

The Functions of Wooden Mallets: Focus on the Kinki Region in Prehistoric and Ancient Times

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ABSTRACT

The aim of this study is to reveal the functions of yokozuchi/kakeya wooden mallets excavated from Prehistoric and Ancient sites mainly in Japan's western Kinki region. These tools have been used since prehistoric times to beat or pack straw, to drive stakes or piles, and for various other pounding purposes, and are folk tools still in use today. In terms of shape, they seem to have had such a wide variety of uses that little research has been done based on excavated artifacts to identify their specific functions other than for pounding. In addition to their morphological attributes, however, yokozuchi and kakeya mallets recovered from archaeological sites retain use marks, and an increasing amount of data on wood chosen for mallet making is being accumulated. What can we conclude in a comprehensive way about the functions of mallets considering these attributes? What role did these tools play in the times and places they were used?

In this study I set up a quantitative framework of classifications by shape and infer the functions of the tools from use marks and the type of wood used. Clear distinctions among yokozuchi, kakeya, and yokozuchigata mallets were not previously made, and here I attempt to define the three focusing on their shapes and elucidate their respective functions. Some of the yokozuchi for handcraft use are distinct from the others in terms of shape. I also show that the yokozuchi with a conical head, as recovered from Yayoi- and Kofun-period sites, likely had functions different from those of the yokozuchi with a cylindrical head. I lastly examine the functional transition of these tools over time, extending my discussion to artifacts excavated outside the Kinki region. This study thereby reveals aspects of the distinctive selection of wood for yokozuchigata mallets as well as the process in which rice-straw processing [rice-straw crafts] and the growing demand for construction of irrigation works as the result of the introduction of wet-rice cultivation led to the stylization of yokozuchi and kakeya shapes and their spread over a wide area. The introduction of the kizuchi wooden hammer, which goes back to the Ancient period, affected the functions of the yokozuchi/kakeya.

KEYWORDS: Prehistoric and Ancient periods, Kinki region, yokozuchi/kakeya, kizuchi, tool functions

Yamada Masahisa defines “yokozuchi/kakeya” (Figure 1) as wooden tools, among those used for beating or pounding objects, that have a head with a handle attached to it (Yamada 2003).¹ They are among wooden artifacts recovered from many ancient wetland sites, but

¹ Yamada uses the term “yokozuchi/kakeya” with a slash to cover all tools that are reported as “yokozuchi,” “kakeya,” or “yokozuchigata.” Since there are not definitions that clearly differentiate between them, I borrow the term “yokozuchi/kakeya” for this paper.

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almost no systematic research has been done about these mallets, except for that by Watanabe Makoto (1985). We surmise, however, that the functions and uses of *yokozuchi*/*akeya* tools for pounding wood and beating plant fiber, may relate to research on diverse topics such as production of vessels made of wood, rice cultivation and subsistence, and utilization of beans. In other words, studying the functions of these mallets is basic to investigation of the history of the use of plant resources. The present study examines the functions mainly of *yokozuchi* and *akeya* excavated from archaeological sites and reveals the role they played in the periods they were in use.

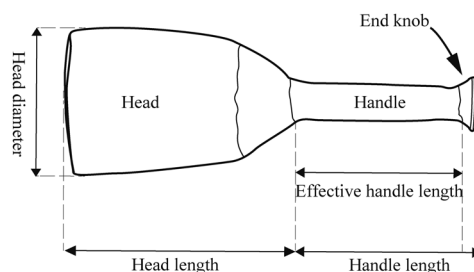


Figure 1. Names of Parts of Yokozuchi/Kakeya
When the grip has no knob, handle length is the same as effective handle length.

1. Research History and Problems

1-1. History of Research

The research history of *yokozuchi*/*akeya* can be divided into three phases: first, discovery of artifacts; second, systematic research by Watanabe Makoto (1985); and third, post-Watanabe (1985) research and proposals.

First phase: Discovery of artifacts

When wetland sites came to be investigated on a large scale in the 1930s–1950s, discoveries of *yokozuchi*/*akeya* from various sites began being reported (Ōba 1939; Kobayashi & Suenaga 1942). These reports analyzed individual excavated artifacts; they studied their functions, referencing not only pictorial historical sources and modern folk artifacts, but also examining use marks. The reports also indicated that the tools were likely used for pounding straw and cloth or for handcraft work.

Second phase: Watanabe’s systematic research (1985)

With increasing archaeological excavations of ancient wetlands, Watanabe Makoto analyzed *yokozuchi* mallets recovered from sites² across the country, giving close attention to the similarities in shape to modern and contemporary *yokozuchi* folk tools (Watanabe 1985, 1989). His analysis identified eight functions for *yokozuchi*: pounding straw,

² Watanabe (1989) defines *yokozuchi* as “a tool that consists of a head and handle that continue horizontally and seamlessly; it is gripped by the handle and swung to strike an object with the head.” How Watanabe understood the *akeya* is not known, so I use Yamada’s (2003) term “*yokozuchi*/*akeya*” in this study.

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crushing beans, straw crafts, pounding paper mulberry bark (*kōzo*), beating cloth, beating cotton, as a tool of craft, and for making *kubishiro/katashiro* (effigies used in rituals), noting that the last two functions developed from the uses for pounding straw and beans. Showing that in folk tools these functions correspond to the shape or structure of the tools, Watanabe applied this correspondence to archaeological artifacts and thereby believed the functions of excavated *yokozuchi* were based on their shape and structure. He also examined chronology of change for each function and demonstrated that the rise and decline of a function was linked to subsistence in each relevant period. Using the analogy with folk tools, Watanabe thus opened up a new approach to the study of tool function.

Third phase: Post-Watanabe research and proposals

After the publication of Watanabe 1985, *yokozuchi/kakeya* began being referred to in studies on relevant wooden artifacts as well as in reports of excavations of folk tools. Most of these works, broadly speaking, followed Watanabe's lead, but some posed doubts.

The *Mokki shūsei zuroku, Kinki genshi-hen* (Catalogue of Collection of Wooden Artifacts, Prehistoric Kinki Region), edited by Uehara Mahito, touches on *yokozuchi*, and, while much of the explanation is borrowed from Watanabe (1985), points out that, in the Yayoi to Kofun periods before *kizuchi* wooden mallets made of two different kinds of wood came into being, the *yokozuchi* for handcraft use was not an adaptation of the function of an existing tool but had its own inherent function (Uehara ed. 1993). The *Mokki shūsei zuroku*, moreover, puts the *kakeya* for handcraft use in a category separate from the *yokozuchi* for agricultural use, thereby emphasizing the difference in terms of function. The *kakeya*, it says, are often oval or angular in cross section in contrast to the *yokozuchi*, which are most often round in cross section; the morphological definition of *kakeya* is relative; the catalogue only says they are "over 50 centimeters in total length and larger than the *yokozuchi*." It also indicates the possibility that some of the tools it classifies as *yokozuchi* might have a handcraft-tool-like function, but that, except for their cross-section shape, they are not distinguishable from other *yokozuchi*. The catalogue further suggests that, among *yokozuchi*, those for handcraft use can be identified by observing use marks. The catalogue includes "yokozuchigata" mallets in the category of ritual tools, indicating the existence of small-sized *yokozuchi* in Prehistoric times, but the catalogue gives no definition or details of "yokozuchigata" mallets.

Murakami Yumiko analyzes the folk tool *yokozuchi* and, while following the data analysis methods of Watanabe (1985), pays particular attention to use marks (Murakami 1997). As a folk tool, she maintains, the farming *yokozuchi* used for pounding plants has a smooth, shiny surface whereas the *yokozuchi* for handcraft use often has a rough surface from use or shows linear use marks. Therefore, she asserts, the *yokozuchi* used for pounding plants and those used in craft work for striking hard objects are clearly

distinguishable. In a separate study, she considers the functions of *akeya*. In discussing wedges (*kusabi*) unearthed from archaeological sites, she touches on the *akeya*, which she says “was quite likely a tool for driving in wedges,” adding that how to distinguish it from the tool for driving in stakes or piles (*kui*) is a question for further study (Murakami 2002).

Hozumi Hiromasa examines a group of tools, excavated at the Rokudai-A site in Mie prefecture and the Ishikawa Jōri site in Nagano prefecture, that are shaped like smaller versions of ordinary *yokozuchi*. “They might possibly be included among small-sized practical items,” he says, but, “The state in which they were found suggests they were unused and probably reserved for ritual use.” Judging from the marks remaining from the carving process and their conditions when excavated, he indicated the possibility that they had a ritual function³ (Hozumi 2011).

In addition to the definition of *yokozuchi/akeya* given above, the *Kōko shiryō taikan* 8: *Moku/sen’i seihin* (Encyclopedia of Archaeological Resources, Volume 8: Wooden and Textile Artifacts), edited by Yamada Masahisa, states that the *akeya* were large-type mallets but that there is no clear distinction between *yokozuchi* and *akeya* (Yamada ed. 2003). Citing several examples of *yokozuchi/akeya* from around the country, it roughly explains the *akeya* as made from hardwoods such as *Cyclobalanopsis* oak and often utilized branching and other parts where the wood is solid and complex in structure.

1-2. Trends and Problems in Research History

In summary, while Watanabe (1985) discussed the specific agricultural functions of *yokozuchi/akeya*, there were also excavation reports from archaeological sites that indicate the presence of large and small examples, suggesting that the *yokozuchi/akeya* might have had more diverse functions. Attention was focused especially on the position of handcraft tools. Large tools and small tools are expected to have vastly differed in function, and some reports call the former “akeya” and the latter “yokozuchi.” Morphological classifications based on functions have not yet been presented.

Watanabe (1985) also inferred *yokozuchi/akeya* functions from folk tools based on their similarities in shape. With simple tools like *yokozuchi*, however, function was not likely to have been strongly limited by shape. It is necessary to identify attributes, other than shapes, that reflect function and try to identify functions based on the artifacts excavated.

³ Hozumi holds that the wooden ritual objects thought of as *katashiro* (effigies) came into existence in the Kofun period (Hozumi 2018). Among *yokozuchigata* (“yokozuchi-shaped”) and *kinegata* (“kine (pestle)-shaped”) tools there are some that are similar in shape to the stone-imitation *ishigine* (stone pestles), Hozumi says, and considering them to derive from the stone pestles used to crush mineral cinnabar into powder, he concludes that the *yokozuchigata* and *kinegata* often correspond to tools recovered from *kofun* tumulus sites.

