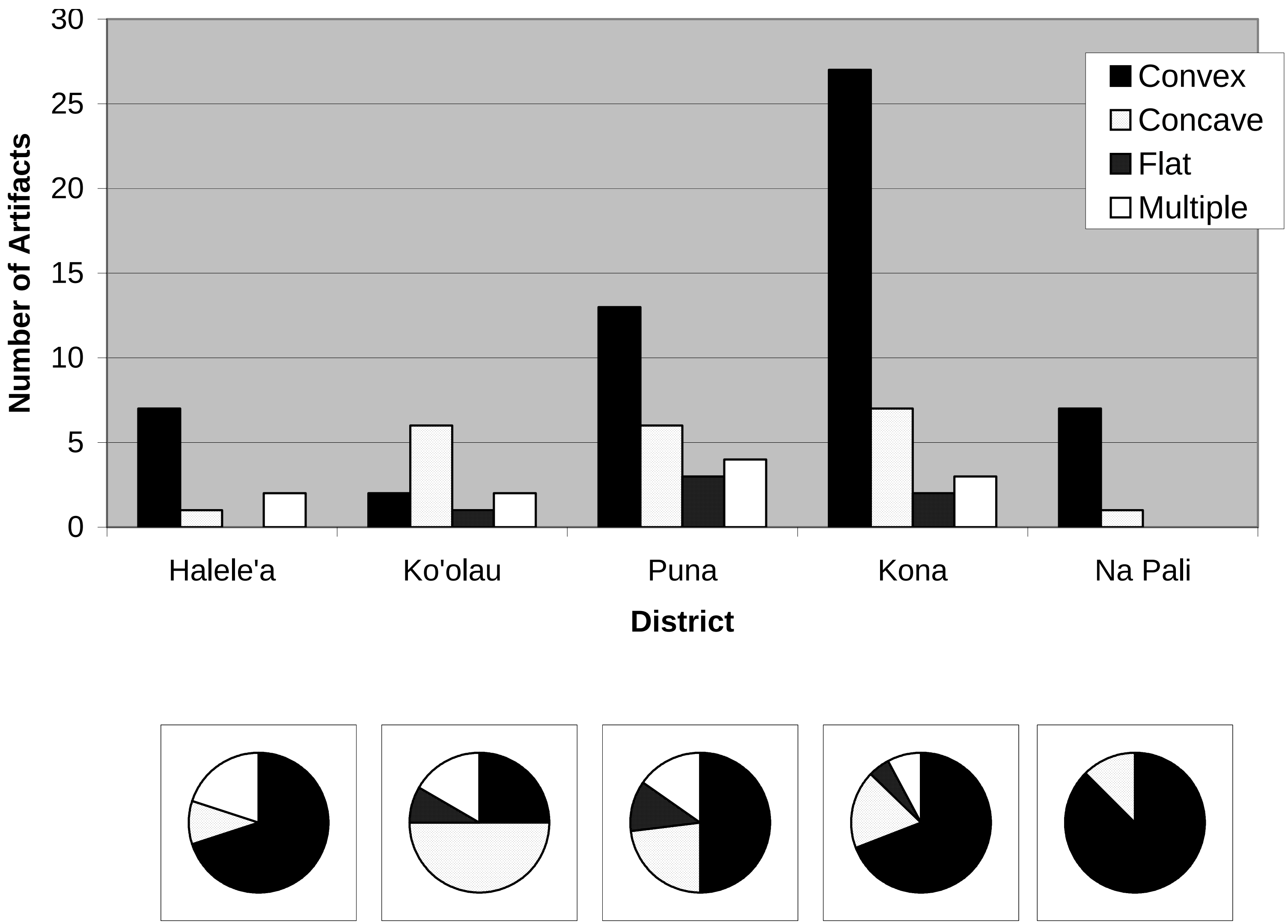



Figure 3.11: Frequency of Top Morphology Modes

The distribution of top morphology modes across the five districts is portrayed in Figure 3.12. The convex mode was most common across all districts except Koʻolau, where concave was most common. All modes were represented in Koʻolau, Puna, and Kona, and the lack of the flat mode in Haleleʻa and the flat and multiple modes in Nā Pali are likely the result of a small sample size. A chi square test showed no association between top morphology and district ($p > .05$).

**Figure 3.12: Top Morphology Modes by District (values shown as number of artifacts in histogram and by percent of district in pie charts) A $\chi^2$ analysis indicates that top morphology is not associated with district ($\chi^2 = 17.09$, 12 d.f., $p > .05$).**



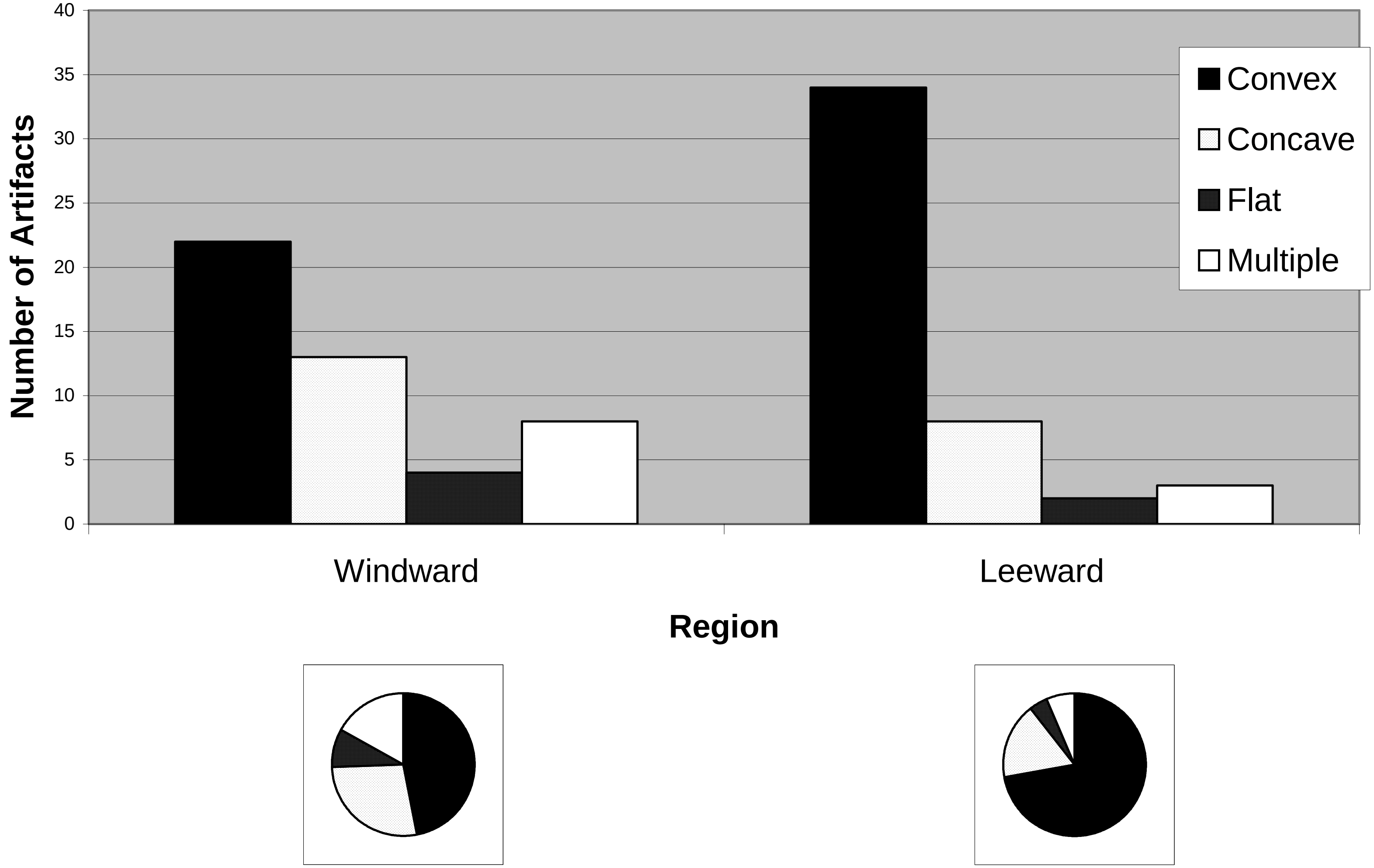
When the districts are combined to form the windward and leeward divisions, the convex mode is most common in the leeward region, while the four modes are more evenly distributed on the windward side of the island (Figure 3.13). This fits well with the earlier observation that the leeward division produced the greatest proportion of classic knobbed pounders (which all have convex tops) while the windward pounders are more diverse. Nevertheless, a chi square test showed no association between top morphology and region ($p > .05$).

Figure 3.14 illustrates the distribution of poi pounders by the second dimension, upper side morphology. The most common mode is angled out (67%), followed by angled in (31%). Straight upper sides were very rare (2%). There were no instances of the multiple mode for this dimension. Artifacts with sides angled in were most variable, represented by seven different classes, while those with sides angled out were distributed across six different classes. There were only two artifacts with straight sides, and they came from two different classes, both of which were un-perforated.

The distribution of upper side modes across the Kaua‘i districts can be seen in Figure 3.15. The angled in and angled out modes occur in every district. The angled out mode was most common in all districts except Nā Pali, where angled in was most common, but again this may be a product of the small sample size for Nā Pali. The straight mode was least common, with only two instances observed - one each from the Puna and Halele‘a districts. A chi square test showed marginal association between upper side morphology and district ($p < .05$).

Figure 3.16 illustrates the distribution of upper side modes across the windward and leeward regions. Poi pounders with upper sides angled in were more common in the

**Figure 3.13: Top Morphology Modes by Region (values shown as number of artifacts in histogram and by percent of region in pie charts) A $\chi^2$ analysis indicates that top morphology is not associated with region ($\chi^2 = 6.70$, 3 d.f., $p > .05$).**



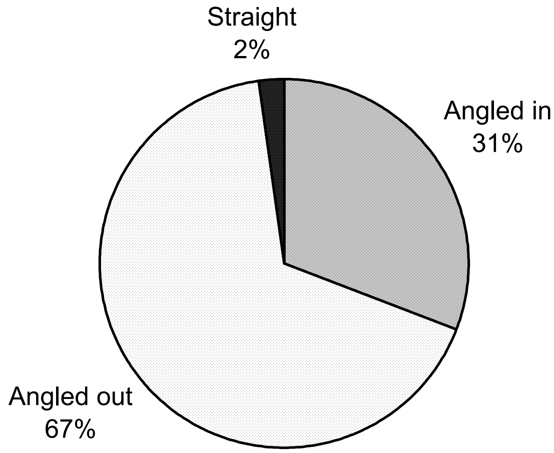



Figure 3.14: Frequency of Upper Side Modes

leeward division than the windward and those with sides angled out were relatively equally divided between the windward and leeward regions. Straight sides occurred only on the windward side of the island. A chi square test showed no association between upper side morphology and region ($p > .05$).

Figure 3.17 shows the distribution of artifacts by the final dimension, perforation. The perforation modes were relatively equally distributed, with 41% partially perforated, 30% not perforated, and 29% perforated. These modes were well distributed across the districts, except for Nā Pali, which lacked perforated pounders (Figure 3.18). Although every mode is represented in the other districts, different proportions of the three modes can be seen in each area. The three modes were most evenly distributed in Kona.

Partially perforated pounders were most common in Koʻolau, Puna, and Kona and less common in Haleleʻa and Nā Pali. Un-perforated poi pounders were most common in Nā Pali and less common in Puna and Kona. Perforated and un-perforated pounders were

**Figure 3.15: Upper Side Modes by District (values shown as number of artifacts in histogram and by percent of district in pie charts) A $\chi^2$ analysis indicates that upper side morphology is marginally associated with district ($\chi^2 = 15.73$, 8 d.f., $p < .05$).**

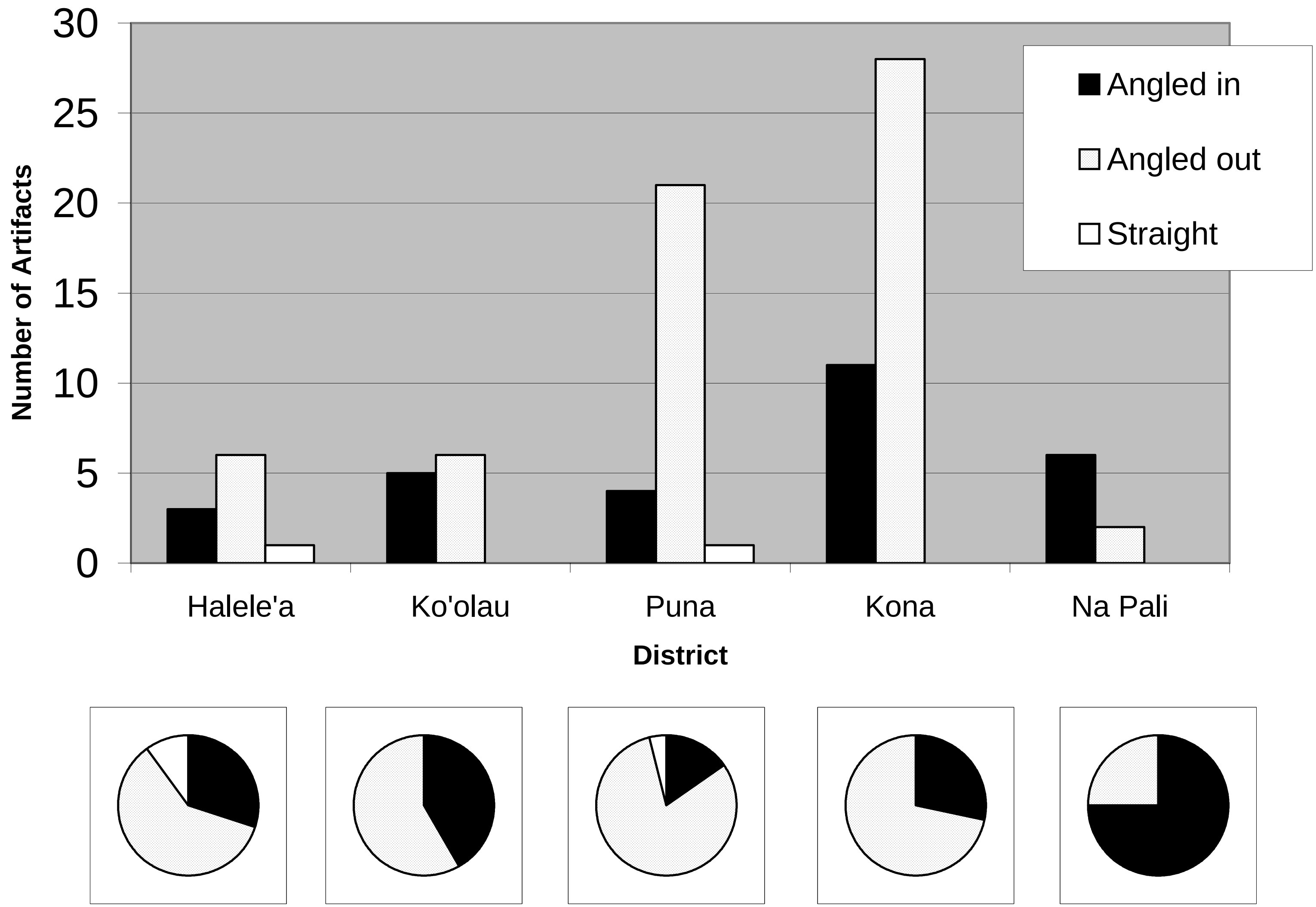
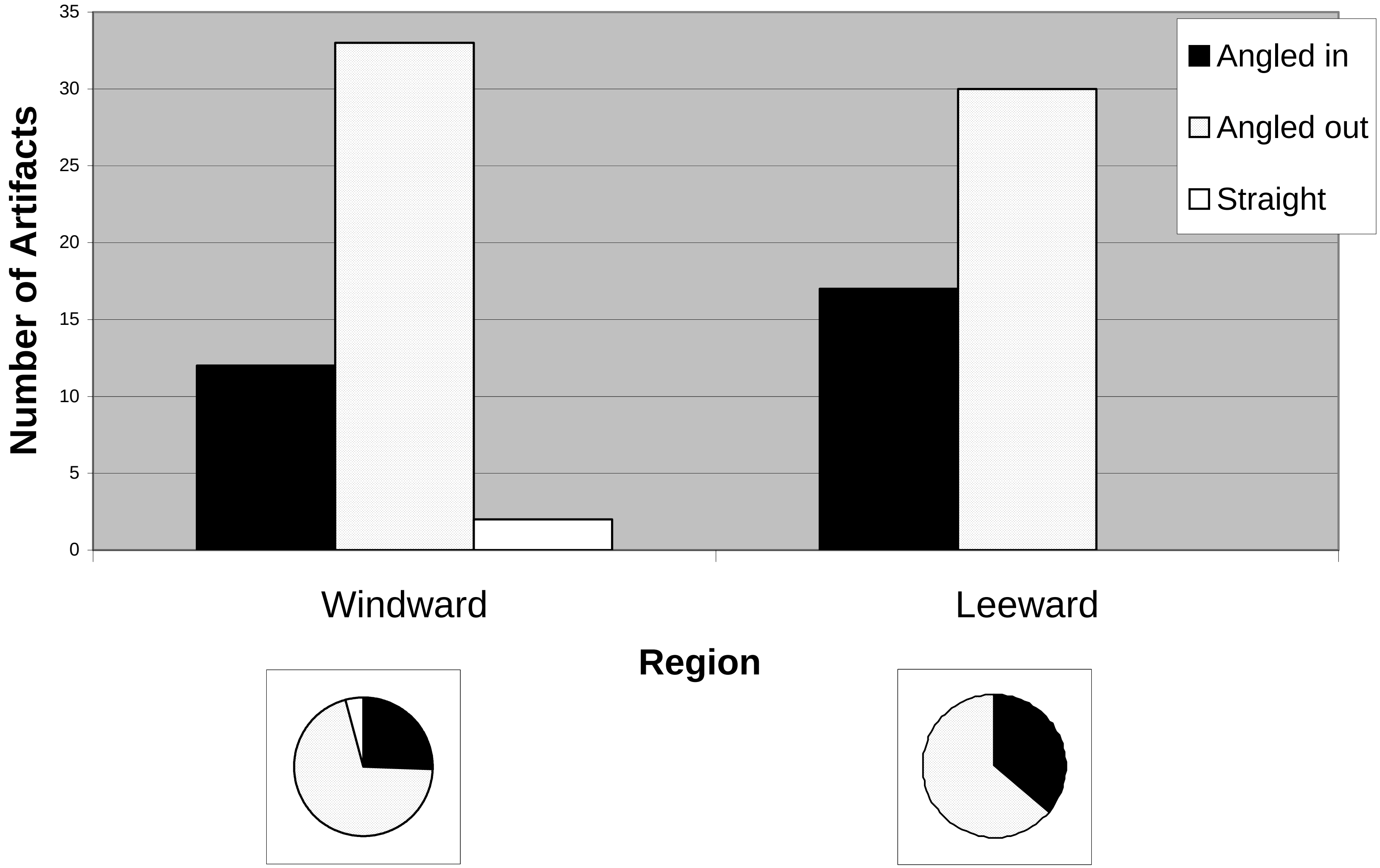


**Figure 3.16: Upper Side Modes by Region (values shown as number of artifacts in histogram and by percent of region in pie charts) A $\chi^2$ analysis indicates that upper side morphology is not associated with region ($\chi^2 = 3.00$, 2 d.f., $p > .05$).**



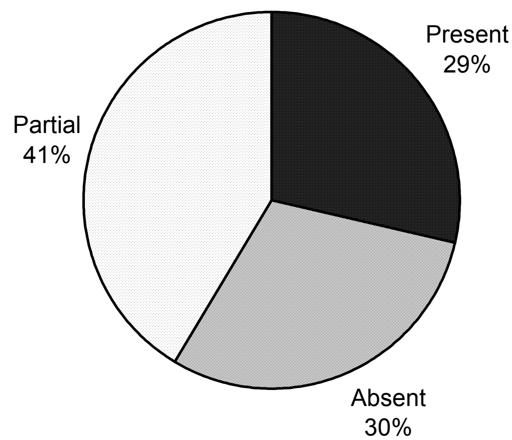



Figure 3.17: Frequency of Perforation Modes

equally common in Halele‘a and Ko‘olau. A chi square test showed marginal association between perforation and district ($p < .05$).

Perforated pounders were evenly distributed across the windward and leeward divisions of Kaua‘i (Figure 3.19). Un-perforated pounders were more common on the leeward side and less common on the windward while those exhibiting full or partial perforation were more common on the windward side and less common on the leeward. This is again a reflection of the abundance of knobbed pounders on the leeward side and the diversity in windward pounder forms. However, a chi square test showed no association between perforation and region ($p > .05$).

