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– ARTICLE –

Functional Classification of Hawaiian Curved-Edge Adzes and Gouges

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ABSTRACT

As part of a project to describe and classify functionally more than 800 Hawaiian stone adzes held in the ethnographic and archaeological collections at Bishop Museum in Honolulu, 24 tools with curved edges were identified and described. The curved-edge tools include adzes and gouges, which can be unambiguously distinguished from one another using a combination of weight and length index. Many of the curved-edge adzes have large cutting edge width ratios; the narrow shoulders and wide edges led archaeologists to describe them as 'hoofed'. Curved-edge adzes and gouges make up less than the 3 percent of the Hawaiian collection. Their rarity in Hawai'i appears to be in line with other island groups in East Polynesia outside New Zealand, where they make up about 10 percent of museum collections.

Keywords: Hawai'i, adze, gouge, classification

INTRODUCTION

As part of a project to describe and classify functionally more than 800 Hawaiian stone adzes held in the ethnographic and archaeological collections at Bishop Museum in Honolulu, this paper identifies and describes 24 tools with curved edges. The project has several interrelated goals, among them: i) develop an alternative to a current practice of Hawaiian archaeology that identifies and distinguishes adzes by their transverse sections; ii) enhance analytic replicability by defining true classes distinguished by their boundaries, rather than groups distinguished by central tendencies; iii) complement the progress made in identifying adze making habits through the study of reduction sequences and replication experiments with a more complete description of the variability inherent in the finished product; and iv) develop a descriptive focus on function rather than culture history.

When Hawaiian adzes are grouped according to the Duff categories (Duff 1959), the uniformity of their quadrangular transverse sections stands out in comparison to adzes from other Polynesian island groups, where oval, lenticular, plano-convex, trapezoidal, sub-triangular, and triangular transverse sections are commonly found (Emory 1968). This is a desirable quality in regional comparison, but within Hawai'i the importance of transverse section in the Duff categories and the striking predominance of quadrangular sections work in tandem to lump the adzes together, rather than distinguishing them in ways that might be analytically useful.

The high level of skill needed to manufacture a stone adze, and the typical Hawaiian quadrangular-section adze in particular, led archaeologists to study the reduction sequence practiced by the adze maker from the evidence of waste materials at quarry sites and by carrying out replication experiments (Cleghorn 1984). This line of inquiry has made impressive progress. Based on a study of manufacturing waste from three quarries on the northwest end of Moloka'i Island, a detailed description of the reduction sequence documents the order in which characteristic adze features – bidirectional edges required for the quadrangular cross section, bevel, poll, and tang – were crafted by the adze maker (Clarkson *et al.* 2014). Replication experiments prove that the quadrangular-section Hawaiian adze can be made with 'direct hard and soft stone hammer percussion' (Clarkson *et al.* 2015:73) in a sequence of flaking determined by the form of the raw material, either a cobble, a flake, or a piece of tabular stone. The habits developed by expert Hawaiian adze makers can now be appreciated in broad outline, although the finesse with which they often worked has so far escaped replication (Clarkson *et al.* 2015:71).

In contrast, the last attempt at a comprehensive description of Hawaiian adzes was completed more than a century ago (Brigham 1902). The canonical description of Hawaiian material culture does not include adzes, presumably because the author died before work with the adzes was complete (Buck 1957). Other work with the adze collections at Bishop Museum focuses on the transverse section

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and presents results statistically, rather than descriptively (Duff 1959; Emory 1968).

The design of the project reported here is based on the results of carving experiments with Māori adzes in New Zealand that identified functional differences among the Duff categories commonly used by Pacific archaeologists (Turner 2000, 2005; Turner and Bonica 1994). Because culture history requires artifact classes based on stylistic, rather than functional, attributes (Dunnell 1978), the limits of the culture historical project envisioned by Duff and by subsequent archaeologists who have described and grouped Polynesian adzes with reference to the Duff categories were exposed. Nevertheless, recognition of these limits to the culture history project should not obscure the fact that the Duff categories do tend to group like with like and that archaeologists continue to 'recognise some practical strengths in the system' (Shipton *et al*. 2016:361). Archaeologists today increasingly regard the Duff categories as groups that represent one step along a path to classifications (Dunnell 1971, 1986) that might be used to structure inquiries into topics such as the technology of adze manufacture (e.g., Shipton *et al*. 2016) or the history of regional interaction spheres based on geochemical sourcing programs (e.g., Richards 2019).