2. Methodology

2-1. Analytical Method and Object Scope

The research history outlined above forms the background against which this paper examines the functions of *yokozuchi/akeya*.⁴ Here we will look at their functional changes over the course of the Prehistoric and Ancient times—with later developments also in perspective—in relation to subsistence and the uses of plant resources, and discuss the historical significance of *yokozuchi/akeya*.

As attributes that reflect function, attention is focused on shape, type of wood, and use marks. The shape attribute can be considered effective in the broad classification of functions. But, since the *yokozuchi/akeya* morphologically had a wide range of usage it is also necessary to analyze use marks, which are attributes acquired at the stage of use. It is highly likely, moreover, that the type of wood was selected according to function.

After proposing a classification by shape, the following analyzes these tools by use marks and type of wood. This section closes with a discussion of changes according to period.

The *yokozuchi/akeya* examined here are artifacts excavated in the Kinki region (Osaka, Nara, Shiga, Mie, and Kyoto prefectures). The scope of analysis is limited to the Kinki region because of the assumption that the functional changes in *yokozuchi/akeya* were related to wet-rice cultivation in the Yayoi period and the introduction of architectural technology in the following Ancient times (Asuka, Nara, and Heian periods). The Kinki area relatively uniformly entered the Yayoi period at an early stage and earliest ancient Buddhist temples were built in the region by the government. A total of 155 wooden mallets were collected, but since classification was made with focus on the handle part of the tool, the 97 items with a handle existing in complete condition and excavated from Prehistoric and Ancient sites were selected for analysis.

2-2. Organizing Functions and Terms Presented in Research History

The functions of *yokozuchi/akeya* presented in previous studies can be organized into three basic types: agricultural, handcraft, and symbolic (ritual) functions. The agricultural functions, as identified by Watanabe (1985), were those for pounding straw (*warauchi*), crushing beans (*mameuchi*), and beating cloth (*kinuta uchi*).⁵ The *yokozuchi/akeya* are also assumed to have had the same function as that of a small *tategine* pestle (Uehara ed. 1993). The handcraft functions include those for pounding a stake or pile or driving in a wedge (Murakami 2002), for straw crafts (Watanabe 1989), as well as for working with a

⁴ This study follows Yamada (2003)'s definition of *yokozuchi/akeya* as tools with a handle and a head for the purpose of pounding/beating/striking. The *yokozuchi* as a modern folk tool is called *mingu yokozuchi* ("folk tool *yokozuchi*") here to distinguish it from an archaeological artifact. Wooden hammers [to use the term you introduced above] made of two different kinds of wood instead of a single kind are referred to as "kizuchi" or "ōgata [large] kizuchi."

chisel or hatchet, or driving in earth-retaining planks (*yaita*). Among symbolic functions, scholars have pointed to the use of *yokozuchi/kakeya* for rituals, but mention them also as “assorted tools” (*zatsugu*), toys, and furniture (Watanabe 1985; Hozumi 2011).

3. Classification and Identification of Functions

3-1. Morphological Classification and Analysis

In classifying the mallets by shape, the first criterion of categorization is the handle area with the head part used as the second criterion of categorization (see Figure 1 for part terms). The handle is the part that is directly gripped with one or both hands by the user, so it represents the most basic structure for the action of use. The head, on the other hand, is what directly acts on the object and is the part best suited for studying the functions of the tool on a finer level.

The handle area

Presented here is a quantitative categorization focusing on handle length. “Effective handle length” is defined as the part of handle that is gripped (Figure 1).⁶ The effective handle lengths for the 97 *yokozuchi/kakeya* tools that have a complete handle are represented in the histogram in Figure 2. Based on the histogram, the tools can be divided into three types by size: Type A (2 or more cm and less than 9cm), Type B (9 or more cm and less than 22cm), and Type C (22 or more cm and less than 34cm). The number of items belonging to each type is: 22 for Type A, 67 for Type B, and 8 for Type C. Since the effective handle length indicates the length actually gripped, Type A has an extremely short handle, Type B a medium-sized handle, and Type C a considerably long handle.

⁵ In this paper “beating cloth” (*kinuta uchi*) refers to beating silk and other fiber and textiles such as hemp, ramie, and cotton. Cotton, however, did not spread widely until the sixteenth century (Nagahara 2004), and can be excluded from the discussion of the functions of Prehistoric and Ancient artifacts. The mallet for “beating cloth,” which functions like an adjusting tool by beating soft textiles, should be considered to have agricultural functions as opposed to the handcraft functions of pounding hard objects. Similar in function to “beating cloth” is pounding and softening the raw material used for making paper *kōzo* mulberry bark, hemp, and other plant fibers. Such practices occurred later than the time under study here, however. According to Yuyama Ken’ichi, who chronicles the history of writing paper, handmade paper (*washi*) was produced at state-run workshops until the ninth century; only when the centralized *ritsuryō* system started to go into decline did papermaking develop as the private local industries that played a part in supporting people’s lives around the country (Yuyama 2017). The tools for making paper, moreover, were likely produced in far smaller quantity than the tools for pounding straw, crushing beans, and beating cloth, which were an essential part of subsistence, and therefore are not included as part of the discussion in this paper. Watanabe (1985), however, confirms examples of *yokozuchi* being used as papermaking tools in his study of folk tools, suggesting the need for further research on the shape, types of wood, use marks, and so on of mallets used in papermaking.

⁶ The effective handle length is that part from the end knob to the border connecting to the head. There were a few examples whose border between handle and head was very difficult to determine, making them undistinguishable from a stick-shaped wooden artifact in terms of shape and use mark. Since it could not be judged whether they were a beating tool or not, they were excluded from analysis here.

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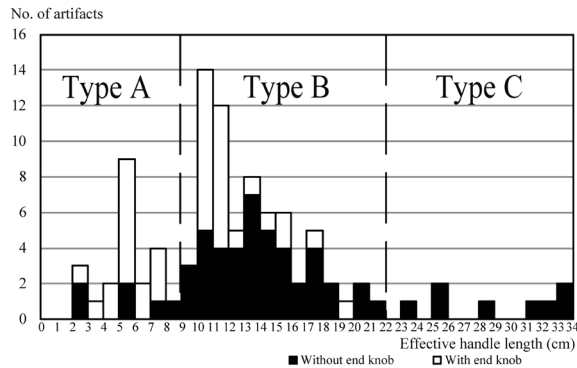


Figure 2. Classification by Effective Handle Length

The head area

Next, each category is further subdivided by the measurements of the head. Volume and weight may differ from one head to another depending on the beating object, and therefore the analysis is performed with attention to the diameter⁷ and length of head, which are strongly related to volume and weight. With head diameter on the vertical axis and head length on the horizontal axis, the scatter plots present analysis for types A to C. Since categorization is determined by the ratio of length and diameter of the head, inevitably the heads are expected to be similar to one another in shape among those of the same type.

Type A is classified with focus on the ratio of head diameter and head length (Figure 3). Here, Type A can be organized into three groups—Type A-1, Type A-2, and Type A-3 in the descending order of the number of items. Type A-1 is the group concentrated near the least square line⁸ and 17 items belong to this group (Figure 7, Nos. 1 to 17). Type A-2, a group with ratio larger than Type A-1, has 3 items (Figure 7, Nos. 18 to 20). Type A-3, a group with ratio smaller than Type A-1, has 2 items (Figure 7, Nos. 21 to 22).

Type B is divided in four, separating the outliers from the box plot for head diameter and for head length (Figure 4). The four are Type B-1, Type B-2, Type B-3, and Type B-4 in descending order of the number of items excavated. Type B-1 has 58 items, the largest of all types studied. In Type B-1 there are two different kinds in terms of head shape, one being cylindrical (45 items; Figure 7, Nos. 23 to 27), the other conical (13 items; Figure 7, Nos. 28 to 32). The latter—“conical Type B”—has the circular head end that narrows toward the axis and most in this group have a head that gradually narrows down toward the handle, but there are exceptions like Figure 7, No. 30. Type B-2 (4 items) have considerably long heads and a large head diameter⁹ (Figure 7, Nos. 33–34). Type B-3 (3 items) have considerably long heads but a

⁷ When used, a wider surface area of the head is thought to act on the beating object; therefore, when the head is oval in cross section its longer diameter is measured.

⁸ Type A-1 can be quantitatively defined as the distance to the least square line ($0.65x - y - 1.16 = 0$) being less than 0.9.

small head diameter (Figure 7, No. 35). Type B-4 (2 items) have a considerably large head diameter (Figure 7, No. 36).

With focus on the size of head diameter, Type C can be classified into two groups (Figure 5). Type C-1 (5 items) have a large head diameter (Figure 7, Nos. 37 to 38) and Type C-2 (3 items) have a small head diameter (Figure 7, No. 39). The foregoing is summed up in Figure 6.

3-2. Perspective of Type of Wood Used

Specific gravity

The specific gravity (relative density) of wood selected for making *yokozuchi/kakeya* is an indicator of the density of the material and is therefore strongly correlated with the weight and strength of the tool and presumably related to its functions.¹⁰ Lightweight and softwoods with low relative density is unlikely to be suitable for mallets.

Texture

A rough-textured wood surface, which risks snagging the fibers of cloth, is presumably unsuitable for beating cloth, and this relates to function. This study is concerned with the texture of the wood used. Wood texture “shows in relative terms the density and evenness of the grain of the wood” (Shimaji *et al.* 1985). In this paper texture is divided between “fine” and “rough” in line with the distinction made by Kishima *et al.* 1977.¹¹

⁹ One item in Type B-2 is not included in the outlier in the box plot (Figure 4), but the head length histogram shows it is distinct from Type B-1 and the scatter plot, too, shows it near Type B-2, and so it is regarded as Type B-2.

¹⁰ For relative density of each wood material, the present study uses air dried specific gravity data published in the *Genshoku mokuzai daizukan* (The Illustrated Encyclopedia of Wood) (Kishima *et al.* 1977) and *Ki no daihyakka* (The Encyclopedia of Wood) (Hirai 1996). It should be noted, however, that wood, a product of nature, varies greatly in density (Saeki 1993). For wood materials identified at the genus or family level, the density of a representative wood of that genus or family is used. In this paper, the term “broadleaf hardwood” is used to refer to heavy and hard broadleaf trees, such as *Cyclobalanopsis* (oak) and *yabutsabaki* (camellia), which were frequently used for making agricultural and handcraft tools.