Perforated pounders were represented in only two realized classes, while non-perforated ones were distributed across seven classes and partially perforated pounders were represented in six classes (See Figure 3.8). Thus, the perforated pounders exhibited

**Figure 3.18: Perforation Modes by District (values shown as number of artifacts in histogram and by percent of district in pie charts) A $\chi^2$ analysis indicates that perforation is marginally associated with district ($\chi^2 = 15.97$, 8 d.f., $p < .05$).**

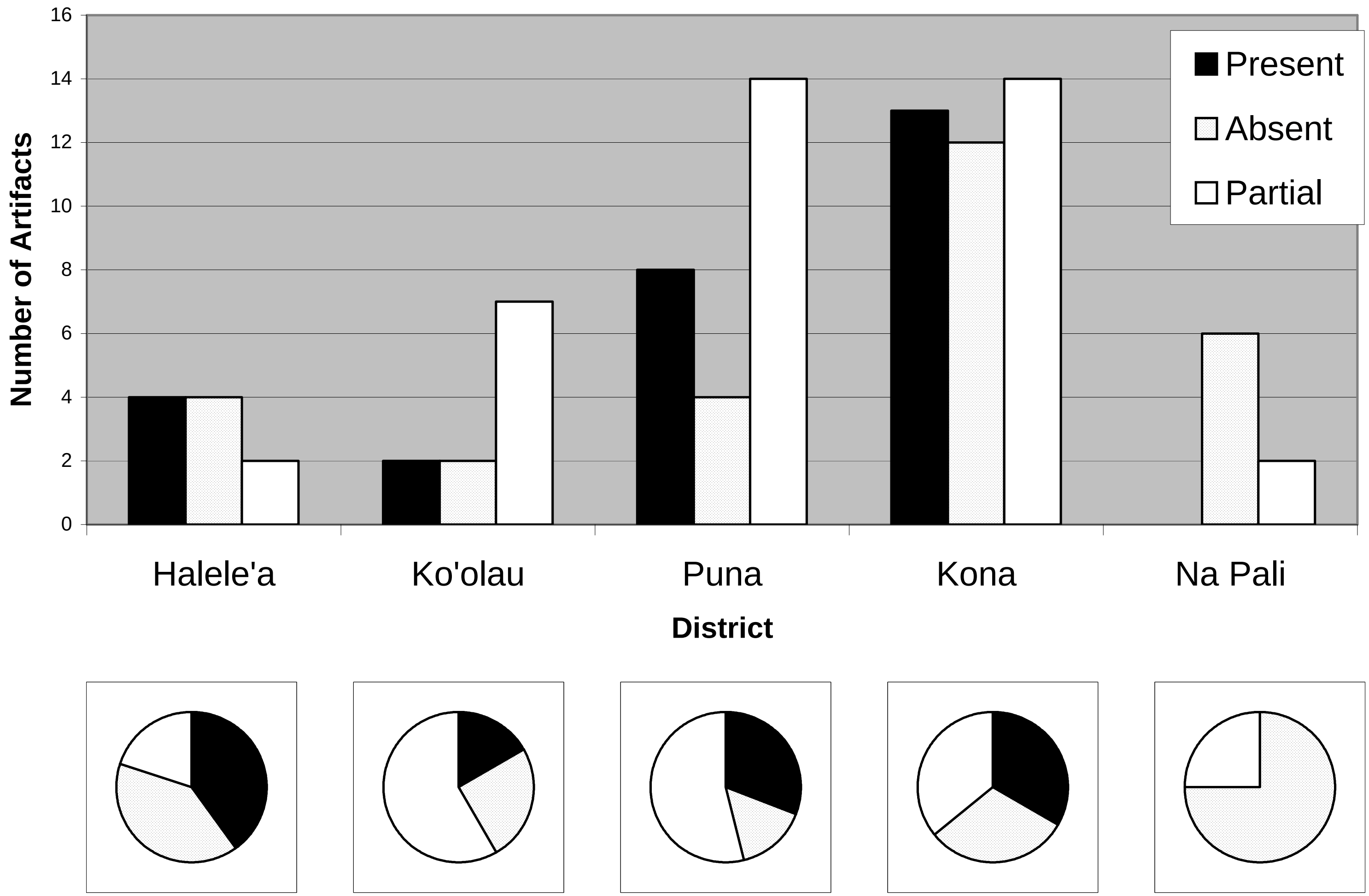
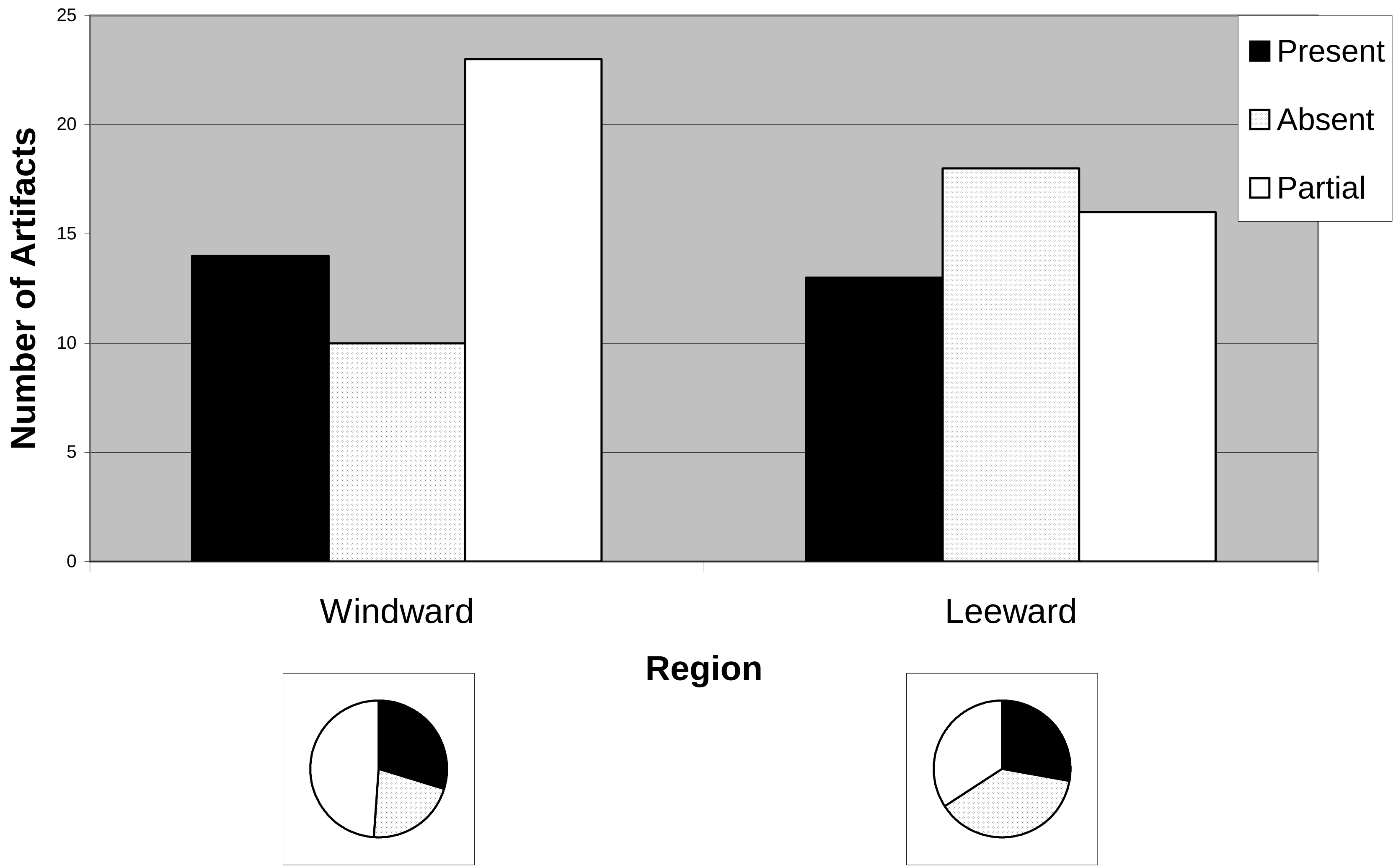


**Figure 3.19: Perforation Modes by Region (values shown as number of artifacts in histogram and by percent of region in pie charts) A $\chi^2$ analysis indicates that perforation is not associated with region ($\chi^2 = 3.58$, 2 d.f., $p > .05$).**



the least variability, with 26 of the 27 artifacts having a convex top and upper sides angled out (class 121).

When the upper side and perforation modes are combined, a significant association by district is revealed ($p < .01$) (Figure 3.20). Classes with very low numbers were removed for the chi square analyses as these affect the accuracy of the chi square test (Snedecor and Cochran 1976). Pounders with upper sides angled out and partial perforation were the most common, appearing in every district. The angled in/full perforation combination was least common, with a single instance observed in Koʻolau district.

These two modes were not associated with the windward and leeward regions ($p > .05$) (Figure 3.21). Classes with low numbers were again removed from the analysis. Pounders with upper sides angled out and partial perforation were more common on the windward side, while those with upper sides angled out and no perforation were found only in the leeward region.

Figures 3.12-3.21 illustrated stylistic variability across the five *mokuʻāina* districts and the windward and leeward regions of Kauaʻi. Chi square tests revealed a significant association by district only when the upper side morphology and perforation modes were combined ($p < .01$) (See Figure 3.20). However, marginally significant associations were evident between district and upper side morphology individually ($p < .05$) (See Figure 3.15), and district and perforation individually ($p = < .05$) (See Figure 3.18). These do not have the degree of confidence as a .01 p-value, yet the association between these dimensions and the districts is suggestive, albeit not well confirmed.

**Figure 3.20: Upper Side and Perforation Modes by District ($\chi^2$ analysis indicates that these two modes are associated with district [$\chi^2 = 32.60$, 16 d.f., $p < .01$])**

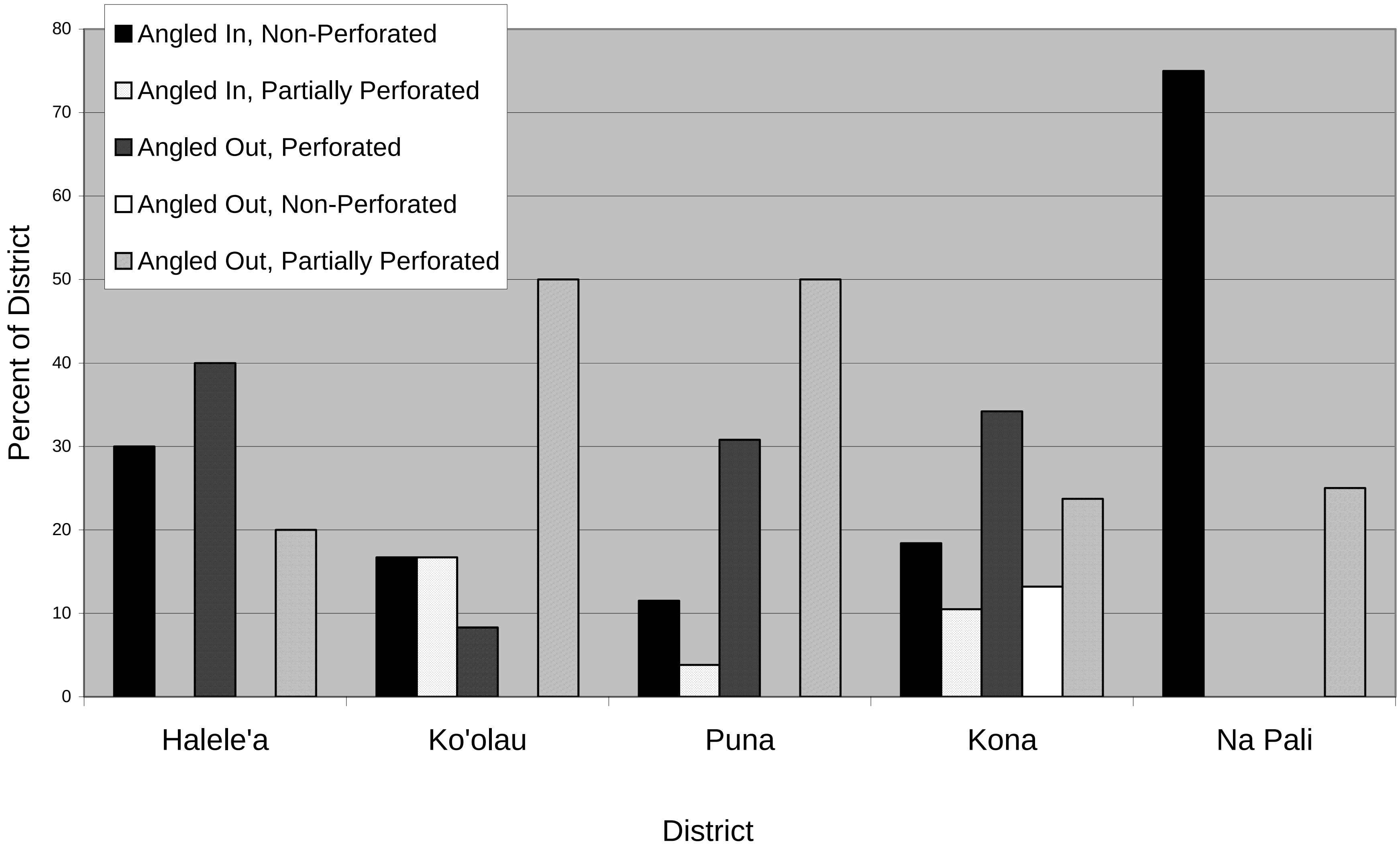
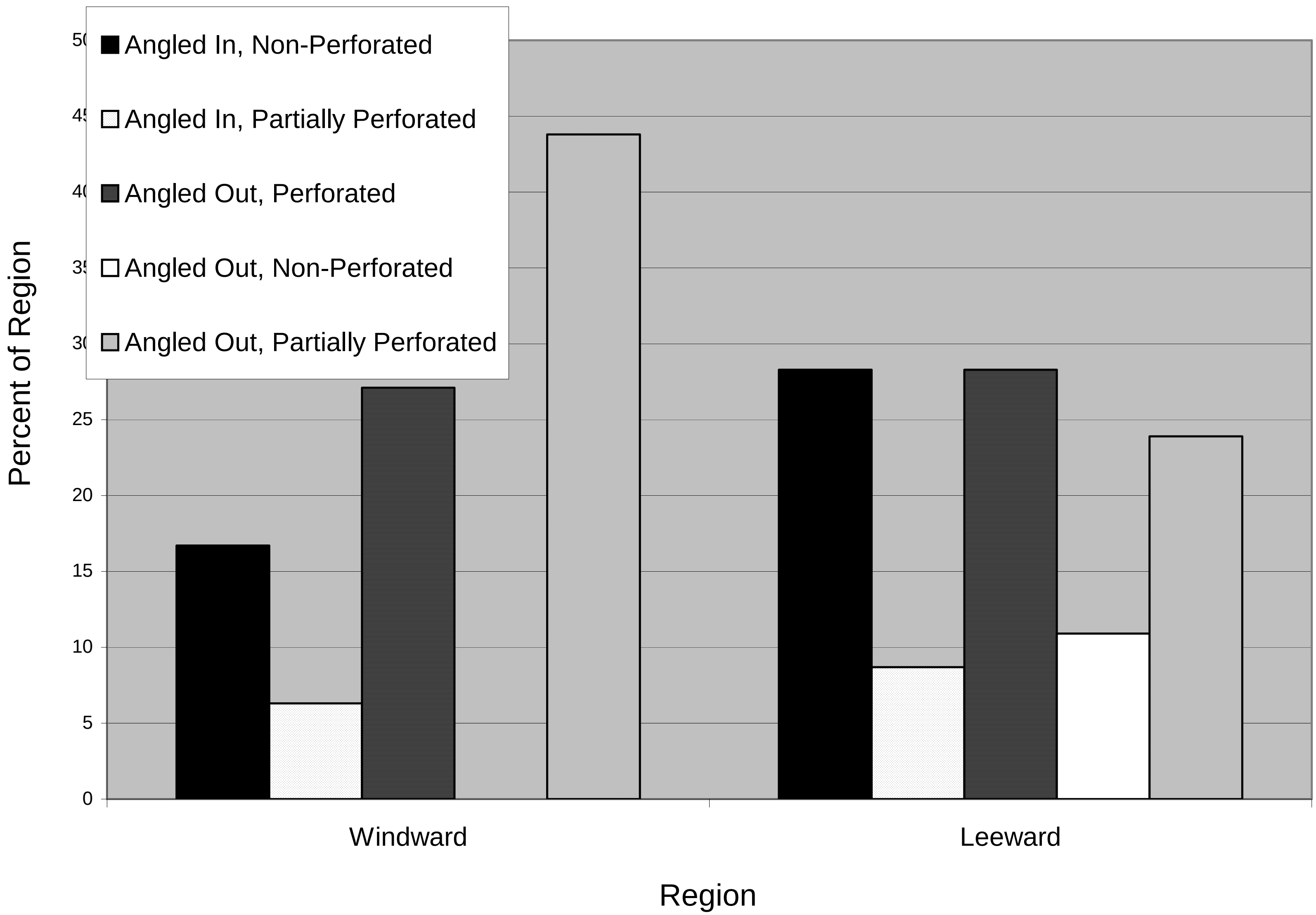


**Figure 3.21: Upper Side and Perforation Modes by Region ($\chi^2$ analysis indicates that these two modes not associated with region [$\chi^2 = 9.45$, 4 d.f., $p > .05$])**



In sum, the spatial analyses did show patterns when the stylistic classes were arrayed across the districts and regions of Kaua‘i. The knobbed pounders of class 112 were more common on the leeward side of the island, while the older stirrup forms were more common in the windward region. The poi pounders of Halele‘a and Ko‘olau district appeared most variable, and those of Kona least variable. Samples were too small to perform a chi square test at this scale, but when the artifacts were arrayed by individual dimension, most distributions were not statistically significant. This suggests that the dimensions that comprise the stylistic classes are a better reflection of variation through time than across space. The seriations showed that information regarding poi pounder form was transmitted at the scale of the entire island, thus it makes sense that significant patterns do not appear in geographic units smaller than this scale.

In conclusion, robust patterns were evident when stylistic classes were arrayed through time. Temporal analyses illustrated a change from variability to homogeneity through time, with stirrup pounders oldest, ring forms intermediate in age, and knobbed pounders most recent. Frequency seriation suggested earlier occupation of the windward region, as more of the older stirrup forms derive from this side of the island. Spatial analyses support this hypothesis, with the majority of knobbed pounders from the leeward region.

# CHAPTER 4

## FUNCTIONAL ANALYSES

Weight, overall height, base diameter, base height, and material type serve as functional or technological attributes. Functional analyses indicate that the knobbed pounders were the tallest and heaviest and exhibited the most variability in weight and overall height. Stirrup pounders were lightest in weight and had the narrowest bases. Ring pounders had the smallest average base heights, suggesting long use-lives. A pairwise correlation of functional variables revealed that the three poi pounder types co-vary according to function, with the knobbed pounders exhibiting the most significant relationships between functional variables. Analysis of material type suggests a shift toward denser materials through time. Overall it appears that poi pounders became heavier over time.

Distinguishing style from function has been a major concern in artifact analysis in the Pacific (Allen 1996, Field 1996:12-13) and elsewhere (Dunnell 1978a, 1978b). Stylistic attributes, such as the decoration on a ceramic vessel, are non-selective, while functional attributes, such as the thickness of a vessel wall, directly affect the fitness of an artifact (Dunnell 1978a:120). In the Pacific, functional attributes are often neglected in favor of stylistic ones, as stylistic attributes are the building blocks of seriation (Graves and Abad 1996, Cochrane 2002). Yet, functional traits can be indicative of environmental conditions, mechanisms of selection, and processes of adaptation.

I chose to investigate weight, overall height, base diameter, base height, and material type as functional characteristics of poi pounders. Pounder weight plays a direct role in the time and energy it takes to process the taro root into poi. A heavier pounder exerts more force on the taro, mashing it in fewer blows than a lighter one, yet a heavier pounder takes more energy to lift. These heavier implements would require more strength to operate but would have gotten the job done in less time than a lighter poi pounder. Also, a heavier pounder may require basalt limited in distribution or larger blocks of basalt. In addition to raw material, the weight of a pounder is likely influenced by overall height and diameter of the base.