This paper is the second in a series designed to describe the formal variability of complete Hawaiian adzes in the ethnographic and archaeological collections of Bishop Museum and to classify them according to function. The first paper in the series identified 11 Hawaiian stone axes that resemble the Māori adzes grouped by Duff as Type 5 (Kahn and Dye 2015). The axes are designed to be 'laterally-hafted excavation tools for working in confined spaces' (Turner 2005:87). Kahn and Dye (2015) identify the double bevel as the characteristic that distinguishes them from the more common single-bevel tools and leads to their classification as axes. These tools are rare wherever they are found; they account for about 2 percent of the New Zealand assemblage (Turner 2005:87) and about 1 percent – reported incorrectly as about 0.1 percent (Kahn and Dye 2015:22) – in the Hawai'i assemblage.

Identification of a curved edge as a distinguishing characteristic of the class extends the focus on the working edge of the tool, whose functional importance was identified and experimentally demonstrated some time ago (Best 1977). The larger members of the curved edge adze class resemble Māori adzes grouped by Duff as Type 3, whose distinctive characteristics have been described as exhibiting 'frontal convexity and a scooped curved blade' (Turner 2005:85). The larger curved-edge adzes were 'designed for shaping curved surfaces such as those found on canoe hulls and bowls' (Turner 2005:85). The smaller tools resemble Māori tools grouped as Type 6, which includes typically small, slender tools often identified as chisels or gouges. These tools were designed to carry out 'a wide range of generally detailed intricate tasks' (Turner 2005:89), such as making lashing holes in canoe hulls. Thus, classification of Hawaiian adzes by edge shape crosscuts the distinction often made between adzes and gouges.

In the following sections, the Hawaiian curved-edge adzes are described, their representation in Hawai'i is compared to similar tools found elsewhere in Polynesia, and their attributes are compared to the Hawaiian straight-edged adzes, whose description and classification will be the subject of the projected third paper in this series.

CURVED-EDGE ADZE DESCRIPTIONS

The cutting edge of an adze can be curved in one or both of two ways, which have been called curve A and curve B (Blackwood 1950). Edges with curve A look curved when the tool is viewed in longitudinal plan, while those with curve B look curved when the tool is viewed from the distal end (fig.1). Edges with curve A are relatively common among Hawaiian adzes, typically because the edge of the tool curves back at one or both sides. An edge with curve A might be due to tool design or to the practice of resharpening adzes whose once straight edges were damaged at one or both ends. Edges with curve B are rarer than those with curve A, nevertheless, edges with curve B were almost certainly created by design, rather than from use modification. The 24 Hawaiian adzes that exhibit a curve B edge are referred to here as curved-edge adzes. Although adzes with a curve B edge frequently also exhibit curve A, the presence or absence of curve A is not a classification criterion.

The adzes described here are identified as Hawaiian in Bishop Museum records, which often rely on information from donors that cannot be verified. The tools are identified by their museum labels, which in most cases are written in India ink directly on the tool. In some cases, a paper label is affixed to the tool. Some tools exhibit multiple labels, often with different identifiers; in these cases it is usually possible to identify the most recent label, which

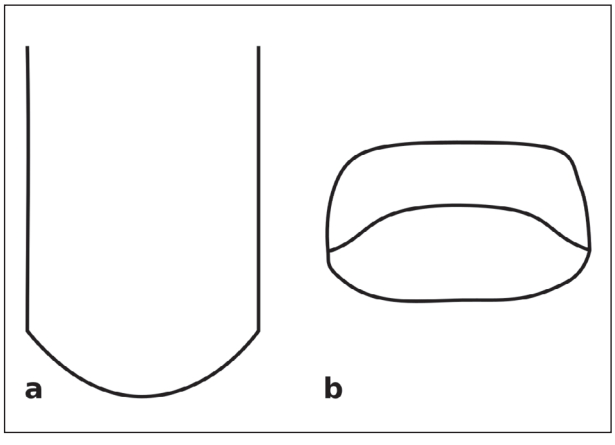

Figure 1. Adze cutting edge curves: a, curve A viewed in longitudinal plan; b, curve B viewed from the distal end with the adze front superior.

is the one used to identify the tool. The identifiers on the adze labels vary in their format; those reported here have been normalized to reflect the convention followed in the digital catalog at Bishop Museum, but the task of joining the table of adze data used in this analysis with the digital catalog is not complete. Nevertheless, museum staff recognize this variability and are able to retrieve adzes with the identifiers as reported.

Five of the 24 Hawaiian adzes are described and illustrated below. The other 19 curved-edge adzes are described in the Supplementary Material (Kahn and Dye 2020). An unusual curved-edge adze, 1986.602, has been fully described and sourced to a quarry on the south coast of Moloka'i Island (Sinton and Sinoto 2015). This the longest Hawaiian adze at Bishop Museum.

In the following descriptions, terms for the parts of an adze follow Buck *et al.* (1930), with the exception that the edge is sometimes referred to as the cutting edge for clarity. Terms for orientation follow the conventions established by Garanger (1972).

