

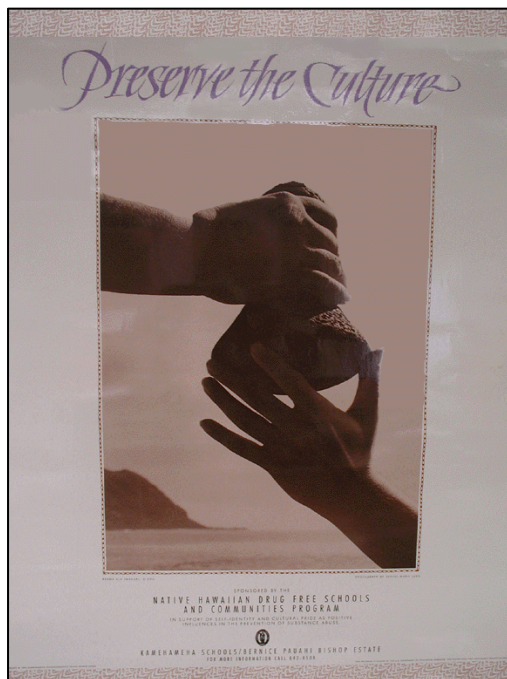
Making the Most of Museum Collections: Analyses of Kauaʻi Poi Pounders and Artifacts from Nuʻalolo Kai

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**and
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Excavation is the stereotypical form of data recovery for archaeologists, but this activity is costly both in labor and for the damage it inflicts on archaeological sites. With rapidly increasing land development in Hawaiʻi, more archaeology is being done than ever before, and the rate and scale at which these non-renewable resources are being destroyed is magnified. By making better use of previously recovered artifact collections, we can acquire new knowledge without excavating new sites.

This talk will showcase recent research based on data collected exclusively from Hawaiian museum collections. The distinctive poi pounders of Kauaʻi will be discussed in terms of their variability through time and across space. This will be followed by an overview of efforts to document a unique collection of material recovered from the ancient fishing village of Nuʻalolo Kai on the Nā Pali Coast of Kauaʻi.



Poi Pounders

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 Hawaiʻi even today. In fact, they are among the most celebrated Hawaiian antiquities, a symbol of strength in the Hawaiian culture.

Given the importance of this unique class of artifacts, surprisingly little systematic research has been done on Hawaiian poi pounders. My work examines variability in the morphology of poi pounders from the island of Kauaʻi, historically known for its distinctive poi pounder forms.



Previous Research

The earliest descriptions of Hawaiian poi pounders identify three basic forms: the classic, also known as knobbed or conical pounders, the ring, and the stirrup pounders. Sources such as Brigham (1902), Bennett (1931), and Hiroa (1964) agree that the ring and stirrup pounders were found only on Kauaʻi.

More recent reviews of Hawaiian material culture often include poi pounders but never go beyond description. Thus, three basic forms of

poi pounders are identified, but the distinguishing features of these forms are not clearly defined, and we know nothing about their distribution across space and time or the ways in which function or technology affects this distribution. My analysis focuses on these areas.

| Collection | Spatial & Temporal Analyses | Functional Analysis | General Total |
|--|-----------------------------|---------------------|---------------|
| Grove Farm Ethnographic Collections | 1 | 44 | 44 |
| Bishop Museum Ethnographic Collections | 45 | 73 | 78 |
| Bishop Museum Archaeological Collections | 7 | 9 | 9 |
| Bishop Museum Archives | 41 | 22 | 41 |
| | | | |
| Totals | 94 | 148 | 172 |

Methods

I examined a total of 172 poi pounders from Kauaʻi. I was not able to obtain a complete set of information for every artifact (for instance, some lacked precise provenience, or locational information, while others lacked weight data), so all 172 artifacts were not used for each analysis. For the temporal and spatial analyses I utilized 94 of the pounders that had provenience information to the scale of district or better and for which the dimensions of my classification could be clearly identified. For the functional analysis I

utilized 148 of the pounders that had weight, height, & base diameter data available.

Of the 172 poi pounders, 131 were housed at museums where I was able to physically examine them - 44 from the Grove Farm Museum and 87 from the Bishop Museum. Of the Bishop Museum pounders, 78 were from the ethnographic collections (donated to the museum) and nine were from archaeological contexts, and all of the Grove Farm pounders were from ethnographic collections. In addition, I gathered information from photographs and measurements of 41 ethnographic pounders in the Bishop Museum archives.

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.

Based on this information, I devised a simple classification that focuses on the handle region of the poi pounder. It includes three dimensions: 1) the morphology of the

top, 2) the morphology of the upper sides, and 3) the presence/absence of perforation.

Classification for Poi Pounders

Top Morphology:

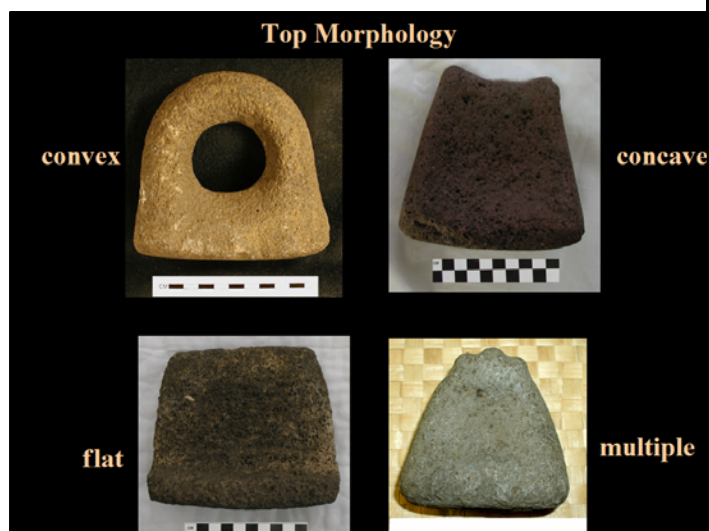
- 1) Convex
- 2) Concave
- 3) Flat
- 4) Multiple

Upper Side Morphology:

- 1) Angled In
- 2) Angled Out
- 3) Straight
- 4) Multiple

Perforation:

- 1) Present
- 2) Absent
- 3) Partial



There are examples of the four modes that characterize the shape of poi pounder top: 1) convex, 2) concave, 3) flat, and 4) multiple.

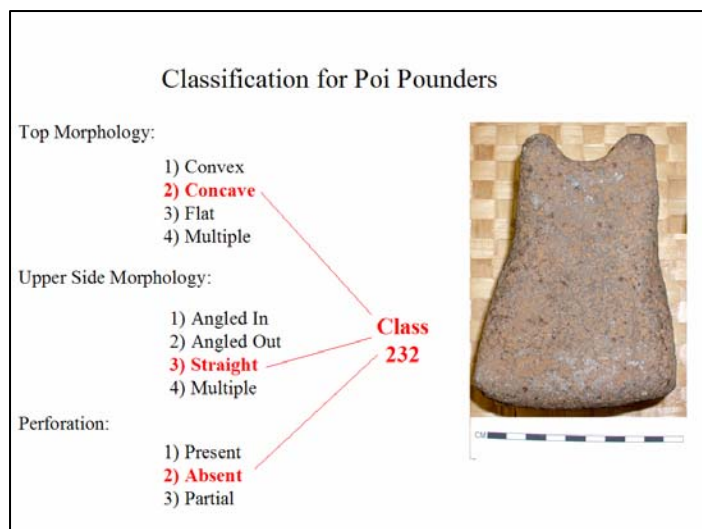


The morphology of the upper sides also has four modes: 1) angled in, 2) angled out, 3) straight, and multiple (the multiple mode is not pictured because there were no examples of pounders whose left and right sides were different).

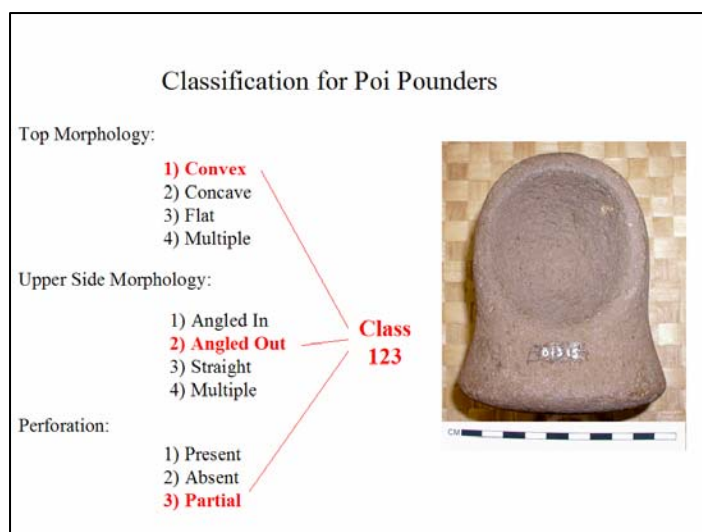


The final dimension characterizes perforation, which refers to the presence or absence of a puncture through the artifact. This dimension includes three modes: 1) present, 2) absent, and 3) partial.

