STONE ADZES OR ANTLER WEDGES? AN EXPERIMENTAL STUDY ON PREHISTORIC TREE-FELLING IN THE NORTHWESTERN BOREAL REGION

Jacques Cinq-Mars
Department of Anthropology, 13-15 HM Tory Building, University of Alberta, Edmonton, AB, Canada T6G 2R3;
jacques@ualberta.ca or jacques.cinqmars@sympatico.ca

Raymond Le Blanc
Department of Anthropology, University of Alberta; ray.leblanc@ualberta.ca

ABSTRACT

"Adze-cut stumps" is the name commonly used by both local residents and passing ethnographers and archaeologists to designate culturally modified tree stumps that are known to occur in many areas of the Northwestern boreal forest. As the name implies, they have been viewed as indicative of ancient logging or tree-felling activities, presumably carried out with stone adzes, and whose resulting particular morphological attributes have long been interpreted as indicative of a relatively great antiquity, i.e., generally dating back to (or prior to) the period of European contact when traded steel axes quickly replaced the stone adzes. However, a close examination of available ethnographic data, personal field observations, and, particularly, the first results of an experimental tree-felling study indicate quite convincingly that such features should best be interpreted as having been created by an entirely different technique making use of "antler wedges." Furthermore, field observations from the Old Crow/Porcupine area can be used to suggest that quite a number of these "stumps," especially when found in clusters, may well be associated with the construction and maintenance of caribou fences, semisubterranean housepits, and various types of caches. Finally, recently obtained preliminary dendrochronological results and radiocarbon dates indicate that these "stumps" are indeed precontact in age, and that some of them date back to at least the beginning of the second millennium AD.

Keywords: experimental archaeology, ethnoecology, lithic technology

INTRODUCTION

Throughout the Yukon Territory, researchers have recorded discoveries of well-preserved old tree stumps that are thought to be the result of precontact tree-felling activities. Such features, which are often called adze-cut stumps, have attributes that distinguish them from stumps that result from using steel axes, and, as we show in this paper, possibly stone axes or adzes as well. Typically, adze-cut stumps taper gradually from the intact portion of the trunk near ground level to the severed portion near the top. The stump sides exhibit tapered flat facets that result from the prying away of thin, narrow slabs of the tree trunk. Unlike steel axe–cut stumps, there are no transverse, or any other, chopping marks, nor do they show evidence of single or multibeveled cut faces resulting from the use of axes to create a notch or overlapping notches in the trunk.

Douglas Leechman provided the first description of these distinctive "culturally modified trees" (using current terminology), based on observations in the southern Yukon along the Alaska Highway. He provided a plate (Leechman 1950:Pl. XI) and a schematic illustration of attributes of these artifacts (Leechman 1950:Fig. 3). He also discussed how they were created based on information he collected from "four people in four different places" (Leechman 1950:46). He noted the use of two methods:

> Two different types of tools ... One was a wedge of caribou antler, shaped like a cold chisel, which was driven into the wood with a maul or stone hammer. The other was a celt, made of greenstone or some other dense, hard rock, and hafted to a spruce root handle. When the wedge was used, it was held horizontally and driven into the tree trunk at a convenient height above the ground, usually about 2 ½ or 3 feet. It was so held as to enable the workman to pry off a vertical slab of the tree trunk about 1 ½ inches wide, ¼ inch thick, and 8 or 9 inches long. When the first slab or sliver had been removed, the edge of the wedge was placed near one side of the scar thus produced and a second slab was pried off. This procedure was repeated till the tree trunk had been completely encircled. If necessary, a second or even a third round was cut, but this was done only when larger trees had to be felled. (Leechman 1950:46)

He added that most of the stumps observed were less than "6 inches [~15 cm] thick at the point where they had been cut, but trees of almost any size could have been felled if it was found necessary or desirable" (Leechman 1950:46). Interestingly, Honigmann reported the use of caribou horn or antler for tree cutting among the Kaska Athapaskans of the southeastern Yukon, noting that "[t]he efficiency of an ax [i.e., stone axe] remained so limited that horn adzes were regarded as eminently more satisfactory for cutting down growing timber" (Honigmann 1954:27). Following the Leechman and Honigmann work, Johnson and Raup (1964:Fig. 50, pp. 193–194) reported other instances of adze-cut stumps from southern Yukon, which were also found along the Alaska Highway. Their excellent illustration of several samples is reproduced here (Fig. 1).