Curved-edge Adze, B.01799

This hoof-shaped adze with a plano-convex transverse section has a reduced, triangular-section butt that shows traces of light polishing, but whose surface is primarily flake scars (fig. 2a). The poll is irregular and in plan does not form a right angle with the longitudinal section. The color of the rock is gray (N5/) and the tool has a reddish yellow (7.5 YR 6/6) patina common on artifacts found on the surface where there is red soil. The blade is fully polished on the front and the back. The edge is curved in both A and B sections, consistent with its classification as hoof-shaped. It is 10.4 cm long, 2.75 × 2.4 cm at mid-section, and weighs 167 g. The cutting edge measures 5.4 cm.

Curved-edge Adze, 11018

This untanged, plano-convex section, very dark gray adze appears to have been re-worked extensively to narrow the butt (fig. 2b). The front and sides of the blade and the bevel are polished, but the rest of the back and the butt are covered with flake scars with small remnant patches of polish

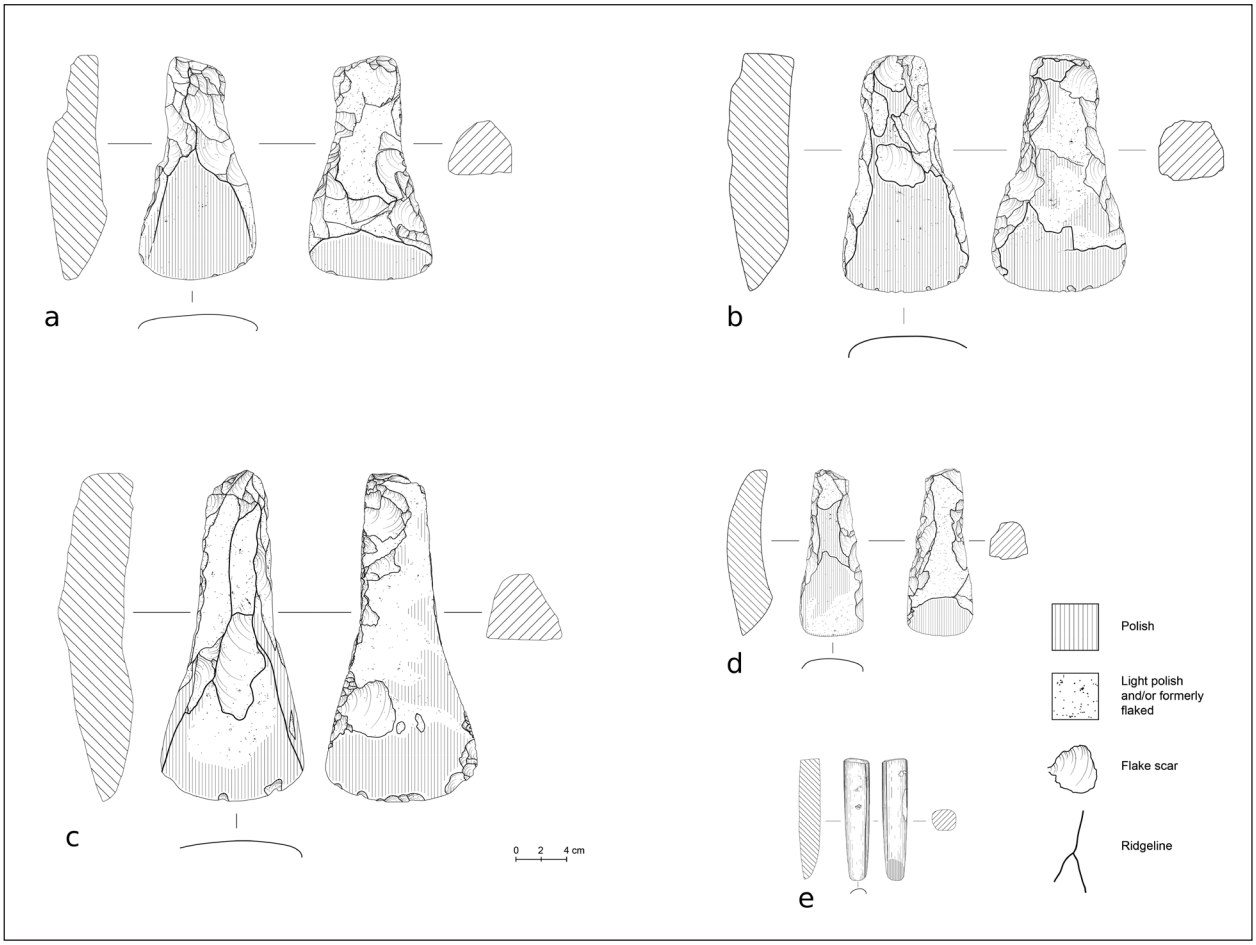

Figure 2. Curved-edge adzes and gouge: a, curved-edge adze, B.01799; b, curved-edge adze, 11018; c, curved-edge adze, 1970.010.020; d, curved-edge adze, C.08290; e, gouge, 70.286.21.

in between scars. The poll is flat but not polished. The tool is widest at the edge and narrows markedly toward the poll. It is 11.4 cm long, 3.65 × 2.5 cm at mid-section, and weighs 258 g. The cutting edge measures 6.6 cm.

