Excavations at the Kipapa Rockshelter, Kahikinui, Maui, Hawai'i

SHARYN JONES O'DAY

DURING THE SECOND HALF of the twentieth century, archaeology has become increasingly concerned with issues such as household organization and the daily life of commoners in prehistoric complex societies. Coupled with this emphasis is a focus on analytical units and recovery techniques. Indeed, if archaeologists are to explore and understand the nature of prehistoric lifeways, their data will need to be as fine grained as possible. Methods employed by researchers in what is referred to as "household archaeology" and "zooarchaeology" are especially useful in uncovering and documenting subtle and microscopic features or patterning in the stratigraphic, faunal, and material culture record (Gordon 1993; Grayson 1984; Reitz and Wing 1999; Van Gilder and Kirch 1997; Weisler and Kirch 1985). Specifically, faunal remains from archaeological sites are a profitable avenue of research in exploring prehistoric animal resource use and diet. Fine-grained data, combined with information from settlement pattern surveys that yield a large scale or landscape perspective, will continue to improve our archaeological interpretations of the past.

In this paper I present zooarchaeological data collected from a rockshelter in the Hawaiian Islands. The combined evidence of faunal remains, subsurface features, and site architecture indicates that the rockshelter was part of a traditional household complex (described below). Most importantly, fine-screen recovery greatly increased the faunal sample, thus facilitating a better understanding of this particular household's diet.

SETTING

The traditional district (*moku*) of Kahikinui is located on the west side of east Maui, Hawai'i. Kahikinui was traditionally divided into eight primary political subdivisions (*ahupua'a*), or tax units, within the *moku*, stretching approximately 12 km along the coastline and up the slopes of Haleakala to about 700 m above sea level (Kirch 1997). Despite urban and commercial development elsewhere on the island, Kahikinui remains today with its ancient sites almost wholly intact, and

Sharyn Jones O'Day is affiliated with the Department of Anthropology, University of Florida, in Gainesville.

geologically looks much as it would have 200 years ago (Kirch 1997). This geologically youthful landscape was created by numerous volcanic eruptions that exhibit little surface weathering, creating an arid, rough lava terrain.

Ethnohistoric accounts differ in their depiction of the area. According to Handy et al. (1972:508; see also Sterling 1998), for example, fishing in Kahikinui was "comparatively good." They depict the prehistoric settlement as scattered from one end of the *moku* to the other, with the inhabitants living in isolated communities. The prehistoric Hawaiians are said to have had their crops of sweet potato and other plants inland, in the forest zone (Handy et al. 1972). Conversely, Handy and colleagues (1972) also state that fishing along the Kahikinui shores was poor, and the coast produced very little seaweed (*limu*) and shellfish. "The coast and coastlands of southern Maui are perhaps the poorest in the islands. The sparse population there must have suffered severe famine at times" (Handy et al. 1972:276). They go on to speculate that the prehistoric population of the area probably far exceeded their resource base (1972:491). While the questions of local demography and overexploitation are beyond the scope of this paper, these and other disparate accounts leave the task of characterizing prehistoric life in Kahikinui open to interpretation through the use of archaeological data.

Previous archaeological work conducted in the *moku* indicates that Kahikinui was a relatively late prehistoric settlement, falling in the Expansion to Proto-historic periods (A.D. 1100–1795) of the Hawaiian cultural sequence as defined by Kirch (1985, 1997). Historic period archaeological assemblages and historical documentation indicate that indigenous Hawaiian occupation of the region ended around A.D. 1860 (Kirch 1985, 1997). Thus the area has a relatively late, short-term chronology, falling within the last 300 years of the precontact period.

THE SITE

Cultural and faunal samples excavated from a rockshelter (site number MA-A35-1137) in Kahikinui in 1999 provide important information on late prehistoric indigenous Hawaiian animal resource use. This site, referred to as the Kipapa Rockshelter, yielded a relatively small but informative assemblage of material culture and faunal remains, both vertebrate and invertebrate. This work was undertaken as part of a long-term research project in Kahikinui under the direction of Patrick Kirch, University of California, Berkeley.

The rockshelter is positioned in the *ahupua'a* of Kipapa. This is roughly in the central section of the *moku*. Geologically, the rockshelter is a natural formation associated with a basalt (*pahoehoe*) escarpment that overlies a deposit of crumbly *a'a* along a small eroded gulch or swale (Fig. 1). This overhang is located along an extended network of small niches and shelves, eroding out of the lava face. Cultural deposits were noted on the dirt flat below the largest overhang. The main overhang and a constructed terrace to the south demarcate the site. In some places two to three levels of stacked rock, in a step-like fashion, form the terrace (see Fig. 1). Just in front of the rockshelter, which opens to the north, is a pathway running adjacent to the southern lava face. Below the stacked terrace the ground slopes into a small swale that was probably a drainage at one time (see Fig. 2). The swale, between 15 and 20 m wide on average, contains three small mounds of *a'a* clinker at the base. Though not all of the edges are well defined, the mounds are

Fig. 1. View of the Kipapa Rockshelter, site MA-A35-1137, Kahikinui, Maui.

roughly squared on the sides and extend between 2 and 3 cm above the ground surface. They measure between about 1 and 5 m on each side. A curved wall down-slope and to the east of the mounds was also identified. Based on the morphology and position of these features, it appears that the swale was used for agricultural purposes.

On the south side of the drainage, southwest of the rockshelter, is a rectangular enclosure. Another structure, an L-shape, is located atop the escarpment, above the rockshelter. Both of these structures have stacked walls and are the size and shape typical of components of Hawaiian household clusters in Kahikinui. Based on evidence described in detail below, I suggest that these structures are associated with the rockshelter and likely form a traditional Hawaiian household (*kaʻu hale*) complex.

Two 1-by-0.50-m test units were excavated at the rockshelter in 1997, under the direction of Patrick Kirch. The site yielded a variety of material culture and faunal remains. Vertebrate fauna identified included the remains of fish (*Scarus* spp.), small bird, rat (*Rattus exulans*), and pig (*Sus scrofa*). Invertebrate fauna were represented by a range of species such as cowries (*Cypraea* spp.), thaidids (Thaididae), cone shells (Conidae), limpets (*Cellana* spp.), nerites (*Nerita picea*), and sea urchin (Echinoidea). In addition, coral (*Porites* spp.), kukui (*Aleurites moluccana*) or candlenut endocarp, charcoal, and lithics were contained in the deposit. Based on the abundance of small fauna, it was determined that the site would be an excellent locale for further excavations, and would provide an opportunity to employ the use of fine-mesh screens. Subsequent excavations conducted under the author's direction in 1999 are the focus of this paper.

Fig. 2. Kipapa Rockshelter and associated features, Kahikinui, Maui.

The present analysis focuses on the zooarchaeological assemblage, but other aspects of the rockshelter's cultural deposit are also presented. The primary objectives of this study were (1) to investigate the temporal scale of site occupation (i.e., was it a temporary or permanent occupation) based on cultural remains, specifically fine-screened faunal remains and charcoal samples obtained for radio-carbon dating; (2) to determine if the structure comprised part of a traditional household (*kau hale*) complex, and if so, what type of domestic component it represents; and (3) to explore the effects of fine-screening techniques on the zooarchaeological assemblage. In addition, I also discuss this site in a broader, districtwide context from a comparative subsistence perspective.