Although the evidence for use of antler wedges in tree-felling activities was documented for the Yukon in the 1950s, anthropologists and other researchers working in the northwestern boreal forest almost invariably continue to refer to faceted, tapered stumps as having resulted from chopping activities using stone adzes (e.g., Flucke 1953; Hadleigh-West 1963:105; Johnson and Raup 1964:Fig. 50; McClellan 1975:193; McKennan 1959:65, 1965:37; Nelson 1973:35). Since there have been archaeological specimens of antler wedges found in the northern Yukon at a number of sites, we decided to conduct experimental work to determine if antler wedges could indeed have been used for felling trees. Here we report on the results of ex-

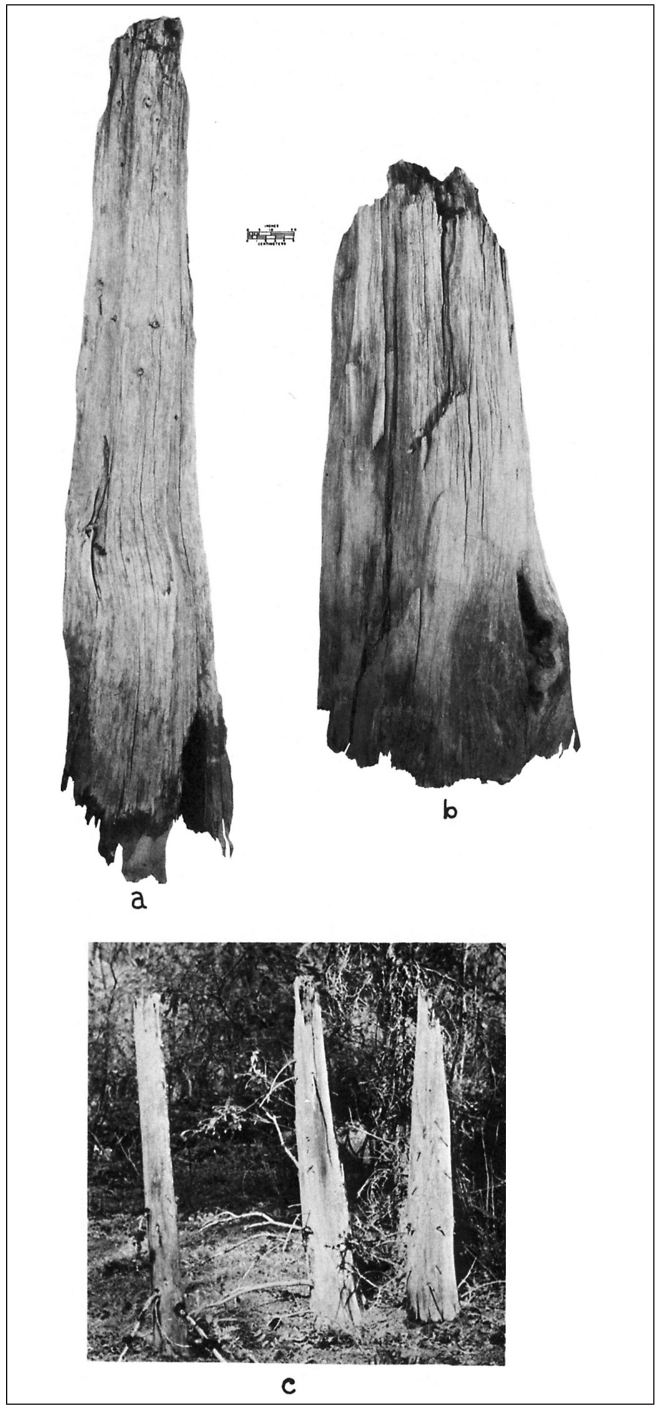

Figure 1. White spruce "adze-cut stumps" from Southern Yukon (from Johnson and Raup 1964:Fig. 50, p. 179)

periments that demonstrate the effectiveness of the use of antler wedges for tree-felling. As well, we document the presence of these stumps in the northern Yukon and, in one instance, examples of the logs that were produced by this precontact technology.

ARCHAEOLOGICAL EVIDENCE FROM THE NORTHERN YUKON: WEDGES AND STUMPS

Fig. 2 shows the distribution of locations with more than one adze-cut stump that have been recorded in the northern Yukon since the 1960s. Clusters of these stumps are often found around caribou fence complexes (Fig. 2:a–e). These log-based structures typically consist of elongated U-shaped corrals or traps, diversion fences with associated cache features, and villages or camps with additional caches (elevated or ground), drying racks, and habitations (e.g., Greer and Le Blanc 1992; McFee 1981; Roseneau 1974; Warbelow et al. 1975). Based on ethnographic data and a preliminary dendrochronological study (Alldritt 1987), most of the wooden components from these fences date to the late nineteenth century, when steel axes were available. However, nearly all of the fence complexes have at least some evidence of stumps and structural parts that were cut with some type of precontact tool. One fence in particular (Black Fox #3), which was in very poor condition when studied in 1981 (Alldritt field notes 1981), had almost no evidence of the use of steel axes; adze-cut stumps (Figs. 3, 4) were common, and virtually all fence components were cut without the aid of steel tools. An estimated tree-ring date suggests a maximum age of AD 1740 (Alldritt 1987), which in this region is considered proto- or precontact.