¹¹ Specifically, cited as “fine textured” wood are *shikimi* star anise, *Cupressaceae*, *kamatsuka* photinia, *Photinia*, *Pyroideae*, *hisakaki* (*Eurya japonica*), *sakaki* cleyera, *yabutsabaki* camellia, *Osmanthus*, and *mochinoki* ilex. Except for “fine textured” are fir, *Quercus*, *konara* oak, *Cerris*, *Cyclobalanopsis* oak, *kuri* chestnut, and *Callicarpa*. In a case study of folk-tool *yokozuchi* (Watanabe 1985), too, it is pointed out that, reflecting the difference in fineness of texture—despite similarity of mallet shape—“the relation between oak and camellia stands out, the former being used for pounding straw and the latter for beating cloth.” As a similar example of study, Shimakura Misaburō wrote that the wood selected for making vertically-held pounding pestles (*tategine*) “is either heavy and strong wood with the large vessel [that moves water from roots to leaves] or fine diffuse-porous wood with small vessel,” suggesting that the function might differ depending on the vessel diameter and density of the wood (Shimakura 1979, 1983). Wood texture thus provides a useful analytical perspective.

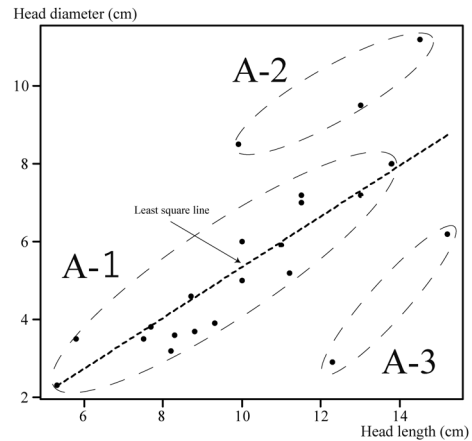


Figure 3. Type A Classification by Head Diameter and Length

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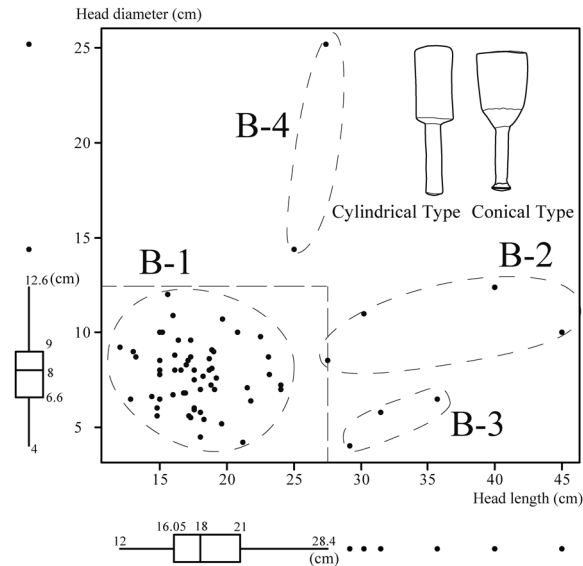


Figure 4. Type B Classification by Head Diameter and Length

3-3. Categorization by Use Marks

With *yokozuchi/kakeya*, use marks¹² are detected as concavities on the head. Use marks of *yokozuchi/kakeya* excavated from archaeological sites are divided into three types (Figure 8). The Use Mark I type shows no concavity on the side of the head and the sides of the Use Mark II type¹³ are gently indented. The creases on the sides of the head of the Use Mark III type¹⁴ are shallow and uneven; items partially with very deep creases also fall in this category.

Considering the relationship between function and use-mark classification, the Use Mark I type has no concavity for various possible reasons, such as that the tool was not used for beating objects, or that the frequency of use was low, or that a use mark does not appear in the form of a depression because the tool was for beating something with a broad surface. When the tool is used to pound a soft object laid on a flat board it would be difficult for it to leave a depression as a use mark. This is the likely tendency found for cloth-beating

¹² In this paper, categorization of concavities on the head is treated as categorization of use marks. But these do not necessarily correspond to the object of beating, because, as described later, the concavity might likely reflect frequency of use or the shape of the block upon which the object was beaten or pounded. With Use Marks I and II, especially, it is difficult to establish a strict relation with function, partly because frequency of use is involved. But, arguably, the concavities were made when the tool was in use, which would obviously mean they were closely related to the tool's function. The concavities can therefore be considered an effective basis for the study of function. Meanwhile, a more elaborate analysis of use marks will be necessary; for example, the overlapping of use marks needs further study.

¹³ Given the impact of earth pressure and reaction wood, dents or creases on opposite sides or all sides of the head would fall into the Use Mark II type.

tools and for some of straw-pounding tools.¹⁵ This also applies to tools of a ritual nature.

The Use Mark II type does not directly reflect the object or material pounded. The shallow concavity of the head is likely the result of being used to pound a soft object laid on a board that had a slightly convex surface. Similar use marks are found on folk tool *yokozuchi* used to pound straw placed on a rounded river stone¹⁶ (Figure 9).

The Use Mark III type presumably comes from striking such a hard object that the wooden head was partially chipped or worn away. The indentations may be considered closely linked to the function of a handcraft tool to pound wedges or drive in stakes or piles.

Some reports present examples of *yokozuchi* with use marks on the top end of the head, suggesting it had a function like that of a vertically held *tategine* pestle. But, it was difficult to confirm the use mark based only on the report's illustrations or through observation after

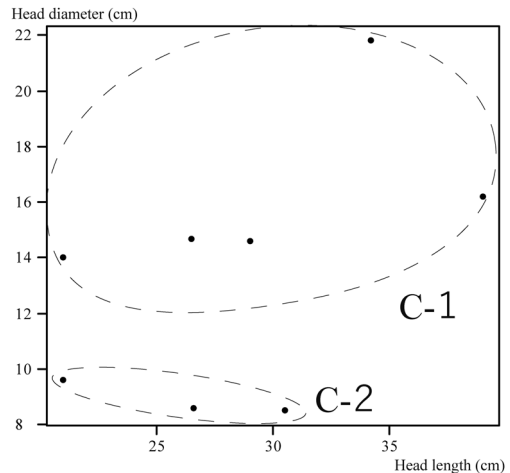


Figure 5. Type C Classification by Head Diameter and Length

¹⁴ Even when an illustration shows a very considerable depression on the head side there is a possibility that the mallet was converted, after its original purpose of use was over, into use as a board on which objects were pounded, causing the deep concavity. An observation of the considerably dented head for the item in Figure 7, No. 27 shows it was struck by an iron blade at a sharp angle, most unlikely a mark left when the *yokozuchi* struck a blade. This example, moreover, is missing half its side and blade marks are found near the missing surface, suggesting that, after the half side was lost, the wood was recycled as a board on which objects were cut with a bladed tool. Such examples, however, are rare and it is difficult to judge the piece from the illustrations; examples with marked depressions, including this one, are considered to belong to the Use Mark III type. A more detailed differentiation of use marks requires confirmation by actually observing individual examples. The overlapping of use marks made both when the tool was used as a wooden mallet and when used as a cutting board also calls for further discussion.

¹⁵ This is the finding of a folk tool survey. The Nara Prefectural Folk Museum conducted a survey of 22 folk *yokozuchi* for beating cloth and found that none of them had a depression. It also found that, of 7 *yokozuchi* thought to have been used for multiple purposes including pounding, 3 had no depression. The result seems to relate to the shape of a board on which the object was beaten or the frequency of the tool's use.

¹⁶ Mostly for pounding straw, it seems, river stone was used as a board on which straw or other such object was set and pounded with the *yokozuchi* folk tool. Note that the use-mark varies depending on frequency of use and how the object was beaten. Figure 9 shows a *yokozuchi* folk tool that was used—together with a circular river stone serving as a board—at this author's house (a mountainous area in the southern part of Mie prefecture). I had an interview survey with my grandfather who used the tool and board, concerning their function and how he used them. *Yokozuchi* folk tools are preserved at folk museums and other such facilities across the country, but it is very rare that they are preserved paired with a board. The shape of such a board is regarded as very important in this study to understand use marks, and folk tool examples are indispensable. I am grateful to my grandfather, who carefully preserved the *yokozuchi* and board even after ceasing to use them and who showed me in detail how he used them.

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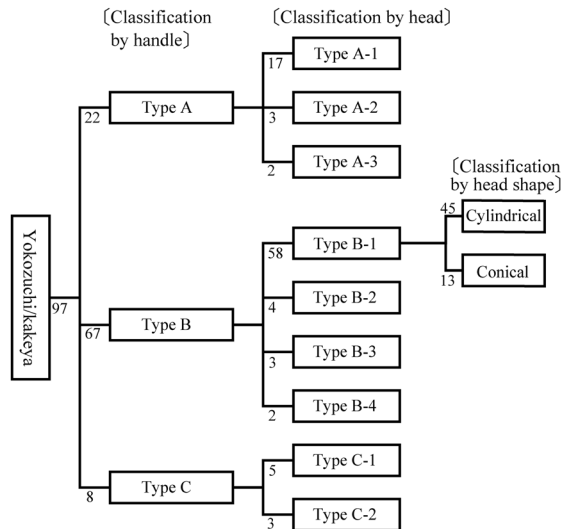


Figure 6. *Morphological Classification*
Small number indicates no. of artifacts.

preservative treatment had been applied. No relations with other attributes were found, either. The present study regards indentations or concavity only on the side of the head as use mark.¹⁷

3-4. Classification of Effective Handle Length and Analysis

Classified effective handle length is compared with the relative density of the type of wood and with the size of the head, to examine their respective correlations.

Handle length and the density of wood

Figure 10 shows types A to C of selected wood in descending order of their relative density. As a whole it indicates that *Cyclobalanopsis* oak and *yabutsubaki* camellia, both with a heavy density, were frequently used. Type A, consisting mainly of conifers and other relatively light woods, was an unsuitable selection for wooden mallets, which need to be heavy.

Type B, meanwhile, includes a diversity of wood, mainly solid broadleaf hardwoods, such as *Cyclobalanopsis* oak and *yabutsubaki* camellia, which were common options for making agricultural and handcraft tools. There are too few Type C examples, making it difficult to study the types of wood used, but broadleaf hardwoods were mostly chosen among the few examples.

¹⁷ Even if, for example, a report says the top end of the head has a use mark, if the side of the head has no depression, this falls under the category of Use Mark I.