Curved-edge Adze, 1970.010.020

This tanged, triangular section, dark gray adze is polished on the front, back, and sides of the blade (fig. 2c). The surface of the butt has not been polished. The poll is squared off. Shallow flakes have been removed from the front, sides, and back of the blade, probably through use. Four small flake scars originate at the edge. The edge is the widest part of the tool. It is 23.3 cm long, 3.55 × 4.5 cm at mid-section, and weighs 1274 g. The cutting edge measures 11.1 cm.

Curved-edge Adze, C.08290

This untanged, plano-convex section, dark grayish brown adze is polished on most of the front, on the sides near the edge, and on the bevel (fig. 2d). Flakes have been taken off both sides to narrow the butt. The front is reduced near the poll, which is small and irregular. Both the front and back of this tool are curved. It is 8.6 cm long, 2.95 × 2.6 cm at mid-section, and weighs 64 g. The cutting edge measures 3.2 cm.

Gouge, 70.286.21

This untanged, irregularly hexagonal section, dark grayish brown adze is polished all over, including the poll (fig. 2e). It has the slender shape of a gouge. There are two small flake scars on one side and one on the poll. The bevel is convex. There is a dark deposit from an old museum label on the front near the poll. It is 8.7 cm long, 1.35 × 1.5 cm at mid-section, and weighs 49 g. The cutting edge measures 1.1 cm.

DISCUSSION

The project goal to devise a classification of Hawaiian adzes that illuminates their function in old Hawai'i requires consideration of the concept of function, which carries a variety of meanings and connotations. It is important to note at the outset that a function is assigned to an adze and is not something that the adze has independent of the assignment. Another way to say this is that adze function is relative to the observer (Searle 2007: 8–9). One implication of this is that the function assigned to an adze by the persons who made and used it, who have long since passed away, cannot now be known. Instead, the archaeologist today assigns a function to an adze based on the form and physical qualities of the tool and assumptions about the range of materials the adze might have worked. The decision to focus on the adze edge as a primary criterion in the classification reflects the degree to which edge characteristics determine the effect an adze has when it is applied with force to a piece of wood (Best 1977). The effect of a curved-edge adze when it is applied to a piece of wood can be predicted by a mechanical analysis (Cotterell and Kamminga 1990), or it can be determined experimentally (e.g., Turner 2005). In either case, it will be found that its effect is to shape a curved surface, perhaps to form a groove or cut a perforation. Having predicted and observed the effect of a curved-edge adze when it is applied to a piece of wood, it seems a short step to assign this effect to the function of the adze and to say that the function of a Hawaiian curved-edge adze is to shape a curved surface in wood. This short step assigns what Aristotle referred to as *telos*, or final cause, to the production of tools assigned to the curved adze class. Such a teleological argument appears to imply that the function predicted by mechanical analysis and determined experimentally was also assigned by the adze maker and user, which would violate the claim that adze function is relative to the observer. Fortunately, the teleological argument does not require the final cause to be a conscious goal (Hulswit 2014) that the adze maker and user assigned as a function of adzes in the curved-edge class. The claim that the function of a curved-edge adze is to shape a curved surface in wood is relative to the archaeological observer whose goal is to explain the formal variability of Hawaiian adzes in terms of the habits of the adze makers and users responsible for creating that variability. This is not to suggest that the habits of Hawaiian adze makers and users were not guided by consciously held goals. They certainly were, but the nature of the goals, how they related to habits, and how they fit into more extensive theories of being and acting in the world are not illuminated by the archaeologist's assignment of function. The best that can be done along these lines today is to note that there is some published evidence that Hawaiian adze makers and users likely distinguished the larger curved-edge adzes as *ko'i 'auwaha*; one English gloss for this term is 'scoop adze' (Holmes 1981: 27).