Other stump clusters are associated with housepit features such as at Rat Ridge Spit (site NbVo-4) (Fig. 2f), located on the northwestern fringe of the Old Crow Flats (Greer and Le Blanc 1992). Dozens of adze-cut stumps were observed at this site, ranging from 10 cm to more than 30 cm in diameter. Finally, what appears to be a collapsed cache made of adze-cut logs was discovered at the mouth of a small cave, in the upper Porcupine River drainage (Figs. 5, 6). The cut ends of the logs have characteristic faceting caused by the detachment of slabs of the tree trunk during felling, and are the complement to the stumps. Preliminary dendrochronological estimates suggest that the logs could well date to the middle of the nineteenth century (Greg Hare 2001, personal communication).

Antler wedges have been reported from a few sites in the northern Yukon. Three surface finds come from localities along the Porcupine River, up- and downstream from the village of Old Crow (Bonnichsen 1979:129–131, Pl. VIII-19, VIII-20; Morlan 1980:336–338) (Fig 7 a–c). Bonnichsen referred to them as beveled antlers, but Morlan preferred the more common "wedge" term. Initially considered to be possible candidates for a late Pleistocene presence in the region, in the mid-1980s two of these wedges were subsequently dated and found to be somewhat less than two millennia old (Nelson et al. 1986:Table 1), likely relating to the Old Chief Phase of the late Prehistoric period (Le Blanc 1984). Two other specimens from the Old Crow River, not reported by Morlan and Bonnichsen, are included in this study (Fig. 7d–e) Finally, one example has been found in excavated context at the Rat Indian Creek site (Fig. 7f). It is from a layer that is also part of the Old Chief Phase, and is likely to be about fifteen hundred years old (Le Blanc 1984:Pl. 77, p. 491). Table 1 presents summary data on sizes of these specimens.

THE EXPERIMENTS

WEDGE MANUFACTURE

Suitable caribou antler was obtained from an Old Crow resident. The condition of the beams was judged to be

Table 1: Attributes of experimental and archaeological wedges

Wedge	Length (cm)	Thickness	Edge Angle**	Illustration
A*	24.4	2.9	18°	Fig. 9
B*	23.5	3.9	26°	Fig. 8
C*	22.5	3.2	22°	Fig. 8
MiVl-1:1	20.3	2.8	25°	Bonnichsen 1979:Pl. VIII-19, 109-1; Fig. 7A
MjVj-6:1	24.8	2.9	25°	Bonnichsen 1979:Pl. VIII-19, 114-1; Fig. 7B
MjVl-1:26c	19.0	3.2	30°	Bonnichsen 1979:Pl. VIII-20, 115-26; Fig. 7C
MjVg-1:4045	20.0	3.8	–	Fig. 7F