The diameter of the base also has a direct effect on the amount of taro that can be mashed at once. A wider base is capable of mashing a larger quantity of taro, while a narrower base is limited in the amount of taro it can process. The height of the base (the measure from the widest point on the base of the artifact to the bottom of the artifact; see Figure 2.1) may correspond with the use-life of the object. Pounders with tall bases can have longer use-lives than those with shorter bases. The underside of a pounder may wear through time, potentially reducing the base height as the artifact is utilized, thus pounders with short bases may have been used for longer periods of time than those with tall bases. The height of the base may have also had an effect on the technique utilized for pounding poi. Pounders with tall bases exhibit undersides that are more deeply convex, and this would facilitate a rocking motion as poi is pounded. Those with short bases have flatter undersides, and this would necessitate a vertical pounding motion without rocking. Thus base height may also reflect a choice by the manufacturer regarding the manner in which the tool was employed to pound food.

Weight, overall height, base diameter, base height, and material type may also be related to the variety of taro being processed. Over 300 varieties of taro were cultivated in ancient Hawaiʻi, and many of these were suitable for making poi (Wang 1983:172, Neal 1965:158). The size and consistency of the species of taro to be processed may have been a consideration in selecting for functional attributes of the pounder. For example, a softer, smaller corm would require a lighter pounder with a smaller base. Poi pounders were also used in the preparation of sweet potato poi (Handy et al. 1991:135), which may have been easier to mash with a lighter pounder.

## Analyses

### Weight

I was able to ascertain the weight, overall height, base diameter, and base height of 149 poi pounders (See Table 2.1). Of these I was able to determine the material type of 132 pounders. The two artifacts from the stylistic sample that were thought to be unfinished were omitted from the functional analyses, as they would not have been utilized (See Table 3.5 and Figures 3.1 and 3.2). However, the two artifacts that may not have been poi pounders (See Table 3.5 and Figure 3.1) were left in these analyses and will be given special consideration.

Weights ranged from 0.580 kilograms to 4.309 kilograms. Figure 4.1 illustrates the distribution of classes by weight. Patterns are easier to see when viewed from the traditional knobbed, ring, and stirrup divisions (Figure 4.2). The knobbed form corresponds with class 112, ring pounders with class 121, and classes 122,123,132, 211,

**Figure 31: Distribution of Artifact Classes by Weight**

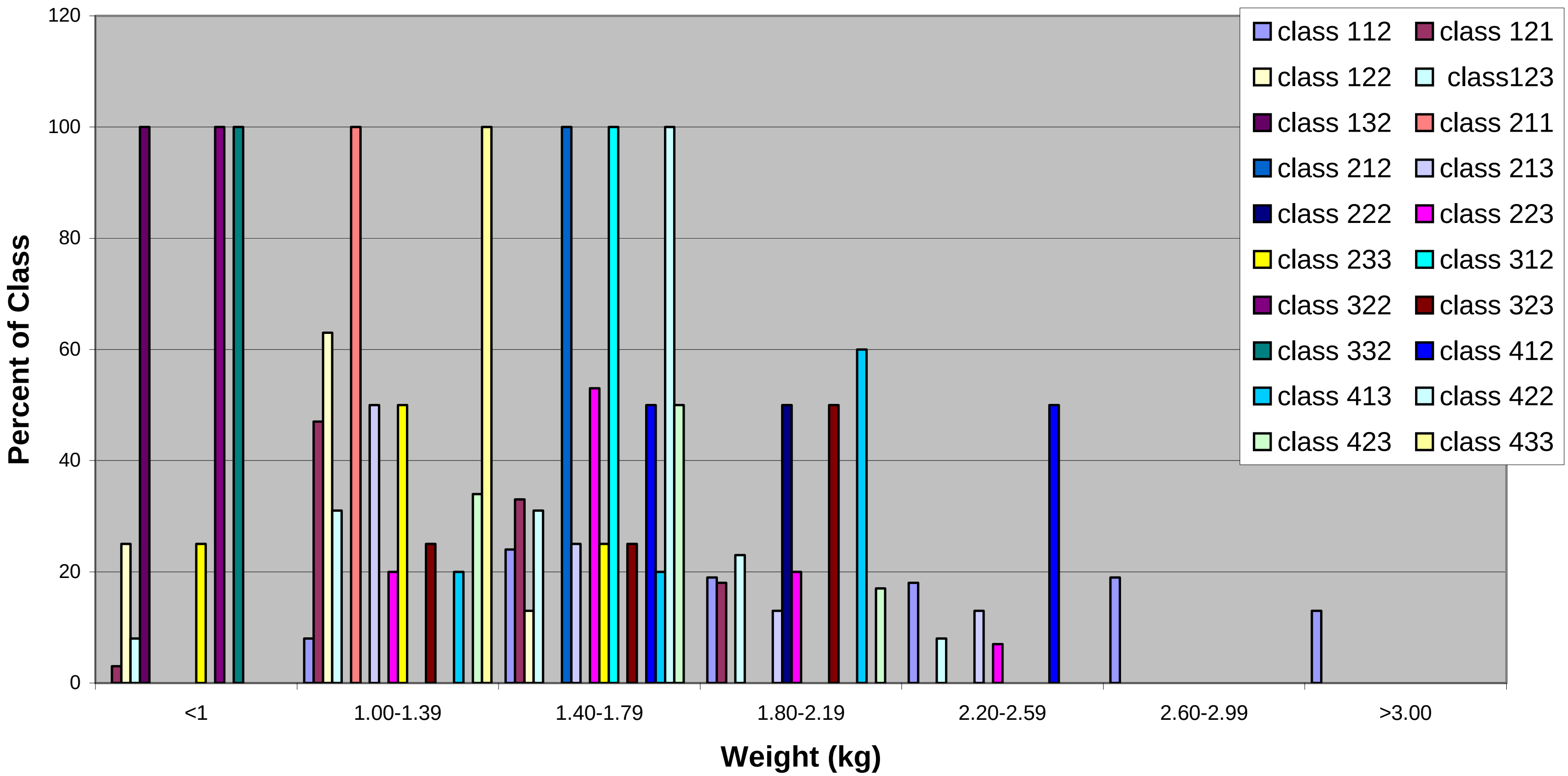
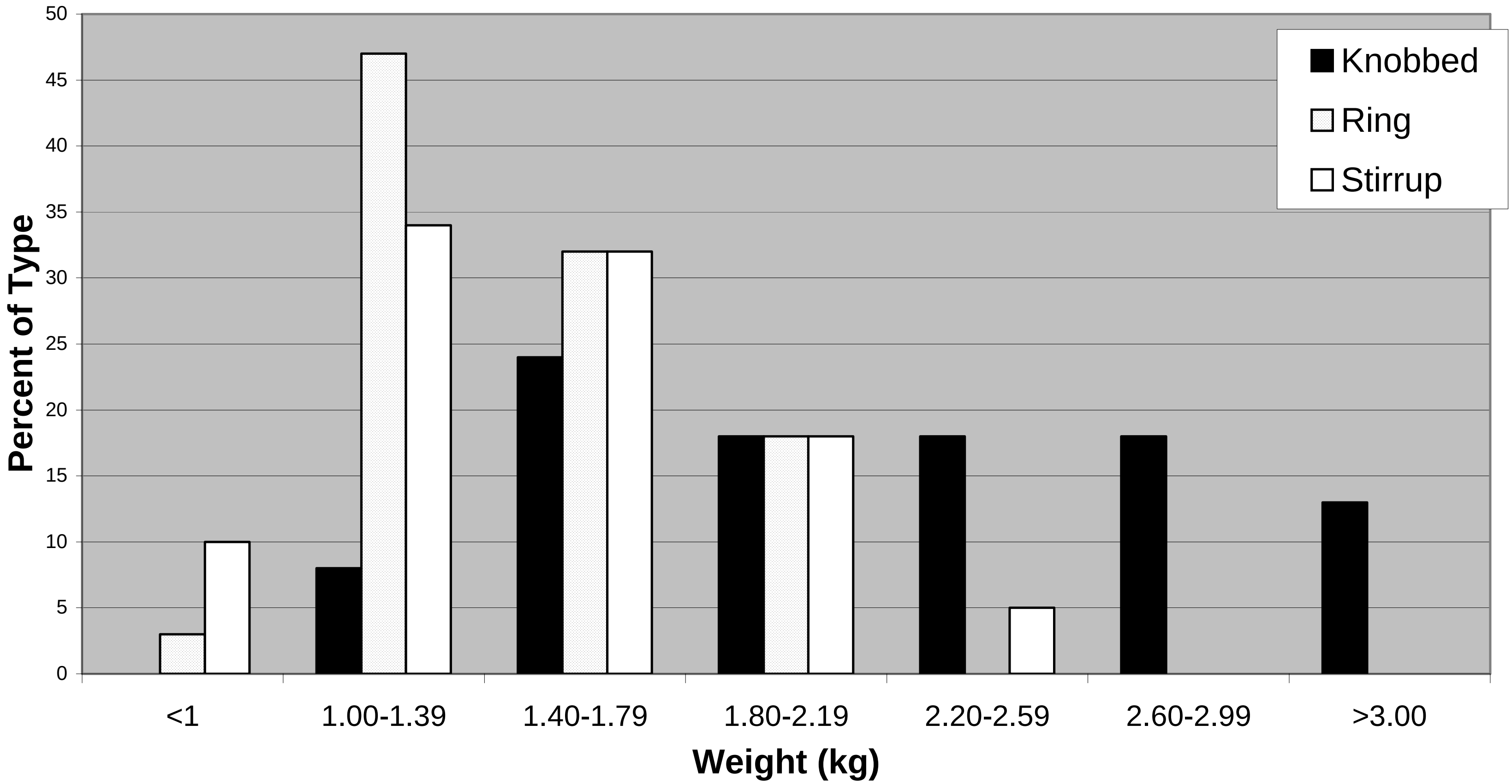


Figure 4.2: Distribution of Knobbed, Ring, and Stirrup Forms by Weight



212, 213, 222, 223, 233, 312, 322, 323, 332, 412, 413, 422,423, and 433 combine to make up the stirrup grouping. The two aberrant artifacts left in the functional analyses are of classes 322 and 422, and would fall into the stirrup grouping. Although the stirrup type includes a greater number of stylistic classes this does not skew variability, as the coefficient of variation for the functional attributes is not always higher for the stirrup pounders (See Tables 4.1-4.4, to be discussed below).

The knobbed pounders are clearly heavier than the ring or stirrup forms (See Figure 4.2). Extra weight may have been necessary to exert heavier blows with the knobbed pounders because they were operated with only one hand. Additional weight may not have been as important to the ring and stirrup pounders as they may have utilized the force of two hands.

The coefficient of variation is an assessment of variation in common units across the different forms. This value is calculated by dividing the standard deviation by the mean (Shennan 1988:43-44). A larger coefficient of variation indicates greater variability. The knobbed pounders were more variable in weight than the other forms (Table 4.1). Differences in weight likely reflect variation in the overall size of the artifacts and not simply variation in the density of the raw materials they were made from, as the knobbed pounders were the most variable in overall height as well (Table 4.2).

Table 4.1: Central Tendency and Variability in Weight (kg)

| | Knobbed | Ring | Stirrup |
|---|---|---|---|
| Mean | 2.300 | 1.460 | 1.486 |
| Standard Deviation | 0.786 | 0.303 | 0.427 |
| Coefficient of Variation | **0.342** | **0.207** | **0.287** |

Table 4.2: Central Tendency and Variability in Overall Height (cm)

| | Knobbed | Ring | Stirrup |
|---|---|---|---|
| Mean | 19.942 | 13.638 | 12.433 |
| Standard Deviation | 2.896 | 1.129 | 1.448 |
| Coefficient of Variation | **0.145** | **0.083** | **0.116** |

### Height

Overall height was measured as the greatest distance from the top to the bottom of the artifact (See Figure 2.1). Overall heights ranged from 9.3 centimeters to 25.5 centimeters (Figure 4.3). Knobbed pounders were tallest by far, while stirrup pounders were shortest. Neither the ring nor stirrup forms exceeded 16 centimeters in height. Knobbed pounders showed the most variability in height, while ring pounders were least variable (See Table 4.2).

### Base diameter

Base diameter was measured as the greatest width at the base of the artifact (See Figure 2.1). Base diameters ranged from 5.5 to 17.9 centimeters (Figure 4.4). Though generally lightweight, the ring pounders exhibited large base diameters. The stirrup forms exhibited the smallest base diameters, while the base diameter of the knobbed pounders was intermediate between the other forms. Although the base diameters of the stirrup pounders were smallest on average, they were most variable (Table 4.3).

Table 4.3: Central Tendency and Variability in Base Diameter (cm)

| | Knobbed | Ring | Stirrup |
|---|---|---|---|
| Mean | 13.276 | 14.088 | 11.428 |
| Standard Deviation | 1.763 | 1.546 | 1.947 |
| Coefficient of Variation | **0.133** | **0.120** | **0.170** |

Figure 4.3: Distribution of Knobbed, Ring, and Stirrup Forms by Overall Height

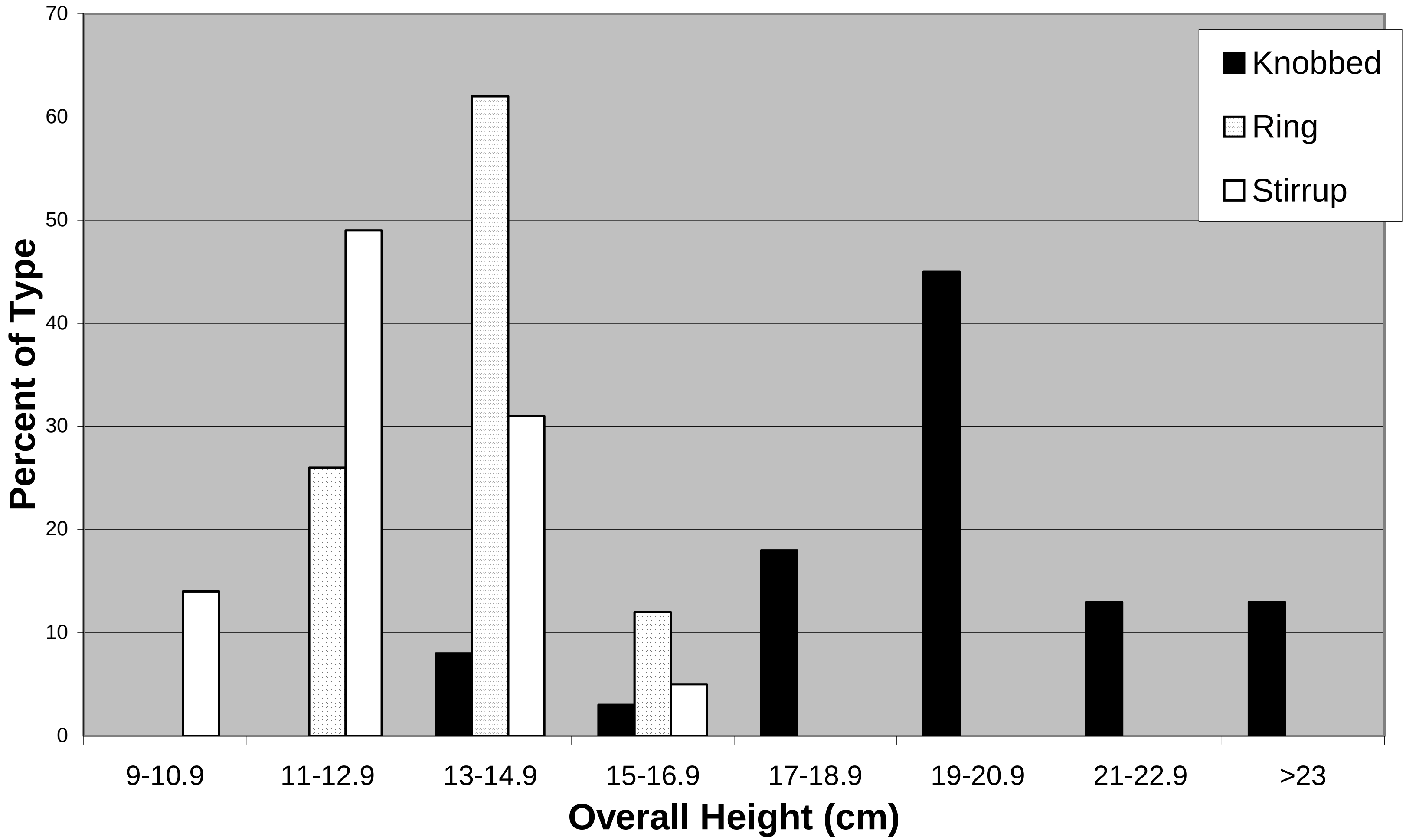
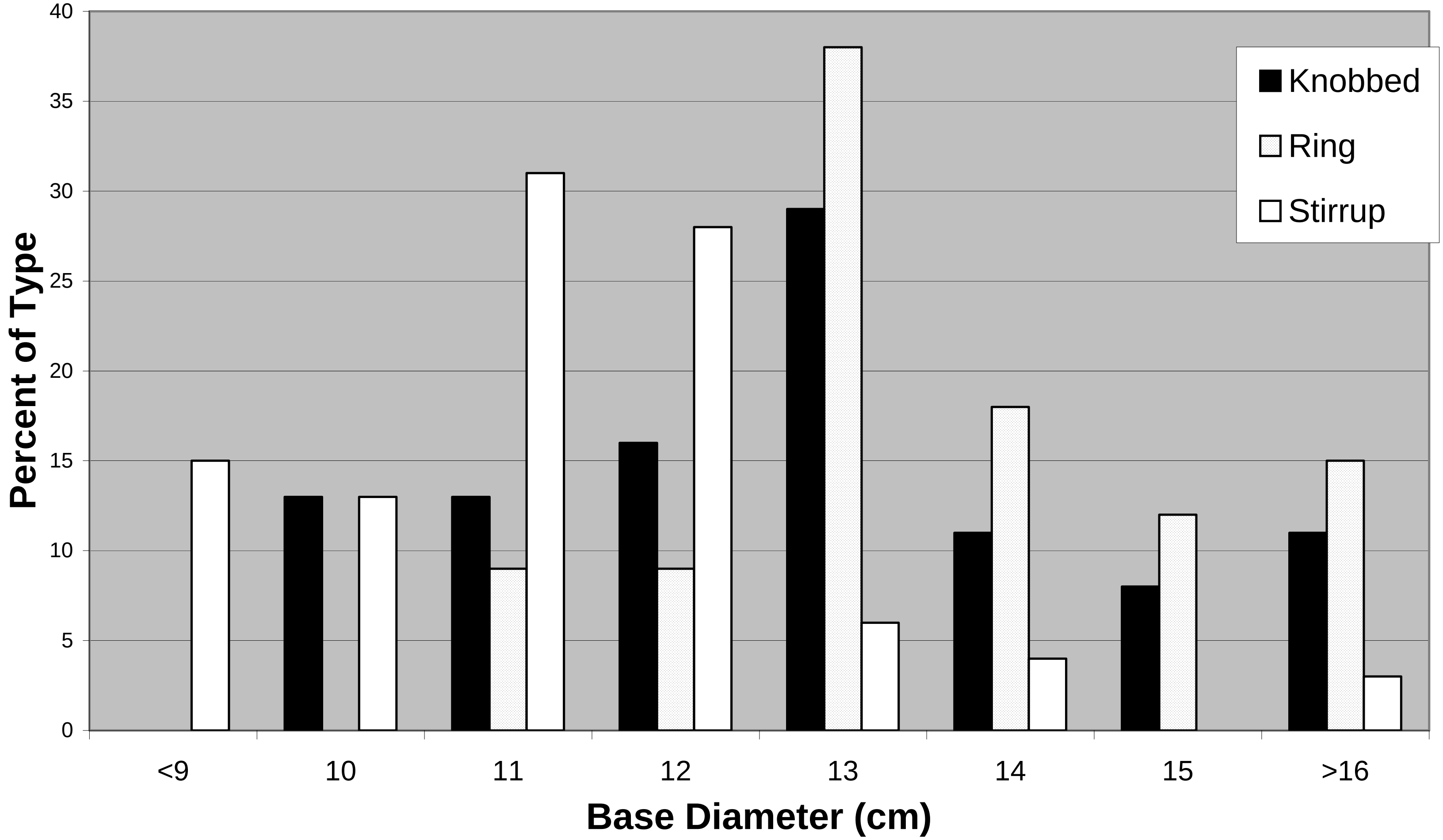