METHODS

Two 1-by-1-m units were laid out along a baseline running north-south, perpendicular to the rear of the rockshelter. Unit J16 was aligned with the east wall of the 1997 test pit, between the back wall of the cave and the drip line, unit J13 was positioned on the terrace south of the shelter overhang (Fig. 3). Sediment was excavated following natural stratigraphic layers, within which arbitrary 10-cm

Fig. 3. 1999 excavations, plan view of Kipapa Rockshelter, Kahikinui, Maui.

levels were designated. All excavated sediment from the units was sieved through screens of $\frac{1}{4}$ in. (6.35 mm) and $\frac{1}{16}$ in. (1.59 mm) mesh. For both units (including features), charcoal was saved from the $\frac{1}{4}$ -in. mesh screens only, but not from the $\frac{1}{16}$ in. mesh. Additionally, column samples were collected from the northwest corner of the north wall and from the southeast corner of the east wall at 20–30 cm and 30–40 cm below the surface in unit J16. Each sample measured 10 cm³.

All faunal material was identified using comparative collections from the Florida Museum of Natural History, University of Florida, Gainesville, and the Oceanic Archaeology Laboratory, University of California, Berkeley. The methods used for zooarchaeological analysis follow techniques developed by Reitz and Wing (1999). Every effort was made to identify all archaeological specimens to the lowest, or most specific, taxonomic level. For example, all fish remains were sorted into elements, and an attempt was made to identify each of these elements to species, though higher level determinations (typically genus) were the norm. The overall small sample size imposed fewer restrictions on time, thus warranting this expenditure. This method significantly reduces the bias typically associated with the identification of Pacific Island fish assemblages using methods developed by Leach (1976), and further instituted by Allen (1992), Leach et al. (1996), and Nagaoka (1994). Higher categories of determination for mammals and birds were additionally broken down into “medium” and “small” size classifications. Remains classified as “small mammal” fall into the size category that includes the house mouse, rats, and mongoose (i.e., a specimen the size of a small mammal, not a small bone fragment from a mammal). The “medium mammal” category

included mammals the size of pig or dog. Similarly, the "medium bird" category included individuals the size of a chicken or goose, and "small bird" included passerines and small seabirds.

Bones of all taxa were counted. Bones were also weighed, modifications recorded, and linear measurements (anterior width) were taken of the fish vertebral centra. NISP, or the number of identified specimens per taxon, is the basic specimen count used here. Minimum number of individuals (MNI) were determined by paired elements and age. Following Reitz and Wing (1999:194), MNI is defined as the smallest number of individuals that is necessary to account for all skeletal specimens of a given species within the assemblage. When estimating MNI, each provenience (i.e., unit or feature) was considered separately. Within a given provenience (layer or feature), levels were considered together, as the deposit exhibited little stratigraphic differentiation. Age estimates were based on the fusion of certain elements, dental development, and comparisons to specimen of known age.

Biomass was calculated based on the skeletal weight of archaeological specimens and was used to estimate the dietary contribution of each animal. These calculations provide information on the quantity of meat potentially supplied by an animal based on the allometric principle that an animal's body mass, skeletal mass, and skeletal dimensions change in proportion with body size increases (Reitz et al. 1987). The following allometric equation describes the relationship between body weight (Y) and skeletal weight (X), estimating the amount of meat related to the archaeological materials:

$$Y = aX^b \text{ or in its linear form, } Y = \log_{10}a + b(\log_{10}X)$$

Y = estimated sample biomass (kg) contributed by the archaeological specimen for a taxon

X = specimen weight of the archaeological specimen for a taxon

$\log a$ = the Y -intercept of the linear regression line

b = slope of the regression line

The allometric constants, a and b , were obtained from Reitz and Wing (1999:72) who originally derived the constants from a large set of reference specimens (Florida Museum of Natural History, University of Florida) with known whole body weights and dimensions of the skeletal or exoskeletal elements. Diversity and equitability indices were calculated based on MNI calculations.

Shannon's H was used to calculate diversity and equitability of the faunal sample. Diversity was calculated using the following formula:

$$H' = - \sum (p_i)(\log_e p_i)$$

where H' is the information content of the sample and p_i is the relative abundance of individuals for each taxon in the collection. The equitability formula used in the analysis is: $V' = H'/\log_e S$, where H' is the Shannon-Weiner function and S is the number of taxa for which MNI was estimated.

The comparative frequencies of identified elements in categories by body part may be indicative of processing and butchery practices. The vertebrate faunal elements (excluding fish) from the rockshelter are summarized into categories by body part as follows. The head/teeth category includes skull, mandible, and teeth. The axial category includes vertebra and ribs. The forequarter category includes

Fig. 4. The west to east stratigraphic profile along the north wall of unit J16, Feature 1; 1999 excavations, Kipapa Rockshelter, Kahikinui, Maui.

scapula, humerus, ulna, and radius. The hindquarter category includes pelvis, sacrum, femur, patella, and tibia. The foot category includes metapodials and phalanges. The shaft fragment category includes all undiagnostic, and thus unidentified, shaft elements. Table 5 presents a summary of bone specimen by anatomical category.

RESULTS

Stratigraphy

The Kipapa Rockshelter has a single stratigraphic sequence, characteristic of late prehistoric habitation sites in Kahikinui. Only two natural stratigraphic layers were designated in both the west to east profile along the north wall of unit J16 (Fig. 4) and the north to south profile of the east wall (Fig. 5). Layer I consisted of a relatively homogeneous, fine, dry, rocky sediment of dark reddish gray color (Munsell 2.5yr 3/1), measuring from the surface about 10–15 cm thick. An abrupt transition delimited Layer I from Layer II. Layer II was characterized by a loose, gravelly, charcoal-flecked, ashy midden, containing abundant molluscan and vertebrate remains. Feature 1 constituted the entire Layer II and was a deep deposit of dark brown and red earth, filled with numerous red ash and charcoal lenses, probably resulting from repeated burning (Munsell soil color 2.5yr 4/1). Feature 1 contained many angular and fire-cracked rocks.

Like unit J16, unit J13 was stratigraphically divided into two layers, the first (Layer I) composed of the shallow, featureless cultural deposit, and the second (Layer II) composed of Features 2 and 3. Layer I was similar in character (color and texture) to that of unit J16, but with fewer and smaller rocks overall. This layer extended ~13 cm below the surface, at which point the sediment became more ashy and charcoal-rich, containing clumps of ash and large (2–3 cm) charcoal pieces. Molluscan remains were also abundant in this layer. The sediment in Layer II was more compact than that in Layer I. Layer II sediment was virtually identical from both Feature 2 fill (in the southwest corner) and Feature 3 fill (in

Fig. 5. 1999 excavations, Feature 1 east wall stratigraphic profile, unit J16, Kipapa Rockshelter, Kahikinui, Maui.

the northwest corner). These features rest on sterile sediment, extending 34 cm and 40 cm below the surface respectively and into natural depressions in the bedrock below the terrace fill.

Chronology

The chronology of the Kipapa Rockshelter excavation is based on two AMS radiocarbon, ^{14}C wood charcoal age determinations. At the base of Level 2, in unit J13, charcoal samples (#AA38668, University of Arizona Accelerator Radiocarbon laboratory) yielded a conventional age of 167 ± 36 B.P. The calibrated calendar date (CALIB) following Stuiver et al. (1998) for this sample is cal B.P. 292–243 at 2σ ($^{13}\text{C}/^{12}\text{C}$ ratio = -24.5‰). The second date of 99 ± 36 B.P. [CALIB = cal B.P. 271–209 (2σ), $^{13}\text{C}/^{12}\text{C}$ ratio = -24‰] comes from Feature 1 in unit J16 (#AA38669). The ^{14}C dates suggest a late occupation for the site, cal B.P. 292–209. The overlap in age ranges at 2σ indicates that cultural remains are probably the result of a single short-term occupation, and possibly a single depositional episode.