*Denotes experimental

**The edge angle was taken dorso-ventrally at the bit end.

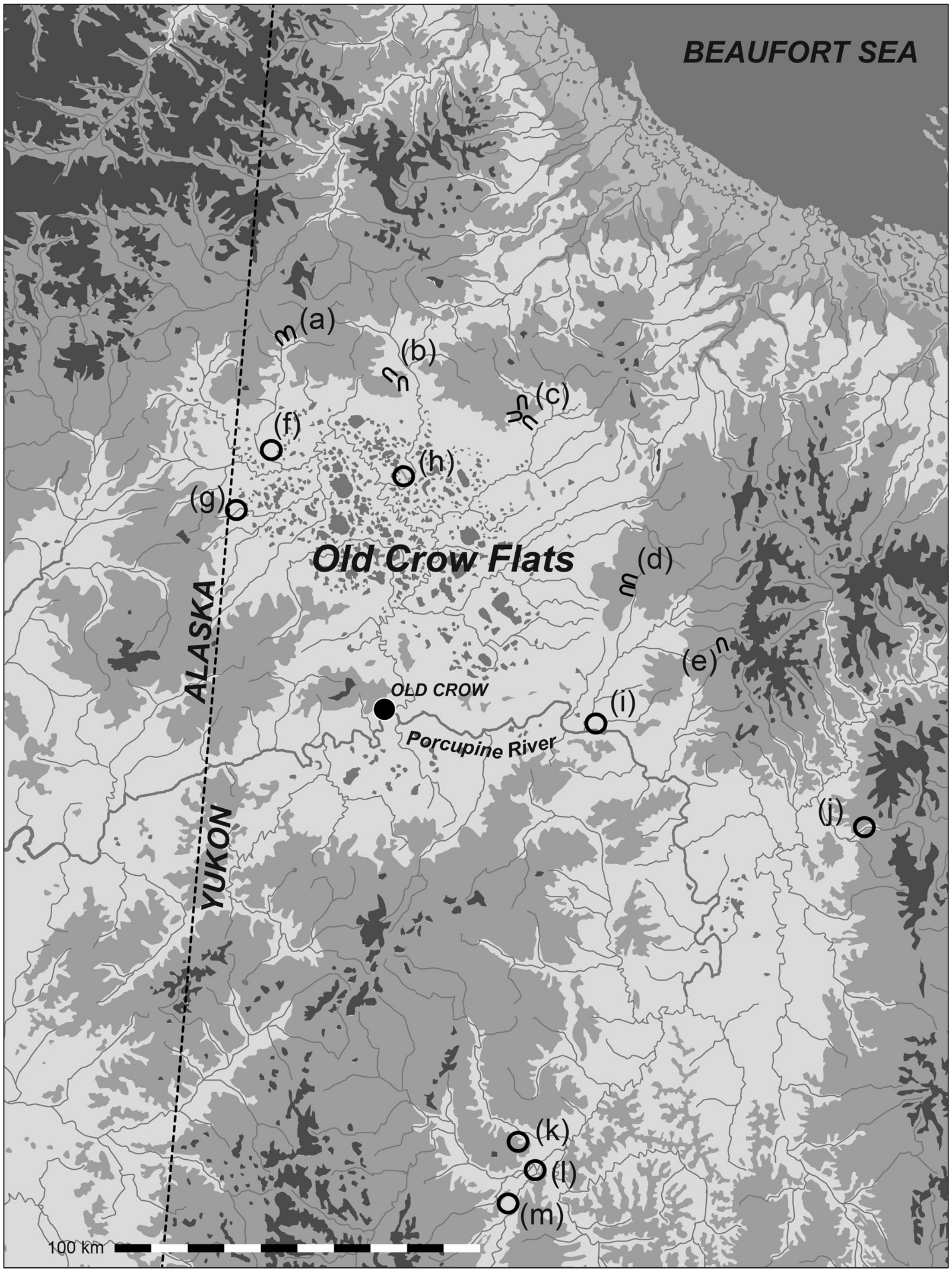

Figure 2. Locations of "Adze-cut stumps and Logs": (a) Thomas Creek—caribou fences; (b) Timber Creek—caribou fences; (c) Black Fox Creek—caribou fences; (d) Driftwood Hills—caribou fences; (e) Berry Creek—caribou fences; (f) Rat Ridge—all associated with prehistoric housepits; (g) Potato Hill—prehistoric housepits; (h) Timber Hill—stump clusters; (i) Rat Indian Creek site; (j) Trail River—stump clusters; (k) Tsi-tché-Han cave—log cache; (l) Bear Cave—cut logs; (m) Fishing Branch cave—log cache.

excellent, as there was no sign of bleaching or desiccation cracking that would suggest long-term exposure; the material was also dense and hard. The antler was probably obtained from 1997 or 1998 kills.

The work sequence for producing three experimental wedges was as follows:

1. Sections were cut from the main beams of two male caribou antlers using a standard carpenter's saw and a Swede or bow saw.
2. Beveling of the working ends was initially shaped with a sharp steel axe.
3. After roughing out, the bevels were further shaped using a steel axe, and completed with a rotary sander equipped with a relatively fine sanding disk.

The whole manufacturing process required an afternoon to make three wedges. Basic attributes are presented in Table 1 along with measurements on comparable archaeological specimens.

Obviously, our fabrication of these items using modern technology does not represent a true replicative experiment in all steps. However, the purpose of the work was to demonstrate the feasibility of the logging action. Inspection of archaeological specimens from the middle Porcupine River region indicates that the wedges were likely made using longitudinal and transverse grooving techniques to extract blanks, then additional working using whittling and scraping to configure and sharpen the working end (Le Blanc 1984). Both felling experiments were conducted at the Rat Indian Creek site (MjVg-1), which is located on the right bank of the Porcupine River about 90 km by boat upstream from the village of Old Crow.