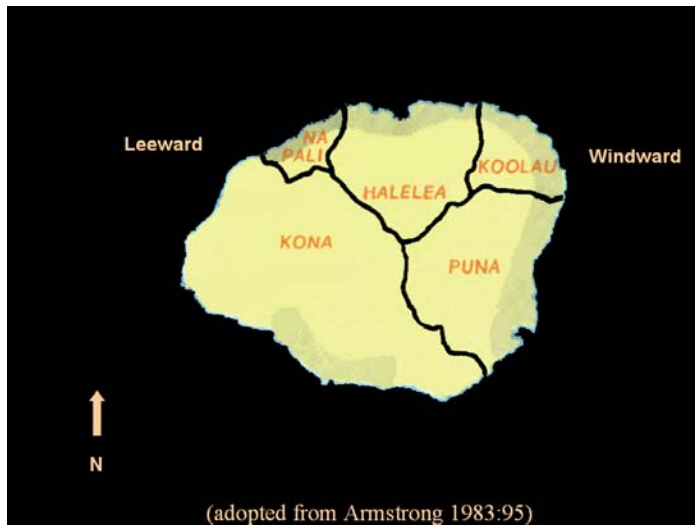
So each pounder gets assigned a 3-digit number, one for the shape of the top, another for the shape of the upper sides, and one for perforation, and this is the artifact's class



For example, a pounder with a concave top, straight sides, and no perforation is a class 232 artifact,



while one with a convex top, sides angled out and partial perforation would fall into class 123. 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).

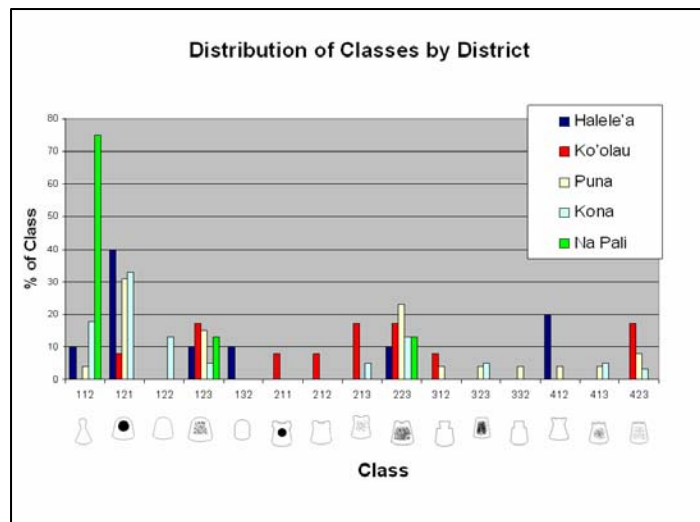


Analysis and Discussion

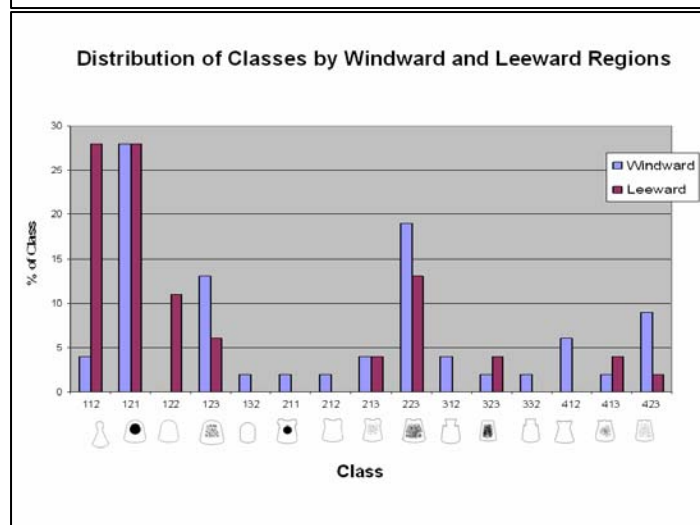
I grouped the poi pounders according to ancient *moku'āina*, or district boundaries and by windward and leeward divisions. The island of Kaua'i consists of five *moku'āina* districts: Halele'a, Ko'olau, Puna, Kona, and Nā Pali. The Kona and Nā Pali districts together make up the leeward division while the remaining three districts comprise the Windward side of the island.

Of the poi pounders that had provenience information, 10 were from Halele'a, 11 from Ko'olau, 26 from

Puna, 39 from Kona, and eight from Nā Pali. Stretching from Nu'alolo to Hanapēpē, the Kona district is by far the largest, and fittingly includes the largest number of artifacts. Correspondingly, Nā Pali, the smallest district, includes the fewest number of artifacts. Class size is more comparable when the poi pounders are grouped according to the windward/leeward divisions, with 47 artifacts from the windward side and 47 from the leeward.



This illustrates the distribution of classes by district. As expected, the Nā Pali district with the fewest number of artifacts yielded the fewest realized classes. However, the 11 poi pounders from the Ko'olau district were spread across eight different classes, while Kona district's 39 pounders were distributed among only nine different classes. Although the sample is small, it appears that Ko'olau district's poi pounders are the most variable in form and those from Kona are the least variable



This illustrates the distribution of classes by the windward/leeward divisions. You can see that the classic knobbed form represented by class 112 is predominantly a leeward phenomenon, while the ring pounders of class 121 were equally common on both sides of the island. The more variable stirrup forms were more common on the windward side.

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 nine classes. The greater diversity in the 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.

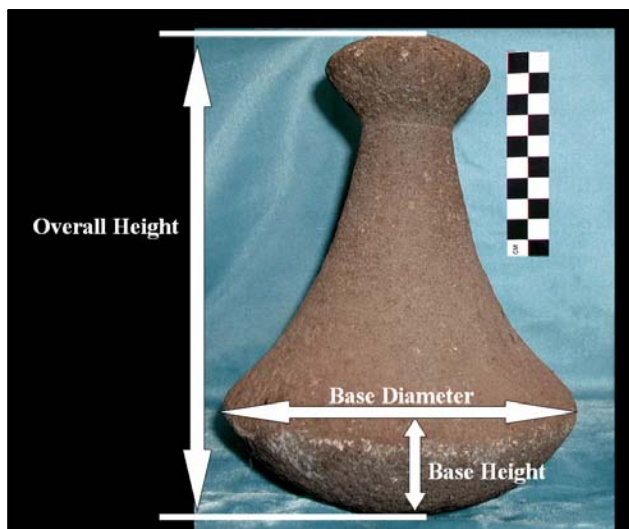
| Temporal Unit | Scale | Convex Top | Upper Sides Angled out | Part/Full Perforation | Classes |
|---------------|--------|------------|------------------------|-----------------------|--------------------|
| 1 | Island | + | | | 112,132 |
| 2 | Island | + | + | | 122 |
| 2 | Island | + | + | + | 121,123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

An attempt to apply seriation to these artifacts 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). A seriation works if no gaps appear in the ordering, like the array you see here.

The poi pounder classes were used to array the individual pounders to track

variation in artifact form through time. This seriation is based on the presence or absence of a given mode of the classification. So, a plus means that that class has a given trait, and no plus means that it does not. For example the pounders in the first row have a convex top but do not have sides angled out or perforation.

This seriation includes pounders from the entire island of Kaua'i. Each row can be considered a Temporal Unit (TU), with TU 1 most recent and TU 5 oldest and this illustrates a hypothetical chronology for poi pounder form on Kaua'i. The knobbed pounders were most recent, ring forms intermediate in age, and most of the stirrup forms were oldest. It is also apparent that pounders with convex tops are most recent while those with concave, straight or multiple tops are older. And poi pounders were more variable in the distant past and became more standardized through time.



Functional Analyses

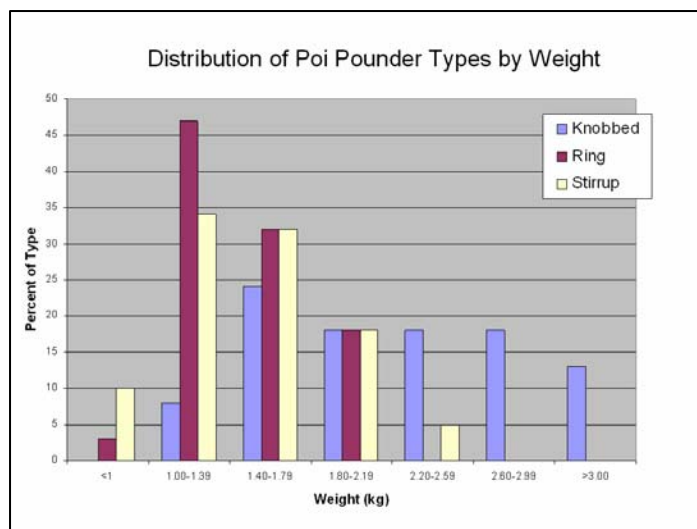
For the functional analysis, I chose to investigate weight, overall height, base diameter, base height, and material type. Pounder weight plays a direct role in the time and energy it takes to process the taro root into poi. A heavier pounder exerts more force on the taro, mashing it in fewer blows than a lighter one, yet a heavier pounder takes more energy to lift.

The diameter of the base 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 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 might wear through time, potentially reducing the base height as the artifact is utilized, so pounders with short bases may have been used for longer periods of time than those with tall bases.