Another consideration in devising a classification of Hawaiian adzes that illuminates their function in old Hawai'i relates to how the tool was applied to the work. The curved-edge adzes at Bishop Museum display a wide variety of forms, ranging from the longest Hawaiian adze in Bishop Museum, 1986.602, to several diminutive tools traditionally referred to as chisels or gouges, a gouge being a variant of the general class chisel and characterized by a curved edge. Gouges and chisels are distinguished from adzes by the manner in which they are applied to the work. The artisan using a gouge or a chisel rests it against the work and applies force either manually or by striking the proximal end of the tool – either the blade itself or a handle to which the blade has been attached more or less inline – with a mallet. In contrast, an adze attached at an angle to a handle attacks the work by percussion, where the force of a glancing blow is supplied by the arm motion required to move the hafted tool in a swinging arc. These differences in

how the tool is attached to a handle and applied to the work cannot be observed by the archaeologist working with an unhafted stone tool. Nevertheless, some of the curved-edge adzes might have been used as gouges, either with or without a handle (Holmes 1981: 29). Although we know of no examples of ancient Hawaiian adzes lashed in-line to a handle, like a modern gouge, examples of small tools lashed in-line to handles are known from elsewhere in Polynesia, including a chisel lashed to an intricately carved handle from the Marquesas (Linton 1923 Plate XLVII) and two bone chisels collected by Cook in the Society Islands (Thomas *et al.* 2016: 302, 306). Archaeologists sometimes attempt to determine whether or not a tool was used with a haft by examining the poll to identify either haft polish (Turner 2005: 89) or mallet abrasions (Stokes 1930: 145), but there is no guarantee that a tool was used in just one way. In fact, a given tool might have been applied to the work in various ways, depending on circumstances. Using the distinction as a basis for classification would lead to a difficult situation where two researchers who differ in their determinations of whether a tool might have been hafted as an adze or used with a mallet lack objective critieria with which to distinguish the correct one. The Hawaiian terms for adzes do not clarify the situation or suggest that a simple distinction is involved. Tools likely used as gouges might have been called one of several names, such as *pao*, *koʻi pāhoa*, *koʻi hōʻoma*, or *koʻi kahela* (Holmes 1981; Pukui and Elbert 1986), the distinctions among which are not apparent in the literature and might have been lost. In this situation, the archaeologist must distinguish gouges from curved-edge adzes with characteristics inherent to the stone tools themselves. How can these characteristics be defined?

In practice, archaeologists typically distinguish gouges from curved-edge adzes on the basis of size and shape. Tools identified as gouges are typically small, narrow, and elongated compared to other curved-edge adzes. These characteristics can be captured using weight as a proxy for size and length index as a measure that combines information on tool width and length (fig. 3). The length index is computed by multiplying the length of the tool by 100 and dividing the result by the width of the transverse section at the shoulder (Garanger 1972: 266). A scatterplot of these measures places small tools on the left, large tools on the right, slender tools at the top, and stout tools at the bottom. Plotted in this way, the nine tools typically identified as