EXPERIMENT 1

A white spruce (*Picea glauca*) about 12 cm in diameter was selected for the first felling exercise. Using a wedge, the bark was peeled off from a section of the tree trunk at a convenient location for the cutting operation, approximately 80 cm above the ground surface. Cutting was initiated by orienting the wedge transversely to the vertical axis of the trunk, placing the tip of the wedge a few centimeters in from the maximum diameter of the tree. The wedge was then hit on the thick or butt end using a 2 lb (~1 kg) sledgehammer. The initial splitting process lifted a small section of the trunk, and further hammering to about halfway through the length of the wedge produced a long, narrow (~5–8 cm wide) segment of wood from the surrounding trunk (Fig. 10 a–c). The segment could then be split away from the trunk by grasping the butt end of the wedge tool and using it as a lever, causing the isolated segment to split up and down the trunk and eventually to snap at the point where the wedge was inserted. It was then a fairly easy task to peel the trunk segments or slabs upward and downward from the wedge entry point, so that they could be pulled away from the tree trunk. This process created a flat area or facet on one side of the tree that then served as a "platform" for removing the next slab. To do so, the wedge was again positioned on the flat area 1–2 cm from the exterior edge of the trunk, and hammered through the next segment. The process was continued around the circumference of the trunk, much like a beaver attacks a tree, until only a few centimeters was supporting the tree; then it was simply pushed over (Fig. 10d). Hadleigh-West (1963:105) used the term "beavered" to refer to the distinctive features of similar stumps from the Chandalar region near Arctic Village in northeastern Alaska.

During the experiment, the first wedge (Fig. 8, wedge B) was replaced after a few minutes because the beveled edge angle (between the dorsal and ventral faces of the wedge) appeared to be too abrupt or steep; a tool with a more acute angle (Fig. 8, wedge A) was then substituted, and the process improved considerably. In all, the felling exercise took ten minutes, but this included pauses for photographs and to change wedge tools. Aside from slight polish, the cutting tip of the wedge did not exhibit any damage at the end of Experiment 1. The butt end showed a moderate amount of compression damage to the rind or antler cortex from the hammer blows. Fig. 11 shows the resulting stump.

EXPERIMENT 2

A second tree, in this case a black spruce (*Picea mariana*) with a diameter of 10 cm, was cut down using the narrow angle wedge (A) using the same technique and at about the same height above the ground surface. The process took five minutes (Fig. 12). A slight nick was left in the cutting edge from contact with a hard knot (Fig. 9). The accumulated impact damage on the butt end from the two experiments was moderate.

General Observations

1. Neither tree sustained any evidence of cutting or abrasion marks on the facets left by the cutting action of

Figure 3. Sample of "Adze-cut stumps": (A–C) Rat Ridge Spit; (D–E) Driftwood Hills Caribou Fence Complex 2; (F) Frances Lake, Northwest Territories.

the wedge. This accords with observed archaeological stumps with similar morphology. In contrast, if a stone axe or copper adze had been used to cut the archaeological examples, one would anticipate that there would have been cut marks left on the stumps.

2. The process goes very fast, but could have been improved with more experience and a slightly longer wedge tool that would improve leverage for prying slabs away from the tree trunk.
3. Although a modern hammer was used as an impactor, similar results could have been achieved easily with a handheld cobble or a wooden maul.
4. The majority of wear/damage occurs on the hammered end of the wedge. This could be minimized by wrapping this end with hide to cushion the blows, or

Figure 4. "Adze-cut stumps" from the Rat Ridge site (NbVo-4).

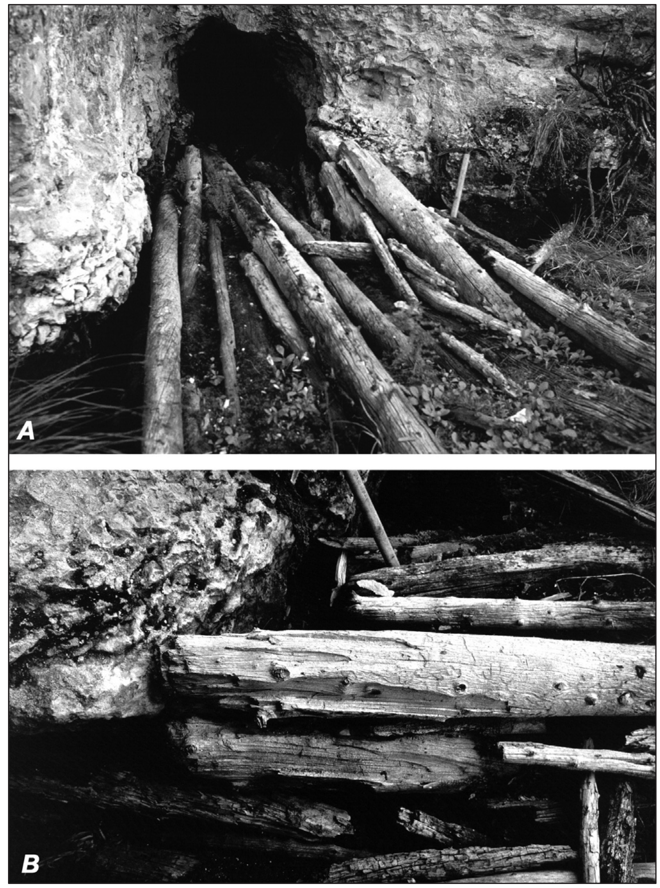

Figure 5. Fishing Branch log cache: (A) collapsed cache in front of the cave; (B) detailed view of some of the logs.