Figure 4.4: Distribution of Knobbed, Ring, and Stirrup Forms by Base Diameter



### Base Height

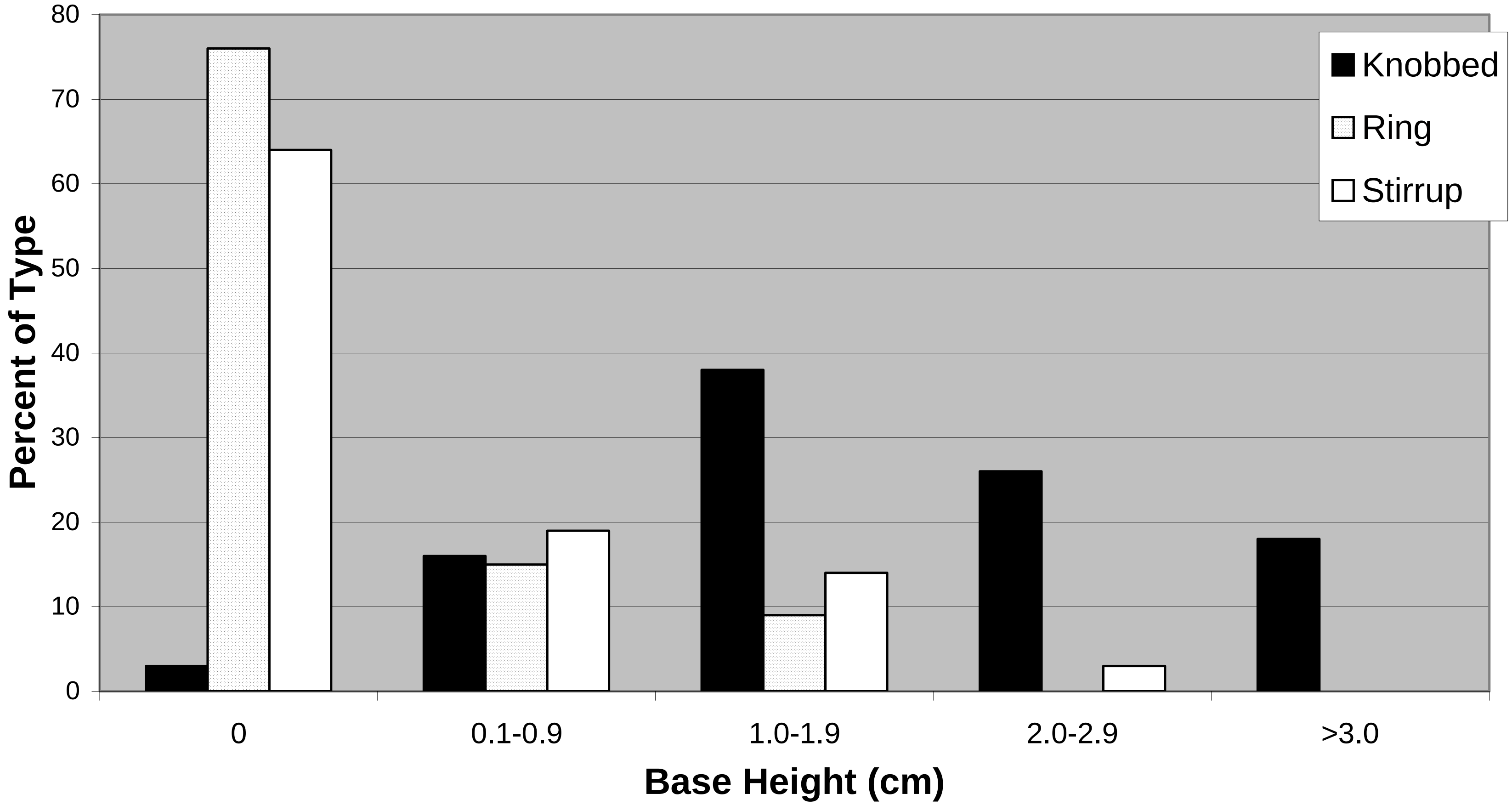
Base height was measured as the greatest height from the base diameter to the bottom of the artifact (See Figure 2.1). Base heights ranged from 0 to 5.2 centimeters (Figure 4.5). The knobbed pounders exhibited a normal distribution with the mean in the center of the histogram. However, the ring and stirrup forms were not normally distributed, as the mean for both types is close to the minimum value. Ring pounders exhibited the shortest bases while knobbed pounders had the tallest bases, and the stirrup pounder bases were intermediate in height. This may indicate that the ring pounders had longer use-lives of the three pounder forms; they were likely utilized until their bases were worn thin. Or perhaps these pounders were manufactured to have short bases in order to pound poi without a rocking motion.

The knobbed pounders had the tallest bases by far. This is consistent with the hypothesis that these artifacts are youngest in age, as their bases are not worn down from use. Alternatively, these artifacts may have been manufactured with taller bases to begin with, to facilitate the one-handed rocking motion utilized by people who pound poi today. Knobbed pounders exhibited the least variability in base height (Table 4.4). This may reflect their younger age and shorter use-lives, as they had less time to be worn down. Ring and stirrup pounders were highly variable in base height, and this may reflect differential use-life.

Table 4.4: Central Tendency and Variability in Base Height (cm)

| | Knobbed | Ring | Stirrup |
|---|---|---|---|
| Mean | 1.855 | 0.206 | 0.331 |
| Standard Deviation | 1.039 | 0.424 | 0.535 |
| Coefficient of Variation | **0.53** | **2.061** | **1.618** |

Figure 4.5: Distribution of Knobbed, Ring, and Stirrup Forms by Base Height



In sum, the knobbed pounders were the tallest and heaviest and exhibited the most variability in weight and overall height. Ring and stirrup pounders were shorter and lighter, suggesting a dichotomy between pounders that utilized the force of one hand (knobbed) and those that required two hands (stirrup and possibly ring). Stirrup pounders were lightest in weight and had the narrowest bases. Ring pounders had the smallest average base heights, suggesting long use-lives for these implements.

**Relationships Between Variables**

A pairwise correlation of weight, overall height, base diameter, and base height considers these variables in relation to each other and across the three types of poi pounders (knobbed, ring, stirrup). This will determine if two given variables are related and if the knobbed, ring, and stirrup types co-vary with functional variation. Factors that may affect function are differential use, differential use-life, and age. Statistics in Tables 4.5-4.22 were calculated with Minitab software.

Figure 4.6 and Tables 4.5-4.7 compare weight with overall height. The slope of the regression lines are very similar across the three types, suggesting a similar relationship between weight and overall height in knobbed, ring, and stirrup pounders (See Figure 4.6). The two artifacts that may not be pounders appeared on the margins of the stirrup distribution, with very low weights and relatively tall heights compared to the other stirrup pounders. Weight and overall height were significantly correlated for all types ($p < .001$). Weight and overall height accounted for much variation in the knobbed ($r^2$ .376 and ring pounders ($r^2$ .427) and the least variation in the stirrup forms ($r^2$ .198).

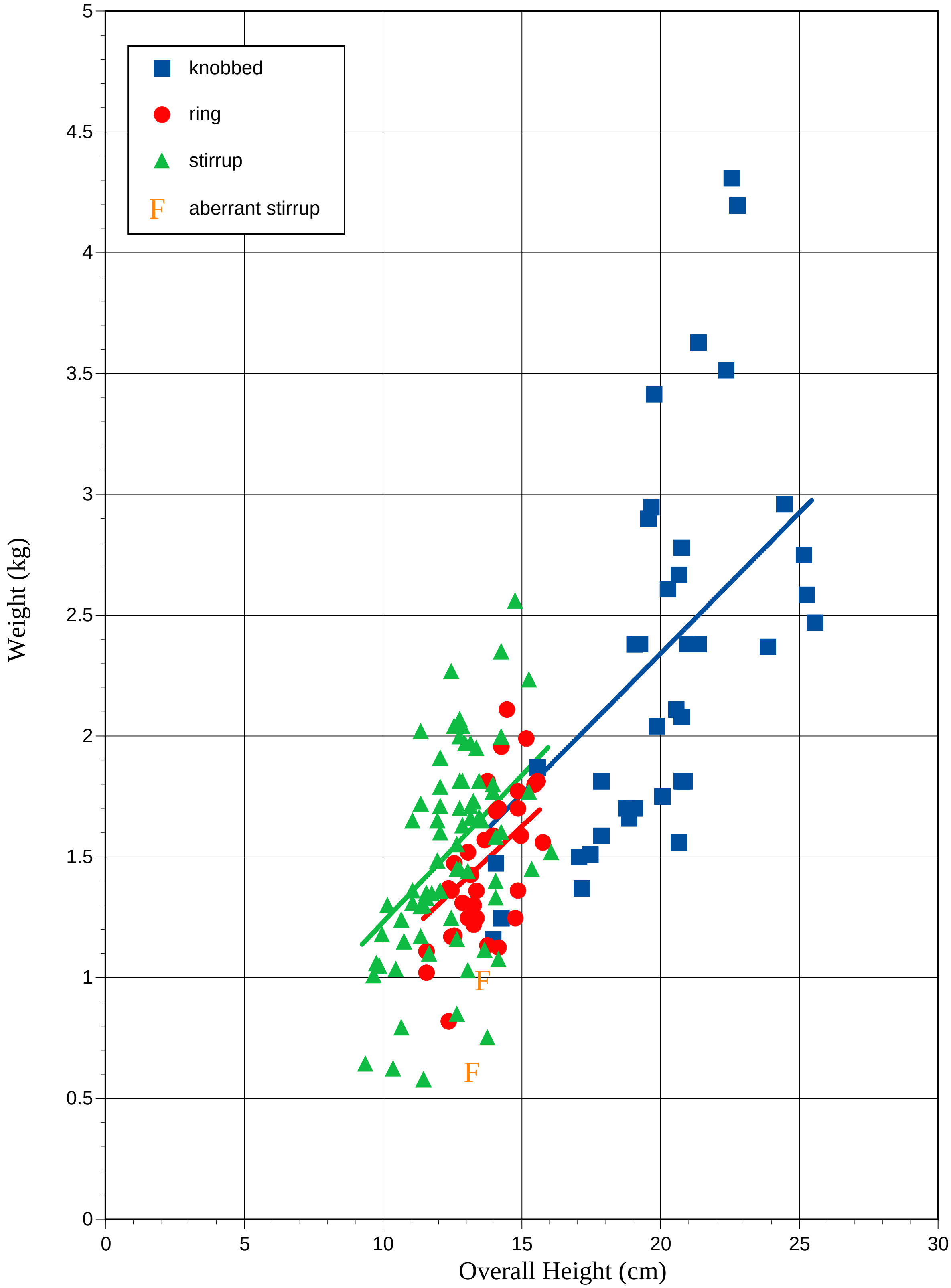



Figure 4.6: Weight vs. Overall Height

Table 4.5: Regression Analysis: Weight vs. Overall Height, Knobbed Pounders

```
The regression equation is y = - 1.09 + 0.170 x

Predictor         Coef       StDev          T        P
Constant       -1.0939      0.7105      -1.54    0.132
x              0.17018     0.03527       4.83    0.000

S = 0.6213      R-Sq = 39.3%     R-Sq(adj) = .376
Analysis of Variance
Source            DF          SS          MS         F         P
Regression         1      8.9883      8.9883     23.28     0.000
Residual Error    36     13.8971      0.3860
Total             37     22.8854
```

Table 4.6: Regression Analysis: Weight vs. Overall Height, Ring Pounders

```
The regression equation is y = - 0.979 + 0.179 x

Predictor         Coef       StDev          T        P
Constant       -0.9791      0.4841      -2.02    0.052
x              0.17887     0.03538       5.06    0.000

S = 0.2294      R-Sq = 44.4%     R-Sq(adj) = .427

Analysis of Variance
Source            DF          SS          MS         F         P
Regression         1      1.3457      1.3457     25.57     0.000
Residual Error    32      1.6843      0.0526
Total             33      3.0300
```

Table 4.7: Regression Analysis: Weight vs. Overall Height, Stirrup Pounders

```
The regression equation is y = - 0.185 + 0.134 x

Predictor         Coef       StDev          T        P
Constant       -0.1852      0.3789      -0.49    0.626
x              0.13442     0.03027       4.44    0.000

S = 0.3823      R-Sq = 20.8%     R-Sq(adj) = .198

Analysis of Variance
Source            DF          SS          MS         F         P
Regression         1      2.8806      2.8806     19.71     0.000
Residual Error    75     10.9589      0.1461
Total             76     13.8395
```

Weight is compared with base diameter in Figure 4.7 and Tables 4.8-4.10. The two aberrant pounders were again on the margins of the stirrup distribution, both with very low weights and one with a small base diameter, the other with a wide base. The relationships are significant in the knobbed and stirrup types ($p < .001$) and less significant in the ring forms ($p$ .023). Weight and overall height accounted for much variation in the knobbed pounders ($r^2$ .546) and very little variation in the ring type ($r^2$ .125).

Figure 4.8 and Tables 4.11-4.13 depict the relationship between weight and base height. The aberrant artifacts were again on the margins of the stirrup distribution, both with low weights and base heights. Weight and base height were correlated in the knobbed ($p < .001$) and stirrup types ($p$ .006), but not in the ring pounders ($p$ .105). Weight and base height accounted for much variation in the knobbed pounders ($r^2$ .416) and very little variation in the ring ($r^2$ .051) and stirrup forms ($r^2$ .083).

Overall height less base height is compared with base diameter in Figure 4.9 and Tables 4.14-4.16. Base height is subtracted from overall height in this analysis to filter out any variability due to wear of the base. The comparison of these two variables should depict the relationship between two attributes that are in direct control of the manufacturer and not a product of wear. The two artifacts that may not be pounders were again at the margins of the distribution, one with a narrow base diameter, the other with a wide base. The overall height less base height values fit in well when evaluated against the rest of the stirrup grouping. Overall height less base height and base diameter were significantly correlated in the knobbed and ring forms ($p < .001$) but not in the stirrup

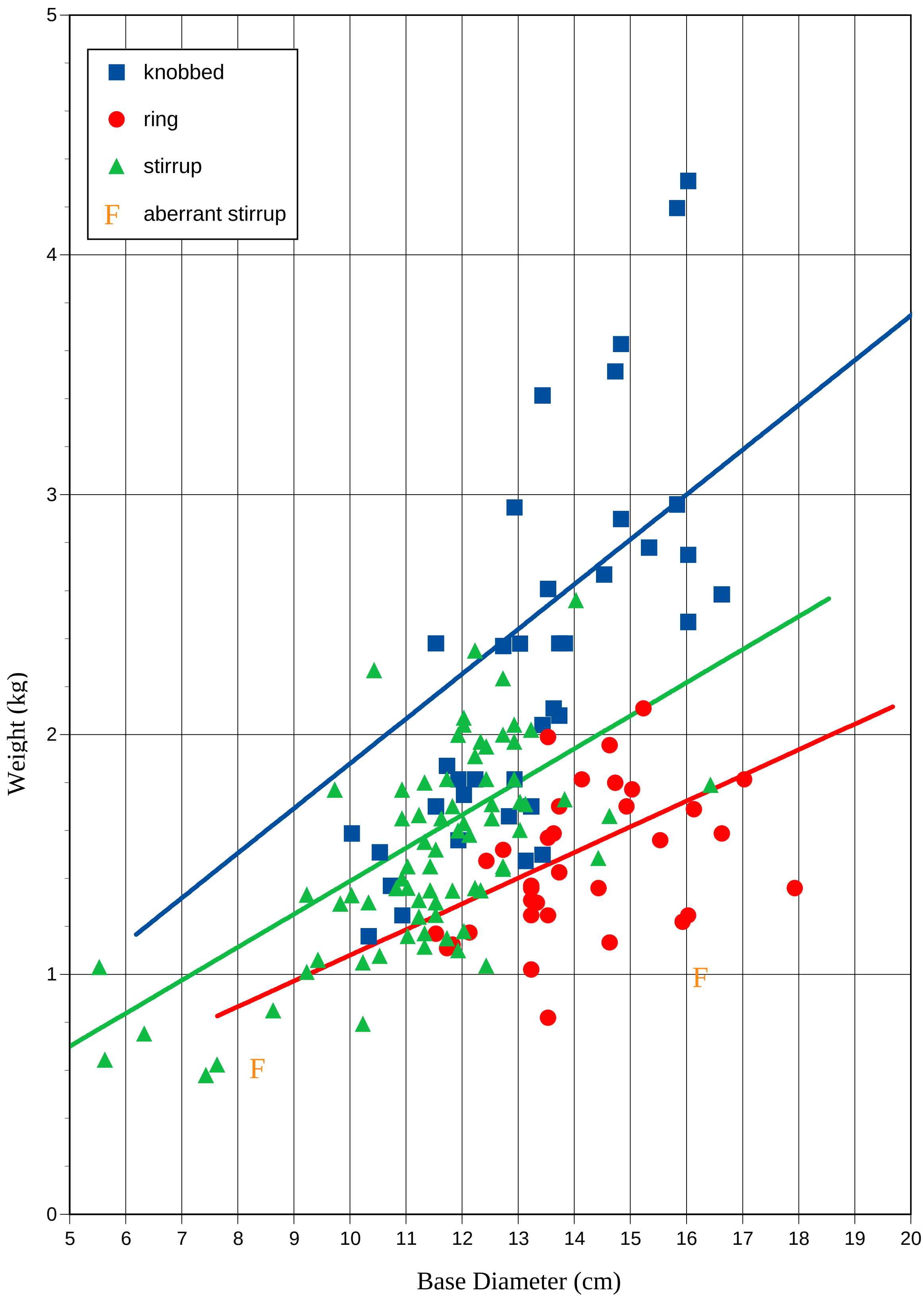



Figure 4.7: Weight vs. Base Diameter

Table 4.8: Regression Analysis: Weight vs. Base Diameter, Knobbed Pounders

The regression equation is y = - 2.13 + 0.333 x

| Predictor | Coef | StDev | T | P |
|---|---|---|---|---|
| Constant | -2.1254 | 0.6613 | -3.21 | 0.003 |
| x | 0.33331 | 0.04939 | 6.75 | 0.000 |

S = 0.5298 R-Sq = 55.9% **R-Sq(adj) = .546**

Analysis of Variance

| Source | DF | SS | MS | F | **P** |
|---|---|---|---|---|---|
| Regression | 1 | 12.782 | 12.782 | 45.54 | **0.000** |
| Residual Error | 36 | 10.104 | 0.281 | | |
| Total | 37 | 22.885 | | | |

Table 4.9: Regression Analysis: Weight vs. Base Diameter, Ring Pounders

The regression equation is y = 0.387 + 0.0762 x

| Predictor | Coef | StDev | T | P |
|---|---|---|---|---|
| Constant | 0.3868 | 0.4523 | 0.86 | 0.399 |
| x | 0.07620 | 0.03192 | 2.39 | 0.023 |

S = 0.2835 R-Sq = 15.1% **R-Sq(adj) = .125**

Analysis of Variance

| Source | DF | SS | MS | F | **P** |
|---|---|---|---|---|---|
| Regression | 1 | 0.45798 | 0.45798 | 5.70 | **0.023** |
| Residual Error | 32 | 2.57205 | 0.08038 | | |
| Total | 33 | 3.03003 | | | |

Table 4.10: Regression Analysis: Weight vs. Overall Height, Stirrup Pounders

The regression equation is y = 0.004 + 0.130 x

| Predictor | Coef | StDev | T | P |
|---|---|---|---|---|
| Constant | 0.0042 | 0.2365 | 0.02 | 0.986 |
| x | 0.12967 | 0.02040 | 6.36 | 0.000 |

S = 0.3463 R-Sq = 35.0% **R-Sq(adj) = .341**

Analysis of Variance

| Source | DF | SS | MS | F | **P** |
|---|---|---|---|---|---|
| Regression | 1 | 4.8450 | 4.8450 | 40.40 | **0.000** |
| Residual Error | 75 | 8.9944 | 0.1199 | | |
| Total | 76 | 13.8395 | | | |