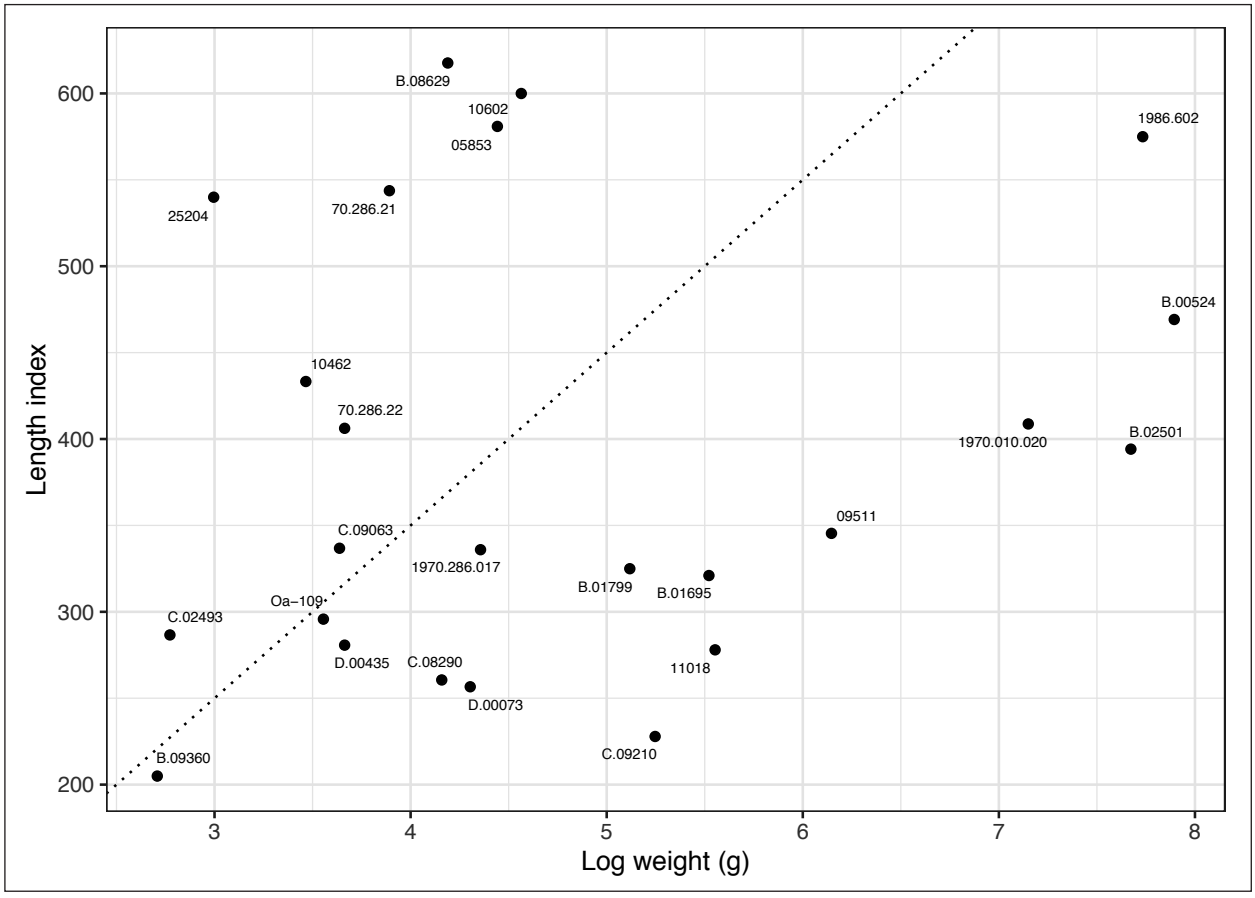

Figure 3. Classification of curved-edge adzes and gouges. The dashed line is drawn as Length index = −50 + 100 * log(weight), where weight is measured in grams. Tools that plot on or above the dashed line are gouges and those that plot below the line are curved-edge adzes.

gouges plot to the left and above the 15 curved-edge tools typically identified as adzes. As shown by the dashed line, a gouge can be distinguished from a curved-edge adze by a length index that is greater than or equal to −50 plus 100 times the natural logarithm of the weight in grams; the length index of a curved-edge adze is less than this number.

As a group, the curved-edge adzes look different than straight-edged adzes. In longitudinal plan, gouges have narrow blades that often taper to the cutting edge, and many curved-edge adzes exhibit narrow shoulders and wide edges. In contrast, the plans of straight-edge adzes are more regular, with modest differences between the width of the shoulder and the edge. This difference shows clearly in a comparison of the distributions of cutting edge width ratios for gouges, curved-edge adzes and straight-edge adzes (fig. 4). The cutting edge width ratio is designed to distinguish among tools that expand or taper toward the edge (Shipton *et al.* 2016: 369). It is defined as the width of the edge divided by the maximum width at the shoulder, where a ratio of 1 indicates a tool with parallel sides, a ratio greater than 1 indicates a blade that expands toward the edge, and a ratio less than 1 indicates a blade that tapers toward the edge. Here, the tendency of gouges to taper to the edge shows in the mode at the lower tail of the distribution for straight-edge adzes, and the tendency of the curved-edge adzes to expand to the edge skews their distribution to greater cutting edge width ratios that extend beyond the upper range of straight-edge adze cutting edge width ratios.

The class of curved-edge adzes is rarely identified in the literature on Hawaiian adzes, in large part because of a preoccupation with the shape of the transverse section and the presence or absence of a tang. The Hawaiian curved-edge adzes are sometimes considered an early form with a restricted temporal distribution, but direct evidence for this claim is equivocal. An early description of Hawaiian adzes at Bishop Museum classifies them according to whether a tang is present or absent and whether or not the edge is wider than the poll (Brigham 1902: 80). It offers no observations specific to the edge. Two small tools with curved edges are described as gouges, one of which is illustrated (Brigham 1902: 93). The gouges were found suitable for carving wooden idols, *ki'i*, because they fit 'the interior curve of the nostrils in two of the large idols in this Museum' (Brigham 1902: 92), and it was further noted that the gouges might have been used with or without a handle, one of them being too short to hold firmly in the fingers. Stokes (1930: 145) claims that gouges in Hawai'i were 'used to perforate canoe sides for cord lashings.' The authoritative description of Hawaiian arts and crafts (Buck 1957) makes only passing mention of adzes, presumably because the work was unfinished at the time of the author's death. Curved-edge adzes figure more prominently in a culture historical study of East Polynesian adze relationships, where they are identified as hoofed adzes and associated with plano-convex transverse sections (Emory 1968: 163–164). Of the 14 hoofed adzes identified at the time, one was recovered from the 'early levels' of the K3 site at Nu'alolo Kai on Kaua'i Island, leading to speculation that it was an early form whose small numbers indicate a restricted temporal distribution (Emory 1968: 164). A recent estimate places the onset of cultural deposition at the K3 site around AD 1400 (Hunt 2005: 253), several centuries after the islands were discovered by Polynesians (Athens *et al.* 2014). A review of adzes recovered from Hawaiian archaeological sites distinguished Curve A edges as a curved bevel form but did not identify Curve B edges (Cleghorn 1992: 141–142). It found that adzes with a curved bevel form are recovered from contexts that appear, on the basis of