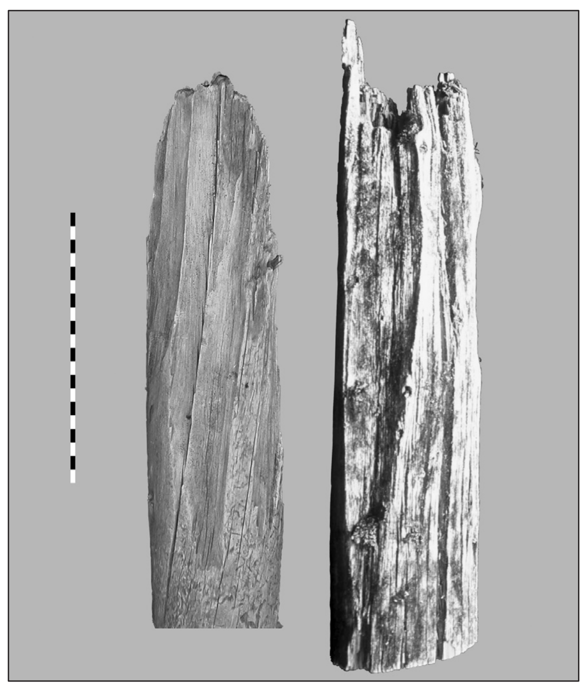

Figure 6. Examples of the culturally modified ends of two of the Fishing Branch cave logs.

perhaps by using a wooden maul in combination with the hide covering. Flake scars on the impact end on the Rat Indian Creek archaeological specimen (Fig. 7f) indicate the use of direct percussion, probably with a stone hammer. In reference to archaeological wedges, Morlan (1980:337) suggested that the cancellous tissue on the hammered end could have been hollowed out and a wooden plug inserted to "preclude serious damage to the butt."

5. The sap in spruce trees (especially white spruce) is slippery and provides an excellent lubricant for the wedge. This likely minimizes wear.
6. Unlike swinging a hafted adze or even an axe, the use of the wedge provides excellent control over the cutting process. This is analogous to the indirect percussion method in used stone flaking.

