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– RESEARCH REPORT –

Foreign Animals, Hawaiian Practices: Zooarchaeology in the Leprosarium at Kalawao, Molokaʻi, Hawaii

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ABSTRACT

Archaeological research on the Hansen's disease settlement at Kalawao, Molokaʻi highlights the relationship between the institutional mandates of the Hawaiian Board of Health, and the village organisation evident in the physical remains of the leprosarium. One aspect of this work focuses on the role of animals in the settlement, using archaeological surface remains as well as faunal remains recovered from excavations. Zooarchaeology in Kalawao reveals changes in diet due to provisioning by the state, notably increased consumption of cattle, but also continuity in traditional Hawaiian food procurement strategies such as shellfish collecting, in addition to other patterns relevant to human-animal interactions.

Keywords: Hawaii, Zooarchaeology, Leprosaria

INTRODUCTION

Archaeological research in the *ahupuaʻa* (traditional Hawaiian land division) of Kalawao, the site of a historical leprosarium on Kalaupapa peninsula, Molokaʻi island (Figure 1), has recovered multiscalar evidence for 19th century Hawaiian village life in a place that written documents portray as a total institution (Flexner 2010). Total institutions, bounded communities that are meant to isolate, discipline, and reform inmates perceived as threatening to society, are an invention of modern Western societies (Foucault 1988, 1995; Goffman 1962). In the Pacific Islands, total institutions followed colonialism, perhaps most famously in the penal colonies of Australia (Casella 2001; Casella and Frederickson 2004) and New Caledonia (Sand *et al*. 2005). Institutional forms in the Pacific were quite variable, and often followed patterns that were adapted to specific island contexts. Thus Christian missions resembled total institutions in Australia, while in New Zealand, they were organised more along the lines of extended households (Lydon and Ash 2010; Middleton 2008, 2010; Sutton 2003).

Leprosaria, total institutions intended to isolate people suffering from Hansen's disease (commonly known as leprosy), are a unique form of modern total institution. Leprosaria were common in medieval Europe, but had dwindled there by the end of the 17th century with the disappearance of Hansen's disease. They were revived as a colonial total institution within the emerging paradigm of tropical medicine in the late 19th century, when the disease was re-encountered in the colonised world. In the Pacific, leprosaria were created in New Zealand (Trotter and McCulloch 2003), Samoa (Akeli 2007), and Hawaii (Flexner 2010) to isolate indigenous Polynesians as well as foreigners with Hansen's disease.

Here I report the results of a faunal analysis of remains recovered from the site of the leprosarium on Kalaupapa peninsula, to shed light on the role of animals in the institutional social life of a late-19th century Hawaiian community. When compared to zooarchaeological results from prehistoric sites in Kalaupapa (Kirch *et al*. 2003: 17–21; McCoy 2006, 2008), the faunal remains from the leprosarium reveal changes in diet due to provisioning by the state, notably increased consumption of cattle, but also continuity in traditional Hawaiian food procurement strategies, such as shellfish collecting.

HISTORICAL CONTEXT

The Kalaupapa leprosarium was established after the Kingdom of Hawaii passed 'An Act to Prevent the Spread of Leprosy' in 1865. This law was created to deal with the perceived leprosy problem in the islands, following almost a century of devastation of the Native Hawaiian population due to introduced diseases. The first exiles to Kalaupapa settled in the eastern part of the peninsula, in the *ahupuaʻa* of Kalawao, in 1866. From 1866 until the early-20th century the settlement's mostly Native Hawaiian population grew to a peak of about 1100 quarantined people, before settlement subsequently shifted to the west (Greene 1985; Inglis 2004).

The Hawaiian Board of Health struggled to determine the best form for Kalawao as an institution throughout the settlement's history. The primary rule for the community