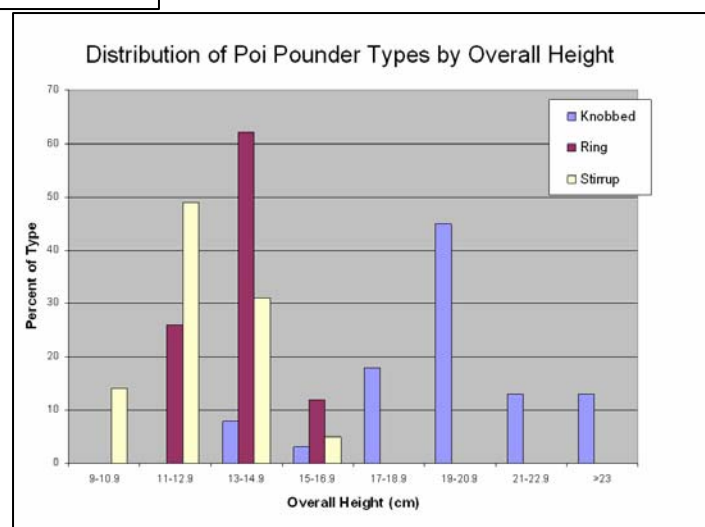


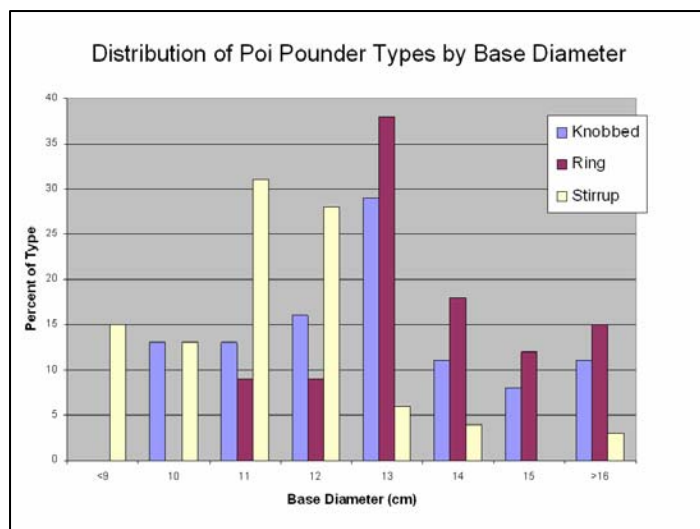
Functional attributes may also be related to the variety of taro being processed. Over 300 varieties of taro were cultivated in ancient Hawai'i, and many of these were suitable for making poi. The size and consistency of the species of taro to be processed may have been a consideration in selecting for 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, which may have been easier to mash with a lighter pounder.



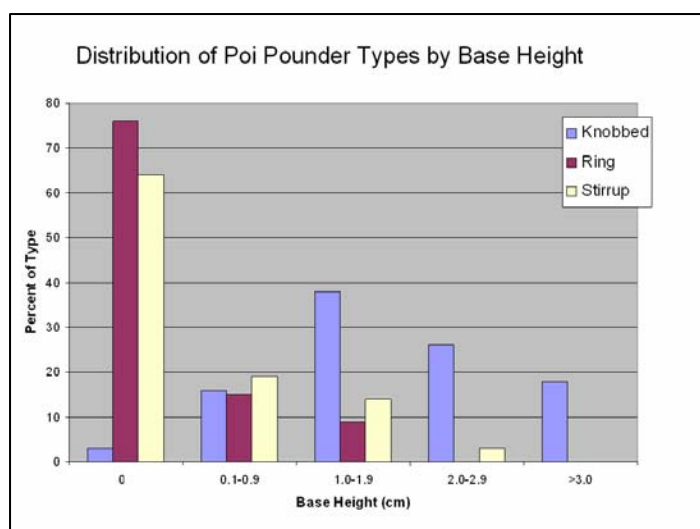
This shows the distribution of the knobbed, ring, and stirrup types by weight. The knobbed pounders are clearly heavier than the ring or stirrup forms. Extra weight may have been necessary to exert heavier blows with the knobbed pounders because they were operated with only one hand. Additional weight may not have been as important to the ring and stirrup pounders as they may have utilized the force of two hands.

This illustrates the distribution of poi pounder types by overall height. Knobbed pounders were tallest by far, while stirrup pounders were shortest. Knobbed pounders showed the most variability in height, while ring pounders were least variable.





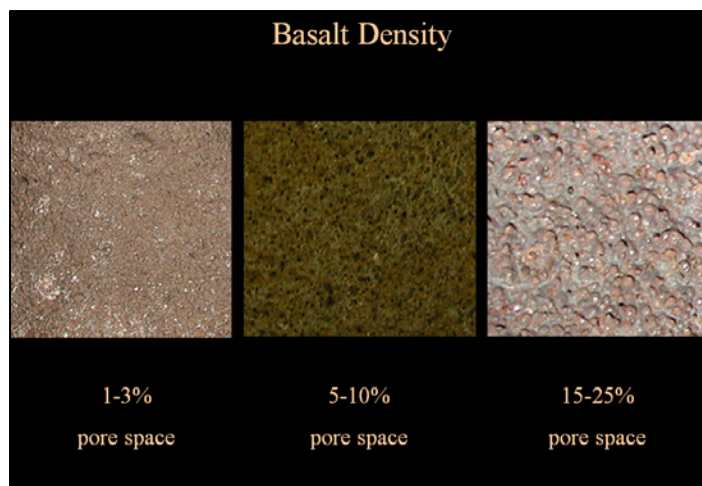
This shows the distribution of the types by base diameter. Though generally light weight, the ring pounders exhibit large base diameters. The stirrup forms had the smallest base diameters, and the base diameters of the knobbed pounders was intermediate between the other forms. Perhaps the stirrup pounders failed to persist through time because their light weight and narrow bases rendered them less efficient.



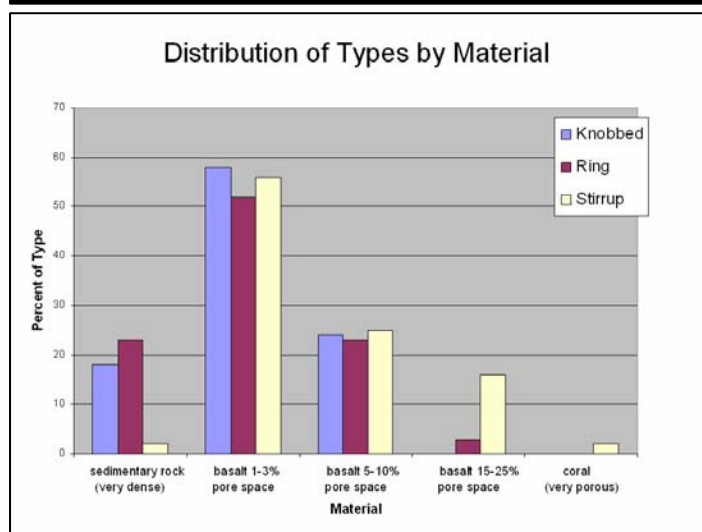
Here you can see the distribution of poi pounder types by base height. Ring pounders exhibited the shortest bases while knobbed pounders had the tallest bases, and the stirrup pounder bases were intermediate in height. This may indicate that the ring pounders had longer use-lives; they were probably utilized until their bases were worn thin.

I also grouped the artifacts by material type. The poi pounders in my sample were manufactured from either sedimentary rock, basalt, or coral and you can see examples of these materials here.





I measured density of the basalt poi pounders by estimating the percentage of pore space in the rock (sensu Terry and Chillingar 1955:332-333). Here you can see examples of the different density categories. Rock with 1-3% pore space has few dispersed pores. 5-10% has a higher concentration of small pores, and 15-25% has many large pores.



This graph shows the distribution of knobbed, ring, and stirrup pounders by material type. Very dense basalt was the most common material. All of the knobbed pounders were manufactured from dense materials. 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.

Conclusion

This analysis of Hawaiian poi pounders shows that these artifacts are highly variable in morphology. The artifacts in my sample were distributed across 15 different classes, demonstrating that these implements show more variability than can be accounted for by the traditional three-group classification of knobbed, ring, and stirrup pounders described in the literature. However, most variability in this classification appears within the stirrup group, suggesting that it acts as a default group for pounders that don't fit into the knobbed and ring categories.



Poi Pounders: Summary of Findings

- Ko'olau district's pounders were most variable
- Kona's were least variable
- Knobbed pounders more common on the leeward side
- Windward pounders more variable
- Stirrup and ring forms older than knobbed
- Knobbed pounders heaviest
- Shift toward denser materials over time

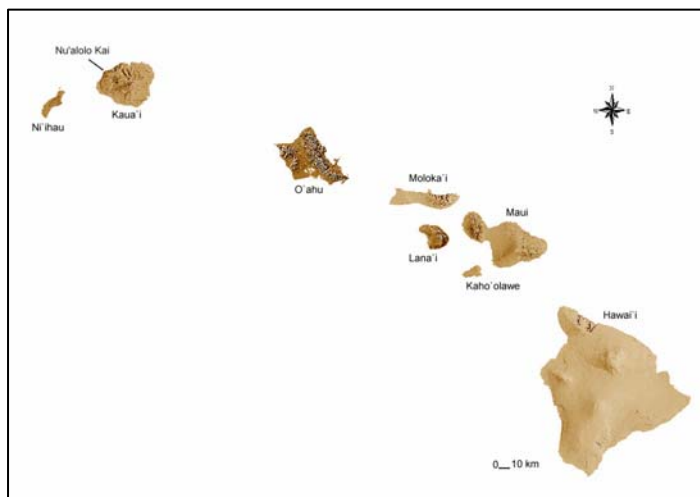
Interesting patterns were evident when these artifacts were grouped according to district. • Though small in area, Ko'olau district exhibited the most diversity of poi pounder form. • By contrast, the large Kona district was least variable. • The classic knobbed pounders were more common on the leeward side of the island, while the • windward poi pounders were more diverse. • Artifact seriation suggests that the stirrup pounders are an older form than the knobbed. • Functional analyses revealed that the knobbed pounders were heavier than the ring and

stirrup forms. 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, rendering them less efficient than the heavier knobbed pounders and wide-based ring forms. This suggests development toward more efficient poi pounders through time. • Analysis of material type indicated a shift toward denser materials, and this is another indication that the implement was perfected over time.