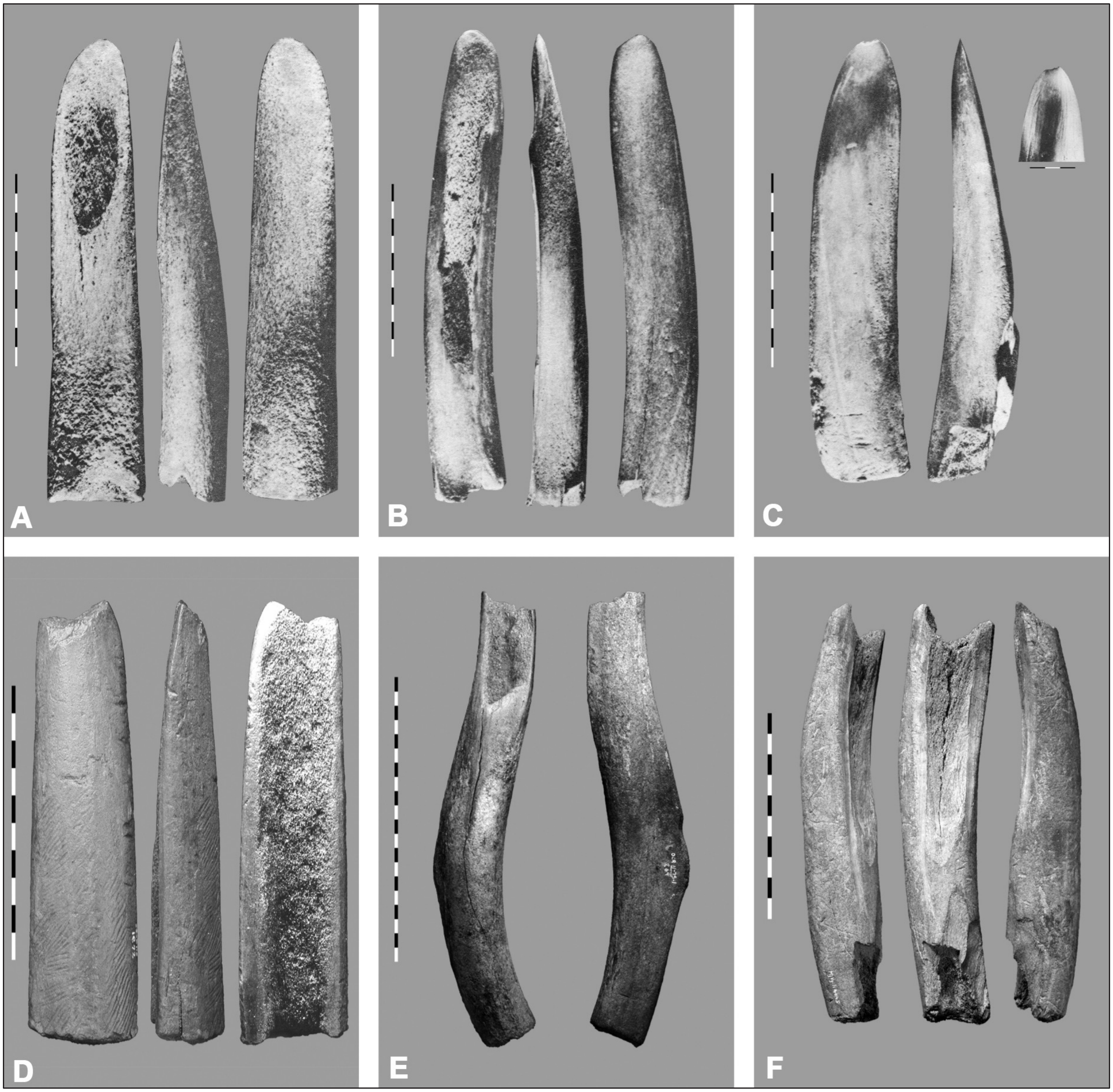

Figure 7. Prehistoric antler wedges from deposits located along the banks of the Porcupine and Old Crow rivers. (A–C) Porcupine River (note slightly damaged tip on C and compare to that illustrated in Fig. 9; (D–E) Old Crow River (note heavy distal wear and damage); (F) Rat Indian Creek site, Porcupine River (note heavy distal and proximal wear and damage; note also that this is the only antler wedge ever found in situ). Scale in centimeters.

Figure 8. Two of the three experimental antler wedges that were made for the tree-felling experiment. Both (B, on the left, and C, on the right) were found to be inefficient due to the obtuseness/thickness and short lengths of the wedges. Scale in centimeters.

DISCUSSION

Using antler wedges to fell trees is comparable in many ways to splitting logs to quarter them for making smaller pieces as blanks for a variety of items, or to producing planks, a procedure that is widely known in western North America (e.g., Jenness 1972:37). What was impressive in our experiments was the speed and ease with which softwood tree species such as spruce could be felled using the replicated wedges. Equally important is the success of the experiment in duplicating the attributes of archaeological stumps and logs in all details, particularly in the faceting and the absence of any chopping marks. Although the experimental exercises were on trees with moderate diameters, observations of stumps at caribou fence complexes and at Rat Ridge Spit indicate that diameters 30+ cm were likely feasible with the use of antler wedges, a fact that Leechman observed, though not specifically in reference to using a wedge. It would appear, therefore, that our data agree quite well with oral history data collected in the 1950s in the southern Yukon.

We believe that the lack of chopping marks, combined with elongate faceting, are hallmarks of the use of antler wedges, rather than stone axes or adzes. Unfortunately, as far as we are aware, there are no other comparative experimental data involving tree-felling with antler wedges. However, there is a significant body of information on experiments with stone, bronze, and iron or steel tools. These usually involve comparing efficiencies measured by timing felling exercises with the axes or adzes made of different (i.e., stone or metal) materials on various species of wood (e.g., Coles 1979:101–102, Fig. 29; Flucke 1953; Mathieu and Meyer 1997; Renfrew and Bahn 2004:336; Saraydar and Shimada 1971). There is also an informative ethnographic