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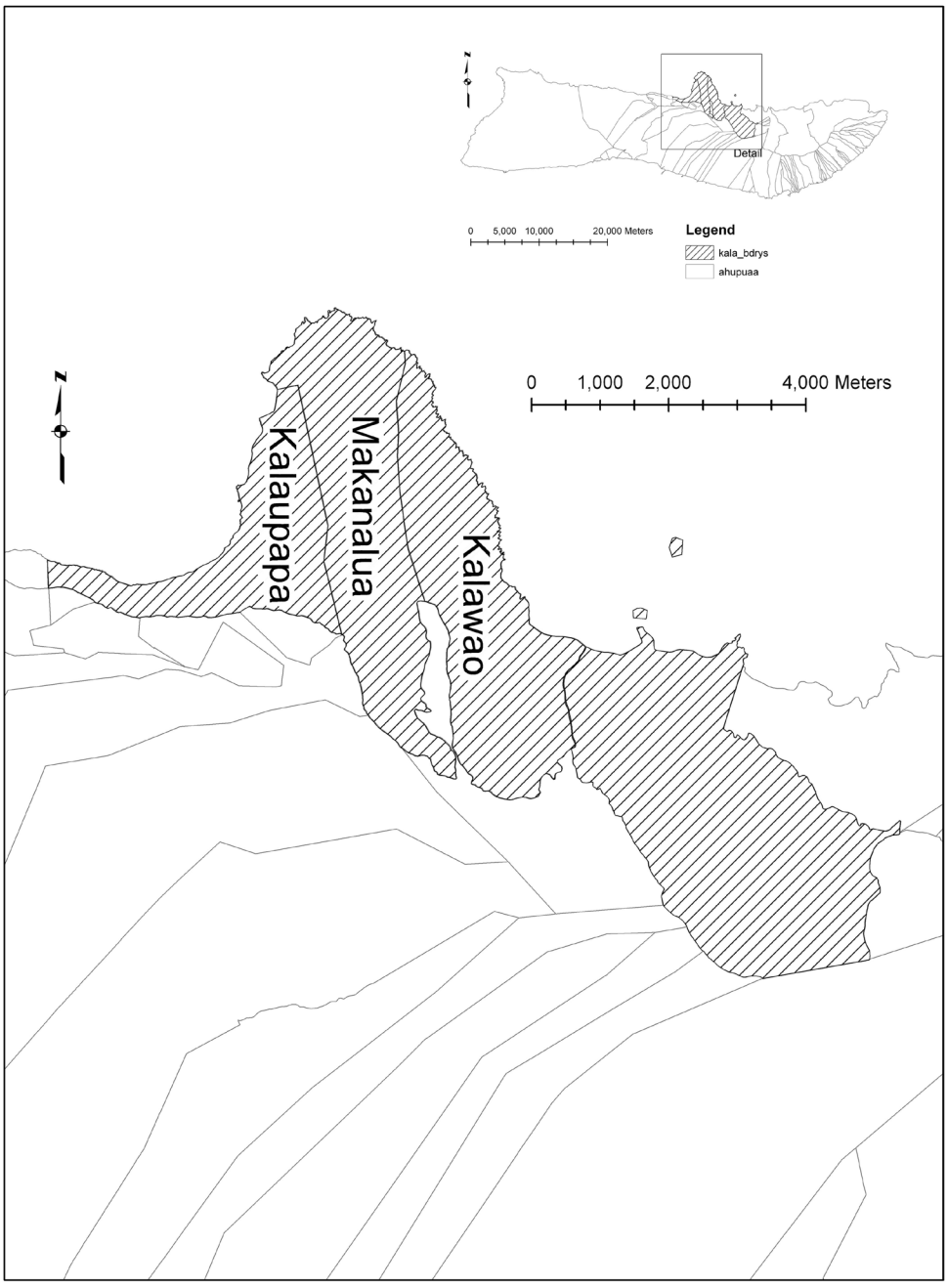

Figure 1. Map of Kalaupapa National Historical Park, research for this study focused on the eastern *ahupua'a* of Kalawao.

stated that people diagnosed with Hansen's disease were not to leave the settlement, although some exceptions were made – the most famous example being Peter Kaeo, a member of the royal family exiled to Kalawao but released in 1876. Other rules forbade intoxication and gambling, required the maintenance of order and cleanliness, and protected the private property of individuals. Some exiles brought *kōkua* (helpers) with them, typically able-bodied relatives expected to help with daily activities, but who were subject to similar behavioural restrictions.

Exiles were allowed to construct their own houses, and the community was allowed to determine household social organisation (Greene 1985; Mouritz 1916). The result was a dispersed settlement pattern with houses spread along a main road that ran from east to west across the peninsula. This settlement pattern was structured around a pre-existing built landscape created by the Native Hawaiians who inhabited Kalawao prior to the passage of the 1865 Act. Multiscalar archaeological patterns suggest social organisation was closer to that of a Hawaiian village than a total institution (Flexner 2010).

Food was a major concern for the Kalawao settlement (Greene 1985: 59, 77, 84, 144). Initially, the Board of Health had believed that self-sufficiency was possible,

with patients growing their own crops and raising livestock. When it became apparent that this would not work, a rationing system was established, supplemented by individual gardening (Greene 1985: 50–55, 61). *Kōkua* were not entitled to rations under this system, being able bodied and expected to provide for themselves. Weekly rations in the 1870s consisted of five pounds of meat (mutton or beef) and 21 pounds of *pa'i ai* (a hard taro paste), though these often did not reach the settlement because of the difficulty of landing ships at Kalawao (Greene 1985: 58, 61; Korn, ed. 1976).

Written accounts report periodic food shortages, especially of the Hawaiian staple *poi*, a greyish-purple paste made of cooked taro (*Colocasia esculenta*). Occasionally these shortages resulted in deaths in the settlement, and were a source of discomfort for Native Hawaiian exiles, as with 'One Kealohi [who] had been liveing [*sic*] on Rice and Salmon for two Weeks until he could not eat any more of it, as it bound him' (Korn, ed. 1976: 153). Rice, which was not part of traditional Hawaiian cuisine, was seen as a starvation food, unlike *poi* which was seen as much more nutritious and preferable (De Veuster 1889; Greene 1985; Korn, ed. 1976). Sources of protein do not appear to have been as marked in terms of desirability as starchy staples and archaeological research shows that foods derived from faunal resources exploited both native and introduced organisms.