Finally, while I focused my research on Kaua'i, I did come across 12 poi pounders from other Hawaiian islands that were not of the classic knobbed form. This is a direct contradiction to the literature (e.g., Brigham 1902, Bennett 1931, Hiroa 1964), which consistently restricts ring and stirrup pounders to Kaua'i. These artifacts may have been transported to other islands by Kaua'i migrants or may have been items of exchange. Geochemical sourcing would reveal if these pounders were actually manufactured from Kaua'i basalts.



Hawaiian poi pounders are unique artifacts which are rarely found in excavation, and have received inadequate attention by archaeologists. 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 through time and space on Kaua'i. Similar kinds of studies can be done with other classes of artifacts, and we've been working with an assemblage from Nu'alolo Kai with these goals in mind.



Nu'alolo Kai

For the past decade archaeologists at the University of Hawai'i have been involved in a study of the artifacts from this site. The Nu'alolo Kai site is an ancient habitation area which was continuously occupied from the 12th century AD into the historic period. It is located on the Nā Pali coast on the northwestern shore of Kaua'i. Nu'alolo Kai shared resources with the adjacent inland valley of Nu'alolo 'Aina. While coastal settlements furnished marine resources, upland valley areas contributed

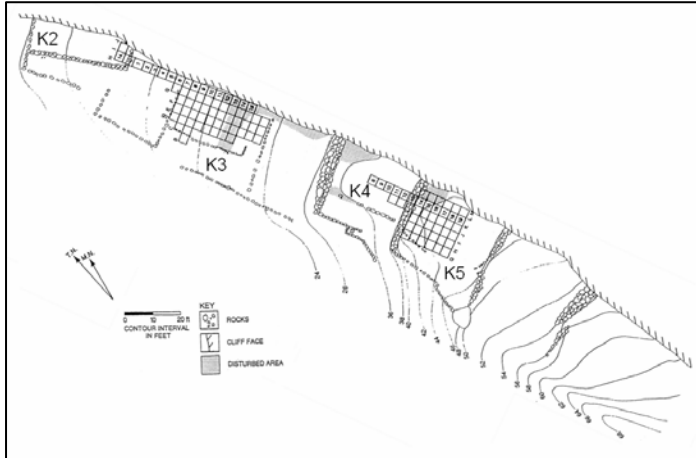
agricultural products. A precarious ladder enabled the inhabitants to travel back and forth between Nu'alolo Kai and Nu'alolo 'Aina over a sheer cliff dividing the two settlements. After the arrival of James Cook in 1778, Nu'alolo Kai remained relatively isolated from foreigners because of the dangerous sailing conditions around the Nā Pali coast and rugged cliffs which separated the settlement from the rest of the island, although there are stories about foreigners' futile attempts to climb the perilous ladder between Nu'alolo Kai and Nu'alolo 'Aina.



The Nu'alolo Kai site complex was first identified by Bennett during his archaeological survey of Kaua'i in the 1920s. In

true Indiana Jones fashion, "X" marks the spot of this site – the "X" on the cliff face above Nu'alolo Kai is formed naturally by volcanic dikes. The Bishop Museum organized an expedition to the site in the late 1950s, when excavations of potentially deep and well preserved archaeological deposits held out great hope for better understanding the settlement and subsequent development of Hawaiian culture. And by all measures, Nu'alolo Kai fits this description, with cultural deposits more than 2 meters in depth, and with an incredible variety of organic and inorganic objects preserved. The

location of the site played a major role in preserving archaeological materials. The habitation areas are adjacent to the cliff face, at a position where the ocean spray mists the site. This salty mist served as a preservation agent, thus materials that deteriorate under normal conditions have been preserved there.



The excavations of the 1950s and 60s focused mostly on the feature known as K3, a habitation terrace, with smaller areas excavated in K2, a canoe shed, and K4 and K5, which are probably ancillary habitation features. This slide shows the excavation grids of the 1950s and 60s work. Radiocarbon dates and introduced Euroamerican artifacts from the site suggest an occupation as early as the 12th or 13th centuries AD, and extending through the 19th and probably early 20th century. More than 20,000 objects were

recovered from the Bishop Museum excavations, but a final report on the findings is yet to be published.

Our most immediate goal on this project is to produce an inventory and limited catalog of these items. These include an array of materials and pieces that are not usually found in Hawaiian archaeological sites, ranging from fiber wrapped sinkers,



fragments of gourd containers, knotted plant material,

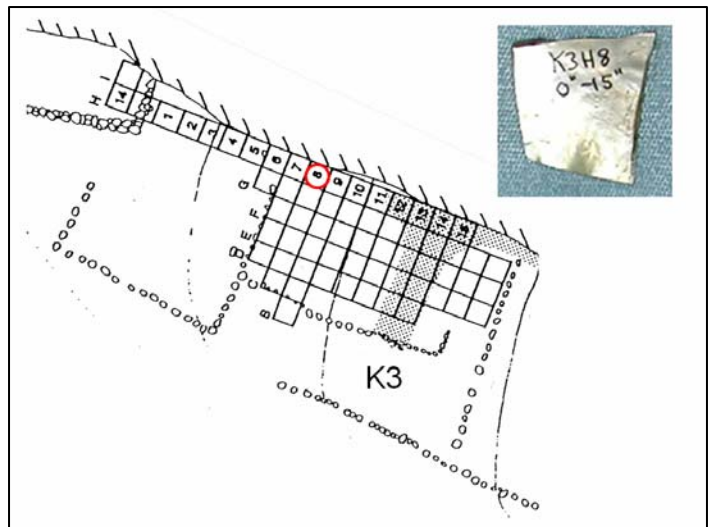
kapa,





cordage, and many other items.

Our inventory began with creating a Microsoft Access database that includes information for each artifact in this large collection. The original excavators used an artifact numbering system based on the provenience of the item. For example, this piece of cut pearl shell was labeled K3-H8-0-15, so it was found at feature K3, excavation unit H8, from 0-15 inches below the surface. But all artifacts found at this location bear the same number, so multiple artifacts could potentially have this ID number. For our database, we wanted each artifact to have a unique number, so we assigned UH identification



| BPM# | UH ID# | Material | ActualDepth | Photo | Class_1 | Portion | Condition | Length_cm | Width_cm | Weight_g |
|------------|--------|-----------|-------------|-------|-------------|-------------|------------------|-----------|----------|----------|
| K3-F08-24 | 0371 | Sandstone | 37.00 | 071 | Ulumaiika | Whole | Chipped | 5.40 | 5.25 | 145.00 |
| K3-F15-22 | 0372 | Limestone | 36.00 | 069 | Ulumaiika | Whole | Unworn | 6.60 | 6.60 | 262.00 |
| K3-H09-07 | 0373 | Limestone | 14.00 | 083 | Ulumaiika | Fragment | Crushed | 6.82 | 6.82 | 222.00 |
| K3-E07-25 | 0374 | Hematite | 59.00 | 066 | Quoit | Fragment | Polished | 3.26 | 2.66 | 6.88 |
| K3-D13-10 | 0376 | Limestone | 18.00 | 069 | Ulumaiika | Fragment | Polished | 2.76 | 1.21 | 6.68 |
| K3-F13-16b | 0379 | Limestone | 14.00 | 069 | Ulumaiika | Fragment | Polished | 2.20 | 1.96 | 1.66 |
| K3-D13-22 | 0380 | Hematite | 23.00 | 066 | Quoit | Fragment | Chipped | 9.30 | 9.30 | 329.26 |
| K3-H08-13 | 0381 | Sandstone | 20.00 | 071 | Ulumaiika | Fragment | Unworn | 6.05 | 4.78 | 169.14 |
| K5-G16-10 | 0416 | Basalt | 12.00 | 004 | Adze | Mid Section | Crushed/Polished | 6.70 | 4.20 | 112.00 |
| K5-K16-01 | 0421 | Basalt | 02.00 | 004 | Adze | Mid Section | Crushed/Polished | 7.50 | 4.60 | 128.00 |
| K5-J14-30 | 0424 | Basalt | 25.00 | 004 | Adze | Mid Section | Chipped/Polished | 7.30 | 5.10 | 87.84 |
| K5-M13-13 | 0427 | Basalt | 16.00 | 005 | Adze | Fragment | Crushed/Polished | 8.00 | 6.20 | 499.00 |
| K5-J14-23 | 0433 | Basalt | 52.00 | 041 | Hammerstone | Whole | Crushed | 5.30 | 5.30 | 114.00 |
| K5-M15-12 | 0440 | Basalt | 17.00 | 057 | Pounder | Whole | Abraded/Crushed | 12.40 | 8.30 | 148.00 |
| K5-H15-01 | 0441 | Basalt | 08.00 | 043 | Hammerstone | Whole | Crushed | 12.00 | 11.50 | 1032.00 |
| K5-M15-24 | 0442 | Basalt | 26.00 | 025 | Sinker | Whole | Crushed | 8.20 | 6.00 | 377.00 |
| K5-J13-16 | 0443 | Basalt | 44.00 | 025 | Sinker | Whole | Crushed | 5.70 | 4.40 | 125.00 |
| K5-SUR | 0445 | Basalt | Surface | 023 | Sinker | Whole | Crushed | 8.60 | 8.25 | 662.50 |
| K5-H15-21 | 0447 | Basalt | 44.00 | 049 | Pounder | Whole | Abraded/Crushed | 12.39 | 8.08 | 612.00 |
| K5-J13-15 | 0450 | Basalt | 44.00 | 001 | Abrader | Whole | Abraded/Crushed | 6.31 | 6.31 | 99.69 |
| K5-L14-11 | 0451 | Basalt | 36.00 | 020 | Ulumaiika | Whole | Crushed | 9.20 | 9.20 | 426.00 |
| K5-K17-1 | 0453 | Basalt | 03.00 | 044 | Whetstone | Whole | Abraded/Crushed | 12.80 | 8.00 | 456.70 |
| K5-K14-23 | 0455 | Basalt | 55.00 | 059 | Reamer | Whole | Abraded/Crushed | 5.15 | 3.24 | 36.06 |
| K5-K14-18 | 0461 | Basalt | 47.00 | 017 | Reamer | Whole | Abraded | .60 | 1.42 | 7.00 |
| K5-M15-06 | 0462 | Basalt | 03.00 | 016 | File | Whole | Abraded | 6.07 | 1.10 | 5.90 |
| K5-H17-09 | 0464 | Basalt | 36.00 | 016 | Reamer | Whole | Abraded | 8.90 | 1.50 | 18.40 |
| K5-H14-34 | 0468 | Basalt | 47.00 | 018 | File | Whole | Abraded | 12.70 | 1.80 | 48.25 |
| K5-H14-31 | 0469 | Basalt | 45.00 | 018 | Reamer | Whole | Abraded/Polished | 8.32 | 2.90 | 48.53 |
| K5-H16-07 | 0520 | Basalt | 16.00 | 024 | Sinker | Whole | Unworn | 7.50 | 7.30 | 242.00 |
| K5-H15-18 | 0618 | Coral | 44.00 | 036 | Abrader | Whole | Abraded | 11.04 | 7.85 | 219.02 |