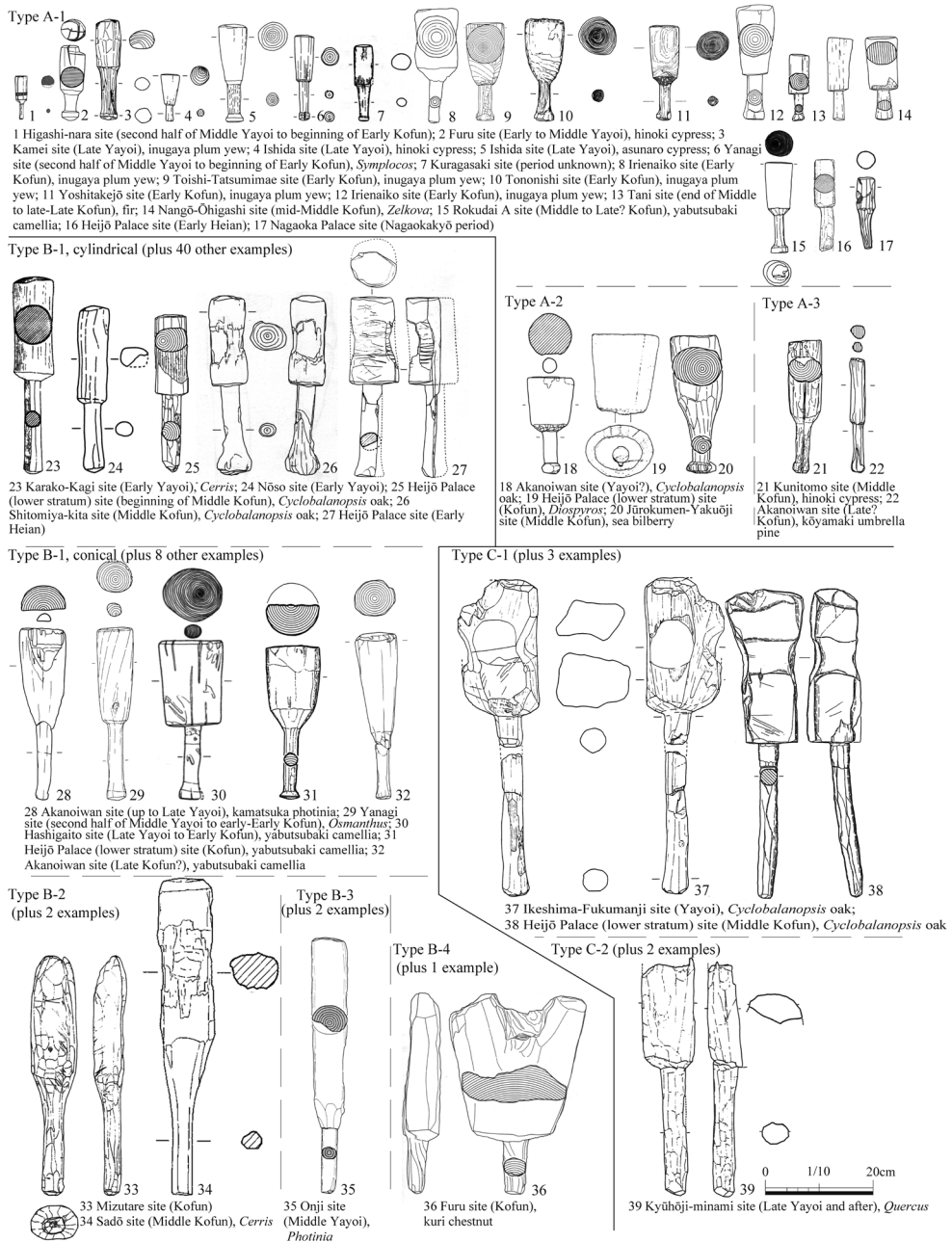


Figure 7. Yokozuchi/Kakeya by Classification

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Handle length and head size

The size of the head is defined as equal to head length multiplied by head diameter,¹⁸ and its relationship with classification by effective handle length is shown in the box plots in Figure 11. A clear tendency can be detected between the handle-length classification and head size; that is, a group with a longer effective handle is likely to have a larger head. Based on this correlation it is possible to use head size to estimate the classification of effective handle length. Classification by effective handle length is a method that can be applied to examples that are missing handles.

Handle length and hand breadth

Finally, a comparison is made between effective handle length classification and hand breadth. Since the effective handle length indicates the part of handle that is gripped, it is expected to have correlation with the person's hand breadth. The average hand breadth of Japanese people today is approximately 7.98 centimeters (Kōchi 2012), and this biological figure of breadth agrees very well with the Figure 2 histogram shown earlier. The hand-breadth average value of 7.98 centimeters lies at the border between types A and B, and the types B and C border is equivalent to more than $7.98\text{cm} \times 2$. Considering that there should

be some leeway for grip on a handle, it is presumed that a tool with a type-A handle is not used for gripping, that a tool with a Type B handle is held in one hand, and that a tool with a Type C handle is held in both hands. The conclusion drawn here gives an important suggestion in describing the possible functions of each type of mallet. That is to say, while summing up the discussion in this section, we can assert that the Type A tool, made

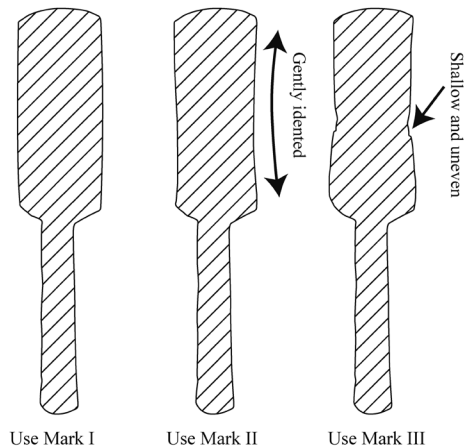


Figure 8. Classification by Use Mark



Figure 9. Folk Tool Yokozuchi for Pounding Straw (Use Mark II)

¹⁸ This equation is not precise because the head has a three-dimensional shape, but it can be a usable measurement.

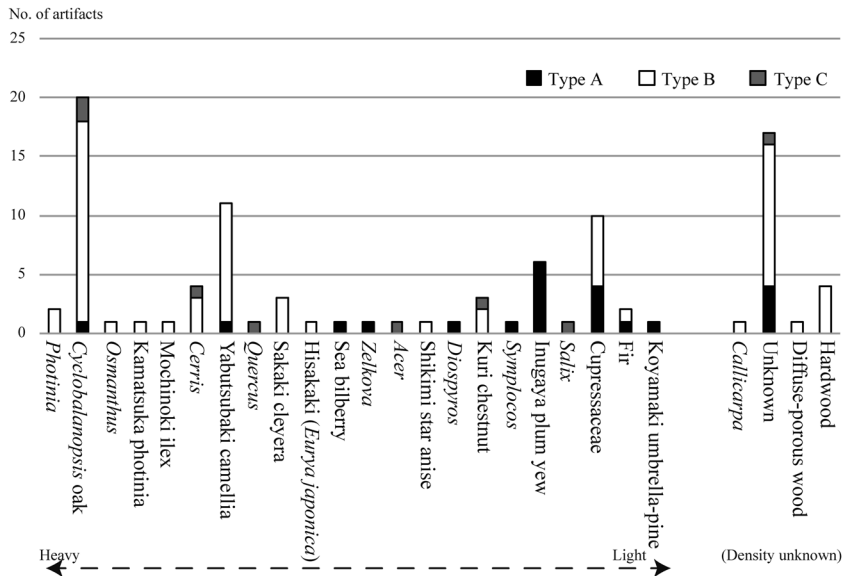


Figure 10. Wood Types for Effective Handle Length Classification

mainly of light wood like conifer trees, has a narrow-size head and is not used by gripping the handle. The Type B tool, made mainly using the wood of broadleaf hardwoods has a handle for a one-handed use, and the Type C tools have a wide head size and a handle long enough to be gripped with two hands. In other words, effective handle length is closely related to head size and hand breadth. From this we understand that effective handle length provides an important perspective from which to broadly classify functions.

What are the functions for types A, B, and C? Let us clarify them in the following section by examining head diameter, a subcategory of the classification of effective handle length.

3-5. Assumed Functions of Each Mallet Type

Correlation by type between wood type and use marks

Especially with types for which the number of items is large, graphs are used to show their correlations with wood and use marks (Figures 12 and 13).

Functions for types A-1, A-2, and A-3

With regard to Type A, its use as a beating tool is unthinkable because holding the handle of this type with a hand is difficult as discussed earlier.

Let us first consider tools of Type A-1 (Figure 7, Nos. 1 to 17). As morphological

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characteristics, most of them have a grip with an end knob and the head area is conical in shape, suggesting that there might have been some specifications that determined the shape. This typical shape was especially notable for tools up to the Early Kofun period. Although it is difficult to tell from the illustrations, Figure 7, No. 5 and Figure 7, No. 11 are said to be finely made (Shimizu *et al.* 1992; Sugiura ed. 2005). Overall, conifer wood was frequently used for type A-1 (Figure 12). Notably, the wood material from the Early Kofun period identified is consistently *inugaya* (plum yew). For this study, all the examples made of *inugaya* are limited to Type A, including those with the handle part missing. This suggests that the mallets in question had some special function that required the use of the *inugaya*¹⁹ wood. Regarding use marks, except for Figure 7, No. 8, there is no noticeable depression on the head categorized as Use Mark I (Figure 13). Figure 7, No. 2 is worn down at its top end and Figure 7, No. 6 is reported to have been used as a *tategine* pestle (Yamauchi ed. 1995; Hirai *et al.* 2008). Many examples were excavated from ditches and sloughs, and some, from the Late Kofun period, were found at well-known archaeological sites of ritual such as the Rokudai-A site (Mie pref.) and Nangō-Ōhigashi site (Nara pref.). Observation of shapes, wood material, use marks, and state upon excavation, therefore, indicates that the likely functions of Type A-1 might be ritual nature, household goods, toys, furniture, or small-type *tategine* pestle. If the tools of this type were toys, however, it would be unnatural that they were highly crafted according to standard specifications of material and shape. If they were small *tategine*, this also would raise a question of why

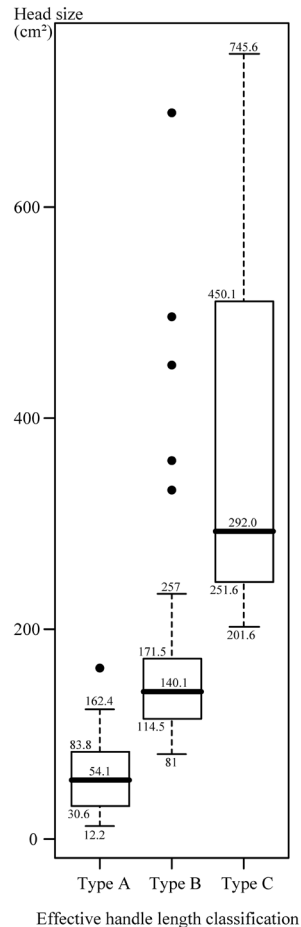


Figure 11. Relationship between Effective Handle Length Classification and the Head Size

¹⁹ Outside the Kinki region there are some cases of *inugaya* having been used for *yokozuchi*. So, we cannot sweepingly generalize this, but this wood is generally considered to have been “rarely utilized for wood product because the timber is too small” (Hirai 1996). It is not a wood suitable for making farming or handcraft tools.