Evidence for Animals in the Kalawao Landscape

Archaeological evidence, written documents, and the presence of feral populations on Kalaupapa peninsula today, are sources of information on the mammalian species and marine fauna that would have been important in people's everyday lives in the leprosarium (Table 1). In addition to the faunal remains themselves, architectural features and other surface features indicate some of the ways that the population engaged with the animal species in their cultural landscape.

In many parts of the world, introduced large mammals were an important part of the process of ecological imperialism – the dispersal of European flora and fauna throughout global landscapes (Crosby 1986; see Kirch 1992: 168–170 for a Hawaiian perspective). On a smaller scale, people experienced changes in animal communities via the foods they ate, clothing, and the pests with which they had to deal. People living in the Hansen's disease settlement of Kalawao experienced ecological imperialism in a distinctive context. From the perspective of the Board of Health, cattle (*Bos taurus*) had a privileged place among domesticates as a source of milk and beef, while horses (*Equus caballus*) were critical for transportation and communication in the exile community. The establishment of a permanent cattle herd was a prominent issue in Board of Health reports, and eventually a purpose-built slaughterhouse was constructed to replace a slaughter pen seen as insufficient for the settlement's needs. This served as a place for butchering and distributing beef to the exiles from 1890 onwards. Foreign livestock in Kalawao were introduced for nutritional and social reasons, rather than capitalistic ones as elsewhere in the islands (Greene 1985: 144, 182, 184, 195).

Table 1. *Sample of contemporary and historically known faunal species in Kalaupapa. 'H' indicates species known from written documents, 'A' indicates species represented archaeologically, and 'P' indicates species present on Kalaupapa Peninsula today (these species are marked with an asterisk as it is unclear what role, if any, they may have played historically).*

Terrestrial Mammals

Common Name	Hawaiian Name	Linnaean Classification	Source
Pig	pua'a	*Sus scrofa*	H/A/P
Cow	n/a	*Bos taurus*	H/A
Horse	n/a	*Equus caballus*	H/A
Mule	n/a	*E. caballus x E. asinus*	H/P
Donkey	n/a	*Equus africanus asinus*	H
Goat*	n/a	*Capra hircus*	P
Axis Deer*	n/a	*Axis axis*	P
Mongoose*	n/a	*Herpestes javanicus*	P
Rat*	iole	*Rattus* spp.	P
Dog*	n/a	*Canis familiaris*	P
Cat*	n/a	*Felis cattus*	P
Rabbit	n/a	unid. *Lagomorph;* prob. *Oryctolagus cuniculus*	A

Marine Fauna

Common Name	Hawaiian Name	Linnaean Classification	Source
Limpet	opihi	*Cellana* spp.	A/P
Parrotfish	uhu	*Scaridae*	A/P
See Hawaiian	pipipi	*Nerita picea*	A/P
See Hawaiian	hihiwai	*Neritina granosa*	A/P
Monk Seal*	ilio holo I ka uaua	*Monachus schauinslandi*	P

Surface Features

An archaeological survey of the core area of the Hansen's disease settlement at Kalawao documented a variety of surface features related to the spatial organisation and everyday life of the community (Flexner 2010: 90–152). The majority of features were constructed after European contact but before the arrival of the first exiles in Kalawao, and this guided the later settlement pattern of the leprosarium (Figure 2). There were, however, ongoing modifications of the built landscape until Kalawao was abandoned