numbers for each item, starting with number 1. We are now up to number 12,451 and we still have many more artifacts to enter in the system.

Our database has 66 fields, including the original Bishop Museum ID number and the unique UH ID. This is an example of a page of the database, showing some of the main fields, which are the columns, and each row represents a single artifact. Some of the main fields we have are material type, the class of the artifact

(e.g., is it a fishhook, an adze, a scraper) provenience information, and measurements, such as length, width, and weight. “Portion” refers to the wholeness or fragmentary nature of the artifact – is it whole or a broken piece. “Condition” is a description of modification, in particular, its degree of wear or completion (e.g., the term polished is a condition of an adze).

We also took photos of 1,468 artifacts and the number in this column corresponds with the file name for that photo, and we have all the photos on CDs. So if I wanted to see a photo of artifact 443, I would just open photo 025,

| BPDM ID# | UN ID# | Material | ActualDepth | Photo | Class 1 | Portion | Condition | Length cm | Width cm | Weight |
|------------|--------|-----------|-------------|-------|-------------|-------------|------------------|-----------|----------|----------|
| K3-F08-24 | 0371 | Sandstone | 37.00 | 071 | Ulumaika | Whole | Chipped | 5.40 | 5.25 | 145.00 |
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| K3-D13-10 | 0376 | Limestone | 18.00 | 069 | Ulumaika | Fragment | Polished | 2.76 | 1.21 | 6.68 |
| K3-F13-10b | 0379 | Limestone | 14.00 | 069 | Ulumaika | Fragment | Polished | 2.20 | 1.96 | 1.66 |
| K3-D13-22 | 0380 | Hematite | 23.00 | 066 | Quail | Fragment | Chipped | 9.30 | 9.30 | 329.26 |
| K3-H08-13 | 0381 | Sandstone | 20.00 | 071 | Ulumaika | Fragment | Unworn | 6.05 | 4.78 | 168.14 |
| K3-G16-10 | 0416 | Basalt | 12.00 | 004 | Adze | Mid Section | Crushed/Polished | 6.70 | 4.20 | 112.00 |
| K3-K16-01 | 0421 | Basalt | 02.00 | 004 | Adze | Mid Section | Crushed/Polished | 7.50 | 4.60 | 128.00 |
| K3-J14-30 | 0424 | Basalt | 25.00 | 004 | Adze | Mid Section | Chipped/Polished | 7.30 | 5.10 | 87.84 |
| K3-H13-13 | 0427 | Basalt | 16.00 | 005 | Adze | Fragment | Crushed/Polished | 8.00 | 6.20 | 459.00 |
| K3-J14-23 | 0433 | Basalt | 52.00 | 041 | Hammerstone | Whole | Crushed | 5.30 | 5.30 | 114.00 |
| K3-M15-12 | 0440 | Basalt | 17.00 | 057 | Pounder | Whole | Abaded/Crushed | 12.40 | 8.30 | 148.00 |
| K3-H15-01 | 0441 | Basalt | 08.00 | 043 | Hammerstone | Whole | Crushed | 12.00 | 11.50 | 1,032.00 |
| K3-M15-24 | 0444 | Basalt | 26.00 | 025 | Sinker | Whole | Crushed | 8.20 | 6.00 | 377.00 |
| K3-J13-16 | 0443 | Basalt | 44.00 | 025 | Sinker | Whole | Crushed | 5.70 | 4.40 | 125.00 |
| K3-SUR | 0445 | Surface | 025 | 025 | Sinker | Whole | Crushed | 8.60 | 8.25 | 662.50 |
| K3-I15-21 | 0447 | Basalt | 44.00 | 049 | Pounder | Whole | Abaded/Crushed | 12.39 | 8.08 | 612.00 |
| K3-J13-15 | 0450 | Basalt | 44.00 | 001 | Abader | Whole | Abaded/Crushed | 6.31 | 6.31 | 99.69 |
| K3-L14-11 | 0451 | Basalt | 30.00 | 028 | Ulumaika | Whole | Crushed | 9.20 | 9.20 | 426.00 |
| K3-K17-1 | 0453 | Basalt | 03.00 | 044 | Whetstone | Whole | Abaded/Crushed | 12.00 | 8.00 | 456.70 |
| K3-K14-23 | 0455 | Basalt | 55.00 | 059 | Reamer | Whole | Abaded/Crushed | 5.15 | 3.24 | 36.06 |
| K3-K14-18 | 0461 | Basalt | 47.00 | 017 | Reamer | Whole | Abaded | 6.0 | 1.42 | 7.00 |
| K3-M15-06 | 0462 | Basalt | 03.00 | 016 | File | Whole | Abaded | 6.07 | 1.10 | 5.90 |
| K3-H17-09 | 0464 | Basalt | 36.00 | 016 | Reamer | Whole | Abaded | 8.90 | 1.50 | 10.40 |
| K3-I14-34 | 0468 | Basalt | 47.00 | 018 | File | Whole | Abaded | 12.70 | 1.80 | 48.25 |
| K3-I14-31 | 0469 | Basalt | 45.00 | 058 | Reamer | Whole | Abaded/Polished | 0.32 | 2.90 | 48.53 |
| K3-H16-07 | 0520 | Basalt | 16.00 | 024 | Sinker | Whole | Unworn | 7.50 | 7.30 | 242.00 |
| K3-I15-18 | 0618 | Coral | 44.00 | 036 | Abader | Whole | Abaded | 11.04 | 7.85 | 219.02 |



and then in our photo log, we have a list of which artifact is which in the picture, so I would check the log, and it would tell me that artifact 443 is in the top row, third from the right, so I can see the picture of the item whose information is in that line of the database.

These are examples of some of the photos we've taken:



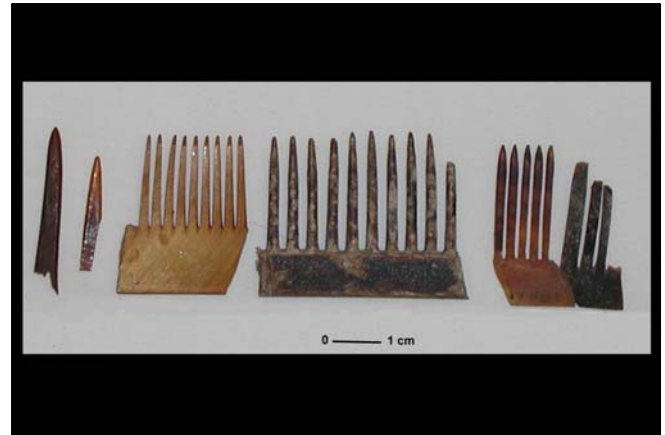
adzes



cut pearl shell



basalt mirrors



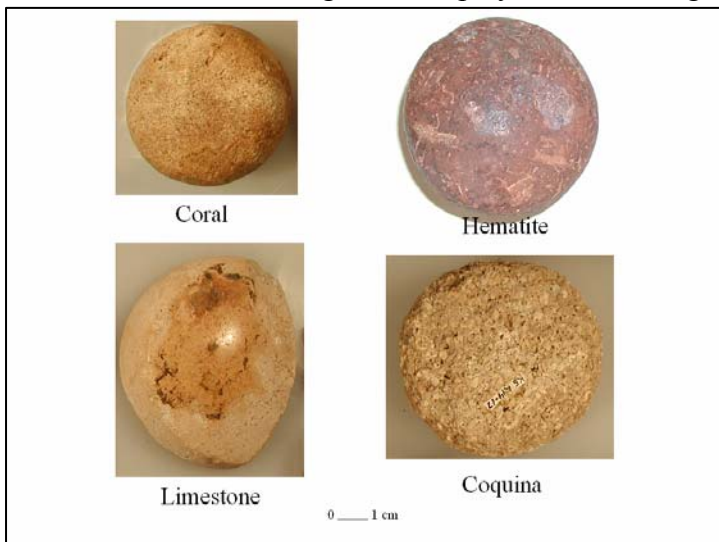
turtle shell combs

We have also completed detailed analyses of several artifact classes from the collection, including *ulumaika*, fishhooks, and abrading tools, and I'll give you a brief summary of each.