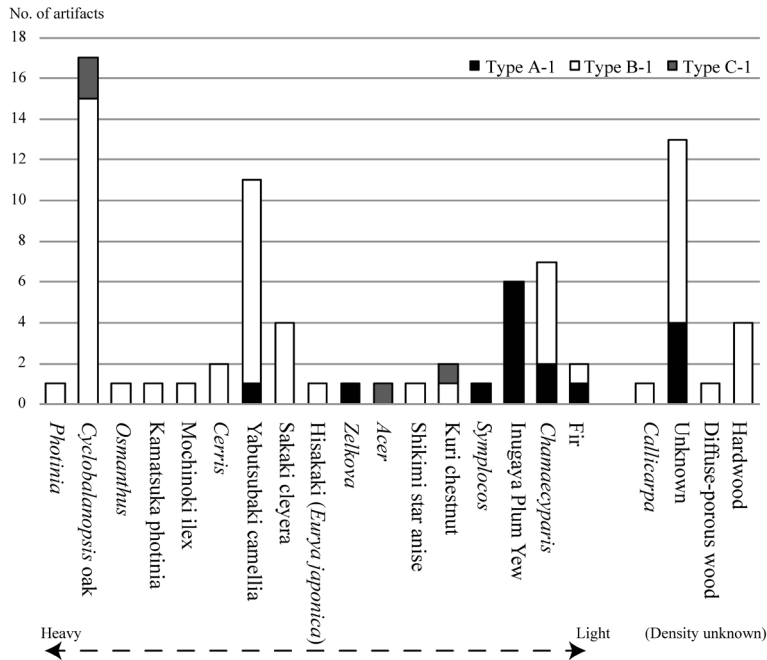


Figure 12. Specific Gravity of Wood Types for Types A-1, B-1, and C-1

conifer wood, not broad-leaf wood, was chosen and, again, why they were highly crafted according to standard specifications of material and shape. Given the above, it seems appropriate to think that tools of type A-1 were not for beating objects but that most of them had a symbolic, such as ritual, function.

The three examples of Type A-2 (Figure 7, Nos. 18–20) are all from the Yayoi and Kofun periods. They have an effective handle length too short to grip, but their head is large and wide and they all have a knob at the end of the grip. The woods selected for this type are *Cyclobalanopsis* oak and *shashanbo* (sea bilberry). The head shaft shows no use mark but the top end for Figure 7, Nos. 18 and 19, is worn away (Machida & Sawada 1981; Hama *et al.* 1998). These observations suggest that they were a type of *tategine* pestle. If they were, the handle area could be shorter than for a mallet used in pounding and might also have been used in combination with a *karaus* mill.

There are two items for Type A-3 from the Middle or Late Kofun period (Figure 7, Nos. 21 and 22). Both have an elongated head and an end knob. The Figure 7, No. 22 example was so finely crafted that it was unlikely to have been used for practical purposes (Hama *et al.* 1998). One of the two is made of *hinoki* cypress and the other of *kōyamaki* umbrella pine. Neither has marks of use. Although the number of examples for type A-3 is very small, they are quite similar to those of type A-1 in terms of types of wood used and

THE FUNCTIONS OF WOODEN MALLETS

presence or absence of use marks. For the time being, I believe their function might have been symbolic, perhaps ritual nature, as for Type A-1.

Functions for types B-1, B-2, B-3, and B-4

Examples of Type B-1 are the largest in number among all types excavated and therefore can be said to be most typical of *yokozuchi/kakeya*. Morphologically, too, they are more densely distributed in the scatter plot than other types (Figure 4). They are mallets to be held with one hand. Using broad-leaf hardwoods such as *Cyclobalanopsis* oak and *yabutsubaki* camellia (Figure 12), and displaying all three types of use marks, these examples most likely had a wide variety of functions (Figure 13).

By shape of the head, this Type B-1 can be further divided into Type B-1 cylindrical and Type B-1 conical. Both have statistical significance in terms of fineness/roughness ratio of texture (Figure 14) and in terms of use-mark (Figure 15).²⁰ A higher proportion of the conical type are assumed to have been made using a fine-grained wood such as *yabutsubaki* camellia, and to have Use Mark I than type B-1 cylindrical. In terms of the presence or not of an end knob (Figure 16), statistical significance was not obtained, but the way they were processed seems to suggest

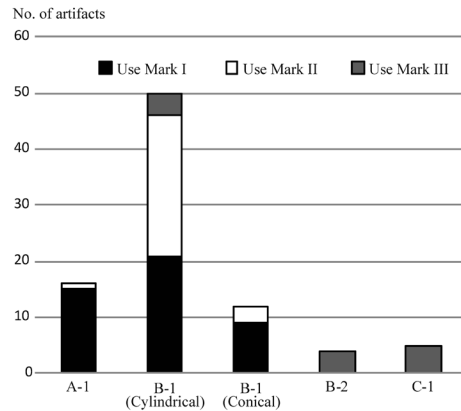


Figure 13. Relationship between Use Marks and Classification

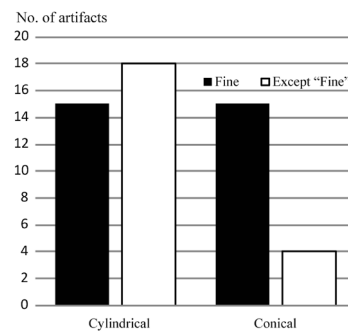


Figure 14. Wood Texture for Type B-1 Cylindrical and Conical (including examples with missing handle)

²⁰ Statistical significance was gained for Type B-1 cylindrical and conical mallets using Fisher's exact test (probability level 0.05). Items of comparison were fineness of wood grain, presence or absence of Use Mark I type, and presence or not of an end knob. Test results show that fineness of grain was $P=0.08$, Use Mark I $P=0.06$, and end knob $P=0.11$. Probability in each case is very low but not below 0.05. This, I think, is because the sample for type B-1 conical was very small. I re-tested for the conical type, this time including examples with missing parts. With the conical type there are a total of 12 items with the head missing, and such items were also found for Type A-1 and Type A-2. Of the 12, four with a very small head were excluded as Type A, and the remaining eight were added to Type B-1 conical mallets for re-testing. It was found that the fineness of grain this time was $P=0.04$ and Use Mark I was $P=0.003$, both below the significance level. The re-testing was not performed as for the presence or not of an end knob, which cannot be known when the head is missing. But the first test results produced a low P value, and so, if the sample size is increased the conical type will likely have a higher significance level.

that many examples of the conical type have a carefully crafted end knob (Figure 7, Nos. 28 to 32).

First, let us look at the functions of type B-1 conical mallets which have more distinctive attributes than those of the cylindrical type. Tools for beating cloth, which is flat, do not easily show use marks, and a fine-grained wood surface is preferred over rough-grained wood by which fabric might be snagged, as mentioned earlier. This matches a characteristic of Type B-1 conical mallets. Making the connection between the head and handle by shaping the head conically can be understood as a way of preventing fabric from getting snagged when beating it. Meanwhile, given the way the head was made conical²¹ and the end knob crafted with care, there is also the possibility that the mallet had a special function such as of a ritual nature. Type A-1 (Figure 7, Nos. 1 to 17) mallets are also a group having conical heads and solid end knobs. But, considering that conifer wood was mostly chosen for making the Type A-1 mallets and broad-leaf hardwoods were used for Type B-1 conical mallets, it is unlikely that both types were made for symbolic purposes; it is more reasonable to conclude that Type A-1 alone consisted of symbolic items that were so-to-speak miniature versions of the Type B-1 conical mallets made for household use.

Next, with regard to Type B-1 cylindrical (Figure 7, Nos. 23 to 27) mallets, broadleaf hardwoods were mostly selected for this type and all three kinds of use marks are found (Figure 13). This makes it difficult to narrow down the functions, but the use marks are mostly of the I and II types, suggesting that the cylindrical type were mainly for practical daily use, such as in farming. Only a few examples, such as Figure 7, No. 26, display Use Mark III, which indicates some were used for handcraft work. Type B-1 are dense in the

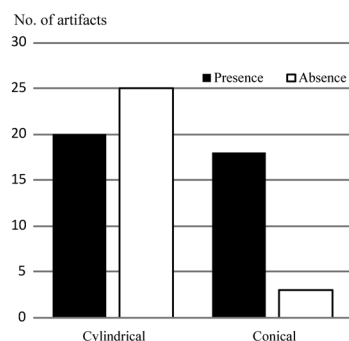


Figure 15. Presence or Absence of Use Mark I for Type B-1 Cylindrical and Conical (including examples with missing handle)

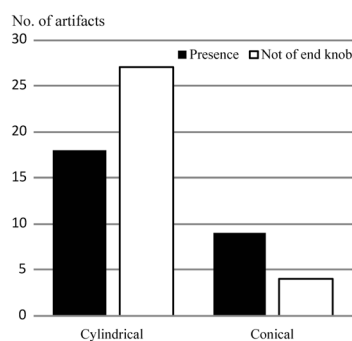


Figure 16. Presence or not of End Knob for Type B-1 Cylindrical and Conical

²¹ A cylindrical shape can be made using the natural surface of a round timber, but to make a conical shape requires going to the trouble of shaving the head that gets narrower downward.

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scatter plot (Figure 4) and, morphologically, they were stylized. There is a high possibility, therefore, that the Type B-1 cylindrical *yokozuchi*, which do not vary much in terms of shape from one example to another, were made to be multifunctional tools from the outset. These tools were presumably used, as needed, for pounding straw, crushing beans or for handcraft purposes.²²

While Type B-1 *yokozuchi/kakeya* are presumed to have generally had a variety of functions, those of Type B-1 conical alone can be specified as being used for beating cloth because of their shape and wood material that was determined by the special requirement that the wood not snag fabric. Otherwise, function did not much determine shape, and it is assumed that Type B-1 tools, most of them cylindrical in shape, were used for a variety of purposes. Further research on individual items' use marks and types of wood used will be needed to open up more insight on their functions.