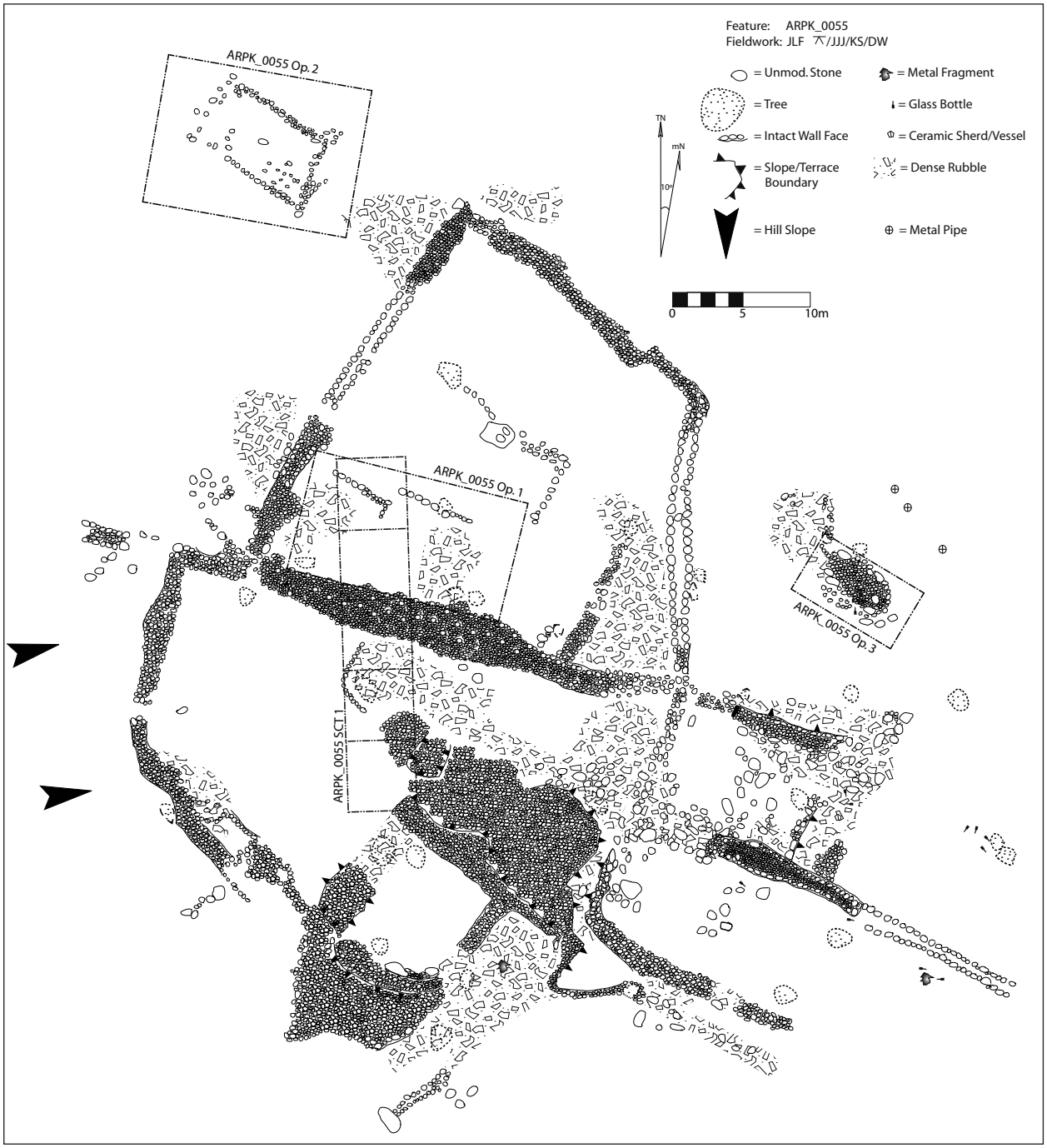

Figure 2. Map of ARPK_0055, a site complex in Kalawao with components constructed prior to 1866, but with evidence for habitation by people living in the leprosarium. See Figure 4 for a detail view of ARPK_0055 Op. 2 (upper left corner).

at the end of the 19th century. Many wall features can be interpreted in terms of the 'architectonic transformations' outlined by Kirch (1992: 175), particularly the construction of 'exclosure' walls to keep cattle away from crops – a continuing concern for members of the community who supplemented their rations through gardening.

Surface midden was present on 28 of 63 archaeological features recorded during survey, and systematic surface collections were carried out recovering a variety of faunal materials (Table 2). Mammal remains included pig (*Sus scrofa*), axis deer (*Axis axis*) and cattle (*Bos taurus*). The pig and deer remains are probably modern specimens, although these species were present in Kalawao during the 19th century and wild pigs were hunted (Greene 1985: 76). The axis deer, a gift from the Hawaiian Consul in Hong Kong to King Kamehameha V, were released onto Kalau-

Table 2. *Counts (NISP) of surface collected faunal remains. Asterisks indicate tentative identifications.*

Row Labels	*Axis axis*	*Axis axis**	*Bos taurus*	*Bos taurus**	*Cellana* sp.	*Cypraeidae*	*Sus scrofa*	unid. Bone	unid. Coral	unid. Shell	Grand Total
'Downtown' Kalawao			2					19	13	14	**48**
Bakery Area								1	1	1	**3**
Baldwin Home						1					**1**
Cistern Area			9		1						**10**
Cistern Area North	1	1	13			2	1		20	4	**42**
Cistern Area South		1	1								**2**
Hospital							1		1	3	**5**
Kalawao Bakery Area									9	3	**12**
South of Road	8	2	1	2		1		3			**17**
Store Area		1	3		55	2		15	1	2	**79**
Grand Total	**9**	**5**	**29**	**2**	**56**	**6**	**2**	**38**	**45**	**27**	**219**

papa peninsula in 1867 and their population expanded rapidly because they were protected (Greene 1985: 36). Poaching is a possibility, though there is no direct archaeological evidence for this. The cattle bones include modified specimens, with evidence for the use of metal saws during the butchery process represented by parallel striations on the flat surface of sawed bone. These are probably from animals butchered at the settlement's slaughterhouse and then distributed to different households in the leprosarium.