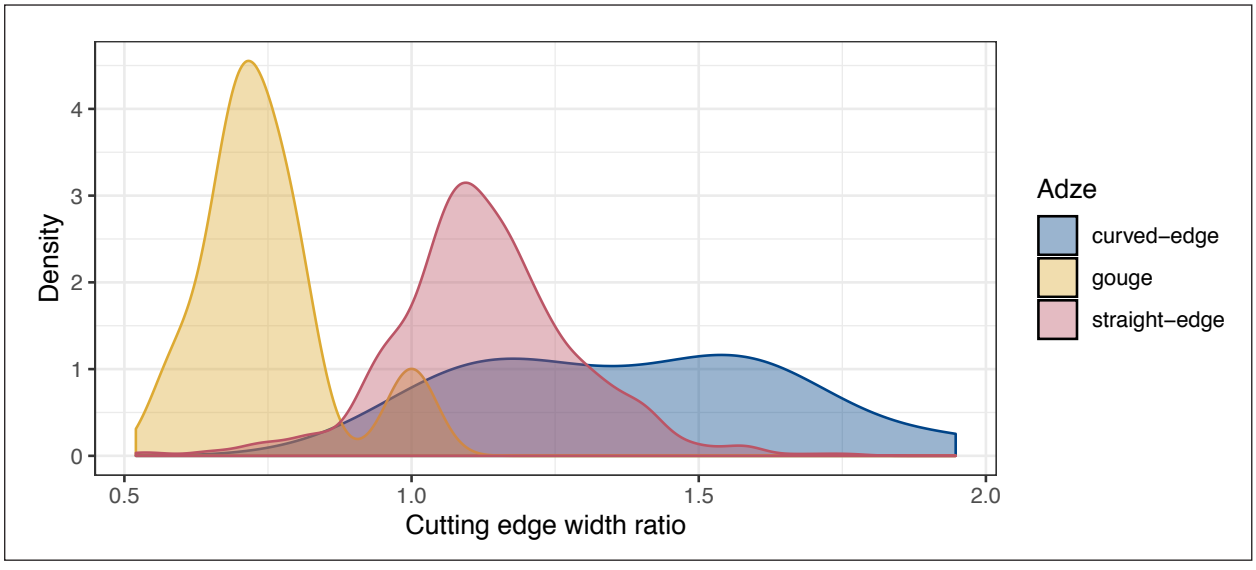

Figure 4. Distribution of cutting edge width ratios for 9 gouges, 15 curved-edge adzes, and 850 straight-edge complete adzes at Bishop Museum.

^{14}C age determinations uncontrolled for in-built age, to be relatively old. Although it might be tempting to view this finding as supporting the hypothesis that the curved-edge adze is an early form with a restricted temporal distribution in Hawai'i, subsequent experience re-dating and re-analyzing several Hawaiian archaeological sites indicates the pervasive effects of in-built age, with estimates that are often several hundred years too old (Bayman and Dye 2013:31–35). Thus, although the curved-edge adzes are demonstrably rare, making up about 3 percent of adzes identified and described at Bishop Museum, their temporal distribution is still poorly understood and it is premature to identify them as an early form.

It is difficult to compare the Hawaiian curved-edge adzes with other adze collections from Eastern Polynesia. As noted earlier, the larger Hawaiian curved-edge adzes resemble Māori adzes classified by Duff as Type 3. Nevertheless, the Duff Type 3 adzes elsewhere in Eastern Polynesia are functionally distinct from their Māori counterparts (Turner 2005:85) and appear to exhibit straight edges, rather than curved edges. Another difficulty is the habit of grouping curved-edge gouges with straight-edged chisels because of their similarly diminutive size. Nevertheless, some rough comparisons are possible because in Eastern Polynesia outside of Hawai'i: i) the curved-edge adze is associated with oval and plano-convex transverse sections, which are often identified; and ii) most authors treat the smaller tools separately, albeit often with some confusion over the distinction between straight-edged chisels and curved-edge gouges (Hiroa 1930:364).

In New Zealand, curved-edge Type 3 adzes make up nearly 11 percent of 3,993 adzes in museum collections (Turner 2005:64). In addition, some curved-edge adzes were assigned to Duff's Type 6, which includes chisels and gouges, on the basis of functional and morphological similarity (Turner 2000:170). Although the morphological similarity of chisels and gouges is striking, the claim for functional similarity appears to have looked to the similar ways chisels and gouges might be applied to the work, with the motive force applied by striking the end of the tool or its handle with a mallet. This definition of function as the manner in which the tool was used makes classification problematic because evidence for how the tool was used is often difficult or impossible to observe (Turner 2000:202). Also, it contrasts with a more restricted concept of function as the intended result of applying the tool to the work. If this restricted definition were used, then the curved-edge tools assigned to Type 6 would be assigned to Type 3, instead.