Unit Descriptions

A variety of cultural material littered the ground in and around the rockshelter. Charcoal, *kukui* nut shell, and endocarp midden were also noted in some of the small niches along the rock face, east of the excavated rockshelter (Fig. 3). Surface collections around the rockshelter yielded relatively large amounts of marine shell and coral (*Porites* spp.), much more than was identified on the surrounding structures. Basalt lithics (flakes, cores, and debitage), and large waterworn stones (25-by-20 cm) were also located and mapped into position on the surface. Large (8.6–50.8 mm in length) individual limpets (*Cellana sandwicensis*, *C. exarata*) and cowries (*Cypraea caputserpentis*, *C. mauritiana*) were collected for identification (Table 1).

Unit J16 was positioned in the interior of the rockshelter, in the central area abutting the 1997 test excavation unit. Several a'a cobbles, basalt flakes, shell

TABLE 1. SUMMARY OF ASSEMBLAGE FROM 1999 EXCAVATIONS AT KIPAPA ROCKSHELTER, KAHIKINUI, MAUI

TAXON/MATERIAL	SURFACE COLLECTION			FEATURE 1			FEATURE 2			FEATURE 3			UNIT J13			UNIT J16		
	NISP	MNI	WT. (g)	NISP	MNI	WT. (g)	NISP	MNI	WT. (g)	NISP	MNI	WT. (g)	NISP	MNI	WT. (g)	NISP	MNI	WT. (g)
<i>Sus scrofa</i>				1	1	0.2							2	1	0.36	3	1	0.33
<i>Canis familiaris</i>				4	1	0.6	1	1	0.08				1	1	0.07	2	1	0.4
Medium mammal				31		1.92	1		0.3				9		1.89	21		4.15
<i>Herpestes auropunctatus</i>													1	1	0.03			
<i>Rattus exulans</i>				57	4	0.51				2	1	0.01	24	2	0.24	218	8	1.62
<i>Mus domesticus</i>													3	1	0.01	6	1	0.02
<i>Hemidactylus</i> spp.				28	2	0.8							3	1	0.01	45	4	0.12
<i>Gallus gallus</i>																1	1	0.63
Small bird				8	1	0.21							3	1	0.1	13	1	0.3
Medium bird										1	1	0.3	1	1	0.1			
Fish				639	11	8.29	56	4	3.92	21	2	0.52	88	6	1.97	178	8	4.55
UID bone				21		0.29	8		0.47	3		0.1	59		1.12	244		2.54
Mollusks	188	99	200.4	230	115	88.7	110	48	80.5	33	15	4.51	651	265	237.7	338	120	140.74
Crustacean				7	1	0.48	1	1	0.2									
Echinoidea	1		1.1	773	45	46.92	133	5	12.4	44	1	2.41	575	32	36.78	736	41	49.45
UID shell						38.49			4.8						81.3			60.02
Coral	37		159.8	13		33.6							4		5.9			
<i>Kukui (Aleurites moluccana)</i>			5.6			11.6			25						13.5			
Lithics	9		122.5	20		45.7	6		34	3		2.4	34		47.3	28		94.6
Charcoal			0.9			42.9			74.9			40.2			64.7			24.2
Stone (<i>ili'i</i> li)	1		2.3	2		15.4	1		5				4		20.4	2		34.8
Volcanic glass																5		0.2
Other artifacts																3		1.7
Total	236	99	492.6	1713	173	332.58	315	58	241.19	105	19	50.44	1419	305	510.87	1547	186	413.1

fragments, and *kukui* nuts were scattered about the surface of the unit. At 7 cm below the ground surface, in the southeast quadrant, a bone fishhook was found. Numerous basalt lithics (primarily debitage) and charcoal chunks were also uncovered (Table 1). Additionally, two fragments of volcanic glass, two waterworn stones, and a historic period trade bead were found in the first 10 cm of the unit's deposit. Other material contained in the unit (Levels 1 and 2) included juvenile pig, dog, medium mammal, rat (MNI = 8), house mouse (*Mus domesticus*), gecko (*Hemidactylus* spp.), chicken (*Gallus gallus*), small bird, and fish. Remains of the house mouse were only encountered in the first 12 cm of the excavation. Throughout excavation levels the invertebrate remains were dominated by mollusks. Black nerites (*Nerita picea*), thaidids, and snakehead cowries (*Cypraea caputserpentis*) were particularly abundant. Sea urchin remains were also abundant (helmet urchin [*Colobocentrotus atratus*], rock-boring urchin [*Echinometra* spp.], and red pencil urchin [*Heterocentrotus mamillatus*]); total calculated MNI for this group equals 41. At 13 cm below the surface basalt flakes were uncovered, at which point ash and charcoal flecking became abundant. The sediment in the east half of the unit was extremely rocky and loose. Charcoal, ash, and shell fragments were concentrated in this area, designated as Feature 1.

Feature 1 extended from the northwest corner across the center of the unit and into the southeast corner. The feature fill contained numerous lightweight, angular fire-cracked, and rounded rocks, in addition to cobble-size (about 7 cm diam.) stones that were likely used for cooking. The sediment was loose and was interspersed with pockets of red ash. The deposit contained coral (*Porites* spp.), *kukui*, basalt lithics, charcoal, waterworn stones, and shell and bone (some burned). The vertebrate fauna was identified as pig, dog, medium mammal, rat, gecko, Bulwer's Petrel (*Bulweria* sp.), small bird, and fish (Table 1). Mollusk remains dominated the invertebrate faunal assemblage with a total MNI of 115. *Nerita picea*, *Cypraea caputserpentis*, and Thaidids contributed substantially to the invertebrate fauna.

Approximately halfway through the excavation of Feature 1 it became clear that the feature had multiple components, that is it consisted of numerous overlapping oval-shaped underground oven pits or *imu*, probably representing repeated cooking events. The features extend into adjacent units (Fig. 3). The rock and feature fill extended 50 cm below the surface in the northwest corner, about 27 cm in the center of the unit, and 31 cm in the southeast corner. The abundance of fish and molluscan remains from the feature indicate that the inhabitants of the rockshelter had regular access to the coast and its marine resources.

Unit J13 was located on the terrace fill, south of the shelter's opening. After the first 2 cm of overburden were swept off, the sediment became more compact and darker in color. Charcoal flecking was visible throughout the levels. Cultural material collected from unit J13 included: mollusk shell, sea urchin, coral (*Porites* spp.), *kukui*, charcoal, waterworn stone (*ili'ili*), basalt lithics, and bone (Table 1). Unit J13 yielded, by far, the most abundant and diverse invertebrate assemblage (by NISP, MNI, wt., and number of species). Total invertebrate NISP = 1,246, MNI = 297, and wt. = 360.71 g (see Table 6). Interestingly, the unit contained comparatively few species of fish as well as a low vertebrate NISP and MNI. An ash concentration was located in the southwestern quadrant of the unit, at about 12–15 cm below the surface. This ash deposit, excavated separately from the unit as

Feature 2, represents a combustion feature or small fire pit. The feature measured 65 cm wide and extended 34 cm below the surface and into a natural depression in the bedrock, below the cultural deposit. This feature was surrounded by eight cobbles of vesicular lava, and appeared to extend into adjacent unexcavated units. A small amount of fish remains were recovered from the feature as well as a single incisor from a juvenile dog. Molluscan remains were primarily represented by *Cypraea caputserpentis* and *Nerita picea*. Sea urchin remains were also identified (MNI = 5), including *Colobocentrotus atratus* and *Echinometra* sp. Overall, invertebrate remains were much less abundant in Feature 2 than those in Feature 1 and in unit J16.