In addition to mammal bone, there is evidence for the use of marine resources in the settlement. A number of shells were recovered in surface collections or observed in uncollected surface middens, including *'opihi* (limpets, *Cellana* spp.), *pipipi* (a marine shellfish, *Nerita picea*), cowrie (*Cypraea* spp.), and *hihiwai* (a freshwater shellfish, *Neritina granosa*), all of which are edible species well known to Hawaiians. A midden deposit under a stone enclosure wall dating to the Hansen's disease period contained late-19th century ceramics and glass artefacts, as well as '*opihi* shell and grinding plates from *uhu* (parrotfish, family Scaridae).

Finally, features documented close to the main road in the old settlement may relate to the use of horses (*Equus caballus*) in the settlement. Documentary evidence suggests that attempts to establish a herd of cattle in Kalawao were complicated by inmate reliance on horses for transport. Eventually the Board of Health passed a ban on bringing additional horses into the settlement in order to mitigate grazing competition with cattle (Greene 1985: 182). Mobility was clearly important to the people living in Kalawao, and evidence of this is provided in the presence of a concrete trough along the road, as well as a stone and concrete ramp that may have assisted individuals with limited mobility resulting from their infection in mounting and dismounting from horses (Figure 3). Despite a problem with food shortages, exiles in Kalawao focused resources on the ability to travel through the settlement landscape.

Excavated Faunal Remains

Following from surface investigations, a program of limited test excavations was carried out to study material culture in stratigraphic contexts related to the Hansen's disease period in Kalawao (Flexner 2010: 153–196). Among the materials recovered were faunal bone, tooth, and shell specimens. A detailed zooarchaeological analysis of these materials was carried out in order to document patterns that may not have been apparent in surface assemblages. Analytical methods followed the general principles of standard zooarchaeology manuals (Reitz and Wing 2008). Element and taxonomic identifications were made using illustrations in Brown and Gustafson (1979) and from comparative specimens in the University of California, Berkeley Museum of Vertebrate Zoology (MVZ #114370). Tooth wear analysis followed Hillson (1986) and Grant (1982). Shell and coral materials were counted and weighed only, while mammal remains underwent more detailed study. Bones and teeth were size sorted into categories using a geometric progression (O'Connor 2000: 43), then counted and weighed. Following this, identification of element, species, and recording of other relevant attributes was undertaken.

A total of 594 individual specimens, weighing a total of 951.1 g were analysed. The level of fragmentation in the assemblage limited identification of specimens. Size class analysis reveals that 72% of bone fragments (293 of 408) fell into category 1 and 2 (i.e. less than 2 cm). Teeth had a more even distribution, and generally larger fragments, with 71% of teeth (36 of 51) belonging to category 2 and 3 (i.e. between 1 and 4 cm). This is most likely a reflection of the greater durability of teeth compared to bones. For