'Ulumaika

The *'ulumaika* study was conducted by Julie Field, a graduate of the University of Hawai'i at Mānoa, who is currently at Cambridge University in London. This research was published in the October 2003 issue of the *Rapa Nui Journal*, and was presented at one of the Society for Hawaiian Archaeology conferences (Field 2003). *'Ulumaika* were the discoidal stones used in the traditional Hawaiian game of *maika*, similar to bowling, in which the game stone was rolled down a track. There are a number of variations on the game - one version is to roll the stone as far as possible, another involves rolling the stone between two sticks, and a third variation was to roll two *'ulumaika* against each other in an attempt to break the opponent's game stone.

Dr. Field examined the material type, morphology and wear of these artifacts to provide more information on how the game was played, how it might have changed over time, and how shape and material type affect the performance of the *'ulumaika*.



Thirty-eight whole and fragmentary *'ulumaika* from Nu'alolo Kai were examined. These were manufactured from coral, hematite (a dense red basalt), regular basalt [not pictured here], limestone, and coquina (made of cemented sand particles). These materials differ significantly in strength and durability, with hematite quite brittle, and coquina very crumbly, suggesting that the color of the raw material and its ability to be worked into a high polish might have

been more important to manufacturers than durability. Limestone and hematite in particular are less durable than basalt and have the potential for a beautiful polished finish.



Most *'ulumaika* are biconvex in morphology, which means that their sides are slightly rounded outward. This shape occurred in all material types, and Field suggests that this was chosen for performance reasons – the flattened morphology would make throwing easier, and the rounded sides would balance the disc and allow it to roll for longer distances. Equal degrees of curvature on the sides of the disc provide stability and kept it rolling in a straight line.

The earliest *'ulumaika* of Nu'alolo Kai dated to AD 1100-1450 and was biconvex and made of hematite. After AD 1450, basalt was the most common material type, and during the period of AD 1450-1750, *'ulumaika* material types became more diverse. In later periods at Nu'alolo Kai, *'ulumaika* were made expediently of low quality materials such as coquina, suggesting that people were practicing with the lesser quality gamestones, or children were using them. And,

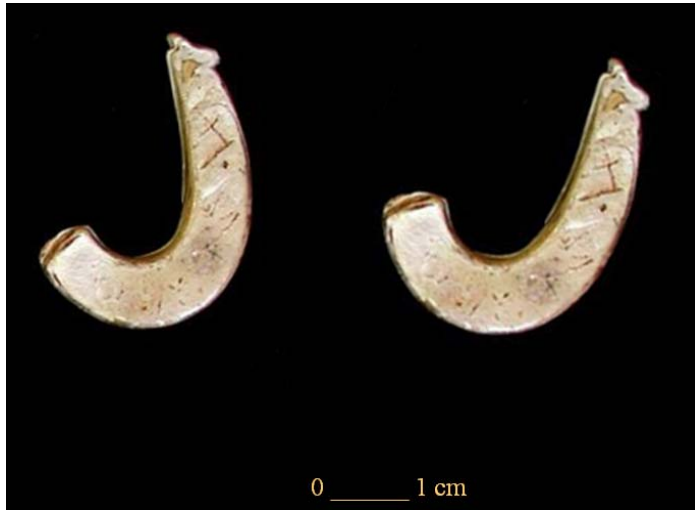
through all periods of time, broken *'ulumaika* were reused as pounding, cutting, and chopping tools.

Fishhooks

The Nu'alolo Kai fishhooks have been examined by Sinoto (1962), Moniz-Nakamura et al. (n.d.), and most recently by University of Hawai'i professor Michael Graves and myself (Graves and McElroy 2004). Our research was presented at the 2004 Society for Hawaiian Archaeology Conference.

We developed a classification for the upper portion of fishhooks, known as the head shank, and we implemented this with digital photography. We believe that in the past, fishhooks may have been classified differently according to the way in which a given researcher positioned the hook while they're looking at it.

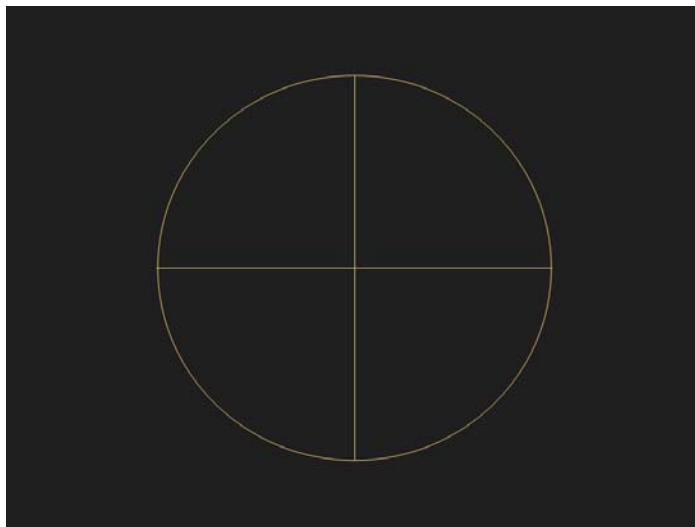




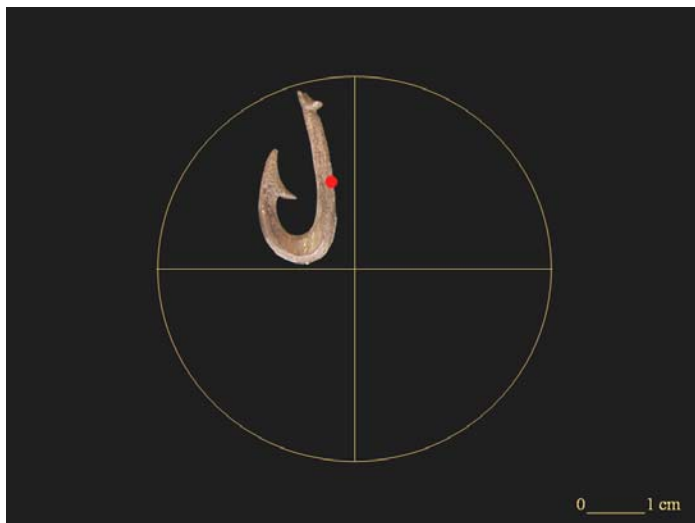
In past classifications, two basic categories of head shanks are notched, where there is an indentation, and knobbed, where there is a protrusion. This slide illustrates how the same hook can be classified differently depending on how it's oriented. It looks like a notched hook here (left), but if it is oriented like this (right), it would be classified as a knobbed hook.

So, we've developed a protocol for studying head shanks on fishhooks that we believe reduces potential inter-observer variation. We do so by

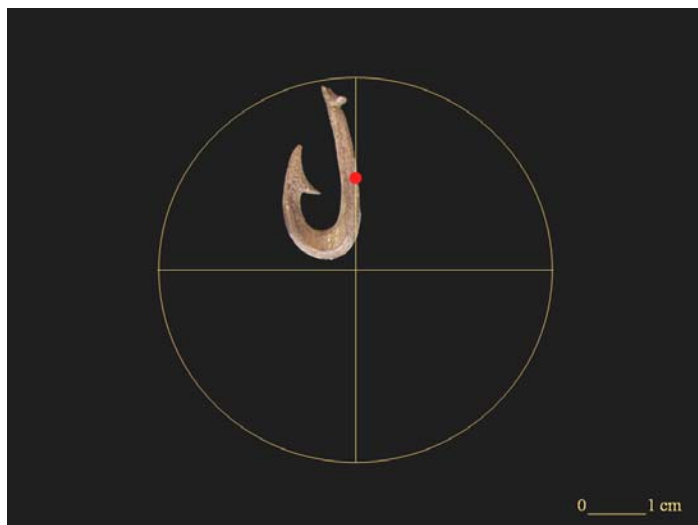
standardizing observations, in this case employing a common system of orientation to all hooks,



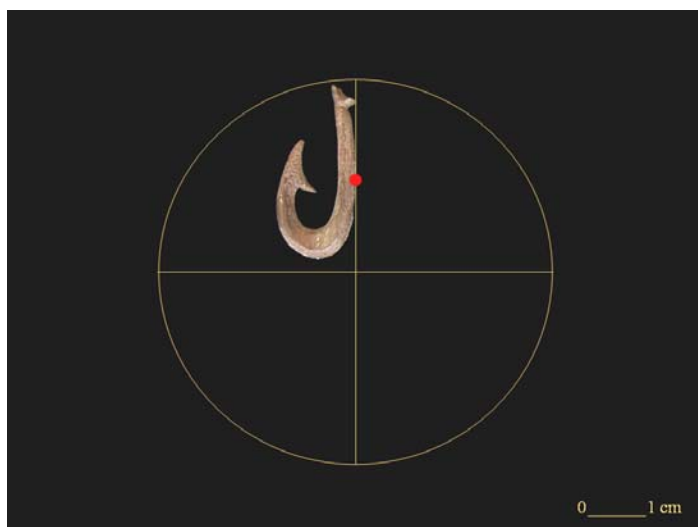
by superimposing a circle with a right angle grid comprised by lines representing two axes of the diameter of the circle.