Feature 3, consisting of a charcoal-rich, fine-textured, ashy sediment, appeared approximately 10 cm below the surface of unit J13, in the northwest corner. Like the first combustion feature, Feature 3 was surrounded by a cobbles and extended into adjacent units. Aside from ash and large chunks of charcoal, the feature contained very little cultural material (i.e., few shells and sea urchins, very little bone, few lithics). It measured 35 cm wide and extended about 41 cm below the surface into the surrounding bedrock forming a small pit. Feature fill, from both Features 2 and 3, was entirely different in form and character than that from Feature 1. Thus, the function of these smaller features was different than that of Feature 1 (the *imu*). Features 2 and 3 represent small, shallow, informal fire pits or hearths, possibly used to create light or for informal cooking. This type of feature, with a concentration of small fire-altered stones, charcoal, and ash, is commonly encountered in archaeological sites of domestic association in Kahikinui (Van Gilder and Kirch 1997).

Artifacts

The Kipapa Rockshelter yielded a small collection of 107 artifacts of indigenous Hawaiian manufacture, and one artifact of foreign origin. Only the bone and shell material will be analyzed here; all other material will later be described and analyzed by Kirch et al. (in prep.). The assemblage is dominated by small basalt flakes and lithic debitage (100 items). Five fragments of volcanic glass were found in unit J16. These small brittle flakes may have been used as expedient cutting or scraping implements; for example, they may have been employed in cleaning fish and preparing foods, or for delicate woodworking tasks. The descriptions of these flakes will be greatly enhanced by future analysis of use wear and production sequence.

A fishhook recovered from just below the surface of unit J16, is a virtually complete example of a one-piece bone jabbing hook where the point is parallel to the shank (Fig. 6, third from left). Note that some of the point and shank have broken off. Based on the size of the hook, it was likely used to catch small-mouthed reef carnivores or omnivores that inhabit Kahikinui's coastal waters. This is the type of fishhook one would expect to find in association with an assemblage of jacks (*Caranx* spp.), snappers (*Lutjanus* spp.), wrasses (Labridae), and triggerfishes (Balistidae).

A single bead made from the spire portion of a *Conus* shell (Fig. 6, second from left) was found approximately 12 cm below the surface, and just above the level of the *imu* (Feature 1). It is perfectly rounded along the edges, disk shaped, and

Fig. 6. Artifacts recovered from Kipapa Rockshelter during 1999 excavations, Kahikinui, Maui. From left to right: European glass trade bead, side view; *Conus* shell bead; bone fishhook; worked and notched bone; bone point or awl fragment; smaller bone point; worked bone tab with notch.

clearly drilled in the center (it is not a naturally formed *puka* shell). A historical glass trade bead was also found in unit J16, in Level 2 approximately 12 cm below the surface (Fig. 6, far left). The bead is about 2 mm in diameter and made of an aqua, or green, wire-rounded glass that is typical of European trade beads. The presence of the trade bead indicates that the site was used into the early phase of European contact. While no other imported goods were found, the remains of the house mouse in Level 2 also points to an occupation contemporaneous with the early contact period. What is most interesting about the presence of this tiny artifact (and a promising line of inquiry for the future) is the potential for such items to illuminate the occurrence and character of trade in the early contact period. Kirch and Sahlins (1992) have thoroughly documented the “two-tiered system of trade” in foreign goods that characterized the Conquest period (1778–1810), part of this system involved the trade of beads as “female-associated items” (Kirch 1992:25).

Four bone fragments exhibiting signs of modification were recovered from the rockshelter’s deposit; they are illustrated on the right side of Figure 6. Two of these fragments, clearly fashioned from medium mammal shafts, have been worked to a point. They were excavated from unit J16 and J13 (this one is burned) and appear to be points from broken awls, the sort of domestic implements that are commonly found in Hawaiian habitation sites (Kirch 1985). They may have been used to split *Pandanus* leaves for mat-making, or they may have been used for extracting meat from shellfish. It is difficult to speculate about the function of the third worked bone fragment, from Feature 2, as it is extremely small (6-by-7 cm [see Fig. 6, far right]). However, the bone has been worked to a thin flat tab and displays a beveled notch in one side, making it resemble a fragment of a fishhook tab. The fourth modified bone artifact was uncovered in unit J16. It was formed from medium-sized mammal shaft fragment and exhibited two notches at one end (Fig. 6, center). The bone is weathered on the exterior, but appeared to be

TABLE 2. SUMMARY OF FAUNAL REMAINS FROM 1999 EXCAVATIONS, KIPAPA ROCKSHELTER, KAHIKINI, MAUI

TAXON	NISP		MNI		WEIGHT		BIOMASS	
	n	%	n	%	g	%	kg	%
<i>Sus scrofa</i>	6	0.33	3	4.05	0.89	2.75	0.02368	4.15
<i>Canis familiaris</i>	8	0.39	4	5.4	0.70	2.16	0.0191	3.35
Medium mammal	62	3.43	4	5.4	2.86	8.84	0.067764	11.9
<i>Herpestes auropunctatus</i>	1	0.06	1	1.35	0.03	0.09	0.00112	0.196
<i>Rattus exulans</i>	301	16.62	18	24.32	2.36	7.3	0.05696	10
<i>Mus domesticus</i>	9	0.5	2	2.7	0.03	0.09	0.00112	0.196
<i>Hemidactylus</i> spp.	76	4.21	6	8.1	0.21	0.65	0.002854	0.5
<i>Gallus gallus</i>	1	0.06	1	1.35	0.63	1.95	0.013409	2.35
Small bird	13	0.72	2	2.7	0.21	0.65	0.004934	0.864
Medium bird	13	0.72	2	2.7	0.70	2.16	0.014758	2.6
Fish	982	54.8	31	41.89	19.20	59.37	0.36461	63.93
UID bone	335	18.56			4.52	13.98		
Total Bone	1807		74		32.34		0.570309	
Mollusks	1920	31.84	712	78.28	959.75	71.76	0.66617	81.84
Crustacean	8	0.13	2	0.22	0.68	0.05		
Echinoidea	2287	37.92	124	13.46	154.30	11.54		
UID shell					186.81	13.97	0.147804	18.16
Total Shell	4215		838		1301.54		0.813975	
Total	6022		912		1333.88		1.38428	

worked to a bevel on the end opposite the notches. The notches may mark areas that were lashed at one time.

Vertebrate Fauna

Among the vertebrate faunal assemblage for the Kipapa Rockshelter, fish remains make up the largest portion of the assemblage; they constitute 55 percent of the vertebrate remains by NISP, 42 percent by MNI, 60 percent by weight, and 64 percent by biomass (Table 2). Diversity ($H' = 2.7836$) and equitability ($V' = 0.8878$) of the vertebrate faunal remains, calculated for MNI using Shannon's H' , were both high. These measures indicate that a large variety of animals were used at the site, and the evenness with which they were used is fairly uniformly distributed. That is, no particular animal was exploited in much greater abundance than the others.

Calculated biomass is notably low overall. This is likely a result of both small sample size and low sample weight. An additional contributing factor is the relatively minor component of medium mammal bone, including pig and dog. Fish comprised the largest percentage of the overall biomass (64 percent), followed by medium mammal (12 percent) and rat (10 percent). Little emphasis is placed on biomass calculations here, as sample size bias may affect computations. Casteel (1978) and Grayson (1984) suggest a sample size of at least 200 individuals or 1400 bones for a confident interpretation. Note that biomass was calculated for all remains, even when animals were only represented by teeth fragments.