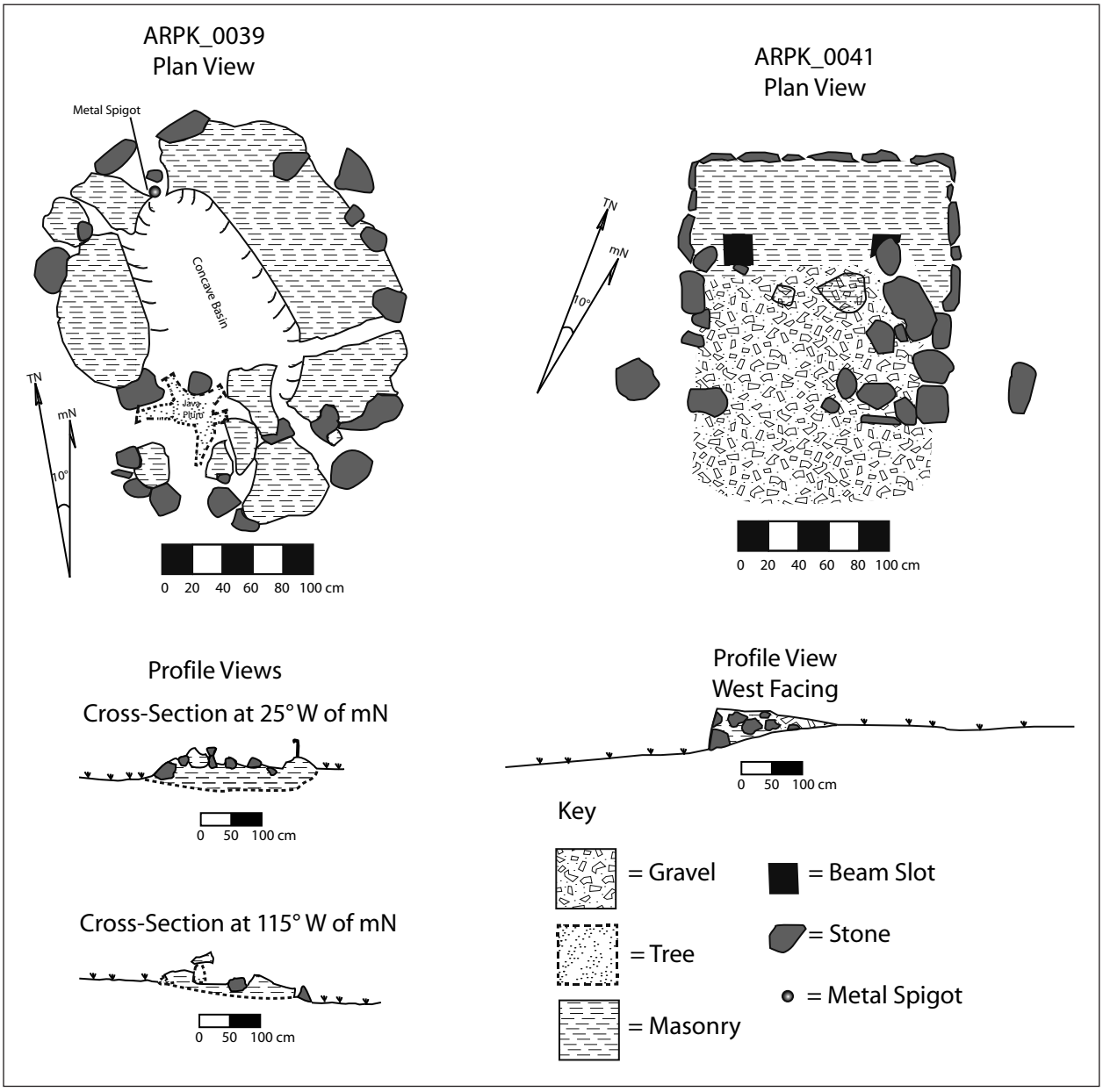

Figure 3. Architectural features probably related to horse transport in Kalawao (Left: a concrete trough for watering horses; Right: a ramp to aid in mounting and dismounting).

bones, 89% of specimens were unidentified (363 of 408) while for teeth the rate of identification was slightly better, with just 51% of specimens remaining unidentified (26 of 51). The identified specimens tended to be among the largest specimens in the assemblage, thus the 5 identified bone specimens from *Bos taurus* have a combined weight greater than the 363 unidentified specimens (Table 3).

In addition to cattle, tentative identifications were made of *Sus scrofa*, and an unidentified rabbit, most likely *Oryctolagus cuniculus*, an invasive species common to the Hawaiian Islands (Flux and Fullagar 1992). The rabbit specimens came from a context with loose, dark soil described during excavation as disturbed by root action and possibly animal burrowing. The presence of rabbit is notable as the species is unknown from written documents and no feral populations exist on Kalaupapa today. It is possible that rabbits were kept by a specific exile as a food source or as pets, but more evidence would be needed to elaborate on this. The elements identified with certainty are all from *Bos taurus* and consist of a right astragalus, a distal end fragment of a left tibia, two shaft fragments from a right metatarsal, and an anterior shaft fragment of a left metatarsal. These specimens were collected from a 1 m × 8 m trench excavated in a domestic structure (ARPK_0055 Op. 2; Figure 4) from late in the Kalawao occupation sequence, as indicated by an 1893 coin recovered

Table 3. *Counts (NISP) and weights of identified bones and teeth from archaeological contexts. Specimens identified tentatively, usually because of the fragmentary nature of the specimen, are marked with an asterisk. Note the great weight of the identified bone specimens from* Bos*, compared with the weight of unidentified specimens.*

Bones

Genus	Data	
Bos	Sum – Count	5.0
	Sum – Weight (g)	286.8
*Bos**	Sum – Count	21.0
	Sum – Weight (g)	130.1
unid.	Sum – Count	363.0
	Sum – Weight (g)	273.4
unid. *Lagomorph*	Sum – Count	19.0
	Sum – Weight (g)	2.1
Total Sum – Count		**408.0**
Total Sum – Weight (g)		**692.4**

Teeth

Genus	Data	
Bos	Sum – Count	15.0
	Sum – Weight (g)	179.4
*Bos**	Sum – Count	8.0
	Sum – Weight (g)	43.6
*Sus**	Sum – Count	2.0
	Sum – Weight (g)	0.2
unid.	Sum – Count	26.0
	Sum – Weight (g)	14.1
Total Sum – Count		**51.0**
Total Sum – Weight (g)		**237.3**

from associated deposits. All bones were recovered from what is interpreted as a pebble-paved occupation layer that has since been obscured by post-depositional processes, primarily root action.

The identified teeth also all came from excavated contexts in ARPK_0055 Op. 2. Almost all of the specimens were from *Bos taurus*, with the exception of two fragments identified as possible incisors from *Sus scrofa*, though these were incomplete fragments of enamel, and the identification was only made because the specimens had a suggestive shape. While it is possible that the identified bones all came from one individual, the *Bos taurus* teeth appear to come from multiple individuals, based on the variable sizes of molar specimens, the presence of deciduous and permanent teeth, and, most clearly, the presence of three cranial p4 specimens. While a formal analysis of tooth wear for the purpose of ageing the specimens was not possible with the small assemblage and limited comparative specimens, most teeth appeared to fit class a–c (no significant wear to very little wear) from a typical tooth-wear chart (Grant 1982: 92), indicating fairly young individuals.