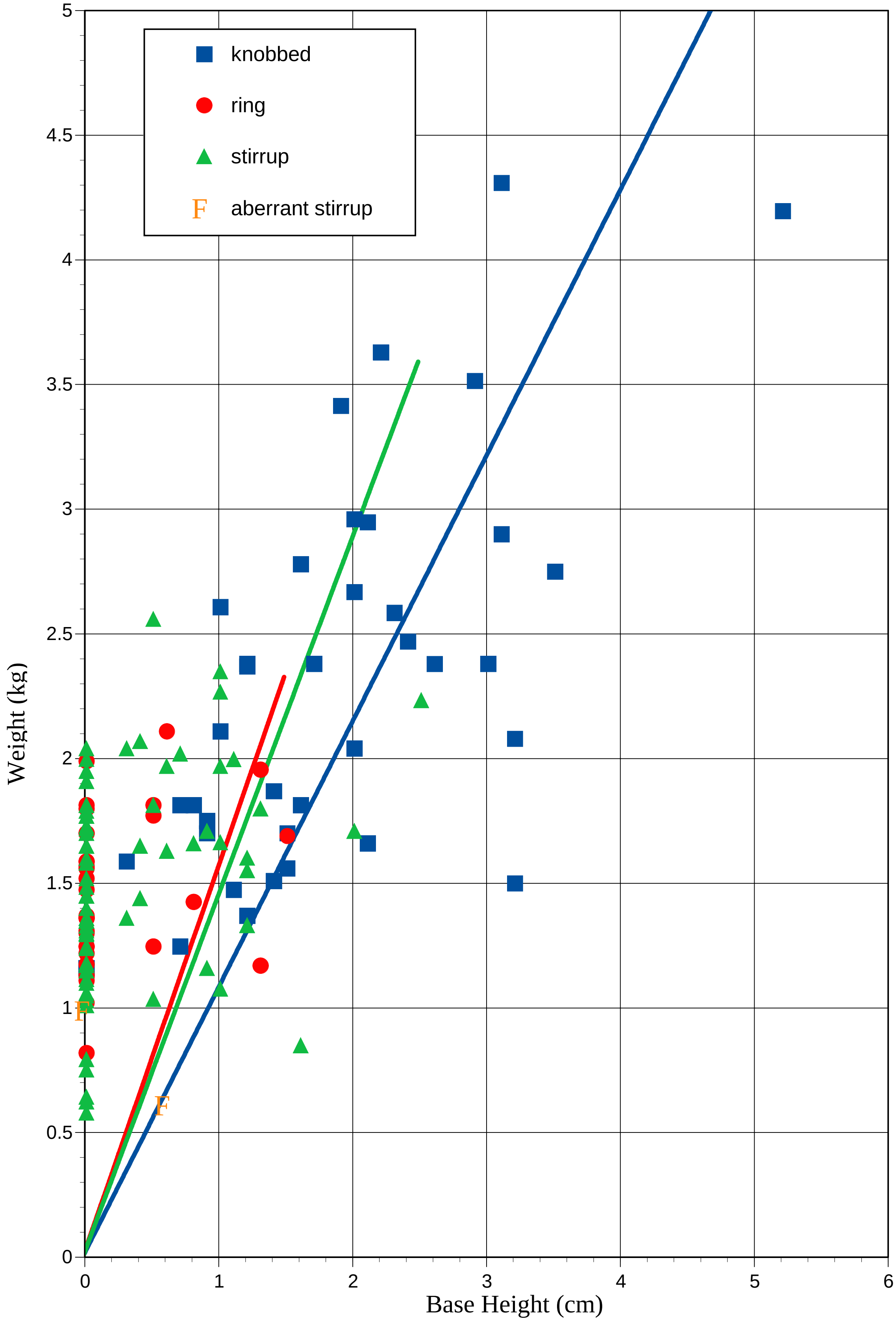



Figure 4.8: Weight vs. Base Height

Table 4.11: Regression Analysis: Weight vs. Base Height, Knobbed Pounders

The regression equation is y = 1.38 + 0.497 x

| Predictor | Coef | StDev | T | P |
|---|---|---|---|---|
| Constant | 1.3769 | 0.2014 | 6.84 | 0.000 |
| x | 0.49743 | 0.09503 | 5.23 | 0.000 |

S = 0.6008    R-Sq = 43.2%    **R-Sq(adj) = .416**

Analysis of Variance

| Source | DF | SS | MS | F | **P** |
|---|---|---|---|---|---|
| Regression | 1 | 9.8909 | 9.8909 | 27.40 | **0.000** |
| Residual Error | 36 | 12.9945 | 0.3610 | | |
| Total | 37 | 22.8854 | | | |

Table 4.12: Regression Analysis: Weight vs. Base Height, Ring Pounders

The regression equation is y = 1.42 + 0.202 x

| Predictor | Coef | StDev | T | P |
|---|---|---|---|---|
| Constant | 1.41877 | 0.05643 | 25.14 | 0.000 |
| x | 0.2020 | 0.1211 | 1.67 | 0.105 |

S = 0.2952    R-Sq = 8.0%    **R-Sq(adj) = .051**

Analysis of Variance

| Source | DF | SS | MS | F | **P** |
|---|---|---|---|---|---|
| Regression | 1 | 0.24232 | 0.24232 | 2.78 | **0.105** |
| Residual Error | 32 | 2.78770 | 0.08712 | | |
| Total | 33 | 3.03003 | | | |

Table 4.13: Regression Analysis: Weight vs. Base Height, Stirrup Pounders

The regression equation is y = 1.40 + 0.246 x

| Predictor | Coef | StDev | T | P |
|---|---|---|---|---|
| Constant | 1.40474 | 0.05484 | 25.62 | 0.000 |
| x | 0.24566 | 0.08746 | 2.81 | 0.006 |

S = 0.4086    R-Sq = 9.5%    **R-Sq(adj) = .083**

Analysis of Variance

| Source | DF | SS | MS | F | **P** |
|---|---|---|---|---|---|
| Regression | 1 | 1.3171 | 1.3171 | 7.89 | **0.006** |
| Residual Error | 75 | 12.5224 | 0.1670 | | |
| Total | 76 | 13.8395 | | | |

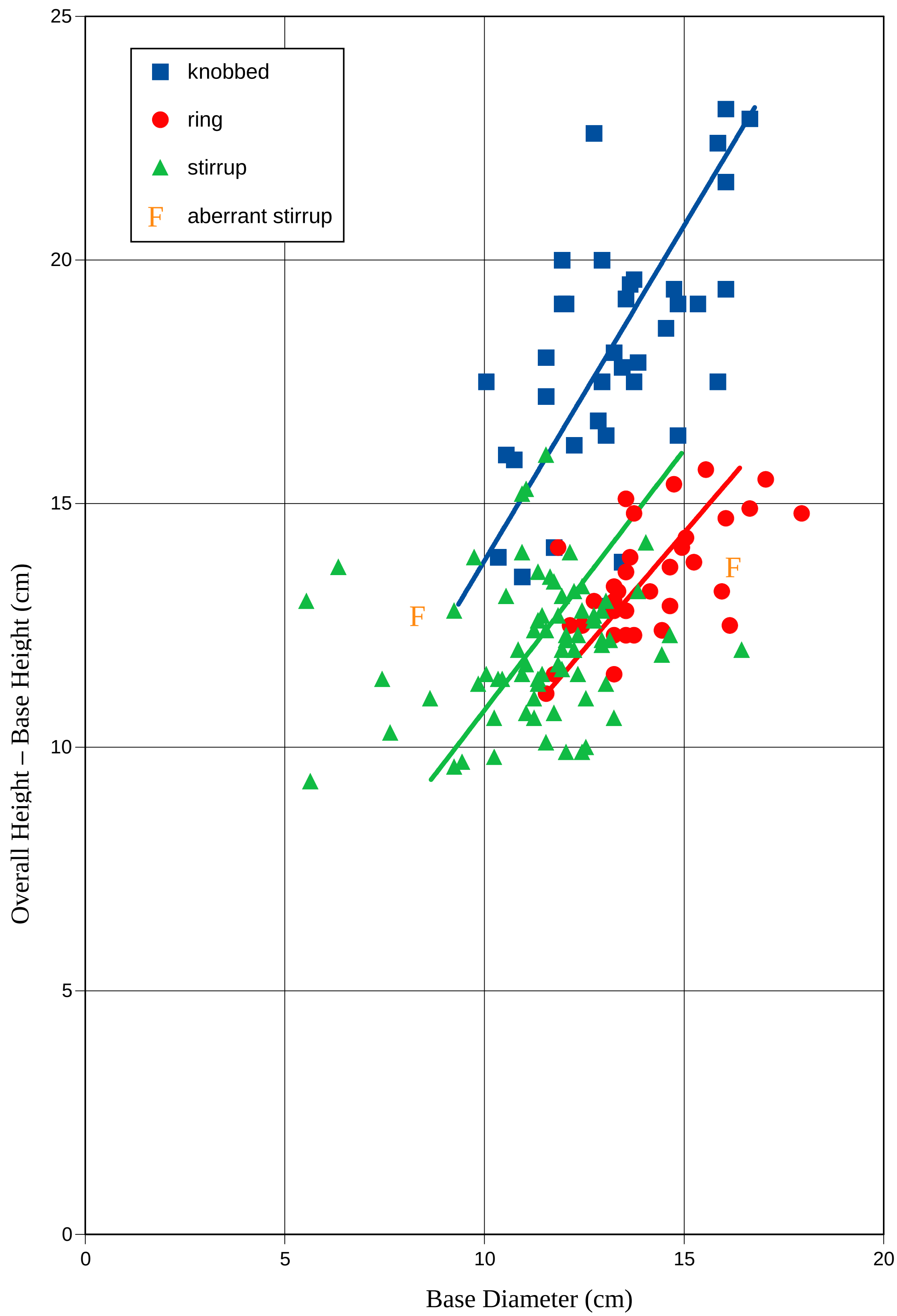



Figure 4.9: Overall Height Less Base Height vs. Base Diameter

Table 4.14: Regression Analysis: (Overall Height-Base Height) vs. Base Diameter, Knobbed Pounders

```
The regression equation is y = 3.38 + 1.25 x

Predictor         Coef       StDev          T        P
Constant         3.383       2.385       1.42    0.165
x               1.2473      0.1781       7.00    0.000

S = 1.910       R-Sq = 57.7%     R-Sq(adj) = .565

Analysis of Variance
Source            DF          SS          MS         F          P
Regression         1      178.98      178.98     49.04      0.000
Residual Error    36      131.39        3.65
Total             37      310.37
```

Table 4.15: Regression Analysis: (Overall Height-Base Height) vs. Base Diameter, Ring Pounders

```
The regression equation is y = 6.79 + 0.486 x

Predictor         Coef       StDev          T        P
Constant         6.791       1.365       4.97    0.000
x              0.48602     0.09634       5.04    0.000

S = 0.8557      R-Sq = 44.3%     R-Sq(adj) = .426

Analysis of Variance
Source            DF          SS          MS         F          P
Regression         1      18.632      18.632     25.45      0.000
Residual Error    32      23.428       0.732
Total             33      42.060
```

Table 4.16: Regression Analysis: (Overall Height-Base Height) vs. Base Diameter, Stirrup Pounders

```
The regression equation isy = 10.7 + 0.154 x

Predictor         Coef       StDev          T        P
Constant       10.6738      0.9740      10.96    0.000
x              0.15400     0.08403       1.83    0.071

S = 1.426       R-Sq = 4.3%      R-Sq(adj) = .030

Analysis of Variance
Source            DF          SS          MS         F          P
Regression         1       6.834       6.834      3.36      0.071
Residual Error    75     152.598       2.035
Total             76     159.432
```

pounders (p .071). The two variables accounted for much of the variation in the knobbed ($r^2$ .565) and ring types ($r^2$ .426) but very little in the stirrup forms ($r^2$ .030).

Figure 4.10 and Tables 4.17-4.19 illustrate the relationship between overall height and base height. The two aberrant artifacts were unremarkable with regard to overall height and base height, fitting in well with the other stirrup pounders in the bivariate plot. Overall height less base height and base height were significantly correlated in the knobbed and stirrup forms (p .002) but not in the ring pounders (p .963). The two variables accounted for relatively little of the variation in either the knobbed ($r^2$ .212) or stirrup pounders ($r^2$ .113) and none of the variation in the ring type ($r^2$ .000).

Base height and base diameter are compared in Figure 4.11 and Tables 4.20-4.22. One of the aberrant pounders had a wide base diameter and low base height, not fitting in well with the other stirrup forms in the bivariate plot. The other aberrant artifact was unremarkable with regard to base height and base diameter but is still arrayed away from the other stirrup pounders in the graph. Base height and base diameter were significantly correlated only in the knobbed pounders ($p < .001$) and not in the ring (p .827) or stirrup forms (p .427). The two variables accounted for much of the variation in the knobbed pounders ($r^2$ .466) and none of the variation in the ring or stirrup types ($r^2$ .000).

This pairwise correlation of functional variables revealed that the three poi pounder types do co-vary according to functional traits (Tables 4.23 and 4.24). The knobbed pounders exhibited the highest degree of correlation between functional variables, with significant relationships in all six bivariate plots and all correlations except overall height vs. base height accounting for knobbed pounder variation.

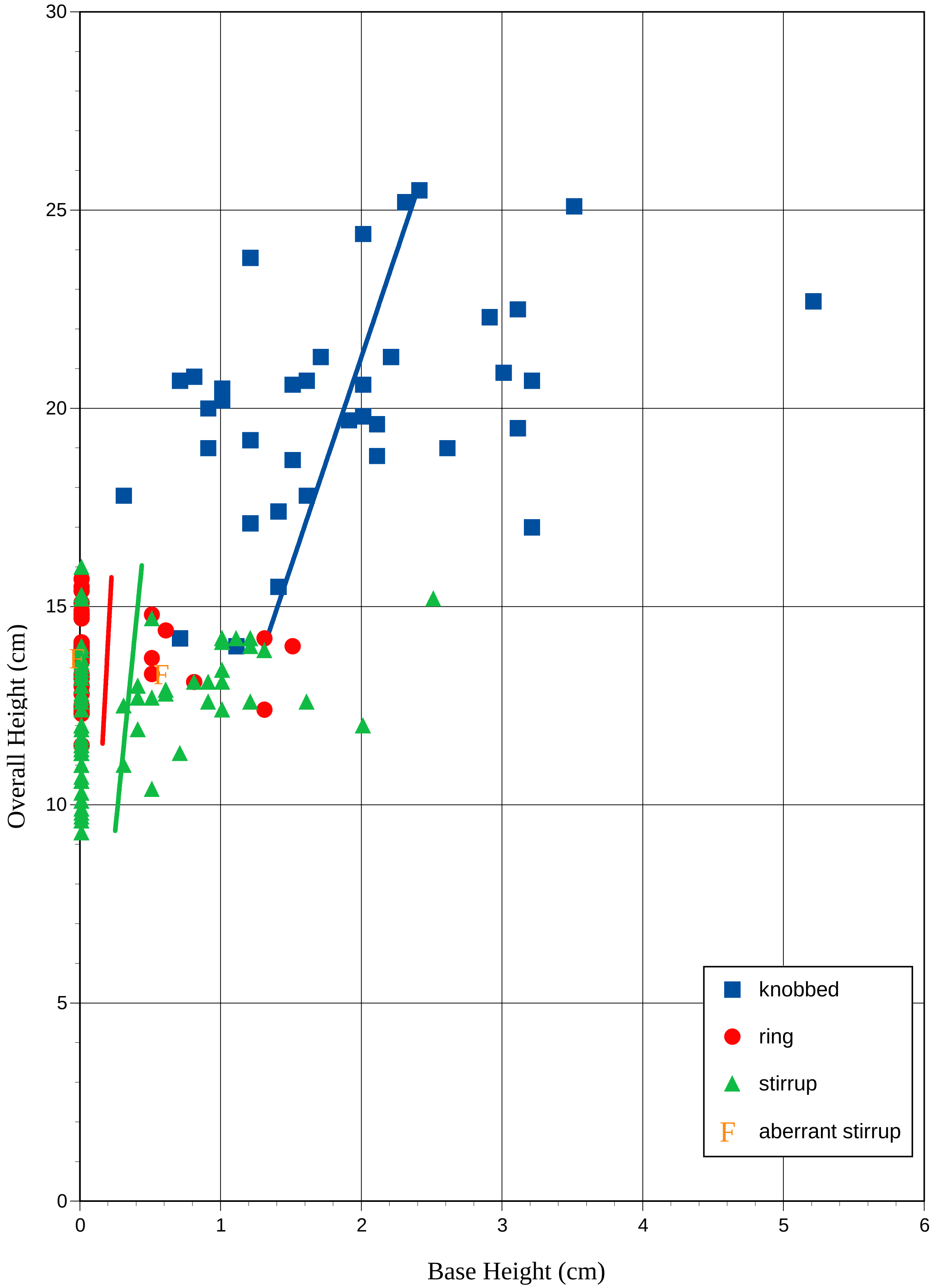



Figure 4.10: Overall Height vs. Base Height

Table 4.17: Regression Analysis: (Overall Height-Base Height) vs. Base Height, Knobbed Pounders

```
The regression equation is y = 17.4 + 1.35 x

Predictor        Coef       StDev          T        P
Constant      17.4441      0.8619      20.24    0.000
x              1.3464      0.4066       3.31    0.002

S = 2.571       R-Sq = 23.3%     R-Sq(adj) = .212

Analysis of Variance
Source            DF          SS          MS         F        P
Regression         1      72.466      72.466     10.97    0.002
Residual Error    36     237.906       6.609
Total             37     310.373
```

Table 4.18: Regression Analysis: (Overall Height-Base Height) vs. Base Height, Ring Pounders

```
The regression equation is y = 13.6 + 0.022 x

Predictor        Coef       StDev          T        P
Constant      13.6336      0.2192      62.21    0.000
x              0.0223      0.4704       0.05    0.963

S = 1.146       R-Sq = 0.0%      R-Sq(adj) = .000

Analysis of Variance
Source            DF          SS          MS         F        P
Regression         1       0.003       0.003      0.00    0.963
Residual Error    32      42.057       1.314
Total             33      42.060
```

Table 4.19: Regression Analysis: (Overall Height-Base Height) vs. Base Height, Stirrup Pounders

```
The regression equation is y = 12.1 + 0.956 x

Predictor        Coef       StDev          T        P
Constant      12.1173      0.1830      66.20    0.000
x              0.9557      0.2919       3.27    0.002

S = 1.364       R-Sq = 12.5%     R-Sq(adj) = .113

Analysis of Variance
Source            DF          SS          MS         F        P
Regression         1      19.936      19.936     10.72    0.002
Residual Error    75     139.497       1.860
Total             76     159.432
```

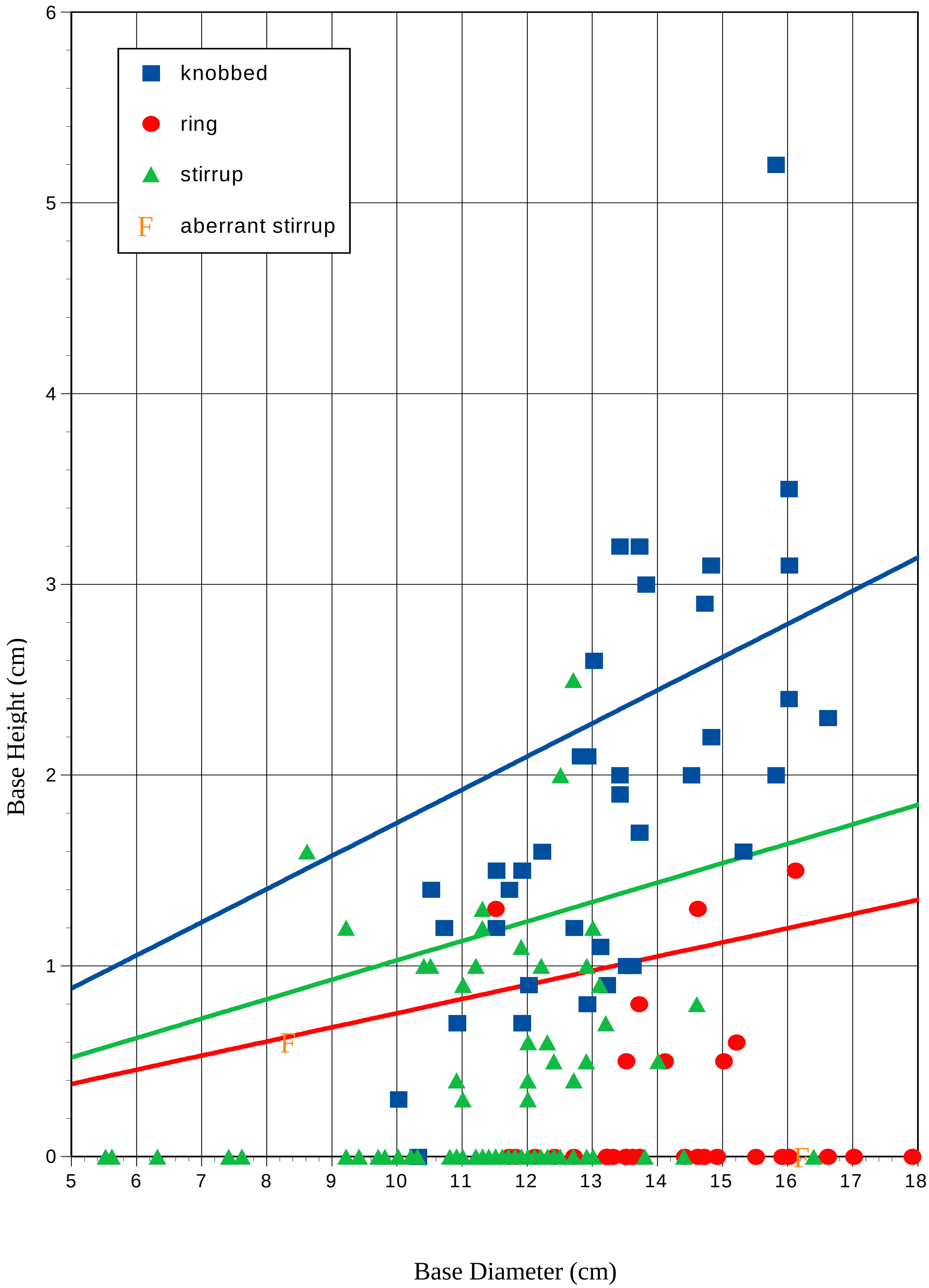



Figure 4.11: Base Height vs. Base Diameter

Table 4.20: Regression Analysis: Base Diameter vs. Base Height, Knobbed Pounders

```
The regression equation is y = - 3.57 + 0.409 x

Predictor        Coef       StDev          T        P
Constant      -3.5684      0.9483      -3.76    0.001
x             0.40852     0.07082       5.77    0.000

S = 0.7596      R-Sq = 48.0%     R-Sq(adj) = .466

Analysis of Variance
Source            DF          SS          MS         F        P
Regression         1      19.200      19.200     33.27    0.000
Residual Error    36      20.774       0.577
Total             37      39.974
```