Calculated NISP, MNI, and weight (g) by provenience for the fish assemblage was dominated by near-shore reef fish including (in order of abundance by MNI): parrotfishes (*Scarus* spp. and *Calotomus* spp.), jacks (*Caranx* spp. and *Scomberoides* sp.), wrasses (Labridae), surgeonfishes (*Acanthurus* spp.), bigeye emperors (*Mono-taxis grandoculis*), snappers (*Lutjanus* spp.), and Hawaiian flagtail or *aholehole* (*Kuhlia sandvicensis*) (Table 3). Other reef fish that occur in the deposit, though less frequently, include squirrelfish (Holocentrinae), mullet (*Mugil cephalus*), and triggerfish (Balistidae). These fish were probably collected using a variety of methods; it is germane to note that certain species could have been taken with more than one method, as a given species may inhabit more than one habitat. The reef omnivores, herbivores, and planktivores (*Scarus*, Labridae, Acanthuridae, *Kuhlia sandvicensis*, *Mugil cephalus*, and Balistidae) may have been harvested with nets and traps, while the near-shore and open-water carnivores (Holocentrinae, Carangidae, *Lutjanus*, Balistidae) were likely taken with hook and line (i.e., handlining) (Halapua 1982; Leach et al. 1997; Tinker 1978). Any of the aforementioned fish could also have been speared; this is probably the case with many of the nocturnal species such as some species of Carangidae, *Lutjanus*, and Holocentrinae.

Two requiem shark (*Carcharhinus* spp.) teeth were also recovered from the site. One of the teeth came from the shark's lower jaw and was burned; it was uncovered in Feature 1. The second tooth, from the upper jaw of a shark, was from the deposit in unit J16. The shark teeth comprise a small but significant portion of the fish assemblage. Sharks were probably collected opportunistically; for example, they may have been caught using a hook and line while targeting other species of fish. Shark teeth, known for being sharp and strong, were highly prized as cutting implements, both for domestic use and for use in warfare (Buck 1957; Titcomb 1972). Titcomb (1972) explains that only the hammerhead and the white-tip reef shark were commonly consumed in prehistoric Hawai'i. Ethnographic records indicate that some Hawaiians avoided eating shark because it was a family or personal god ('*aumakua*') (Titcomb 1972). '*Aumakua*' were deified ancestors that assumed the shape of an object, such as a shark or an owl (Pukui and Elbert 1986). Humans did not harm or eat their personal gods, and often, in the case of sharks, people fed them (Pukui and Elbert 1986). In return for care and worship, it is said that sharks protected their keepers.

Fish bone was concentrated in Feature 1. It contained 65 percent of the overall fish assemblage by NISP, 35 percent of the fish assemblage by MNI, and 43 percent of the fish assemblage by weight. The feature contained by far the most abundant and diverse fish collection, though the frequencies, by MNI, of all taxa are equal. A small percentage (1.4 percent) of the fish remains exhibited evidence of burning, though all of the burned bone was identified from Feature 1. The entire unit J16 yielded numerous fish remains. No otoliths were recovered; in fact, these elements are extremely rare in Kahikinui deposits.

Sixty-four fish vertebrae were recovered from the Kipapa Rockshelter excavations (Table 4). The measured widths of vertebral centrum from unidentified fish can be used as a proxy for fish size, following Wing (1998), assuming that the unidentified fish vertebrae come from a cross section of the identified species. Centrum widths are indicative of the mean size of fish in the assemblage; further, this information is also useful in a comparative sense. Changes in fish size and species composition of various assemblages can be compared among and between

TABLE 3. FISH IDENTIFICATIONS BY PROVENIENCE FROM 1999 EXCAVATIONS, KIPAPA ROCKSHELTER, KAHIKINUI, MAUI

TAXON	FEATURE 1 (J16)			FEATURE 2 (J13)			FEATURE 3 (J13)			J13			J16		
	NISP	MNI	WT. (g)	NISP	MNI	WT. (g)	NISP	MNI	WT. (g)	NISP	MNI	WT. (g)	NISP	MNI	WT. (g)
<i>Carcharhinus</i> sp.	1	1	0.02										1	1	0.1
Holocentrinae													2	1	0.05
<i>Kuhlia sandvicensis</i>	2	1	0.1				1	1	0.01						
Carangidae	2	1	0.1												
<i>Caranx</i> spp.	3	1	0.12										1	1	0.08
<i>Scomberoides</i> sp.	1	1	0.04												
<i>Lutjanus</i> spp.				1	1	0.01							2	1	0.81
<i>Monotaxis grandoculis</i>	3	1	0.02							2	2	0.01			
<i>Mugil cephalus</i>	1	1	0.1												
Labridae	2	1	0.08							1	1	0.02	7	2	0.08
<i>Calotomus</i> sp.				1	1	0.9				1	1	0.2	1	1	0.1
<i>Scarus</i> spp.	3	1	0.16	1	1	0.03	1	1	0.01	4	1	0.23	1	1	0.01
Acanthuridae	6		0.1												
<i>Acanthurus</i> spp.	1	1	0.02	3	1	2.3				1	3	0.04			
Balistidae	2	1	0.02												
UID fish	612		7.41	50		0.68	19		0.5	81		1.47	163		3.32
Total	639	11	8.29	56	4	3.92	21	2	0.52	88	6	1.97	178	8	4.55

TABLE 4. FISH VERTEBRAL CENTRUM WIDTHS (mm) FROM 1999 EXCAVATIONS, KIPAPA ROCKSHELTER, KAHIKINUI, MAUI

PROVENIENCE	<i>n</i>	MEAN	STDEV	RANGE
Feature 1	35	2.85	0.78	1.0–4.6
Feature 2	3	2.4	0.173	2.3–2.6
Feature 3	1	2		
J13	9	3	0.977	2.1–4.8
J16	16	2.93	0.932	1.8–5.8
Overall	64	2.875	0.825	1.0–5.8

Note: *n* = number of vertebra measured; stdev = standard deviation.

sites. Centrum widths from the Kipapa Rockshelter indicate that relatively small individuals were being exploited, with widths ranging from 1.0 mm to 5.8 mm. Fish vertebrae were most abundant in Feature 1, where the mean width was 2.8 mm. The small range and uniformity in the widths of vertebral centra throughout the excavation units indicates that nets and traps may have been the primary method of fish capture.

The frequency of fish remains (by NISP, MNI, weight, and biomass) was followed by that of rat and medium mammals (see Table 2). Interestingly, though the Pacific rat (*Rattus exulans*) is commonly considered to be a commensal species rather than a food item, rat remains account for a large portion of the deposit (17 percent NISP, 24 percent MNI, 10 percent biomass). Ethnographically, *Rattus exulans* is recorded as a nonfood item (Buck 1957:2); they reportedly lived in and around houses, relying on humans for food and shelter (Kramer 1971; Stokes 1917). Based on the sheer density and the taphonomic and depositional contexts of *Rattus exulans* remains, it is a probability that the prehistoric inhabitants of the rockshelter ate rats. *R. exulans* remains were recovered in situ from both features and unit fill, whole skeletons were not recovered, and over half of this material was fragmentary (predepositional breakage). Despite their small size and diminutive potential meat contribution per individual (though certainly more than a small fish), rat remains were encountered much more frequently than bones of *Sus scrofa*, *Canis familiaris*, or medium mammal. *R. exulans* was eaten regularly by other Pacific Island groups, including the New Zealand Maori and the Mangaian of the Cook Islands (Buck 1934; Roberts 1991; Watson 1956). Hawaiians may also have used *R. exulans* as a supplementary food source. For example, Roberts suggests that humans fed these commensals to their pet dogs (Roberts 1991:128). Further, the Hawaiian word *pa'iole*, as described in Pukui and Elbert, suggests that trays of food were left outside one's house for rats to eat (1986:303). Indeed, this practice would attract rats and make them easier to catch. The frequency of recovered rat remains is likely a combined function of the fine-screening methods and possibility that rat bones constitute food remains.