The identified elements, which include the lower parts of the hind legs and loose teeth, provide an unclear pattern. It is possible that the loose teeth represent intensive butchering of elements from the head, possibly to access edible portions such as the brain and tongue, though identifiable fragments of mandible or cranium showing evidence for butchery would be necessary to verify this. The lower leg bones may represent the distribution of butchered cuts of meat throughout the settlement from the historically known slaughterhouse (Greene 1985: 163). The two shaft fragments of the right metatarsal appear to result from splitting the long bone to extract the marrow, as does the distal tibia fragment. The areas where identifiable mammal remains were recovered were part of a larger site complex (Figure 2). It is possible that these faunal materials are associated with a group of households that shared resources, as there is also nearby evidence for taro cultivation. Additional excavations at these structures could shed further light on these potential patterns, especially if this structure, located off to the side of the main site complex at ARPK_0055 served as a cook house. Further testing from other areas in the settlement, especially domestic contexts, may also help to clarify patterns of meat distribution from the settlement slaughterhouse.

While no taxonomically identified elements were recovered from excavations elsewhere in the research area, other diagnostic phenomena were recorded in the assemblage. Several possible butchery marks were recorded, as were bones that showed evidence of cooking practices. For the bone assemblage, attributes relevant to age, cooking or butchering were recorded in 12.75% (52 of 408) of specimens. One specimen, probably a long bone from *Bos taurus*, had a small scrape mark, probably from the use of a tool to remove flesh from the bone. Three specimens showed evidence of breaking the long bone shaft to access the marrow, as noted above. Two specimens showed evidence for unfused epiphyseal growth, though these elements were not identified. If these specimens are from *Bos taurus* it follows the pattern revealed by the teeth from ARPK_0055 Op. 2 that suggests the slaughter and butchery of younger individuals.

Specimens with attributes relevant to cooking practices showed evidence of charring, evidence of pot polish, in which bones were calcined to a grey or white colour, or some combination of those. Heat to which bone was exposed can be related to colour and other changes in bone structure, from black and relatively undistorted (lower heat) to white and highly distorted (highest heat), though the process is 'imperfectly understood' (O'Connor 2000: 45). Of the bones showing some evidence of burning in the form of charring or pot polish, 76.3%(29 of 38) came from ARPK_0001 Op. 1, a house site with a large stone masonry chimney where large amounts of burned glass and other burned materials were recovered. The remain-