Table 4.21: Regression Analysis: Base Diameter vs. Base Height, Ring Pounders

```
The regression equation is y = 0.055 + 0.0107 x

Predictor        Coef       StDev          T        P
Constant       0.0554      0.6868       0.08    0.936
x             0.01068     0.04847       0.22    0.827

S = 0.4305      R-Sq = 0.2%      R-Sq(adj) = .000

Analysis of Variance
Source            DF          SS          MS         F        P
Regression         1      0.0090      0.0090      0.05    0.827
Residual Error    32      5.9298      0.1853
Total             33      5.9388
```

Table 4.22: Regression Analysis: Base Diameter vs. Base Height, Stirrup Pounders

```
The regression equation is
y = 0.042 + 0.0253 x

Predictor        Coef       StDev          T        P
Constant       0.0424      0.3668       0.12    0.908
x             0.02527     0.03164       0.80    0.427

S = 0.5372      R-Sq = 0.8%      R-Sq(adj) = .000

Analysis of Variance
Source            DF          SS          MS         F        P
Regression         1      0.1840      0.1840      0.64    0.427
Residual Error    75     21.6412      0.2885
Total             76     21.8252
```

Table 4.23: Summary of P-values for Bivariate Analyses (p <0.01 = significant)

| | Knobbed | Ring | Stirrup |
|---|---|---|---|
| Weight vs. Overall Height | 0.000 | 0.000 | 0.000 |
| Weight vs. Base Diameter | 0.000 | 0.023 | 0.000 |
| Weight vs. Base Height | 0.000 | 0.105 | 0.006 |
| Overall Height-Base Height vs. Base Diameter | 0.000 | 0.000 | 0.071 |
| Overall Height vs. Base Height | 0.002 | 0.963 | 0.002 |
| Base Height vs. Diameter | 0.000 | 0.827 | 0.427 |

Table 4.24: Summary of Adjusted $R^2$ values for Bivariate Analyses

| | Knobbed | Ring | Stirrup |
|---|---|---|---|
| Weight vs. Overall Height | .376 | .427 | .198 |
| Weight vs. Base Diameter | .546 | .125 | .341 |
| Weight vs. Base Height | .416 | .051 | .083 |
| Overall Height-Base Height vs. Base Diameter | .565 | .426 | .030 |
| Overall Height vs. Base Height | .212 | .000 | .113 |
| Base Height vs. Diameter | .466 | .000 | .000 |

Ring pounders exhibited the lowest degree of correlation between functional variables, with significant relationships in only two bivariate plots and only two correlations accounting for variation in these artifacts (See Tables 4.23 and 4.24). This suggests that other variables are responsible for the functional variation in ring pounders. Size of perforation and flare of base are not measured here but likely play a role in functional variation (Figures 4.12 and 4.13).

Stirrup pounders exhibited significant relationships in four of the bivariate plots but only weight vs. overall height and weight vs. base diameter accounted for a significant portion of poi pounder variation (See Tables 4.23 and 4.24). The two aberrant artifacts appeared at the margins of five of the six bivariate plots, supporting the hypothesis that they may not have been used as pounders.

Figure 4.12: Examples of Variation in Perforation Size


Figure 4.13: Examples of Variation in Flare of Base, Ring Pounders

This comparison of functional variables may also test if base height reflects use-life or is a product of manufacture (i.e., if pounder bases vary because they were worn down from use or were manufactured with different base heights before use). If use-life is solely responsible for the height of the base, this measure should not be correlated with the other variables in the older pounders because they would be worn thin regardless of their weight, overall height, or diameter. A correlation between base height and the other variables would be expected for the youngest pounders (knobbed) because they are not as worn. Correlation between all variables **except base height** in all pounders (regardless of age) would also be expected if base height reflects use-life. If base height is a product of manufacture and not use, this measure would be correlated with all other variables regardless of age.

All of these conditions were met, suggesting that base height is a product of use-life (See Table 4.23). Weight and overall height are correlated in all pounder types. Weight and base diameter were also correlated in all forms, though more strongly so in the knobbed and stirrup than the ring pounders. Weight and base height were most strongly correlated in the youngest pounders (knobbed). Overall height less base height was correlated with base diameter in all pounder forms, but not as strongly so in the stirrup pounders. The strongest correlation between overall height (less the base height) and base height was seen in the youngest pounders (knobbed). Base height and base diameter were only correlated in the knobbed forms. These analyses support the hypothesis that base height reflects use-life.

**Material Type**

I was able to ascertain the material type of 132 of the poi pounders (89% of the pounders used in the functional analyses). These artifacts were manufactured from sedimentary rock (beach rock/sandstone), basalt (lava rock), or coral (Figure 4.14). Sedimentary rock is made from compacted sand, shell, and other particles. This material has large grains but is quite dense, as there is no pore space between the grains. Basalt varies in texture (as a result of varying levels of olivine, pyroxene, and feldspar phenocrysts) and density (because of differing amounts of pore space). Coral is generally very porous.

Material density is an important aspect to examine as it has a direct relationship with pounder weight and size. Dense materials are heavier than porous ones and require less volume of raw material per unit of weight. Basalt was the only material that

Figure 4.14: Examples of Poi Pounder Material Types (Left to Right: Sedimentary Rock, Basalt, Coral)

exhibited within-group variability with regard to density. I chose to measure basalt density by estimating the percentage of pore space with reference to illustrations designed for estimating the percentage composition of rock (Figure 4.15). The accuracy of this method is widely accepted by geologists (Floyd McCoy, pers. comm. 2003).

Figure 4.16 illustrates the frequency of material type for the 132 pounders. The largest number of artifacts (73 poi pounders) were made of very dense basalt ($\leq$3% pore space). Thirty-two artifacts were made of basalt of a moderate density (5-10% pore space). Only 11 artifacts were made from porous basalt (15-25% pore space). Fifteen artifacts were made of sedimentary rock and only one was fashioned out of coral.

Thus 91% of the poi pounders were made from dense materials (i.e., basalt of $\leq$10% porosity and sedimentary rock). A likely explanation is that manufacturers selected for heavier stone to add more weight to the pounders relative to their size. Alternatively, porous materials may have been avoided because pounders made from these materials would have been more difficult to clean. The porous basalts have larger

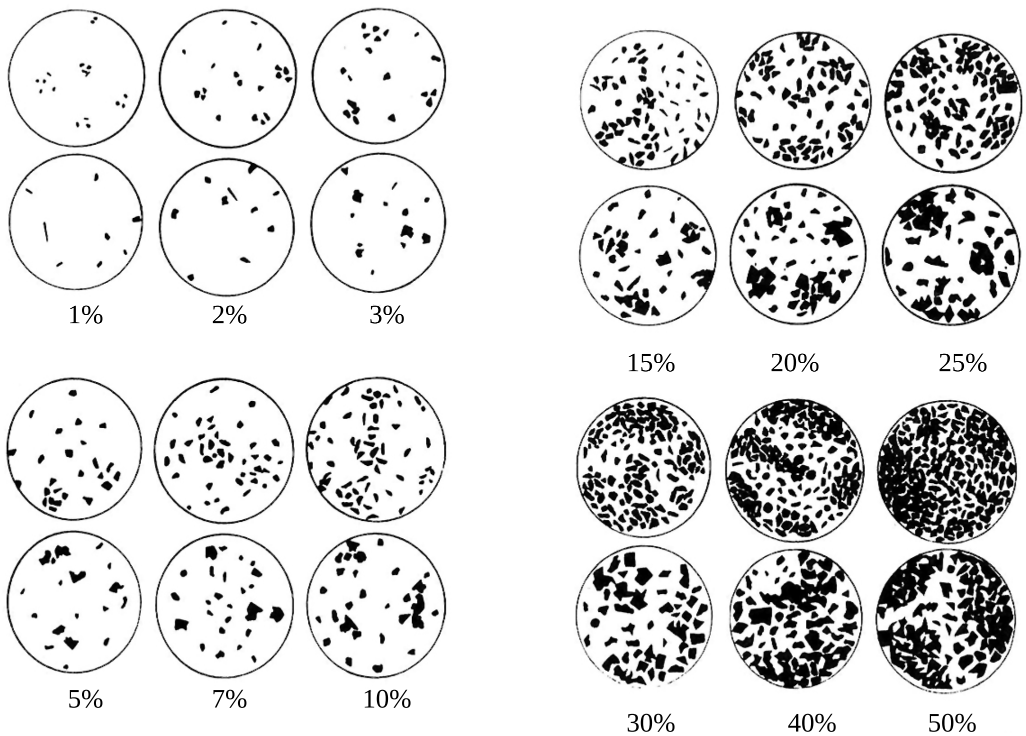



Figure 4.15: Charts for Estimating Percentage Composition of Rocks and Sediments (dark areas represent pore space) (Adopted From Terry and Chilingar 1955: 332-333)

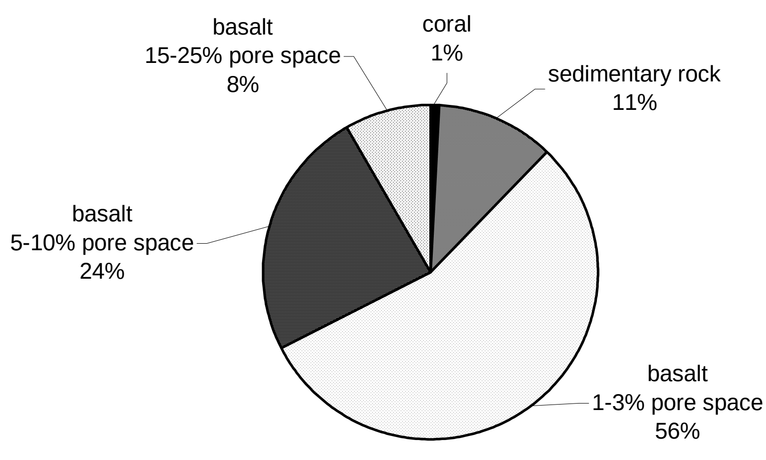



Figure 4.16: Frequency of Material Type

or more numerous pores for poi to get stuck in. If not thoroughly cleaned, this lodged poi would ferment and contaminate fresh poi pounded with that implement.

Figure 4.17 illustrates the distribution of knobbed, ring, and stirrup pounders by material type. All types exhibit normal distributions, with basalt of 1-3% pore space (very dense) the most common material. All of the knobbed pounders were manufactured from dense materials (basalt of ≤10% porosity and sedimentary rock). Earlier analysis suggested that weight was a key determining factor for the one-handed knobbed pounders. It now becomes apparent that manufacturers were selecting dense basalt and varying tool size dimensions in the production of knobbed poi pounders. The stirrup forms tend to be made from less dense material than the other pounder types, and since these are earlier forms this suggests a shift toward materials of higher density through time. It is possible that manufacturers were initially experimenting with different materials and came to find dense rock most efficient. The occurrence of a single coral pounder in stirrup form is consistent with this hypothesis.

Only 56 (42%) of the 132 pounders utilized in the material type analysis had provenience information available, thus sample size was too small to perform an analysis of material type by district. However, material types were roughly equally distributed between the windward and leeward regions of Kaua‘i (Figure 4.18). Sedimentary rock was a bit more common on the windward side and dense basalt more common on the leeward. The single coral pounder lacked provenience information.

In conclusion, clear patterns were evident in the functional analyses when poi pounders were grouped by type (knobbed, ring, and stirrup). This suggests that variation of these types relates primarily to aspects of function rather than style. There seems to be

Figure 4.17: Distribution of Knobbed, Ring, and Stirrup Forms by Material Type

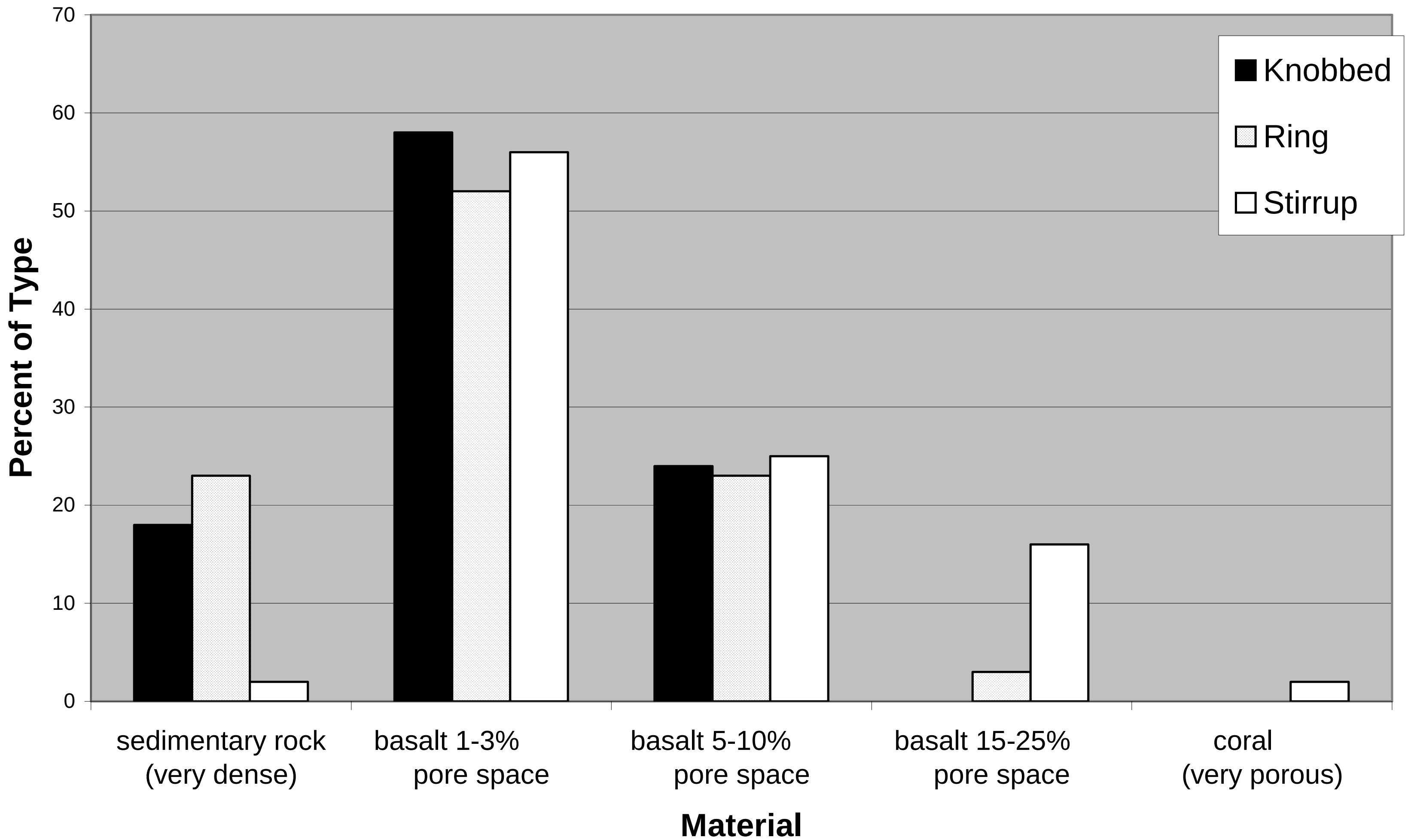
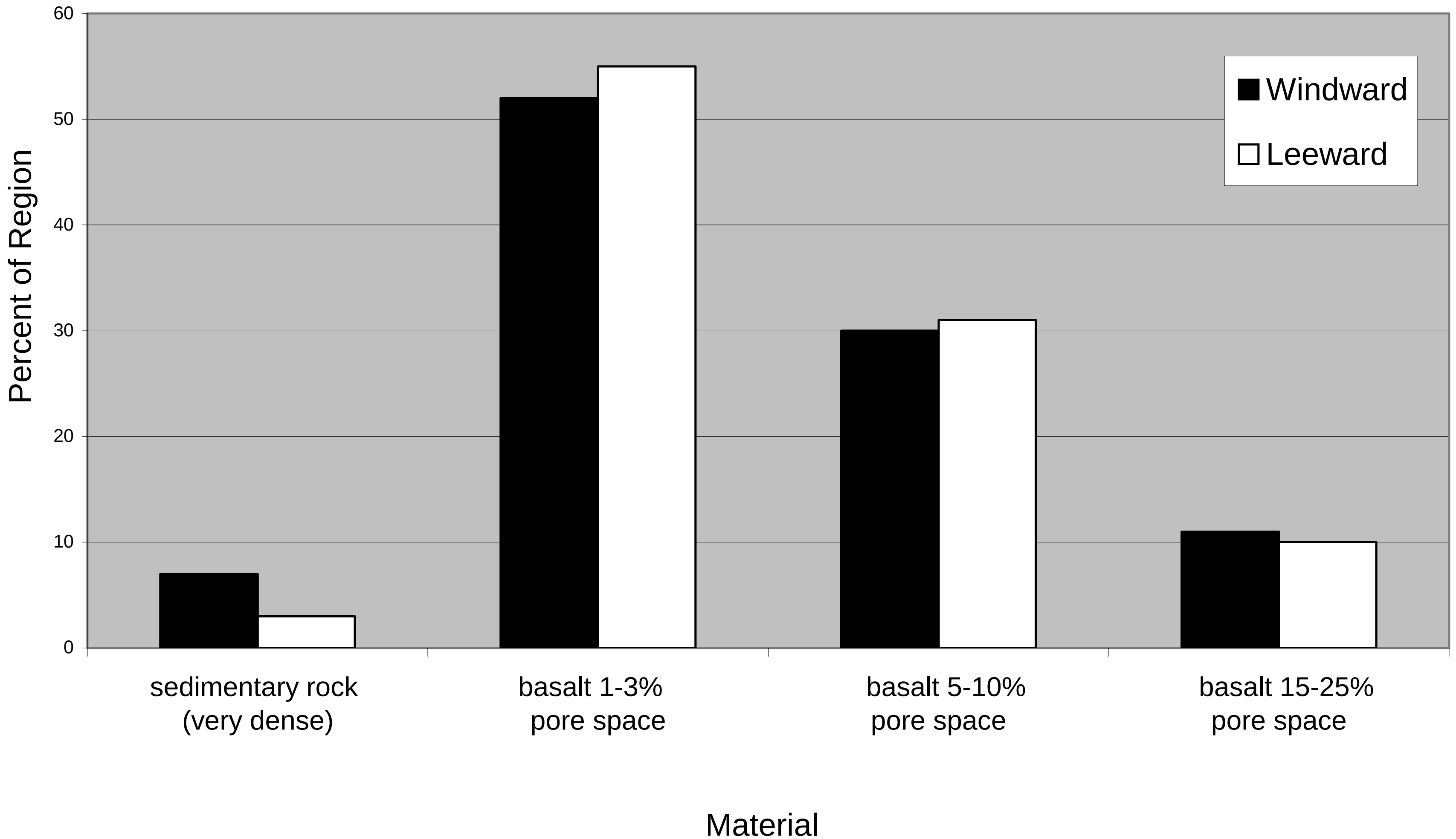


Figure 4.18: Distribution of Material Type by Region



an underlying common pattern of variability across all types for weight vs. overall height, thus manufacturers were able to control artifact weight through manipulation of the overall height of the artifact. However, there is little overlap between the knobbed pounders and the other forms with respect to weight and height, as the knobbed pounders are taller and heavier than the other types. A shift toward heavier, denser artifacts with wider bases indicates that later pounders were capable of mashing taro in less time and mashing greater quantities of taro at once. Thus, it appears that manufacturers perfected these implements over time.

# CHAPTER 5

# DISCUSSION AND CONCLUSIONS

This analysis of Hawaiian poi pounders showed that these artifacts are highly variable in morphology. The 98 artifacts included in the stylistic analyses were distributed across 17 different classes, demonstrating that these implements show more stylistic variability than can be accounted for by the traditional three-group classification of knobbed, ring, and stirrup pounders described in the literature. Thus, abandoning the traditional ethnographically-derived classifications of Hawaiian artifacts will enable archaeologists to identify and systematically study much of the variability that has often been overlooked.