Few bones of historically introduced small mammal were identified in deposits from units J13 and J16. Unit J13 yielded remains of one house mouse (*Mus domesticus*) and one mongoose (*Herpestes auropunctatus*). This material was found in the first 5 cm of Level 1, and probably represents commensal species rather than food items. Likewise, the mouse bones found in unit J16 were confined to the

first 12 cm of the deposit. *Herpestes auropunctatus* was originally introduced to the Hawaiian Islands in 1883, and *Mus domesticus* was later introduced in the early twentieth century (Tomich 1986). Both of these animals are now ubiquitous in Hawai'i as they exist not only as commensal species, but also as highly adapted wild species (Tomich 1986). Their remains probably derive from a late occupation or an intrusive context.

Small fragments of pig and dog bone were recovered from Features 1 and 2 and units J13 and J16. Both of these species were Polynesian introductions to the Hawaiian Islands that were regularly husbanded for food. These remains were evenly distributed throughout the deposit. Unit J13 and Feature 1 each contained fragments of pig molars. Unit J16 yielded the remainder of the pig material, all of which came from a juvenile individual, probably less than six months of age (based on fusion and developmental attributes of the teeth). Half of the dog remains (virtually all teeth fragments) were burned. These were excavated from Feature 1. Bones of dog were also found in unit J13 and in Feature 2; the size and developmental characteristics of this bone (an incisor and an unfused metapodial) indicated that these dogs were also juveniles. Similarly, excavations in a late pre-contact rockshelter in the Anahulu Valley of Oahu by Kirch (1992), yielded remains suggesting differences in husbandry practices based on age at death. Specifically, 75 percent of the pig bone came from immature or juvenile individuals; dog bone, in contrast, represented only 35 percent immature to juvenile specimens (Kirch 1992:41). This suggests that while dogs were more frequently raised to maturity, pigs were most often consumed while still immature. Based on comparative faunal data from household complexes throughout Kahikinui, we should be able to determine if this is a pattern associated with most commoner households.

Ethnographic records indicate that pigs and dogs were prized as food items and bred in large numbers for food (Buck 1957; Titcomb 1969). Dog appeared to be the favored of the two meats, though Titcomb notes that, "commoners seldom tasted dog" (Titcomb 1969:23), because in times of scarcity it was reserved for the chiefly class. Traditionally, it was taboo for women to partake of pig, which was reserved for men and high-status individuals. Pigs and dogs had other social functions in addition to use as food items. Kolb has found that pig is frequently associated with ritual structures as offerings in Kahikinui (Kolb and Radewagen 1997). Buck explains that pigs and dogs were often used as offerings to an 'auma-kua or raised for payment to overlords (Buck 1957).

Teeth were the primary identified elements of both the pig and dog remains, constituting 88 percent of the pig elements and 88 percent of the dog elements (Table 5). Only a single foot fragment was identified from each of these species. Bones classified as medium mammal were entirely confined to the shaft fragment category; all of this material was small, fragmentary, and frequently modified by burning or cutting. Elements from most parts of the rat skeleton are present, though head and teeth remains are substantially more abundant than those from other parts of the body. Remains in the head and teeth category make up 47 percent of the rat assemblage, while 15 percent of the assemblage comes from axial elements, 14 percent comes from the forequarter, and 19 percent comes from the hindquarter.

Remains classified as "unidentified medium mammal" are likely either pig or

TABLE 5. SUMMARY OF BONE SPECIMENS BY ANATOMICAL REGION (NISP) FROM 1999 EXCAVATIONS, KIPAPA ROCKSHELTER, KAHIKINUI, MAUI

SKELETAL GROUP	PIG	DOG	MEDIUM MAMMAL	RAT
Head/teeth	5	7		140
Axial				44
Forequarter				43
Hindquarter				57
Foot	1	1		17
Shaft fragment			38	
Total	6	8	38	301

dog (see Table 2). All of the medium mammal material was highly fragmentary and undiagnostic, often displaying evidence of burning or butchery. Thirteen percent of all the medium mammal remains (by NISP) recovered were burned. Six of the medium mammal fragments showed signs of butchering; all of the excavation units contained some of this material, though it was most concentrated in unit J16, around the *imu* feature. The fishhook was also found in unit J16.

Reptiles were a minor component of the faunal assemblage, represented by a few individuals (MNI = 6) of the small house gecko (*Hemidactylus* spp.) (see Table 2). While their presence probably reflects their commensal relationship with humans rather than being food items, they are notable simply because they were found in the deposit. To date the author has analyzed over 60 faunal assemblages from Kahikinui, and gecko remains have only been identified where fine screens ($\frac{1}{16}$ in. [1.59 mm] mesh) were used.

Bird bones comprise a small but significant part of the rockshelter's faunal assemblage. A single bone from the Hawaiian domestic chicken was found in unit J16 (Table 2). This domesticate fowl (*moa*), was a well-known Polynesian introduction to the islands and a food item. According to Buck (1957), chicken was also an appropriate offering to the gods. A few undiagnostic fragments of medium bird were found in unit J13 and in Feature 3, but they came from a bird roughly the size of a chicken. Two halves of the tarsometatarsus from a Bulwer's Petrel were identified from unit J16 and Feature 1. The remains represent an extremely small individual of this pelagic or seabird (Steadman, pers. comm. 2000). Bulwer's Petrel is known to inhabit Maui, though none have previously been identified from archaeological sites in Kahikinui. They are migratory breeders that breed locally, but then depart for the remainder of the year (Pratt et al. 1987). Seabirds may be a relatively large and predictable food resource for humans, due to their breeding habits. Petrels and shearwaters typically return to their nesting colony between February and April, and then depart in October and November (Moniz 1997). A number of additional characteristics of seabird ecology make them an abundant and predictable avian resource (Moniz 1997); this is demonstrated archaeologically as bird assemblages throughout Polynesia are dominated by seabird remains. It is worth noting that the *Rattus exulans* is known to prey on seabirds in general and, specifically, on Bulwer's Petrel when they are nesting (Tomich 1986). Indeed, most indigenous birds, especially nesting land birds, flightless species, and burrowing seabirds were particularly vulnerable to predation by humans, dogs, pigs, and rats alike (Olson and James 1982). Hawaiians probably

caught petrels locally, as there is little evidence that Polynesians captured seabirds at sea (Steadman and Olson 1986).

Invertebrates

Mollusks and sea urchins made up a substantial quantity of the faunal assemblage (Table 2). By NISP (70 percent of overall), MNI (92 percent), weight (97.5 percent), and biomass (61 percent) the invertebrates dominate the faunal deposit. All of the invertebrate taxa identified were of marine origin. Invertebrate remains from each provenience included eleven families of mollusk; nine were gastropods and two are bivalves (Table 6). Limpets or 'opihi (*Cellana* spp.), nerites (*Nerita* spp.), littorines (*Littorina pintado*), cowries (specifically *Cypraea caputserpentis*), and thaidids (Thaididae) were the most common taxa identified and were found in all the excavation units. The single most abundant family by weight was Cypraeidae, the cowries, weighing a total of 35.6 g, and including *Cypraea* spp., *C. caputserpentis*, and *C. mauritiana*. Cowries (especially *C. caputserpentis*) also comprised a majority of the deposit by NISP (650) and MNI (112). Very few bivalves were recovered (NISP = 9); the family Mytilidae (probably a species of the sedentary *Brachidontes* mussel) were identified, as was the burrowing venerid clam, *Periglypta reticulata*. Calculated values for Shannon's H statistic of marine invertebrates suggest that diversity and equitability were moderate ($H' = 2.0465$) and ($V' = 0.6621$). These measures quantitatively indicate that a variety of invertebrates were used at the site, and the relative importance of each was fairly even.