Regarding Type B-2 (Figure 7, Nos. 33 to 34), all the four examples of this type have considerably long heads, and the diameter of the head is wide, as well. The head was made wide probably to increase its weight and also to avoid missing a small object when pounding. It was likely wielded in broad strokes. The type of wood used has been identified for only two examples; broad-leaf hardwood—*Cyclobalanopsis* and *Cerris*, both types of oak—were selected. All of the four examples display Use Mark III. Given these conditions, there is a possibility that Type B-2 were one-handed-use *yokozuchi* for handcraft uses.

Among mallets with a considerably long head, those with a small head diameter are of Type B-3 (Figure 7, No. 35). Three items fall under this category. All excavated in Osaka prefecture, they date from the Yayoi period. Selected woods are *Cyclobalanopsis* oak, *Photinia*, and *hinoki* cypress. Use marks are either “unknown” or “Use Mark I.” Attempts at conjecture about the functions for Type B-3 have failed. The shape of this type suggests a *tategine* pestle that was split in two. In fact, a comparison of the measurements of *tategine* and *yokozuchi* examples from a wetland area at the Yōkaichi Jikata site, a Yayoi-period wetland site in Ishikawa prefecture, indicates the possibility that the *tategine* might have been converted into use as a *yokozuchi* mallet (Shimohama 2004). Type B-3 were likely examples for which head was not cut short when converted for use as a *yokozuchi* mallet. Since they originally were not made as *yokozuchi*, they have a very long shape and were therefore detectable as outliers.

Two items fall into type B-4 (Figure 7, No. 36). They date from the Kofun period and their head diameters are remarkably wide. One of the two is made of *kuri* chestnut. Neither have noticeable use marks. It is difficult to imagine their functions, but morphologically they are clearly different from other examples, suggesting that they might have had a

²² This speculation is based on investigations of folk tools. There are some cases where a single folk tool *yokozuchi* was used for several different purposes.

special function. More examples of this type need to be found before it will be possible to make any conjectures about their function.

Functions for types C-1 and C-2

Type-C examples have a handle area large enough to grip with both hands. Five items come under type C-1 (Figure 7, Nos. 37 and 38). They were excavated at different sites in the Kinki region. Their head diameter is the largest in this Type C group, indicating that they have a relatively large area of contact with an object pounded. As in the case of Type B-2, examples of Type C-1 have a wide and flat head, apparently to increase effectiveness in striking the target material. As for the wood used, the sample is too small to detect tendencies, but all Type C-1 examples available are made with broadleaf hardwood (Figure 12). They clearly show Use Mark III (Figure 13), and most of them seem to show that the four sides of the head were all used for beating. As pointed out in previous studies (Uehara ed. 1993; Yamada ed. 2003), the head often is shaped in a square bar or made from a part of the wood where the timber branched. Given these conditions, it can be considered that the Type C-1 items were tools for fashioning handcrafted products by striking something hard with broad strokes.

Next are three items from Middle and Late Yayoi sites in Osaka prefecture, which fall under Type C-2 (Figure 7, No. 39). They have what appears to be a handle area, so they are included in this collection of *yokozuchi/kakiya*, but their characteristics as tools are hard to identify. Their handle and head are long and narrow; they are made of *Salix* (willow) or other wood not often selected for *yokozuchi/kakiya*. As for traces of use, they do not display concavities or indentations, but all the examples of this group seem to be missing part of the head, which suggests that part might have been broken off in the pounding or striking process. Due to these conditions it is difficult to propose the possible functions of Type C-2. The possibility should be considered that they might have been a timber for a building or a pole-like object, rather than a *yokozuchi/kakiya* mallet.

The following chapter will organize the terms used so far while summarizing the foregoing discussion and move on to understand how the functions of these items changed in the course of time.

4. Functions and Changes for *Yokozuchi/Kakeya*

4-1. Functions

While organizing the findings of the analysis discussed in the previous chapter, this section reconsiders the *yokozuchi*, *kakeya*, and *yokozuchigata* terms used in previously published reports and studies, classifying them as terms distinguished by morphology. Their functions will also be reexamined below.

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Type B and *yokozuchi*

Type B mallets are all wooden mallets for one-handed use and their head area is moderate in size. Use Marks I, II, and III are all found with this group. They are mainly made using broad-leaf hardwoods such as *Cyclobalanopsis* oak and *yabutsubaki* camellia. In functional terms, they were used either for handcraft or agricultural purposes.²³ Examples of Type B-1 cylindrical mallets were multifunctional tools; their functions were for farming in general, but they might also be used for some kind of handcraft. Type B-1 conical mallets, on the other hand, were likely used for beating cloth or for ritual purposes. The two types are referred to respectively as “*entokei yokozuchi*” (cylindrical *yokozuchi*) and “*ensuikei yokozuchi*” (conical *yokozuchi*). Some of *yokozuchi* for handcraft use are separately categorized as “Type B-2” and called “*ōgata yokozuchi*” (large-type *yokozuchi*). Type B-3 and Type B-4 might possibly be tools that had a special function, but they are included among the *yokozuchi* group because they are the same as types B-1 and B-2 in that they too were mallets for one-handed use. Their functions cannot be identified and are not discussed here. The term *yokozuchi* is suitable for the Type B group, which are close to folk tool *yokozuchi* in both shape and function.

Type C-1 and *kakeya*




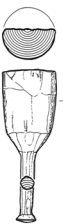

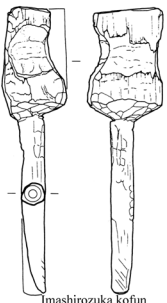
Type C-1 mallets can be used with both hands, their head area is wide, they are made with broadleaf hardwood, and they display only “Use Mark III.” These attributes all indicate that they were mallets used for handcraft work. The term *kakeya* is therefore suitable for these mallets. No particular name is assigned to examples of Type C-2 as their functions remain unidentified.

Types A-1 and A-3 and *yokozuchigata*

The term “*yokozuchigata*” is used to refer to Type A-1. Their handles are not made for gripping and their head areas are small. They often show “Use Mark I” and are mainly made of conifer wood. The functions of these mallets appear to have been mainly symbolic, such as for use in a ritual. Type A-3 is separated from Type A-1 in the scatter plot, but they are close to each other in terms of type of wood used and use marks. It would be better to understand Type A-3 as an exceptional example of the *yokozuchigata* category. Examples of Type A-3 may be considered miniature versions of *yokozuchi*; I would call them *yokozuchigata* (which means “like *yokozuchi*”). It is presumed that type A-2 were *tategine* pestles, not mallets.

Above I have assigned names to these tools according to their morphological

²³ Ritual use might have been possible as an exceptional function. There is no evidence that *yokozuchi* mallets from archaeological sites were ever used for ritual purpose, but many cases of folk tool *yokozuchi* being used in ritual context have been reported by Kamino 1987.

Classifi- cation	Tool type	Examples (1/10)	Assumed functions	
A 1 A-3	Yokozuchigata	 Toishi-Tatsumimae site	Non-pounding tools	<div>Symbolic function</div> <ul style="list-style-type: none"> Ritual tools Assorted tools Toys Furniture (Small tatekine pestles)
		 Yoshitakejō site		
B 1 B-3 B-4 B-2	Yokozuchi	 Karako-Kagi site (cylindrical yokozuchi)	Pounding tools	<div>Agriculturing function</div> <ul style="list-style-type: none"> Beating cloth Crushing beans Pounding straw
		 Heijō Palace lower stratum site (conical yokozuchi)		
C 1	Large-type yokozuchi		Pounding tools	<div>Handcraft function</div> <ul style="list-style-type: none"> Chopping Wedge driving Chiseling Pile driving Plank driving
	Kakeya	 Imashirozuka kofun		

Type A-2 . . . Tategine pestle? Type C-2 . . . Bar-shaped wooden artifact?

Figure 17. Relation between Classification and Functions

classification and described their respective functions (as outlined in Figure 17).²⁴

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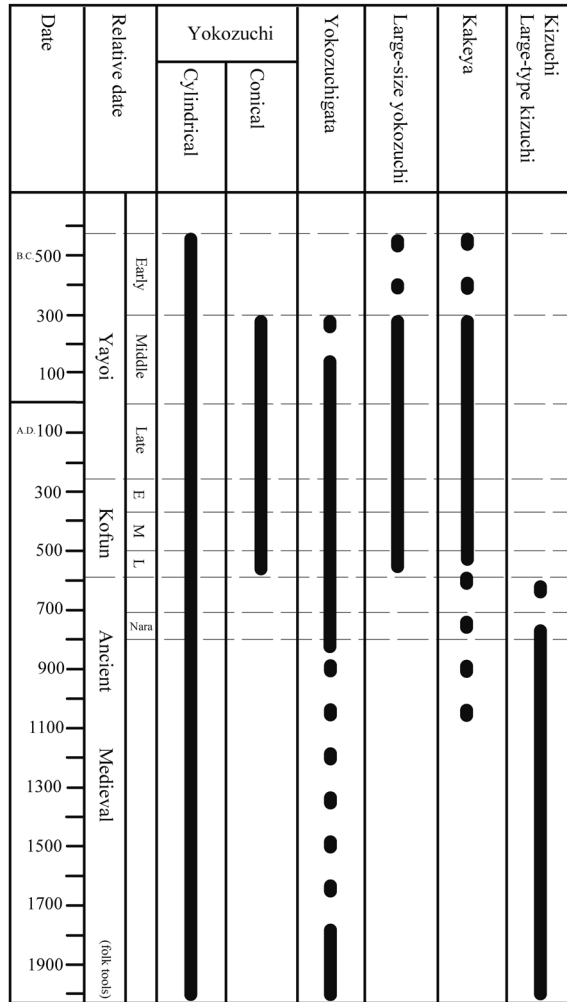


Figure 18. Chronological Survey of Mallets in the Kinki Region

Dotted lines indicate presumption.

²⁴ In terms of function, *yokozuchi* alone had agricultural-tool functions. They often combine Use Mark I or II and use of broadleaf hardwood. The *yokozuchi* with handcraft functions are, in order of small to large, some of cylindrical *yokozuchi*, *ōgata* (large) *yokozuchi*, and *kakeya*. The *kakeya* were large hammers for use with both hands, while the cylindrical *yokozuchi* and *ōgata yokozuchi* were used mainly for striking a hatchet, wedge, chisel, or small pile. The *kakeya* were mainly used to drive in large piles or earth-retaining planks (*yaita*). They often combine Use Mark III and use of broadleaf hardwood. The *yokozuchigata* and some of the *yokozuchi* had a ritual function. They often have Use Mark I and were mostly made of conifer wood, especially until the Early Kofun period.