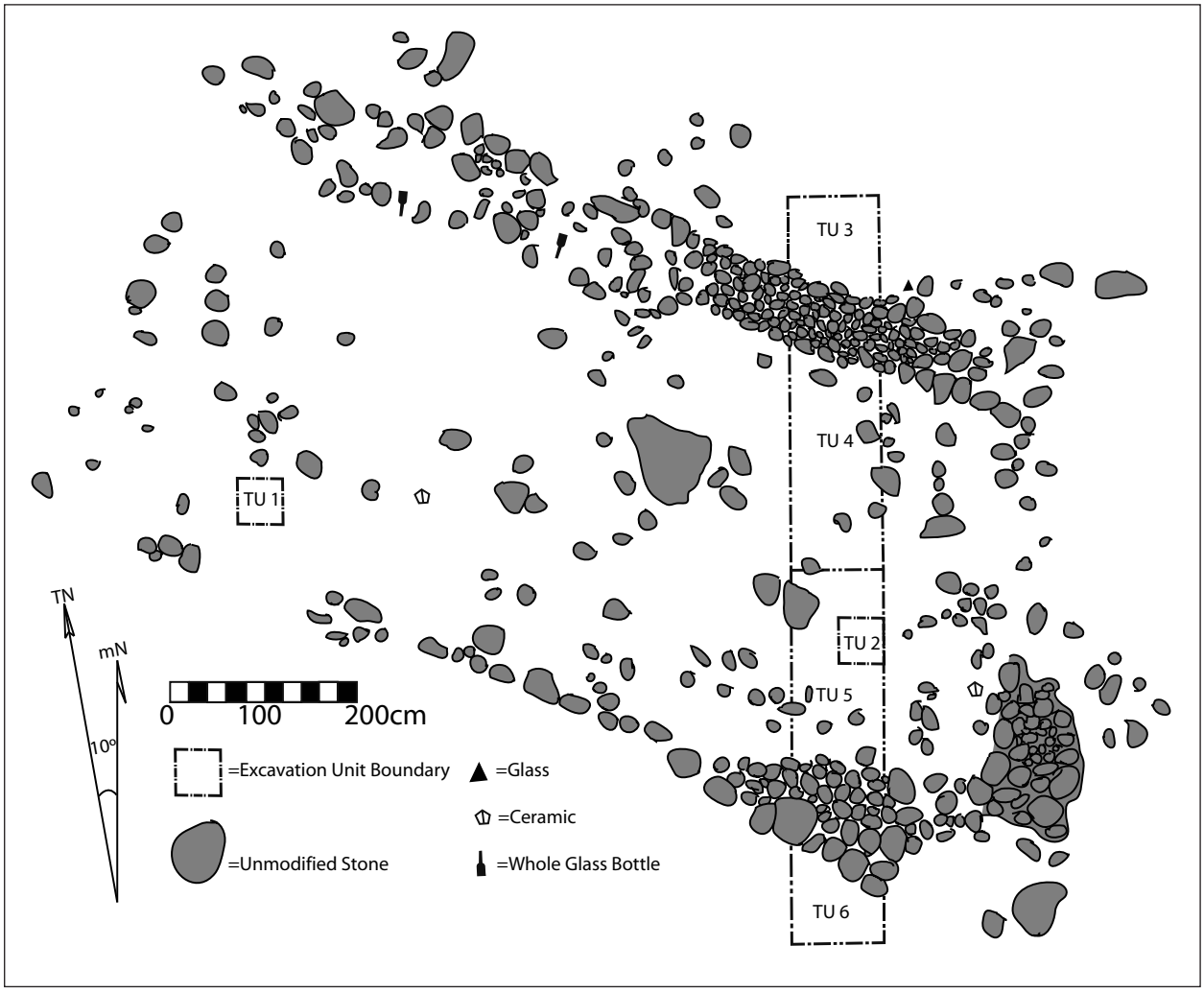

Figure 4. Plan map of the domestic structure ARPK_0055 Op. 2. Most of the identified faunal bones came from the 1 × 8 m trench on the right.

ing charred or calcified bones were equally split between ARPK_0055 Op. 1 (N=5) and ARPK_0055 Op. 2 (N=4).

Burned bones likely indicate that meat cuts sometimes reached a very high temperature during cooking, resulting in charring and sometimes calcining of the bones. While further testing would help to confirm the pattern, it appears that refuse at ARPK_0001 Op. 1 was burned in the fireplace and then discarded. The presence of pot polish suggests that at least some of the modification of bone resulted from the cooking process. In addition to refuse disposal practices involving burning, this pattern may be related to the use of metal pots, which could reach very high temperatures when placed directly on a cooking fire. The small size of many burned bone fragments may reflect a Hawaiian culinary preference for stews as accompaniments for the staple *poi*. Archaeologically, this has been shown in a prominence of bowl forms in ceramic assemblages (Kirch 1992:182), as is also seen at Kalawao (Flexner 2010:206).

CONCLUSIONS

The faunal remains from the Hansen's disease settlement at Kalawao can be linked to modern institutional provisioning as well as continuity in Hawaiian foraging practices. Archaeological remains show that shellfish continued to be an important part of the Hawaiian diet in Kalawao, collected by exiles and/or *kōkua* to supplement the sometimes unreliable rations and perhaps to provide a familiar comforting meal. Metal pots were incorporated into cooking practices as evidenced by the charring and calcining of some bones. The widespread adoption of horses for transport and communication in the settlement was an important social choice, especially as the effects of Hansen's disease on the body can limit people's ability to walk.

Cattle appear to have been the primary source of terrestrial animal protein in Kalawao, distributed through the Board of Health's weekly provisioning system. This contrasts with evidence from earlier in the 19th century

in the Anahulu Valley on O'ahu, where archaeological evidence for cattle consumption is extremely rare in Hawaiian house sites, despite documentary evidence for cattle presence throughout the valley (Kirch 1992: 170). It would be useful to see evidence from other, later 19th century sites in Hawaii to understand whether the shift to increasing use of cattle in Hawaiian cuisine is simply related to change over time, or if Kalawao is still somewhat unique in this regard. Mills' (2007) recent work on Hawaiian *paniolo* ('cowboys') reflects the increasing importance of *Bos taurus* to the Hawaiian economy, but what was the role of this species in the local diet away from the ranches?

Overall, zooarchaeological patterns from Kalawao suggest that Hawaiian practices continued to be an important aspect of people's engagement with animal communities, while changes wrought by historical processes in Hawaii, of which the establishment of the leprosarium was one, also altered people's diets and modes of transportation. Additional research on Polynesian total institutions and other colonial sites in Oceania could provide a wider comparative context for zooarchaeological research on assemblages such as the one from Kalawao. At the Te Puna Mission Station in New Zealand, Middleton (2008: 196–197) notes raising of cattle and rabbits by the missionary family, with pigs likely being traded with local Maori. Allen's (1973: 54) work on Port Essington in Northern Australia, in contrast, showed that livestock was almost exclusively brought in to the settlement from elsewhere in Australia, with local aborigines occasionally supplying marine fauna. Future zooarchaeological work on post-contact sites, especially those related to longer-term colonial entanglements, should help to clarify the role of introduced animals in multicultural and indigenous Pacific Island contexts, including situations where institutional power structures played a role in food distribution.

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