A majority of the molluscan shell remains was recovered from unit J13 (NISP = 1246, MNI = 297, weight = 360.71 g). Invertebrate remains were also concentrated in unit J16 (NISP = 1074, MNI = 162, weight = 250.75 g) and in Feature 1 (NISP = 1010, MNI = 163, weight = 175.31 g). Features 2 and 3 contained comparatively little shell. The surface collection yielded numerous complete specimens, thus the NISP (189) was low but the MNI (105) was high. Species located on the surface were generally the same as those recovered from excavations. Essentially, the units and features each contained similar species; the features, however, yielded less abundant and diverse assemblages.

Of particular note was the abundance and frequency of sea urchin remains. Virtually all material classified as echinoidea probably represents either the rock-boring urchin (*Echinometra* spp.) or the helmet urchin (*Colobocentrotus atratus*). Only one spine from the red pencil urchin (*Heterocentrotus mammillatus*) was identified, from Feature 1; this species is much rarer than either the ubiquitous rock-boring urchin or the helmet urchin, presently and possibly in the past as well. Spines from all of these species were readily identifiable, though the undiagnostic mouth parts "Aristotle's lantern" were used to calculate MNI (whole specimens of this element were counted and divided by ten to obtain MNI). One hundred and twenty-five individuals were obtained from the sample (NISP = 2266, MNI = 125, weight = 150.67 g). According to ethnohistoric accounts, sea urchins were commonly consumed by native Hawaiians (Titcomb 1972) both raw and cooked. The sheer abundance of sea urchins, given the small area excavated, was surprising. The urchin MNI far exceeded what one would suspect given the total weight of sea urchin remains. That is, the test of a single individual sea urchin (*C. atratus*), of average length 34 mm, weighed approximately 35 g (calculations based on living

TABLE 6. INVERTEBRATE REMAINS BY PROVENIENCE FROM 1999 EXCAVATIONS, KIPAPA ROCKSHELTER, KAHIKINUI, MAUI

TAXON	SURFACE COLLECTION			FEATURE 1			FEATURE 2			FEATURE 3			UNIT J13			UNIT J16		
	NISP	MNI	WT. (g)	NISP	MNI	WT. (g)	NISP	MNI	WT. (g)	NISP	MNI	WT. (g)	NISP	MNI	WT. (g)	NISP	MNI	WT. (g)
<i>Acanthochiton</i> spp.				1	1	0.5										1	1	0.08
<i>Cellana</i> spp.	12	11	6.7				4	2	0.8	4	1	0.2	16	3	2	18	15	5
<i>Cellana exarata</i>	11	8	25.5	7	5	4.4	3	3	0.4				33	14	7	11	6	5.9
<i>Cellana sandwicensis</i>	9	7	9.4	15	4	3	5	4	2.7				19	6	5.6	22	7	7.8
<i>Nerita picea</i>	28	26	7.2	72	60	10.6	24	17	4.5	11	5	1.2	174	156	41.8	59	46	10.76
<i>Littorina pintado</i>	2	2	0.7	16	16	1.6	5	5	1	3	3	0.2	15	15	3.1	5	5	1.2
<i>Strombus</i> sp.				1	1	0.05												
<i>Cypraea</i> spp.	7	7	10.8	11	2	11.8	4	3	5.1				9	2	14	11	3	1.6
<i>Cypraea caputserpentis</i>	56	15	43	72	14	37.6	49	7	19.4	12	4	2.7	255	39	114.6	161	15	70.4
<i>Cypraea mauritiana</i>	3	1	24.6															
Thaididae	31	8	14.1	31	10	13.3	13	4	4.1	2	1	0.2	111	15	35.5	31	8	13.2
<i>Drupa</i> spp.	6	6	6.6										5	5	3.3	2	2	1.7
<i>Drupa morum</i>	6	6	10.3				1	1	0.6									
<i>Drupa rubusidaeus</i>	2	2	3.9				2	2	1.4				5	5	6.1	7	7	6.8
<i>Morula granulata</i>													1	1	1.3			
<i>Purpura aperta</i>	6	3	15.2										3	1	5.8	6	2	13
<i>Nassarius</i> sp.	1	1	1.7										1	1	0.3	2	1	0.8
<i>Conus</i> spp.	1	1	19.6	1	1	6.1										2	2	2.5
Bivalvia													3	1	1.5			
Mytilidae				3	1	0.2				1	1	0.01	1	1	0.1			
<i>Periglypta reticulata</i>	1	1	0.3															
Crustacea				7	3	0.75	1	1	0.2									
Echinoidea	7		1.9	716	45	43.98	119	5	11.04	43	1	2.4	500	32	34.18	619	41	45.56
<i>Echinometra</i> spp.				8		0.32	2		0.22				27		1.13	62		1.75
<i>Echinometra mathaei</i>				18		1.5	6		0.6	1	1	0.01	8		0.5	3		0.4
<i>Colobocentrotus atratus</i>				31		1.12	4		0.18				40		1.6	51		1.68
<i>Heterocentrotus mammillatus</i>																1		0.6
UID shell						38.49			4.8				20		81.3			60.02
Total	189	105	201.5	1010	163	175.31	242	54	57.04	77	17	6.92	1246	297	360.71	1074	161	250.75

specimens collected in Kahikinui, Maui). If the total weight of archaeological sea urchin remains (150.67 g) is divided by 35 g, the number 4.3 is obtained; indicating that 150 g could be expected to represent approximately four individuals, assuming that the entire test is recovered. However, most of the sea urchin remains were minute and highly fragmentary, thus indicative of processing techniques. Given the common indigenous practice of smashing the test to obtain the gonads, it is understandable that more complete fragments of test were not recovered. Note that a biomass measurement is not given for sea urchins, unfortunately, no data on meat weight to test weight was available.

Two additional classes of invertebrate were significant, though not abundant. Two plates of the green chiton (*Acanthochiton* spp.) were identified, one each from unit J16, and from Feature 1. Ethnographically, chitons were not used as food, but were used in the *mawaewae* ceremony for first-born children, held a few days after the birth, during which the mother was given a "special food" (Pukui and Elbert 1986:245; Titcomb 1972:337). The presence of chiton in the deposit may indicate that the rockshelter's inhabitants had recently celebrated the birth of a first-born child. Crustaceans also comprised a relatively small quantity of the invertebrate deposit, their total weight was less than 1 g. The remains probably represented a species of shore crab, such as the ubiquitous thin-shelled rock crab, the 'a'ama (*Grapsus tenuicrustatus*). Crustacean remains were rarely encountered in faunal assemblages from Kahikinui.

A small portion, 1.1 percent, of the overall invertebrate assemblage showed signs of burning. Burned shell was most common in Feature 1—the earth oven or *imu*—and around the feature in unit J16. Cowries were found burned more frequently than other species of invertebrate.

Screen Size Comparisons

A comparison between faunal remains recovered from the $\frac{1}{4}$ in. screens and the $\frac{1}{16}$ in. screens is instructive (Table 7). The bone sample recovered from the fine screen (NISP = 1063, MNI = 46, weight = 12.88 g) is considerably larger than that from the $\frac{1}{4}$ in. screen (NISP = 409, MNI = 28, weight = 15.12 g). In terms of individuals recovered (MNI), the greatest increase that results from using the fine screen, as anticipated, is in the numbers of small animals; rats (17), mice (2), lizards (6), small birds (2), and fish (16) are all well represented in the $\frac{1}{16}$ in. sample. Conversely, few if any of these individuals were recovered in the $\frac{1}{4}$ in. mesh. Further, small vertebra, from reef fish (some that were identifiable to the species level), were recovered exclusively in the fine screen. Without the fauna recovered from the fine screen, the rockshelter's vertebrate assemblage would look significantly different.