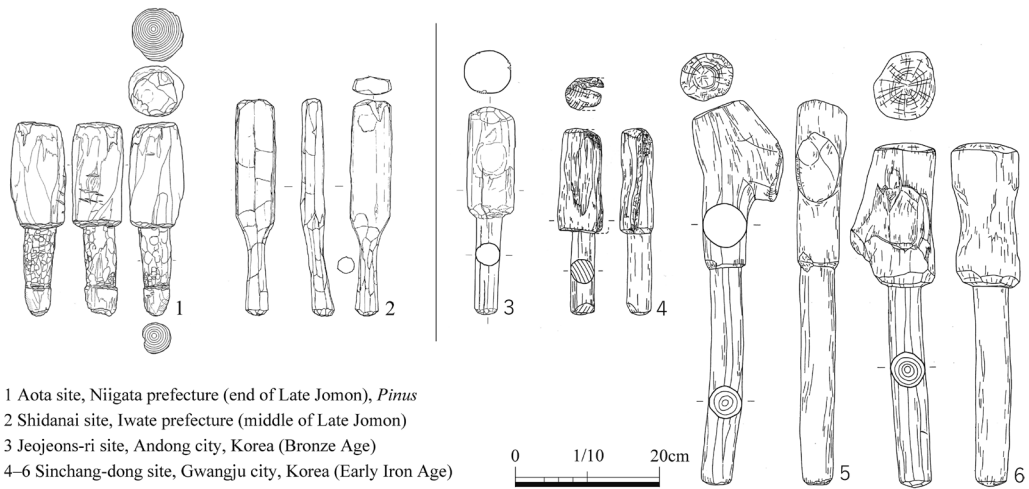


Figure 19. Yokozuchi-Kakeya-like Artifacts in the Jomon Period and the Korean Peninsula

4-2. Chronological Changes

This section considers changes in the *yokozuchi/kakeya* over the course of time and narrows down the possibilities of their functions for each period to discuss the roles they may have performed (Figure 18).

Before the Yayoi period

The *yokozuchi/kakeya* considered here are based on examples collected from the Kinki region that date from the Yayoi period and after. Nationwide, however, a number of *yokozuchi*-like wooden artifacts from the Jomon period have been found²⁵ (Figure 19). The example recovered from the Aota site (19-1) in Niigata prefecture, from the Jomon period, is closer in shape to the *yokozuchi* of the Yayoi period and later, but the use marks seem to be not on the side of the head but on the top end of the head (Arakawa *et al.* 2004). The example from the Shidanai site (19-2) in Iwate prefecture most closely resembles the Yayoi-and-later *yokozuchi*. But it is not very thick; it is shaped rather like a flat paddle. In this way, those from the Jomon period, vary widely in shape, while some have a shape similar to Yayoi and later tools. Very few Jomon mallets have a neatly shaped cylindrical

²⁵ I have confirmed 17 such Jomon wooden artifacts for this paper. Besides these, in Hokkaido many discoveries of *yokozuchi*-like wooden mallets called “Kiusu-style *kizuchi*” (Miura *et al.* 2008) have been reported (Sawada 1996, 1998; Miura *et al.* 2008; Tanishima *et al.* 2010; among others). These discoveries are concentrated in the Ishikari lowlands in Hokkaido (Tanishima *et al.* 2010), and the wood used for most of these mallets is limited to *Acer* (maple) (Miura *et al.* 2008). The artifacts are morphologically diverse: some have carvings or horn-like projections, others are flat in cross section, still others have a handle attached diagonally. The area where they were excavated is very limited, moreover. This suggests discontinuity between these tools and the *yokozuchi* made from the Yayoi period onward.

or conical head found with mallets of the Yayoi period and later. Jomon tools were less stylized than in the later periods. Moreover, *yokozuchi*-like mallets from the Jomon period were found mainly in Hokkaido and the Tohoku region, and none were confirmed in the Kinki region, whereas Yayoi and later *yokozuchi* have been found in large quantities throughout the country. No tools from the Jomon period that are confirmed to have been *yokozuchi* or *akeya* exist. Meanwhile, a small number of Jomon wedges used for splitting wood do exist (Murakami 2002), and so, in the Jomon period there possibly existed wooden tools for driving wedges and stakes, but such have not been confirmed. As things stand now, there is no archaeological evidence for linear continuity between *yokozuchi*-like wooden artifacts of the Jomon period and *yokozuchi* of the Yayoi period. Looking at the Korean peninsula, we find that tools very similar to Yayoi-period *yokozuchi/akeya* have been excavated from the Bronze Age at the Jejeons-ri site in the city of Andong and from the Early Iron Age at the Sinchang-dong site in Gwangju. Most notably, at least nine examples from the Sinchang-dong site correspond to Type B and Type C. Discovery of more such examples and further investigation of them is much needed. From what we know now, it is quite possible that the *yokozuchi* were introduced from the Korean peninsula.

Yayoi and Kofun periods

Yokozuchi, *akeya*, and *yokozuchigata* mallets were made in large quantities in the Yayoi and Kofun periods. *Yokozuchi* mallets with a cylindrical head and a bar-shaped handle—a form typical of *yokozuchi* in later periods had already emerged in the Early Yayoi period—as found at the Karako-Kagi site in Nara prefecture (Figure 7, No. 23) and the Nōso site in Mie prefecture (Figure 7, No. 24). Regarding the function of the earliest type of *yokozuchi* from the Early Yayoi period, Watanabe speculates that it was for crushing beans since *yokozuchi* excavated from the first half of the Yayoi period have a shape corresponding to the shape of folk tool *yokozuchi* used for crushing beans (Watanabe 1985). He also indicates the strong possibility that *yokozuchi* for pounding straw began to diverge from the bean-crushing mallets in the Late Yayoi period.²⁶ The reason he cites is that the species of rice that was introduced to Japan in the Middle to Late Yayoi period was suitable for making things out of straw. He assumes that the earliest *yokozuchi* had the function of crushing *daizu* soybeans (*Glycine max*) and *azuki* red beans (*Vigna angularis*) as with the later *yokozuchi* folk tool. Pointing out that *azuki* red beans appeared in the middle of the Late Jomon period, he suggests the possibility that the bean-crushing *yokozuchi* (the origin of *yokozuchi*) date back to the middle of the Late Jomon period.

In my view, pounding straw was likely among the functions of the earliest *yokozuchi*.

²⁶ Uehara ed. 1993 supports this speculation and emphasizes that straw beating tools proliferated with the spread of root-cutting (*negari*) in harvesting rice.

There is currently no evidence, as mentioned earlier, that indicates continuity of *yokozuchi* from Jomon to Yayoi. Even if some continuous lineage could be identified, recent research has revealed that the widespread use of beans began in the Middle to Late Jomon period (Nasu 2018; Obata 2014), making it incongruous to link beans with a sudden increase of *yokozuchi* in the Yayoi period. It is also notable that although use marks from bean crushing are unknown, *yokozuchi* bearing Use Mark II were already in existence in the Early Yayoi period. As things stand, it seems more appropriate to consider the influence of rice cultivation introduced from the continent than bean crushing as the impetus for making *yokozuchi*.

Yokozuchi were likely used not only for pounding rice straw, but also for pounding or crushing many different fiber materials. The techniques of using vegetable fibers such as hemp, ramie, and mulberry (*kōzo*) to make cloth (Takeuchi 1989), which requires beating them until soft, were probably known since very olden times. While the spread of rice straw pounding can be seen as a major factor behind the quantitative increase and stylization of *yokozuchi* in the Yayoi period, the *yokozuchi* were most likely a tool to beat other fiber materials, too.

Conical *yokozuchi* appeared around the Middle Yayoi period and disappeared around the Middle Kofun period. If the conical *yokozuchi* was for beating cloth, then it means that cloth beating with a conical *yokozuchi* had started by the Middle Yayoi period at the earliest. The practice of beating cloth itself has since continued to the present, as frequently found in historical documentary and pictorial sources, indicating that the cloth-beating function was taken over by cylindrical *yokozuchi* and other bar-shaped wooden tools in the Middle Kofun and later periods.²⁷

Yokozuchigata mallets were already in use in the Middle Yayoi period, and those that were highly standardized in terms of shape and type of wood used existed from the Late Yayoi to Early Kofun periods, coinciding more or less with the rise and fall of conical *yokozuchi*. This increases the probability that *yokozuchigata*-type mallets of the time originated in conical *yokozuchi*. In the Early Kofun period, especially, there emerged a group of *yokozuchigata*-type mallets with a highly standardized shape, made using

²⁷ As a documentary source, the Yūgao chapter from the *Genji monogatari* (The Tale of Genji) has a passage that goes, “Shirotae no koromo utsu kinuta no oto mo kasuka ni konata kanata kiki watasare . . .” (The sound of white cloth being beaten with wooden mallets (*kinuta*) is faintly heard hither and yon . . .). From this passage we know that the work of cloth beating with a *kinuta* was in existence by the early eleventh century when the *Tale* was written. A pictorial source from the Kamakura period, *Ise shinmeisho utaawase emaki*, an illustrated handscroll showing a poetry contest on the themes of newly selected places in Ise, written around 1295, has an illustration showing a woman beating cloth with a mallet (Komatsu ed. 1992). The mallet she holds seems to be a cylindrical *yokozuchi*. Moreover, according to Nagahara Keiji, before the spread of cotton in the sixteenth century, the main fibers for weaving cloth had been hemp and ramie, and such hard fibers had to be beaten in order to produce cloth comfortable to wear (Nagahara 2004). Even after cotton became widely in use, beating cloth with a mallet continued to be widely practiced in the bleaching, calendaring, and washing processes, as depicted in *ukiyo*e and other paintings.

inugaya plum yew (*Cephalotaxus harringtoni*). A miniature stone artifact shaped like *yokozuchigata* was unearthed at the Tenjinyama Kofun site (Middle Kofun period) in Gunma prefecture (Toyama 1976; Hōjō & Negita 2002), as also pointed out by Hozumi 2011, and this discovery at the largest tumulus in eastern Japan is important in understanding the way ritual ceremonies using *yokozuchigata*-type mallets were conducted in those days. *Yokozuchigata* mallets from the Middle and Late Kofun period were not as standardized as in the earlier times in terms of shape and type of wood used, but those excavated at such well-known ritual sites as the Rokudai A site and the Nangō-Ōhigashi site are worthy of note.²⁸