Most variability in this classification appears within the stirrup group, suggesting that this artifact type may never have been as well defined (it acts as a default group for any pounders not resembling the knobbed or ring forms). The knobbed and ring pounders encompass only one class each, 112 and 121 respectively (See Figure 3.8), suggesting that their shape manufacture may have been more standardized or specialized or their use more limited. This leaves the stirrup forms distributed across the remaining 15 classes, although there appear to be transitional forms between the three types (See Figure 3.3, classes 122, 123, and 211)

Through visual inspection, one can ascertain that the stirrup pounders are clearly more variable than the other forms, but the knobbed and ring pounders are not completely homogenous. The bases of these artifacts flare to differing degrees (Figure 5.1; See Figure 4.13 for examples of base flare in ring pounders) and even though the tops of the knobbed pounders were all convex with upper sides angled in, variations occur in this region as well, ranging from mushroom-shaped to underdeveloped (Figure 5.2). This

Figure 5.1: Examples of Variation in Flare of Base, Knobbed Pounders


Figure 5.2: Examples of Variation in Top Morphology, Knobbed Pounders

classification was unable to detect variability at this level, but the addition of more dimensions would resolve this problem.

Research questions 1, 2, and 3 examine poi pounder variation across space and through time. The patterns in variation may relate to who did the pounding (male or female), what was mashed (different varieties of taro; sweet potato), or how mashing was performed (rocking vs. vertical pounding).

Poi pounders did vary stylistically through time (research question 1), with knobbed pounders most recent, ring forms intermediate in age, and stirrup pounders apparently oldest. The oldest stirrup pounders are likely those with non-convex tops and no perforation. This hypothetical chronology is supported by multiple lines of evidence, including artifact distributions, ethnographic information, archaeological evidence from the Marquesas, and the artifact seriation for Kaua‘i.

The observation that the leeward side of the island (where knobbed pounders are predominant) may have been occupied after settlement of the windward side suggests that the knobbed forms are most recent. The equal regional distribution of the ring forms implies that they were intermediate in age, and the frequency of stirrup forms in the windward region suggests that they may be the earliest form.

Ethnographic sources lend support to the hypothetical chronology as well. Brigham observed that the stirrup and ring pounders were out of use by the mid 1800s (1902:46). Bennett noted that conical pounders continued to be used in the 1920s while ring pounders remained unused in Hawaiian homes, and stirrup pounders were only known from archaeological sites (1931:69). In addition, the Hawaiian name for the stirrup form has been lost, suggesting greater antiquity for this type of pounder.

Evidence from Ua Huka Island in the Marquesas is also consistent with the hypothesized chronology for poi pounders of Kaua‘i (Yoshiko Sinoto, pers. comm. 2002, Sinoto 1970). Two stirrup-like pounders were found in the lower layers of the Hane dune site, which Sinoto assigns to Phase II (AD 600-1300). Sinoto believes these artifacts to be incipient forms of the Hawaiian stirrup pounders (Sinoto 1970:110). Knobbed pounders were not found until Phase III (AD 1300-1600) at Hane (Sinoto 1970:111-113).

The occurrence and frequency seriations produced by the poi pounder classes also support the hypothesized chronology. Stirrup pounders appeared oldest in the sequence, while ring pounders were intermediate in age, and the knobbed form most recent. This chronology suggests a change in the technique of pounding poi, from a two-handed to a one-handed approach. A change from diversity to homogeneity was also evident for poi pounders on the island of Kauaʻi. The seriations at different scales of analysis provided evidence for transmission processes that included at the very least the entire island as a single local group.

Poi pounders also exhibited stylistic variability across space on Kauaʻi (research question 2). Patterns were evident when the elements of these artifacts were isolated (top, upper sides, and perforation) and grouped according to district. Though small in area, Koʻolau district displayed the most diversity of poi pounder form. By contrast, the large Kona district was least variable. Concave tops were most common in Koʻolau, while convex tops were the norm for the other districts. Upper sides angled out were most common overall, while straight upper sides were least common. Artifacts exhibiting different angles on either side (multiple mode) were never observed. This illustrates the high standard of craftsmanship of Hawaiian poi pounders, with many artifacts almost perfectly symmetrical.

The patterns that emerged when the artifacts were grouped according to windward and leeward regions were notable as well. The classic knobbed pounders were more common on the leeward side, while the windward poi pounders were more variable. This may reflect a greater dependency on poi in the windward region, earlier occupation of this area, less rigid political control on the windward side of the island, a larger number of poi pounder manufacturers in this region, or a combination of these factors. Spatial patterns were not statistically significant, and this supports the argument for an island-wide geographic scale of information-sharing regarding poi pounder manufacture.

However, the spatial patterns produced when the dimensions were isolated proved statistically insignificant (p=>.01). This suggests that these dimensions vary more by time than by space. This observation is in agreement with the hypothesis that information regarding poi pounder manufacture occurred on an island-wide scale.

Functional analyses revealed that the knobbed pounders were heavier than the ring and stirrup forms (research question 3). When viewed in light of the chronology, it appears that the weight and base diameter of these artifacts increased through time. The stirrup pounders exhibited both the lightest weights and narrowest base diameters.

A pairwise correlation of functional variables revealed that the three poi pounder types co-vary according to function, with the knobbed pounders exhibiting the most significant relationships between functional variables. Comparison of functional variables also suggested that base height is a reflection of use-life for poi pounders. Analysis of material type indicated a shift toward denser materials through time.

**Stylistic and Functional Variability and the Environment**

Environmental data suggests higher taro productivity in the windward region (research question 4). Although much of the land on Kaua‘i is suitable for agriculture, a dichotomy exists between windward and leeward precipitation and soils (Figures 5.3 and

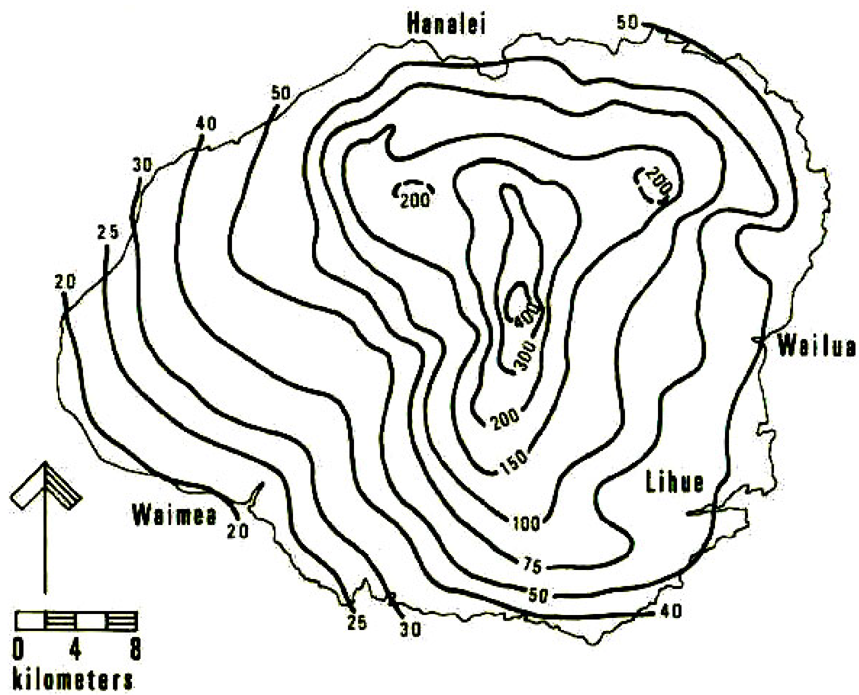



Figure 5.3: Annual Rainfall for Kaua‘i (isohets depicted in inches) (Adopted from Earle 1978:24)

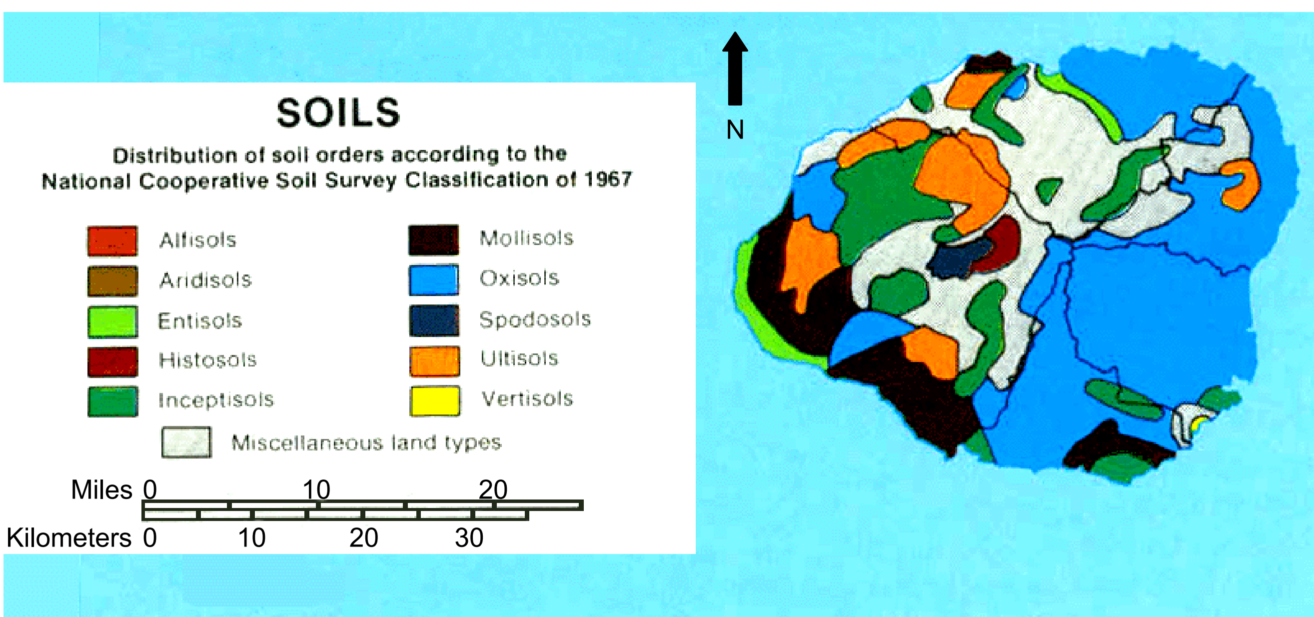



Figure 5.4: Kaua‘i Soils (Adopted from Armstrong 1983:46)

5.4). The windward region is wetter, with a mean annual rainfall of approximately 250 centimeters, while the leeward region receives significantly less precipitation, averaging only 50-60 centimeters per year (Earle 1978:24, Morgan 1986:1999). This disparity in leeward precipitation is caused by a rain shadow effect which originates in the high interior mountains.

As wetland taro varieties require massive amounts of water (ca. 280,000 liters per hectare per day), they need irrigation for survival (Wang 1983:174). Thus, wetland species are dependent on permanent streams, and these occur in both the windward and leeward regions of Kaua‘i as a result of high amounts of rainfall in the interior mountains (e.g., Mount Wai‘ale‘ale). Dryland species are not irrigated, therefore they depend largely on rainfall for survival. Thus rainfall distribution has a greater effect on dryland taro than wetland taro. Dryland taro requires approximately 150 centimeters (59 inches) of rain per year (Wang 1983:175), rendering it unsuitable for growing on much of the leeward side of the island (See Figure 5.3).

A dichotomy also exists between windward and leeward soil quality. Soils vary as a result of factors such as age, climate, and drainage conditions, thus different types of soils are found on the windward and leeward regions of Kaua‘i (Armstrong 1983:45). High-quality oxisols, which are important to agriculture today, occur in geologically old areas on flat land. The windward region of Kaua‘i has a higher percentage of oxisols than the leeward, thus more of the windward land was suited to taro farming.

As the windward region received greater amounts of rainfall and had a higher percentage of arable land, taro production may have been more prolific in this area. Perennial streams are numerous across the windward region and taro terraces were extensive in the Halele‘a and Puna districts (Earle 1978, Handy et al. 1991). Though taro was grown on the dry leeward side of Kaua‘i, sweet potatoes were the main crop in this area (Handy et al. 1991: 275). In addition, the leeward coast was known for its prime fishing grounds, thus the population of this region was probably more dependent on fishing for subsistence.

Spatial analyses indicated that windward poi pounders were more variable in morphology than those from the leeward side of the island (See Figure 3.9) and this may reflect greater taro production in an area more suited to taro cultivation. By contrast, leeward pounders were more stylistically homogenous, possibly due to less taro production and processing in the dry leeward region.

Knobbed pounders were primarily a leeward phenomenon (See Figure 3.9) and functional analyses revealed that knobbed pounders were more variable than the other types with regard to weight (See Table 3.10). This may reflect the use of some of these pounders to mash sweet potatoes and others to mash taro in the leeward region where sweet potatoes were the principal crop. As sweet potatoes are softer than taro, they may have been easier to mash with lighter pounders. Heavier knobbed pounders may have been reserved for pounding taro poi. This would explain the greater variation in weight in the knobbed pounders. Ethnographic sources confirm that stone pounders were utilized in the production of sweet potato poi, or *poi ‘uala* (Handy et al. 1991:135). *Poi ‘uala* was not as prized as taro poi, but at least one other dish was made with mashed sweet potatoes (Handy et al. 1991:135). *Piele ‘uala* was a blend of mashed sweet potato and coconut milk steamed in an *‘imu* (earth oven). Thus, sweet potatoes were likely to have been mashed on a regular basis on the leeward side of the island where they were widely grown.

## Non-Kauaʻi Ring and Stirrup Pounders

Finally, while I focused my research on Kauaʻi Island, I did come across 9 poi pounders from other islands that were not of the classic knobbed form (Figure 5.4, Table 5.1). This is a direct contradiction to the literature, which consistently restricts ring and stirrup pounders to Kauaʻi. A possible explanation is that these pounders were transported to other islands by Kauaʻi migrants. Geochemical sourcing would reveal if these artifacts were actually manufactured from Kauaʻi basalts. If they were, the traditional view of Kauaʻi isolation would be challenged.

The anomalous pounders are both stirrup and ring forms and come from various islands. All derived from the ethnographic collections at the Bishop Museum. Two were fragments of ring pounders (possibly pieces of a single artifact) found on Kīholo beach,

Figure 5.4: Illustration of Non-Kaua‘i Ring and Stirrup Pounders (Top Row Left to Right: C.1551; C.1552; D.0063; B.9408, Bottom Row Left to Right: C.4961; D.3558; D.3559; C.9789; D.3769)

Table 5.1: Data for Non-Kaua‘i Ring and Stirrup Pounders

| Artifact # | Island | Provenience | Notes | Class | Material |
|---|---|---|---|---|---|
| C.1551 | Big Island | Kīholo beach | Fragment | 121? | Basalt 5-10% pore space |
| C.1552 | Big Island | Kīholo Beach | Fragment (probably same artifact as C.1551) | 121? | Basalt 5-10% pore space |
| D.0063 | Big Island | Kamuela | | 121 | Basalt 5-10% pore space |
| B.9408 | Lāna‘i | Lāna‘i | Broken/Battered | Unclassifiable | Basalt 1-3% pore space |
| C.4961 | Maui | Hāmākua Poko | | 121 | Basalt 1-3% pore space |
| D.3558 | Moloka‘i | Makanalua | | 413 | Basalt 1-3% pore space |
| D.3559 | Moloka‘i | Kalaupapa | | 413 | Basalt 1-3% pore space |
| C.9789 | O‘ahu | Pearl City Graveyard in Beach | Fragment | 121 | Basalt 5-10% pore space |
| D.3769 | O‘ahu | East of Waiau Power Plant | | 323 | Basalt 1-3% pore space |

Hawai‘i Island, one was a complete ring pounder from Kamuela, Hawai‘i Island, one broken, unidentifiable pounder was from an undisclosed location on Lāna‘i, a complete ring pounder was from Hāmākua Poko, Maui, two complete stirrup pounders were from Moloka‘i (one each from Makanalua and Kalaupapa), and one stirrup and one ring pounder were from the Pearl City area on O‘ahu.

Another area for future research would be to examine poi pounders from the island of Ni‘ihau. Ni‘ihau and Kaua‘i have been linked historically, and little is known about the archaeology and material culture of this enigmatic island. Only one poi pounder from Niʻihau is housed at the Bishop Museum and it is of the knobbed variety (Betty Kam, pers. comm. 2002). However, if more Niʻihau pounders can be located it would be interesting to see if they resemble the Kauaʻi poi pounders in form.

In conclusion, this research shows the value of examining artifacts from museum collections, even if they are poorly provenienced. By making better use of previously excavated artifacts and those donated to museums, we can acquire new knowledge without excavating new sites. This approach contributes to our understanding of these collections and the past while helping to preserve the archaeological record.

Hawaiian poi pounders are unique artifacts which have received inadequate attention by the archaeological community. My classification highlights some of the variability within and between the traditional three-group classification of poi pounders and identifies similarities and differences in poi pounder form across space and through time. Nevertheless, further research is needed to fully understand these fascinating artifacts and the skilled craftsmen who made them.

## APPENDIX A

## ARTIFACTS USED IN SPATIAL AND TEMPORAL ANALYSES

| Artifact # | Provenience | District | Notes | Class |
|---|---|---|---|---|
| 10560 | Molowaʻa [Moloaʻa] | Koʻolau | | 211 |
| 1927.124.01 | Wailua, Kapaʻa | Puna | | 223 |
| 1927.124.02 | Wailua | Puna | | 322 |
| 1974.53.01 | Keālia | Puna | | 423 |
| 1974.53.02 | Keālia | Puna | | 223 |
| 1982.435.1 | Waimea Valley | Kona | | 112 |
| 24559 | West | Kona | From Photo | 223 |
| 276 | Nuʻalolo Kai | Kona | | 423 |
| 277 | Nuʻalolo Kai | Kona | | 121 |
| 280 | Nuʻalolo Kai | Kona | | 122 |
| 281 | Nuʻalolo Kai | Kona | | 323 |
| 446 | Nuʻalolo Kai | Kona | | 122 |
| 447 | Nuʻalolo Kai | Kona | | 322 |
| 452 | Nuʻalolo Kai | Kona | Base Chipped | 122 |
| 8000 | Kawaihau yard | Puna | | 121 |
| 827 | Nuʻalolo Kai | Kona | | 122 |
| 9356 | Koʻolau | Koʻolau | | 223 |
| a | Hanalei | Haleleʻa | From Sketch | 121 |
| aa | Hanapēpē | Kona | From Sketch | 121 |
| b | Mouth of Hanalei River | Haleleʻa | From Sketch | 121 |
| B.1315 | Līhuʻe Canefield, plantation parallel to Wailua R. | Puna | | 123 |
| B.1316 | Wailua | Puna | Base Chipped | 332 |
| B.1727 | Līhuʻe Canefield | Puna | | 121 |
| B.1728 | Līhuʻe Canefield | Puna | | 121 |
| B.1729 | Kōloa | Kona | | 121 |
| B.1730 | Kōloa | Kona | | 112 |
| B.1731 | Līhuʻe | Puna | | 112 |
| B.4496 | Kalalau Valley | Nā Pali | | 112 |
| B.4497 | Kalalau Valley | Nā Pali | | 112 |
| B.4498 | Kalalau Valley | Nā Pali | | 112 |
| B.4499 | Kalalau Valley | Nā Pali | | 112 |
| B.4500 | Kalalau Valley | Nā Pali | | 112 |

| Artifact # | Provenience | District | Notes | Class |
|---|---|---|---|---|
| B.8789 | Hanamāʻulu canefield | Puna | | 312 |
| B.8813 | Waimea | Kona | | 112 |
| B.8814 | Waimea | Kona | Base Chipped | 112 |
| bb | West | Kona | From Photo | 323 |
| c | Kalihi Wai | Haleleʻa | From Sketch | 121 |
| C.10206 | Kalalau Valley | Nā Pali | | 223 |
| C.10207 | Kalalau Valley | Nā Pali | | 123 |
| C.10211 | Kalalau Valley house platform | Nā Pali | Broken - top only | 112 |
| C.1174 | Māhāʻulepū beach house sites | Kona | Reused as Weight | 223 |
| C.1182 | Hanalei dist. Anini house site destroyed by fire | Haleleʻa | | 112 |
| C.1588 | Lāwaʻi Valley | Kona | | 121 |
| C.1589 | Kipū Kai, Kauaʻi | Puna | | 121 |
| C.1590 | Lāwaʻi Valley | Kona | | 112 |
| C.1651 | Nuʻalolo | Kona | | 322 |
| C.5510 | Kōloa | Kona | | 121 |
| C.5511 | Kōloa | Kona | | 112 |
| C.5512 | Kōloa | Kona | | 112 |
| C.5513 | Hanalei | Haleleʻa | | 121 |
| C.7325 | Between Keālia and Kīlauea | Koʻolau | | 123 |
| C.7327 | Between Keālia and Kīlauea | Koʻolau | | 212 |
| C.7328 | Between Keālia and Kīlauea | Koʻolau | | 223 |
| C.7329 | Between Keālia and Kīlauea | Koʻolau | | 213 |
| C.7330 | Between Keālia and Kīlauea | Koʻolau | | 423 |
| C.7331 | Between Keālia and Kīlauea | Koʻolau | | 423 |
| C.7332 | Between Keālia and Kīlauea | Koʻolau | Base Chipped | 312 |
| cc | Kapaʻa | Puna | From Sketch | 423 |
| d | Hanalei | Haleleʻa | From Sketch | 123 |
| D.1612 | Waimea | Kona | | 121 |
| D.4099 | Grove Farm | Puna | | 121 |
| D.4100 | Grove Farm | Puna | | 223 |
| D.4577 | Big Central Makalena Area [Makaleha] | Koʻolau | | 121 |