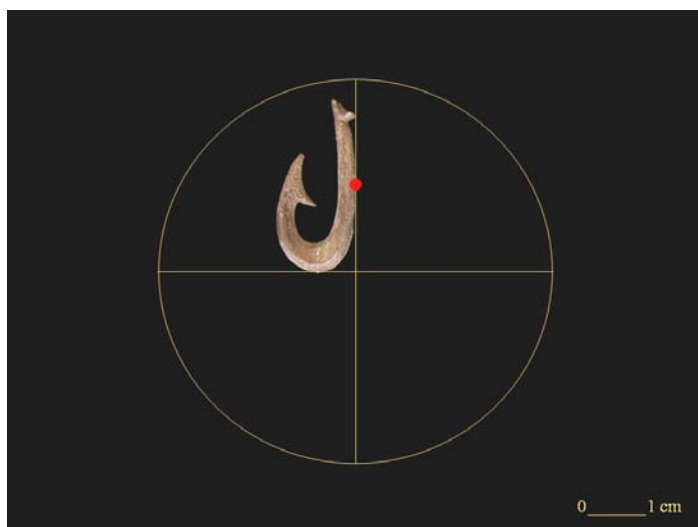
We then measure the length of the hook to determine its midpoint; the midpoint of this hook is indicated by the red dot.



We then move the hook to align the midpoint of the outer edge with the vertical line of the grid.



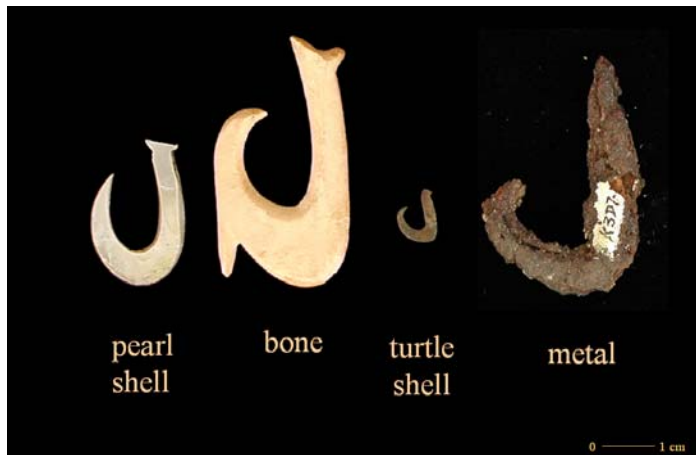
Then we orient each hook shank so that the long axis of the outer edge forms a tangent at the mid-point of the shank with the vertical line of the grid.



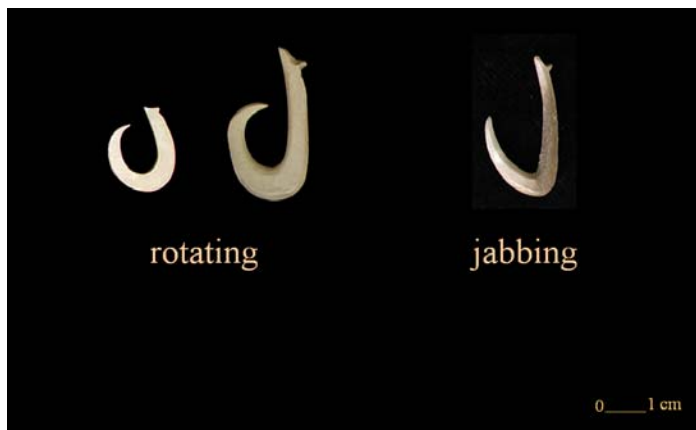
From there we slide the hook along this vertical tangent so that its base forms a tangent with the horizontal line of the grid.

What this does is give us a common standard for the orientation of all hooks. While this orientation of fish hooks can be done manually using a printed circle and grid along with the fish hooks, we found it easier to use digital photograph images of fish hooks and a computer created circle and grid. One can then copy one image at a time out of a series

for appropriate positioning, and it reduces handling and wear and tear on the artifacts.



We classified 386 of the Nu'alolo Kai fishhooks this way, but instead of going into the details of the classification, I'd like to just show you some pictures of the different kinds of hooks represented in the collection. There are hooks of all shapes and sizes, hooks made of pearl shell, bone, turtle shell, and metal.



There are rotating hooks, where the point angles in toward the shank – these hold fish well and they don't snag on coral, so they're thought to have been used in deeper water. There are also jabbing hooks, where the point does not angle in – these pierce easier and faster but the fish comes loose easier, so they are thought to have been used more in shallow water where there's less time for fish to struggle & escape.



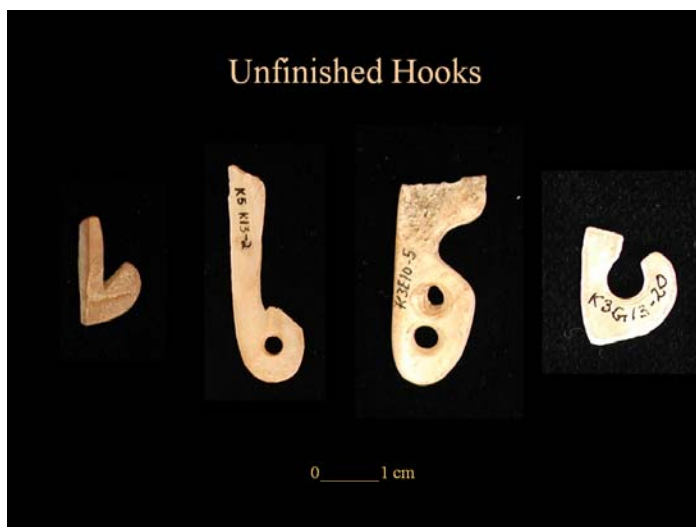
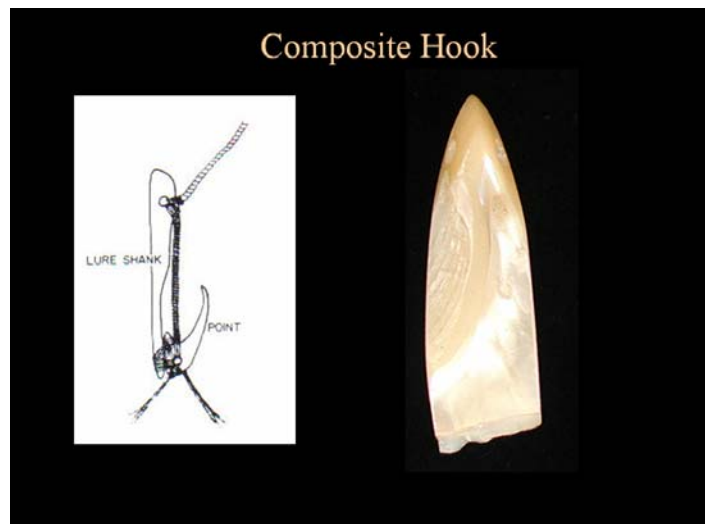
There are also barbed hooks in the collection - these hold fish even better, so there's less chance of escape.



There are also a number of 2-piece points and shanks. These don't necessarily go together, but I wanted to illustrate what Sinoto (1991) calls the slender and massive types of 2-piece hooks. These would have been lashed together at the bend, the place on the hook that receives the most stress. So if a hook broke on the bend, instead of making a whole new hook, just the point could be replaced.

We also have composite, or bonito hooks that were used for trolling. These have two parts – a lure, attached to a point. You can see an example of the lure portion here.

Drawing at right from Emory et al. (1959)



And there are unfinished hooks in all different stages of manufacture.

Abrading Tools

Abrading tools are thought to have been used in fishhook manufacture, and these were examined by UH Mānoa graduate student Cy Calugay and myself. This research was presented at the 2000 Society for Hawaiian Archaeology Conference (McElroy 2000), and is in press as an article in the Society for Hawaiian Archaeology special Kauaʻi issue (Calugay and McElroy in press).

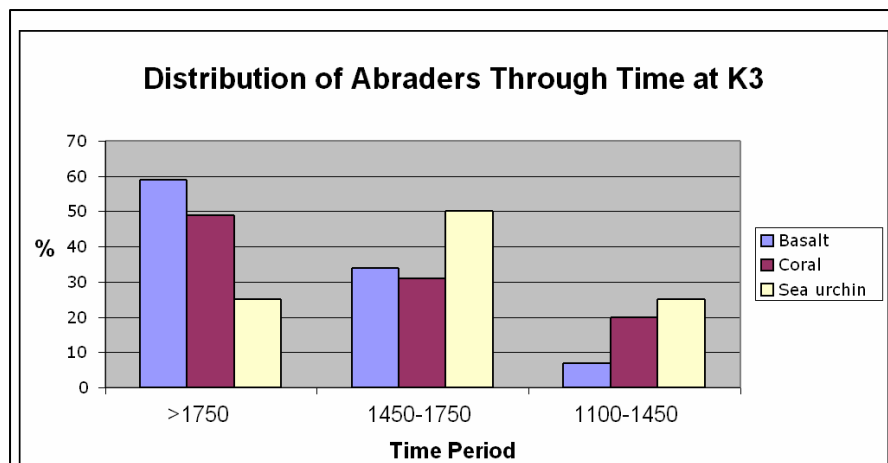
Abrading tools are typically those artifacts whose edges and/or surfaces are worn down by friction caused by contact with the edges and/or surfaces of other material for purposes of shaping. They are also referred to as files. Most objects assigned as abrading tools from Nuʻalolo Kai are small, elongated portable artifacts that taper to a point at one or more ends and have one or more facets of wear. They are



most commonly made of coral, basalt, and sea urchin spine. Coral abraders are frequently found in association with fishhook manufacturing debris and are believed to have been used in fishhook production. Similar morphology and wear patterns in coral, basalt, and sea urchin spine abraders may indicate similarity in function as fishhook manufacturing tools.