The Yayoi and Jomon periods were also the time when *akeya* and large-type *yokozuchi* were used in handcraft work. Yamada Masahisa argues that, given that few wedges or no *akeya* have been excavated from the Jomon period, the splitting of timber did not become a wide practice until the Yayoi period (Yamada 2018). He also indicates that, given the stylization of *akeya* in the Yayoi period, the spread of wedges and *akeya* suggests splitting timber was a daily practice in that period (Yamada 2012). This indication agrees with the present study's finding that the period of production of the *akeya* unearthed in the Kinki region is limited to the Middle Yayoi to Kofun periods. But, if the *akeya* and large-type *yokozuchi* that appeared in the Yayoi and later periods were also used for pounding stakes or piles and driving in earth-retaining planks as with modern-day large-type *kizuchi* wooden hammers, then we would not be able to attribute the increase of *akeya* only to the spread of the timber splitting. Among the *akeya* examples were those with a concavity covering a broad area of the surface, such as shown in Figure 7, No. 38, suggesting the strong possibility that they might have also been used to strike earth-retaining planks (*yaita*) and large piles. A useful reference here might be a report on the *akeya* from the Hyakkengawara Ojima site in Okayama prefecture. "These [*akeya*] were used for driving in piles, etc., and both sides of their thick head are indented. They were indispensable tools for rice cultivation related earthworks such as irrigation ditches, weirs, and embankments" (Okada 1984). We should understand that the increase of *akeya* was related not only to timber splitting but also to the work of driving piles and *yaita* planks into earthworks. In the Yayoi period, "Rice paddy irrigation technologies [for building water channels, weirs, ridges] . . . were introduced along with farming tools, as a single system" (Hirose 1988), and if that was the case, it is highly likely that numerous piles and *yaita* planks were required to install weirs and other structures necessary for maintaining rice paddies, increasing the demand for *akeya*. At the Nakakyūhira site in Fukuoka prefecture, indeed,

²⁸ The *yokozuchigata*-type mallets were found in river and ditch areas at the Nangō-Ōhigashi and Rokudai A sites, and from the same stratigraphic location wooden ritual items such as *katashiro* effigies were unearthed. Hozumi reports that groups of finely made *yokozuchi* and *yokozuchigata* tools have sometimes been excavated from ritual sites like the Rokudai A site (Hozumi 2011).

rows of piles and a large number of *akeya*, likely used to drive them into the ground, have been excavated (Rikitake & Ōba ed. 1987).

It is still difficult to judge whether *akeya* were uniquely created on the Japanese archipelago or were introduced from the Korean peninsula, but tools closely resembling *akeya* have been unearthed in the peninsula (Figures 19-5 and 19-6). If information on rice-related living and production environments, including the methods of building settlements and fields, was also introduced along with paddy rice cultivation (Kuraku 2008), it would be quite possible that the *akeya*, an important tool for reclaiming land, might have made their way from the continent.

In the Yayoi and Kofun periods, as the above shows, the demand for such works as driving in piles and *yaita* planks grew as rice cultivation spread. This presumably had a strong bearing on the increase of *yokozuchi* and *akeya*.

Ancient period and later

In my view, cylindrical *yokozuchi* did not change much from those in the Kofun period and continued to exist in the Ancient period. They were also found at Medieval and Early Modern sites (Yamaguchi 2014 and others). They were presumably linked to modern folk tool *yokozuchi*. Since cylindrical *yokozuchi* are thought to have been multifunctional tools, they were probably used for pounding rice straw, crushing beans, and beating cloth in various eras and regions.

As for *yokozuchigata* tools, two examples from the Ancient and later periods were collected (Figure 7, Nos. 16 and 17), and, compared with *yokozuchigata* examples of previous times, both were very roughly made such as with a curved handle. And no longer having such features as an end knob or a conical head, they were far less standardized than before. They likely show a change in the symbolic function earlier represented in the *yokozuchigata* mallets. *Yokozuchigata* of this period have a relatively long effective handle length, indicating a possibility that they might have been small-sized beating tools. From later times, too, many examples of *yokozuchigata* mallets from the medieval Kamakura period (Yamaguchi 2014) has been confirmed, and so also were modern folk tool *yokozuchigata* mallets. This suggests that miniature *yokozuchigata* mallets continued to be produced while their functional significance underwent changes.

A major epochal shift occurred as the *akeya* and large-type *yokozuchigata* mallets that had been used for handcraft functions disappeared, and were replaced by *kizuchi* hammers. In my view, the *kizuchi* were introduced and then began to spread for construction of large-scale buildings of political significance in and after the Asuka period (552–645).

Among *kizuchi* and large-type *kizuchi*, the oldest unearthed as of today is an item from the eighth century (Figure 20). Excavated examples are very few in the Ancient period (approx. seventh to twelfth centuries) and their exact dates are unknown.²⁹ *Kizuchi* were

unearthed at the sites of capital cities and government offices.

Another handcraft tool excavated in large numbers from capital city sites and government-office sites around the same time were carpenter's ink pots (*sumitsubo*). Uehara Mahito writes, "The epochal event in the Ancient history of building technology on the Japanese archipelago was the introduction of Buddhist temple architecture from the continent. [Most significant] was the construction of the Asukadera temple," adding that the oldest ink pot made its way to Japan from Baekje, Korea around that time (Uehara 2009).

Watanabe Akira, who studies carpenter's tools from an architectural history perspective, points out that the advanced architectural technology introduced from the continent by Baekje carpenters who

were invited to Japan during the Asuka period brought a major change in the composition of tools for processing timber and wood (Watanabe 2004b). Among the tools that he says appeared around that time were large-type saws and planes. I speculate that *kizuchi*, too, were among the wooden tools brought from Baekje in the Asuka period. Actually, on the Korean peninsula *kizuchi* from the Three Kingdoms period (the first century BCE to seventh century CE) were excavated at the Samnyeong Sanseong fortress, Boeun (Figure 21). In the context of ruling-class control of building technology, it is likely that the increase in timber splitting was strongly linked to the shift from large-type *yokozuchi* and *akeya* to the *kizuchi*. Medieval illustrations often depict scenes of timber being split with a *kizuchi* (Watanabe 2004a), which indicates that *kizuchi* were indispensable tools for processing wood in the construction of temples and shrines. In regions outside of Kinki, meanwhile, large *akeya* have been excavated even from Ancient sites (Figure 22), which suggests the possibility that, for a certain period of time after their introduction, *kizuchi*

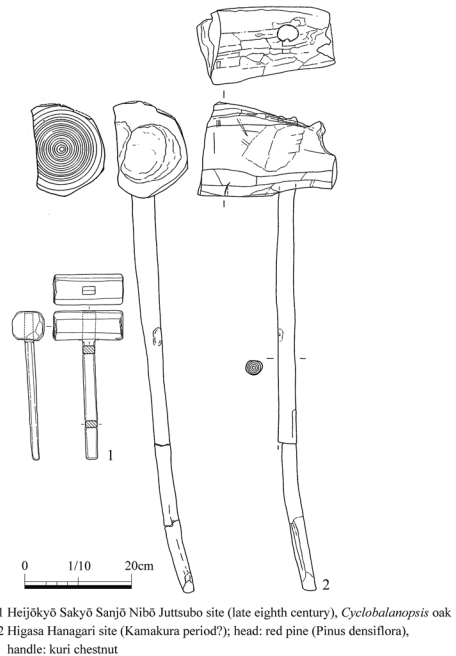


Figure 20. *Kizuchi* and Large-type *Kizuchi*

²⁹ For this study, I have confirmed five large-type *kizuchi* and eight *kizuchi* in the Kinki region. Distinguishing the two requires quantitative analysis, but with so small a number of examples available such analysis is difficult. Here let me define "large-type *kizuchi*" (*ōgata kizuchi*) as the ones that are larger than easy-to-carry *kizuchi*. Excavated *ōgata kizuchi* are especially rare, and the oldest example confirmed for this study dates back only to the Kamakura period (the earliest phase of the Medieval period). However, because the *kizuchi* that have the same structure as *ōgata kizuchi* that were excavated from Ancient sites, this study assumes that *ōgata kizuchi* appeared either about the same time or slightly later than *kizuchi*.

were used only by carpenters who belonged to the system of officially patronized workshops. I presume that handcraft-use *yokozuchi* and *kizuchi* continued to be used even in the Ancient period and later with functions divided between them.

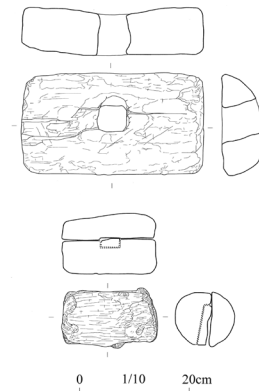
5. Epilogue

Given their simple shapes, *yokozuchi* and *akeya* appear to have been suited to beat or pound almost anything. That is precisely why it is necessary to adequately identify and analyze the attributes that reflect their functions, which would lead to an empirical study of functions.³⁰ The present study focuses on the handle length of the tools that have been called “*yokozuchi*,” “*akeya*,” and “*yokozuchigata*” and classifies them according to their handle length. It assumes their respective functions by looking at the relationship among their head part, selection of wood type, and use marks, and organizes their names by morphological definition. Tracing the changes in these tools over time, furthermore, provides glimpses into the development of farming tools.

Acknowledgements

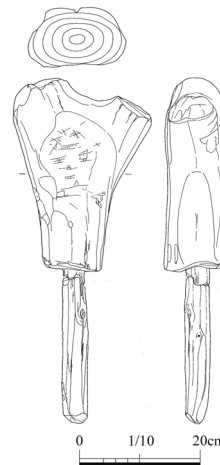
This paper is a revision of my graduation thesis submitted to the Ritsumeikan University College of Letters in December 2018. Professor Nagatomo Tomoko kindly gave me invaluable comments and suggestions on both the content and methodology of the thesis.

³⁰ A more empirical way to identify functions is to analyze the residue attached to a tool’s head area. Regarding pestles, mortars, and other folk tools used by the Ainu people, Kamijō Nobuhiko identifies the specific materials processed, by analyzing residual grains of starch on these tools and discusses the relationship between these materials and tool shapes and use marks (Kamijō 2014). In the case of *yokozuchi*, residue of plant fibers other than starch may be attached; analysis of residues is thus also important in assuming functions.



Samnyeong Sanseong Fortress, Boeun
(Three Kingdoms period [1st century BCE to 7th century CE])

Figure 21. *Kizuchi in the Korean Peninsula*



Shimokawatsu site, Kagawa prefecture
(Ancient, 7th to late 8th century)

Figure 22. *Akeya in the Ancient Period*

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