| Artifact # | Provenience | District | Notes | Class |
|---|---|---|---|---|
| dd | Waimea | Kona | From Sketch | 413 |
| e | Hanalei | Halele‘a | From Sketch | 132 |
| ee | Kalāheo | Kona | From Photo | 121 |
| f | Hanalei | Halele‘a | From Sketch | 223 |
| ff | Kōloa | Kona | From Sketch | 121 |
| g | Kīlauea ‘Ili of Piloa | Halele‘a | From Photo | 412 |
| GF118 | Hulē‘ia/Kipū Kai | Puna | | 121 |
| gg | Waimea | Kona | From Sketch | 121 |
| h | Kīlauea | Halele‘a | From Photo | 412 |
| hh | Hanapēpē McBride | Kona | From Sketch | 213 |
| I | Keālia Flats | Puna | From Sketch | 123 |
| ii | Hanapēpē McBride | Kona | From Sketch | 223 |
| j | Anahola | Ko‘olau | From Sketch | 213 |
| jj | Hanapēpē McBride | Kona | From Sketch | 123 |
| k | Keālia | Puna | From Sketch | 121 |
| Ka120 | Kōloa Caves | Kona | Kaua'i General | 422 |
| kk | Hanapēpē McBride | Kona | From Sketch | 223 |
| l | Wailua | Puna | From Sketch | 121 |
| ll | Kōloa | Kona | From Sketch | 121 |
| m | Keālia | Puna | From Photo | 123 |
| mm | Māhā‘ulepū | Kona | From Sketch | 123 |
| n | Makaweli | Kona | From Sketch | 121 |
| nn | Hanapēpē - McBride | Kona | From Sketch | 121 |
| o (B1317) | Wailua | Puna | From Photo | 413 |
| p | Hanapēpē - McBride | Kona | From Sketch | 121 |
| q | West | Kona | From Photo | 223 |
| r | Kalāheo | Kona | From Photo | 213 |
| s | Kalāheo | Kona | From Photo | 122 |
| t | Kōloa | Kona | From Sketch | 413 |
| u | Kapa‘a | Puna | From Sketch | 223 |
| v | Līhu‘e | Puna | From Sketch | 323 |
| w | Līhu‘e Plantation | Puna | From Sketch | 223 |
| x | Niumalu | Puna | From Sketch | 412 |
| y | Olohena, Wailua + Kapa‘a | Puna | From Sketch | 123 |
| z | Keālia | Puna | From Photo | 223 |

## APPENDIX B

## ARTIFACTS USED IN FUNCTIONAL ANALYSES

| Artifact # | District | Notes | Class | % Pore Space (Basalt) | Weight (kg) | Overall Height (cm) | Base Diameter (cm) | Base Height (cm) |
|---|---|---|---|---|---|---|---|---|
| 10424 | | | 123 | 05-10 | 1.440 | 13.0 | 12.7 | 0.4 |
| 10560 | Ko‘olau | | 211 | 01-03 | 1.160 | 12.6 | 11.0 | 0.9 |
| 10614 | | | 112 | 01-03 | 2.900 | 19.5 | 14.8 | 3.1 |
| 10615 | | | 112 | 05-10 | 2.380 | 19.0 | 13.0 | 2.6 |
| 10621 | | | 223 | 01-03 | 1.450 | 12.7 | 11.4 | 0 |
| 10737 | | | 122 | 15-25 | 1.100 | 11.6 | 11.9 | 0 |
| 10739 | | | 233 | 01-03 | 1.770 | 15.2 | 10.9 | 0 |
| 10741 | | | 423 | 01-03 | 1.770 | 13.9 | 09.7 | 0 |
| 10742 | | | 413 | 01-03 | 1.240 | 10.6 | 11.2 | 0 |
| 10745 | | | 433 | 01-03 | 1.360 | 12.0 | 12.2 | 0 |
| 1927.124 .01 | Puna | | 223 | 05-10 | 1.360 | 12.0 | 10.8 | 0 |
| 1927.124 .02 | Puna | | 322 | 05-10 | 0.990 | 13.7 | 16.3 | 0 |
| 1974.53. 01 | Puna | | 423 | 05-10 | 2.020 | 11.3 | 13.2 | 0.7 |
| 1974.53. 02 | Puna | | 223 | 01-03 | 1.650 | 11.9 | 10.9 | 0.4 |
| 1982.435 .1 | Kona | | 112 | 01-03 | 1.870 | 15.5 | 11.7 | 1.4 |
| 1986.287 .073 | | | 423 | 01-03 | 1.800 | 13.9 | 11.3 | 1.3 |
| 24559 | Kona | From Photo | 223 | Unidentified | 1.710 | 12.0 | 12.5 | 2 |
| 276-K3-F7-3 | Kona | | 423 | 01-03 | 1.036 | 10.4 | 12.4 | 0.5 |
| 277-K3-E9-8 | Kona | | 121 | 05-10 | 1.426 | 13.1 | 13.7 | 0.8 |
| 280 | Kona | | 122 | 15-25 | 1.115 | 13.6 | 11.3 | 0 |
| 281-K3-G16-4 | Kona | | 323 | 05-10 | 1.171 | 11.3 | 11.3 | 0 |
| 4109 | | | 223 | 01-03 | 1.999 | 12.7 | 12.7 | 0 |
| 4110 | | | 223 | 05-10 | 1.349 | 11.7 | 11.8 | 0 |
| 4112 | | | 123 | 01-03 | 1.950 | 13.3 | 12.4 | 0 |
| 4113 | | | 213 | 05-10 | 1.060 | 09.7 | 09.4 | 0 |
| 4116 | | | 123 | 05-10 | 1.330 | 11.5 | 10.0 | 0 |
| 4118 | | | 121 | Sandstone | 2.110 | 14.4 | 15.2 | 0.6 |
| 4124 | | | 121 | Sandstone | 1.310 | 12.8 | 13.2 | 0 |
| 4125 | | | 121 | Sandstone | 1.370 | 12.3 | 13.2 | 0 |

| Artifact # | District | Notes | Class | % Pore Space (Basalt) | Weight (kg) | Overall Height (cm) | Base Diameter (cm) | Base Height (cm) |
|---|---|---|---|---|---|---|---|---|
| 4128 | | | 121 | Sandstone | 0.820 | 12.3 | 13.5 | 0 |
| 4129 | | | 121 | Sandstone | 1.220 | 13.2 | 15.9 | 0 |
| 447 | Kona | | 322 | 15-25 | 0.612 | 13.3 | 08.4 | 0.6 |
| 452 | Kona | Base Chipped | 122 | 01-03 | 0.644 | 09.3 | 05.6 | 0 |
| 6326 | | | 323 | 01-03 | 1.910 | 12.0 | 12.2 | 0 |
| 8000 | Puna | | 121 | 01-03 | 1.360 | 13.3 | 13.2 | 0 |
| 827 | Kona | | 122 | 01-03 | 0.753 | 13.7 | 06.3 | 0 |
| 9355 | | | 213 | Unidentified | 1.600 | 12.0 | 11.9 | 0 |
| 9356 | Koʻolau | | 223 | 05-10 | 1.730 | 13.2 | 13.8 | 0 |
| 9357 | | | 213 | 05-10 | 1.310 | 11.0 | 11.2 | 0 |
| aa | Kona | From Sketch | 121 | Unidentified | 1.247 | 13.3 | 13.5 | 0.5 |
| B.1315 | Puna | | 123 | 01-03 | 1.650 | 13.5 | 11.6 | 0 |
| B.1316 | Puna | Base Chipped | 332 | 15-25 | 0.580 | 11.4 | 07.4 | 0 |
| B.1727 | Puna | | 121 | 05-10 | 1.800 | 15.4 | 14.7 | 0 |
| B.1728 | Puna | | 121 | 01-03 | 1.110 | 11.5 | 11.7 | 0 |
| B.1729 | Kona | | 121 | 05-10 | 1.170 | 12.4 | 11.5 | 1.3 |
| B.1730 | Kona | | 112 | 05-10 | 2.960 | 24.4 | 15.8 | 2 |
| B.1731 | Puna | | 112 | 05-10 | 1.510 | 17.4 | 10.5 | 1.4 |
| B.2540 | | | 213 | 01-03 | 1.350 | 11.5 | 12.3 | 0 |
| B.4496 | Nā Pali | | 112 | 05-10 | 2.110 | 20.5 | 13.6 | 1 |
| B.4497 | Nā Pali | | 112 | 05-10 | 2.585 | 25.2 | 16.6 | 2.3 |
| B.4498 | Nā Pali | | 112 | 05-10 | 2.750 | 25.1 | 16.0 | 3.5 |
| B.4499 | Nā Pali | | 112 | 05-10 | 2.470 | 25.5 | 16.0 | 2.4 |
| B.4500 | Nā Pali | | 112 | 01-03 | 1.500 | 17.0 | 13.4 | 3.2 |
| B.8789 | Puna | | 312 | 15-25 | 1.790 | 12.0 | 16.4 | 0 |
| B.8813 | Kona | | 112 | 01-03 | 1.160 | 13.9 | 10.3 | 0 |
| B.8814 | Kona | Base Chipped | 112 | 01-03 | 2.370 | 23.8 | 12.7 | 1.2 |
| bb | Kona | From Photo | 323 | Unidentified | 1.650 | 11.0 | 12.5 | 0 |
| C.10206 | Nā Pali | | 223 | 05-10 | 1.485 | 11.9 | 14.4 | 0 |
| C.10207 | Nā Pali | | 123 | 01-03 | 1.050 | 09.8 | 10.2 | 0 |
| C.1174 | Kona | Reused as Weight | 223 | 01-03 | 1.18 | 09.9 | 12.0 | 0 |
| C.1182 | Haleleʻa | | 112 | 01-03 | 2.780 | 20.7 | 15.3 | 1.6 |
| C.1588 | Kona | | 121 | 01-03 | 1.300 | 13.2 | 13.3 | 0 |
| C.1589 | Puna | | 121 | 01-03 | 1.990 | 15.1 | 13.5 | 0 |
| C.1590 | Kona | | 112 | Sandstone | 1.560 | 20.6 | 11.9 | 1.5 |
| C.4442 | | | 123 | 01-03 | 1.300 | 10.1 | 11.5 | 0 |
| C.5510 | Kona | | 121 | 01-03 | 1.570 | 13.6 | 13.5 | 0 |

| Artifact # | District | Notes | Class | % Pore Space (Basalt) | Weight (kg) | Overall Height (cm) | Base Diameter (cm) | Base Height (cm) |
|---|---|---|---|---|---|---|---|---|
| C.5511 | Kona | | 112 | 01-03 | 2.080 | 20.7 | 13.7 | 3.2 |
| C.5512 | Kona | | 112 | 01-03 | 1.370 | 17.1 | 10.7 | 1.2 |
| C.5513 | Halele‘a | | 121 | 01-03 | 1.175 | 12.5 | 12.1 | 0 |
| C.7325 | Ko‘olau | | 123 | 01-03 | 1.720 | 11.3 | 13.0 | 0 |
| C.7327 | Ko‘olau | | 212 | 01-03 | 1.400 | 14.0 | 10.9 | 0 |
| C.7328 | Ko‘olau | | 223 | 01-03 | 1.970 | 12.9 | 12.3 | 0.6 |
| C.7330 | Ko‘olau | | 423 | Unidentified | 1.450 | 12.6 | 12.7 | 0 |
| C.7331 | Ko‘olau | | 423 | 15-25 | 1.350 | 11.5 | 11.4 | 0 |
| C.7332 | Ko‘olau | Base Chipped | 312 | 05-10 | 1.450 | 15.3 | 11.0 | 0 |
| C.8942 | | | 433 | Sandstone | 1.295 | 11.3 | 09.8 | 0 |
| C.9454 | | | 412 | 05-10 | 1.520 | 16.0 | 11.5 | 0 |
| cc | Puna | From Sketch | 423 | Unidentified | 1.660 | 13.1 | 14.6 | 0.8 |
| D.1520 | | | 423 | 05-10 | 2.070 | 12.7 | 12.0 | 0.4 |
| D.1521 | | | 222 | 01-03 | 1.300 | 11.4 | 10.3 | 0 |
| D.1522 | | | 122 | 01-03 | 1.030 | 13.0 | 05.5 | 0 |
| D.1612 | Kona | | 121 | 01-03 | 1.125 | 14.1 | 11.8 | 0 |
| D.4099 | Puna | | 121 | Sandstone | 1.520 | 13.0 | 12.7 | 0 |
| D.4100 | Puna | | 223 | 05-10 | 1.150 | 10.7 | 11.7 | 0 |
| D.4577 | Ko‘olau | | 121 | 05-10 | 1.560 | 15.7 | 15.5 | 0 |
| dd | Kona | From Sketch | 413 | Unidentified | 1.998 | 14.2 | 11.9 | 1.1 |
| e | Halele‘a | From Sketch | 132 | Unidentified | 0.624 | 10.3 | 07.6 | 0 |
| ee | Kona | From Photo | 121 | 15-25 | 1.690 | 14.0 | 16.1 | 1.5 |
| g | Halele‘a | From Photo | 412 | 01-03 | 2.234 | 15.2 | 12.7 | 2.5 |
| GF104 | | | 112 | Sandstone | 2.041 | 19.8 | 13.4 | 2 |
| GF105 | | | 112 | Sandstone | 1.247 | 14.2 | 10.9 | 0.7 |
| GF106 | | Letter "K" inscribed on body | 112 | 05-10 | 1.814 | 20.7 | 11.9 | 0.7 |
| GF107 | | | 112 | Sandstone | 2.948 | 19.6 | 12.9 | 2.1 |
| GF108 | | | 112 | Sandstone | 4.196 | 22.7 | 15.8 | 5.2 |
| GF109 | | | 323 | Coral | 1.814 | 12.7 | 12.9 | 0.5 |
| GF110 | | | 222 | 15-25 | 1.814 | 12.8 | 12.4 | 0 |
| GF111 | | | 223 | 01-03 | 2.041 | 12.5 | 12.0 | 0.3 |
| GF112 | | | 213 | 01-03 | 2.041 | 12.8 | 12.9 | 0 |
| GF113 | | | 122 | 15-25 | 1.247 | 12.4 | 11.5 | 0 |
| GF114 | | | 123 | 01-03 | 1.814 | 13.4 | 11.7 | 0 |
| GF115 | | | 121 | 01-03 | 1.474 | 12.5 | 12.4 | 0 |

| Artifact # | District | Notes | Class | % Pore Space (Basalt) | Weight (kg) | Overall Height (cm) | Base Diameter (cm) | Base Height (cm) |
|---|---|---|---|---|---|---|---|---|
| GF116 | | | 121 | 01-03 | 1.814 | 15.5 | 17.0 | 0 |
| GF117 | | | 121 | 01-03 | 1.701 | 14.8 | 13.7 | 0 |
| GF118 | Puna | | 121 | Sandstone | 1.588 | 14.9 | 16.6 | 0 |
| GF15-T | | | 233 | 01-03 | 0.794 | 10.6 | 10.2 | 0 |
| GF18-T | | | 121 | 01-03 | 1.247 | 13.0 | 13.2 | 0 |
| GF19-T | | | 121 | 01-03 | 1.021 | 11.5 | 13.2 | 0 |
| GF20-T | | Base Chipped | 121 | 05-10 | 1.361 | 12.4 | 14.4 | 0 |
| GF21-T | | | 121 | 01-03 | 1.814 | 13.7 | 14.1 | 0.5 |
| GF22-T | | | 112 | 01-03 | 1.588 | 17.8 | 10.0 | 0.3 |
| GF23-T | | | 112 | 01-03 | 1.701 | 18.7 | 11.5 | 1.5 |
| GF24-T | | | 112 | 01-03 | 1.814 | 17.8 | 12.2 | 1.6 |
| GF25-T | | | 112 | 01-03 | 2.381 | 22.3 | 11.5 | 2.9 |
| GF26-T | | | 112 | 01-03 | 2.381 | 19.2 | 13.8 | 1.2 |
| GF27-T | | | 112 | 01-03 | 3.515 | 20.9 | 14.7 | 3 |
| GF28-T | | | 112 | 01-03 | 3.629 | 21.3 | 14.8 | 2.2 |
| GF29-T | | | 112 | 01-03 | 3.415 | 19.7 | 13.4 | 1.9 |
| GF30-T | | | 112 | 01-03 | 4.309 | 22.5 | 16.0 | 3.1 |
| GF31-T | | | 112 | Sandstone | 2.608 | 20.2 | 13.5 | 1 |
| GF598 | | | 233 | 01-03 | 1361 | 11.0 | 11.0 | 0.3 |
| GF599 | | | 121 | 05-10 | 1361 | 14.8 | 17.9 | 0 |
| GF601 | | | 121 | 01-03 | 1588 | 13.9 | 13.6 | 0 |
| GF602 | | | 121 | 01-03 | 1701 | 14.1 | 14.9 | 0 |
| GF603 | | | 121 | 01-03 | 1134 | 13.7 | 14.6 | 0 |
| GF604 | | | 121 | 05-10 | 1247 | 14.7 | 16.0 | 0 |
| GF605 | | | 112 | 01-03 | 1701 | 19.0 | 13.2 | 0.9 |
| GF606 | | | 112 | 05-10 | 1660 | 18.8 | 12.8 | 2.1 |
| GF608 | | | 112 | 01-03 | 2381 | 21.3 | 13.7 | 1.7 |
| GF609 | | | 112 | 01-03 | 2668 | 20.6 | 14.5 | 2 |
| GF610 | | | 112 | Sandstone | 1750 | 20.0 | 12.0 | 0.9 |
| GF611 | | | 112 | 01-03 | 1814 | 20.8 | 12.9 | 0.8 |
| GF612 | | Top Partially Grooved | 112 | 01-03 | 1474 | 14.0 | 13.1 | 1.1 |
| GFNO#A | | No Tag | 123 | 01-03 | 1701 | 12.7 | 11.8 | 0 |
| hh | Kona | From Sketch | 213 | Unidentified | 1077 | 14.1 | 10.5 | 1 |
| ii | Kona | From Sketch | 223 | Unidentified | 1602 | 14.2 | 13.0 | 1.2 |
| j | Koʻolau | From Sketch | 213 | Unidentified | 2350 | 14.2 | 12.2 | 1 |
| jj | Kona | From Sketch | 123 | Unidentified | 1970 | 13.1 | 12.9 | 1 |

| Artifact # | District | Notes | Class | % Pore Space (Basalt) | Weight (kg) | Overall Height (cm) | Base Diameter (cm) | Base Height (cm) |
|---|---|---|---|---|---|---|---|---|
| K-15 | | Kauaʻi General | 123 | 15-25 | 2560 | 14.7 | 14.0 | 0.5 |
| K270 | | Arnemann Collection | 122 | 05-10 | 1010 | 09.6 | 09.2 | 0 |
| kk | Kona | From Sketch | 223 | Unidentified | 2268 | 12.4 | 10.4 | 1 |
| m | Puna | From Photo | 123 | 01-03 | 1332 | 14.0 | 09.2 | 1.2 |
| mm | Kona | from sketch | 123 | Unidentified | 850 | 12.6 | 08.6 | 1.6 |
| nn | Kona | From Sketch | 121 | Unidentified | 1772 | 14.8 | 15.0 | 0.5 |
| o (B1317) | Puna | From Photo | 413 | Unidentified | 1552 | 12.6 | 11.3 | 1.2 |
| p | Kona | From Sketch | 121 | Unidentified | 1956 | 14.2 | 14.6 | 1.3 |
| q | Kona | From Photo | 223 | 01-03 | 1630 | 12.8 | 12.0 | 0.6 |
| r | Kona | From Photo | 213 | 01-03 | 1710 | 13.1 | 13.1 | 0.9 |
| s | Kona | From Photo | 122 | 15-25 | 1582 | 14.0 | 12.1 | 0 |
| z | Puna | From Photo | 223 | 01-03 | 1664 | 13.4 | 11.2 | 1 |

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