In Ancestral Polynesia, files and abraders were common material culture. They have been found in assemblages from both Eastern and Western Polynesia. In Hawaiʻi, abrading tools are found in large numbers at many early archaeological sites. At the Puʻu Aliʻi Sand Dune on the Big Island, more than 4,000 coral files and 7,000 sea urchin files were found along with nearly 2,000 fishhooks (Emory et al. 1959). Emory et al. (1959) interpreted the proximity of hooks and abrading tools as evidence for fishhook manufacture. They suggested that initial filing was performed using coral saws and files, while sea urchin spines were used for the last stages of fine finishing. Other archaeological sites with abrading tools include the Bellows Dune site (O18) on Oʻahu, the Hālawā Dune site on Molokaʻi, and the Kalāhuipuaʻa site on the west coast of the Big Island.

Well over 1,000 abrading tools were recovered from Nuʻalolo Kai, and we examined 95 basalt, 738 coral, and 564 sea urchin spine abraders. We focused on exploring variability in the wear patterns of these tools across the three features of Nuʻalolo Kai and also through time. Of the 738 coral abraders we examined, all exhibit abrasion on multiple surfaces, while the basalt and sea urchin artifacts present a range of wear types and locations. This suggests that many of the basalt and sea urchin artifacts were used for activities other than abrasion, and the basalt and sea urchin files were more likely to have functioned as multi-purpose tools than their coral counterparts.



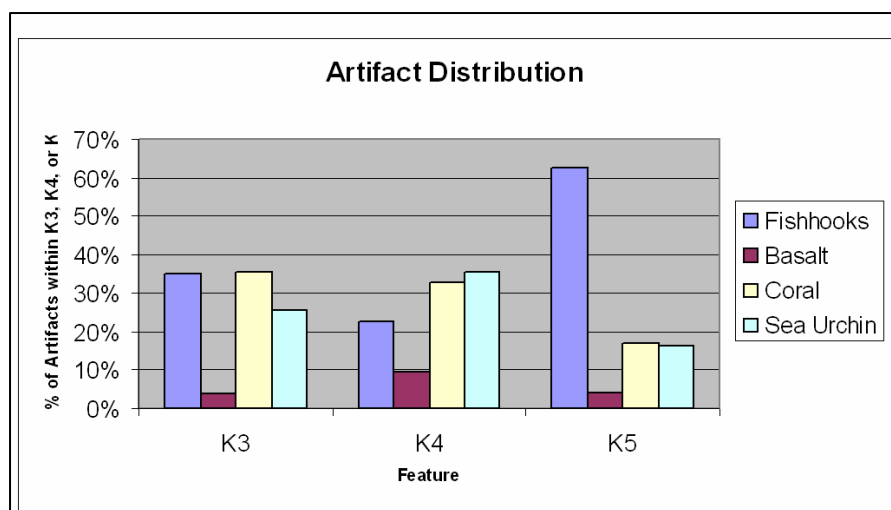
This graph shows the temporal distribution of abrading tools at feature K3 of Nu'alolo Kai. Basalt and sea urchin tools showed an inverse relationship, with sea urchin spines most prevalent in the lowest layers of the site and declining over time, and basalt increasing in number over time, with

the greatest number in the upper layers. Coral abraders were roughly equally distributed by depth. This suggests that basalt files may have replaced those made of sea urchin over time, and their manufacture and use was independent of the manufacture and use of coral abraders.



Many of the basalt abrading tools are strikingly similar in morphology to sea urchin spine files and likely had the same function. It is possible that sea urchin became less available through time due to overexploitation, and this necessitated the manufacture of imitation sea urchin spine files made of basalt, a readily available resource. Alternatively, basalt abraders may have been substituted for sea urchin files because basalt provides a more efficient tool material.

Since basalt, coral, and sea urchin abrading tools are thought to have been used in fishhook manufacture we plotted the distribution of these artifacts within the three main archaeological features of Nu'alolo Kai. Fishhooks were more abundant than abrading tools in K5, suggesting that this portion of



Nu‘alolo Kai was not used as heavily for fishhook manufacture, whereas there are more abrading tools than fishhooks in K3 and K4. In all three features, basalt abrading tools were not as abundant as coral and sea urchin tools.

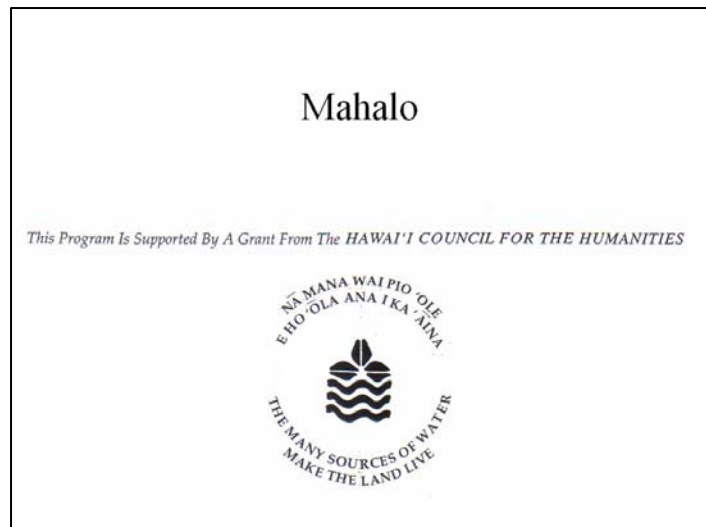
Conclusion

In conclusion, our research on poi pounders, ‘ulumaika, fishhooks, and abrading tools from Kaua‘i shows the value of examining artifacts from museum collections, even if they are poorly provenienced. By studying previously excavated artifacts and those donated to museums, we can gain new information without excavating new sites. This approach contributes to our understanding of these collections and the past while helping to preserve the archaeological record.



Acknowledgments

Before I take questions I would like to thank the Kaua‘i Historical Society for inviting me to speak tonight. I would also like to thank the staff of the Grove Farm Museum and Bishop Museum for graciously allowing us to work with their collections. Our work with the Nu‘alolo Kai database was funded by the Hawai‘i Council for the Humanities. This organization supports public dialogue that explores human values, interprets human experience, promotes cross-cultural understanding, strengthens our community, and connects us to the wider world.



References

- Armstrong, R.W. 1983 *Atlas of Hawaii*, Second Edition, edited by R.W. Armstrong. University of Hawaii Press, Honolulu.
- Bennett, W.C. 1931 *Archaeology of Kaua‘i*. Bernice P. Bishop Museum Bulletin 80. Bishop Museum Press, Honolulu.
- Brigham, W.T. 1902 *Stone Implements and Stone Work of the Ancient Hawaiians*. Memoirs of the Bernice P. Bishop Museum. Vol. I, No. 4. Bishop Museum Press, Honolulu.
- Calugay, C. and W.K. McElroy in press (2005) “An Analysis of Coral, Basalt, and Sea Urchin Spine Abrading Tools from Nu‘alolo Kai, Kaua‘i.” In *Na Mea Kahiko O Kaua‘i: Archaeological Studies in Kaua‘i*, edited by Mike Carson and Michael Graves, pp. 212-235. Society for Hawaiian Archaeology Special Publication 2. Honolulu: Society for Hawaiian Archaeology.

- Dunnell, R.C. 1970 Seriation Method and Its Evaluation. *American Antiquity*. 35(3):305-319.
- Emory, K.P., W.J. Bonk, and Y.H. Sinoto 1959 *Fishhooks* Bernice P. Bishop Museum Special Publication 47, Second Edition. Bishop Museum Press, Honolulu.
- Field, J.S. 2003 A Classification for Hawaiian Artifacts Based on Morphology and Wear: Analyses of Discoidal Artifacts from Nu'alolo Kai, Kaua'i. *Rapa Nui Journal* 17(2):94-105.
- Graves, M.W. and McElroy, W.K. 2004 *Advancing Archaeological Classification of Fish Hooks from Hawai'i: A Case Study from Nu'alolo Kai, Kaua'i*. Presented at the 17th Annual Society for Hawaiian Archaeology Conference in Kona, Hawai'i, 14 November, 2004.
- Hiroa, T.R. 1964 *Arts and Crafts of Hawaii, Section I, Food*. Bernice P. Bishop Museum Special Publication 45, Bishop Museum Press, Honolulu.
- McElroy, W.K. 2000 *Expanding the Role of Artifact Analysis in Hawaiian Archaeology: A Comparison of Coral and Basalt Artifacts of Nu'alolo Kai, Kaua'i*. Presented at the 13th Annual Society for Hawaiian Archaeology Conference in Hilo, Hawai'i, 7 October, 2000.
- Moniz-Nakamura, J., M. Allen, and M. W. Graves. n.d. Methodological Issues in Artifact Analysis: Explaining Stylistic Variability in Hawaiian Fishhooks. Unpublished Manuscript on file. Department of Anthropology, University of Hawai'i, Honolulu.
- Sinoto, Y. 1962. Chronology of Hawaiian Fishhooks. *Journal of the Polynesian Society* 71:162-166.
- 1991. A Revised System for the Classification and Coding of Hawaiian Fishhooks. *Bishop Museum Occasional Papers* 31:85-105.
- Terry, R.D. and C.V. Chillingar 1955 Data Sheet 6 *Geotimes*. Available from the American Geological Institute, Washington. D.C. Reprinted in the *Journal of Sedimentary Petrology* 25:229-234.