Two curved-edge gouges from the Marquesas in Bishop Museum have been identified as examples of 'implements uncommon to the group' (Linton 1923:330). Excavations at the Ha'atuatua site recovered nine gouges, which were grouped as Ha'e'eka Type (Suggs 1961:111). Five other Ha'e'eka Type gouges were collected from surface contexts in the Marquesas (Suggs 1961:112). In addition, the Hatiheu type, a rare find in the Marquesas, exhibits a bevel that is 'somewhat concave' (Suggs 1961:110) and might have supported a curved edge, although the shape of the edge is not described. Four basalt gouges were recovered from the Hanamiai site on Tahuata (Rolett 1998:187–188).

At Tubuai in the Austral Islands a 'gouge with a rounded edge and hollow ground bevel … belongs to a type found intermittently throughout Polynesia' (Stokes 1930:145). The Type 3 adzes reported from Rurutu appear to exhibit straight edges (Vérin 1969) and curved-edge adzes are rare or absent in the collections made at the Peva site (Bollt 2008).

Illustrations of several adzes from Easter Island suggest curved edges. Three small implements identified as chisels or gouges appear to have curved edges (Figueroa and Sanchez 1961 Fig. 48 a–c), as do two grooved butt adzes (Figueroa and Sanchez 1961 Fig. 52 a, b). In addition, adzes classified as Type 2E, which is characterized by a plano-convex transverse section, are reported as present on Easter Island, the Marquesas, and possibly Pitcairn (Figueroa and Sanchez 1961:171).

The Huahine site in the Society Islands yielded eight adzes with '(s)emicircular (quadrangular-oval and plano-convex) [sections] with curved cutting edge' (Emory 1979:213).

Quantitative data on the relative proportion of plano-convex adzes in Eastern Polynesian adze collections indicate they make up: i) more than 25 percent of a small collection from excavations at a burial ground on Maupiti in the Society Islands; ii) more than 10 percent of a collection made in the lagoon pass on Maupiti by divers; iii) less than 1 percent and slightly more than two percent of other collections in the Society Islands; iv) slightly more than 2 percent of the adzes recovered during excavations at the Hane site on Ua Huka in the Marquesas Islands; v) more than 3 percent of various museum and private collections from the Marquesas; vi) more than 4 percent of adzes from Easter Island; and vii) less than 1 percent of two Hawaiian collections (Emory 1968 Tables 1–6). These rough comparisons indicate that curved-edge tools are relatively rare wherever they are found in Eastern Polynesia, and that Hawai'i is not unusual in this regard. They make up less than 5 percent of most collections, the exceptions being two small collections from the island of Maupiti and the large collection of Māori adzes in New Zealand, where the relative proportion of curved-edge adzes is greater than 10 percent, more than double what it is elsewhere in the region.

SUMMARY AND CONCLUSIONS

Curved-edge adzes can be distinguished from i) straight-edge adzes by a curved edge when viewed from the distal end, and ii) axes by the presence of a single bevel. A curve B edge and a single bevel are the necessary and sufficient conditions for membership in the curved-edge adze class.

The primary role assigned to edge shape in this classification reflects the importance of edge attributes to the function of the tool (Best 1977).

The curved-edge adze class can be divided into curved-edge adzes and gouges on the basis of tool shape and size. Gouges are small curved-edge adzes that are comparatively long and slender. They can be unambiguously distinguished from curved-edge adzes using weight as a proxy for size and length index as a proxy for shape (see fig. 3). The 24 curved-edge Hawaiian adzes identified in Bishop Museum collections can be divided in two classes based on weight (w) and length index (l) (see fig. 3). A curved-edge adze is classified as a gouge when $l \geq -50 + 100 * \log(w)$ and as a curved-edge adze when $l < -50 + 100 * \log(w)$. Using this criterion, the Bishop Museum collection includes nine gouges and 15 curved-edge adzes. Archaeologists who use these criteria to identify gouges and curve-edge adzes should find the results of their efforts confidently replicated by independent analysts.

From the point of view of an archaeological observer, the function of a curved-edge adze is to shape a curved surface when applied to the work, which is typically a piece of wood. In practice a curved-edge adze might be applied to the work in any number of ways, including direct percussion, either with the adze hafted to a handle or held directly in the hand, and indirect percussion, where a mallet is used either to strike the poll of the adze directly or the end of handle to which the adze has been hafted in line. Inferences about how a particular curved-edge adze was used in practice might be based on observations of use wear and the position of flake scars that are distinct from the observations of edge curve, length, width, and weight used to identify curved-edge adzes and gouges.

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