The fine screen yielded an invertebrate assemblage that was largely composed of sea urchins (NISP = 1479, MNI = 98, and weight = 88.97 g) (Table 7). In contrast to the assemblage recovered from the $\frac{1}{16}$ in. screen, the $\frac{1}{4}$ in. assemblage yielded few sea urchin remains, and was dominated by molluscs. Though crustacean remains were not abundant, it is significant that more fragments from this animal were recovered in the $\frac{1}{16}$ in. screen than in the $\frac{1}{4}$ in. screen.

Finally, the historical glass bead was also recovered in the $\frac{1}{16}$ in. screen, as were three of the small worked bone fragments. Without fine screening these items

TABLE 7. SCREEN SIZE COMPARISONS OF IDENTIFIED FAUNA FROM 1999 EXCAVATIONS, KIPAPA ROCKSHELTER, KAHIKINUI, MAUI

TAXON	NISP			MNI			WEIGHT (g)		
	$\frac{1}{4}$ "	$\frac{1}{16}$ "	TOTAL	$\frac{1}{4}$ "	$\frac{1}{16}$ "	TOTAL	$\frac{1}{4}$ "	$\frac{1}{16}$ "	TOTAL
<i>Sus scrofa</i>	5	1	6	2	1	3	0.87	0.2	1.07
<i>Canis familiaris</i>	6	2	8	3	1	4	0.55	0.15	0.7
Medium mammal	62	0	62	4	0	4	2.86	0	2.86
<i>Herpestes auropunctatus</i>	0	1	1	0	1	1	0	0.03	0.03
<i>Rattus exulans</i>	20	281	301	1	17	18	0.21	2.15	2.36
<i>Mus domesticus</i>	0	9	9	0	2	2	0	0.03	0.03
<i>Hemidactylus</i> spp.	0	76	76	0	6	6	0	0.21	0.21
<i>Gallus gallus</i>	1	0	1	1	0	1	0.63	0	0.63
Small bird	0	13	13	0	2	2	0	0.21	0.21
Medium bird	7	6	13	2	0	2	0.58	0.12	0.7
Fish	308	674	982	15	16	31	9.42	9.78	19.2
Total Bone	409	1063		28	46		15.12	12.88	
Mollusks	1686	46	1732	581	32	613	756.71	2.64	759.35
Crustacean	3	5	8	0	1	1	0.53	0.15	0.68
Echinoidea	807	1479	2286	26	98	124	64.23	88.97	153.2
Total Shell	2496	1530		607	131		821.47	91.76	
Total	2905	2593		635	177		836.59	104.64	

Note: Surface collection data outside units not included.

would have fallen through the $\frac{1}{4}$ in. mesh and they would not have been collected. Interpretations were clearly affected by the increased recovery of small fauna and artifacts in the fine-mesh screens.

CONCLUSIONS

Test excavations in the Kipapa Rockshelter established that relatively small excavation units may produce rich cultural and faunal records if appropriate recovery techniques are employed. Proveniences J13 and J16, as well as the three features, produced relatively large amounts of microfaunal materials. More small fish and mammal bone was identified from this limited excavation than from other sites in Kahikinui that were previously excavated more extensively, but without the use of $\frac{1}{16}$ in. mesh screens. This increase in faunal recovery may be a combined function of screen size and better preservation in a rockshelter context. However, archaeological investigations in Hawai'i can only benefit from the use of fine-mesh screens; they increase sample size of small (and perhaps, seemingly unimportant) vertebrates and invertebrates (rats, chitons, and sea urchins, for example) that may have formed a significant portion of the diet or constituted part of household ritual activities. Use of fine screens also provides a more accurate representation of relative species abundance, as fewer small bones are lost through the fine mesh (Table 7). In addition, fine-screened samples furnish invaluable data on material culture, such as small fragments of worked bone and beads, that contribute to the remains of domestic technologies and evidence for trade or interactions beyond the domestic or regional context.

Based on the combined evidence of zooarchaeological remains, subsurface features, and site architecture (associated terraces and structures), the Kipapa Rockshelter appears to be a component of a household (*kau hale*) complex, rather than a temporary occupation site. The deposit is laden with ash and charcoal, indicative of regular burning of earth oven and smaller hearth fires. An array of domestic activities—typical of permanent occupation sites—are evidenced by *kukui* nuts (the meat of which were either burned for light or consumed as a condiment), fragments of bone awls, worked bone, basalt lithics, volcanic glass, and beads. I suggest that the rockshelter was used as a *hale kahumu* or cookhouse. Ethnographic records indicate that the traditional Hawaiian household was comprised of a group of functionally differentiated structures. Among these household components were: the men's eating house (*mua*), the women's eating house (*hale 'aina*), the shared sleeping house (*hale noa*, or literally, house free of taboo), and numerous other structures that probably varied according to family and social status (Handy and Pukui 1958). The *hale kahumu* was described as, "... a thatched shed where cooking was done in bad weather and cooking materials were stored ... In good weather cooking was done in outdoor *imu*, one for the men and one for the women; but in rainy weather, or if there was not a quantity of cooking to do, the *hale kahumu* was the place to go. Some of these were small but many were large enough to include storage of utensils and implements" (Handy and Pukui 1958:12). While the Kipapa Rockshelter is not exactly what is described by Handy and Pukui (1958), the site does display many physical characteristics that make it ideally suited for a cookhouse. Indeed, there must have been much local variation in *kau hale* structures. The large natural shelf-like niche to the west of unit J16 may have served as a storage area for cooking utensils or water. A number of similar small niches were located along the rock face and around the largest overhang. Rock overhangs to the east and west of the main terrace may also have served as storage areas. Shell midden and remains of *kukui* found in these niches indicate that they served domestic functions in the past. The swale or drainage located below the rockshelter's stacked terrace, containing many small rock mounds, is likely an agricultural feature, thus lending further evidence for permanent occupation of the rockshelter.

Questions of chronology, household organization, subsistence, resource exploitation, and political intensification as exemplified by the Hawaiian family can all be addressed with fine-grained data from domestic contexts, such as that presented here. Further, final analysis of excavations carried out in the *moku* of Kahikinui will greatly enrich our knowledge of late prehistoric Hawaiian occupation in peripheral settings, that is in areas marginal to centers of long-term high population densities and political control. Finally, from a broader perspective, it is germane to note that because Kahikinui is a late precontact, peripheral settlement it may clearly reflect the archaeological signatures of late prehistoric and early historic political change that occurred rapidly and concurrent with intensive exploitation in these areas (see Kirch 1992).

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ABSTRACT

Test excavations of a late precontact to early contact rockshelter site in the traditional district of Kahikinui, Maui, Hawai'i, are discussed. The excavated cultural deposits primarily consist of three combustion features, two informal fire pits, and an earth oven. The deposit contained indigenous Hawaiian artifacts, such as basalt lithics, bone awls, and a fishhook. Fine-screening methods were employed with the use of $\frac{1}{16}$ in. (1.59 mm) mesh, and relatively large amounts of fish bone and microfauna were also recovered. Using faunal and material culture evidence, it is argued that the rockshelter is a single component of a traditional Hawaiian household complex (*kau hale*), probably a cookhouse (*hale kahumu*). KEYWORDS: Hawai'i, Maui Island, archaeology, screen size, zooarchaeology, fauna, *kau hale*.