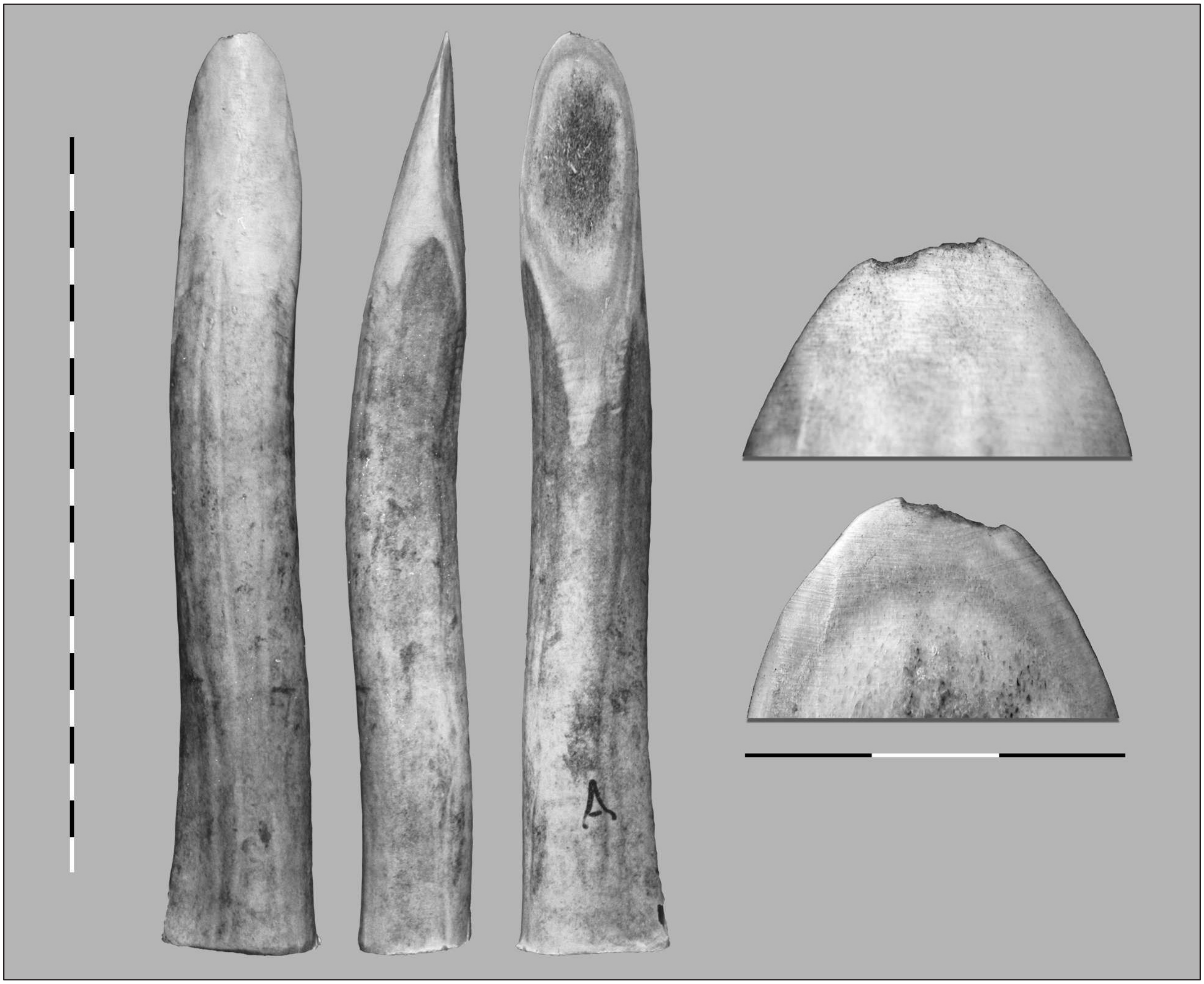

Figure 9. Experimental antler wedge A, which was used for the tree-felling experiment (note the slightly damaged tip).

report from Indonesia (Pétrequin and Pétrequin 2000). Where figures are provided, the stumps resulting from these experiments all exhibit varying degrees of chopping marks, some quite intensive. Coles (1979:Fig. 29), for example, illustrates the results of two experiments on spruce with stone and bronze axes, respectively. The stone-cut stump (~13 cm in diameter) is described as splintered, with chopping facets clearly visible on the log portion. The effect on the visible portion of the stump is actually highly splintered if not shredded in appearance. The bronze axe-cut stump (~20 cm in diameter) has clear, short chopping marks that closely resemble what would be achieved with the use of a modern steel axe. Both cutting experiments took three minutes.

Recent ethnographic work in Indonesia deals with a comprehensive study of stone axes. Stumps cut with a hafted, long-handled stone axe show a process of felling by chopping a notch into a trunk, much like using a steel axe (Pétrequin and Pétrequin 2000:Fig. 15), i.e., by swinging the axe in an inclined horizontal plane. The short horizontal base of the notch is splintered, but the long inclined upper portion is covered with short, overlapping chopping facets. In contrast, the adze was swung in a vertical plane in line with the vertical axis of the tree (Pétrequin and Pétrequin 2000:Fig. 18). The resulting chopped section has long, and once again, overlapping, fairly thin chopping facets that result in a cluster of attached wood shavings at the base of the chopping area.

In short, the cutting attributes on stumps and logs using stone, bronze, and steel axes differ clearly from the experimental examples reported in this paper. The major differences are that facets on wedge-cut stumps are split

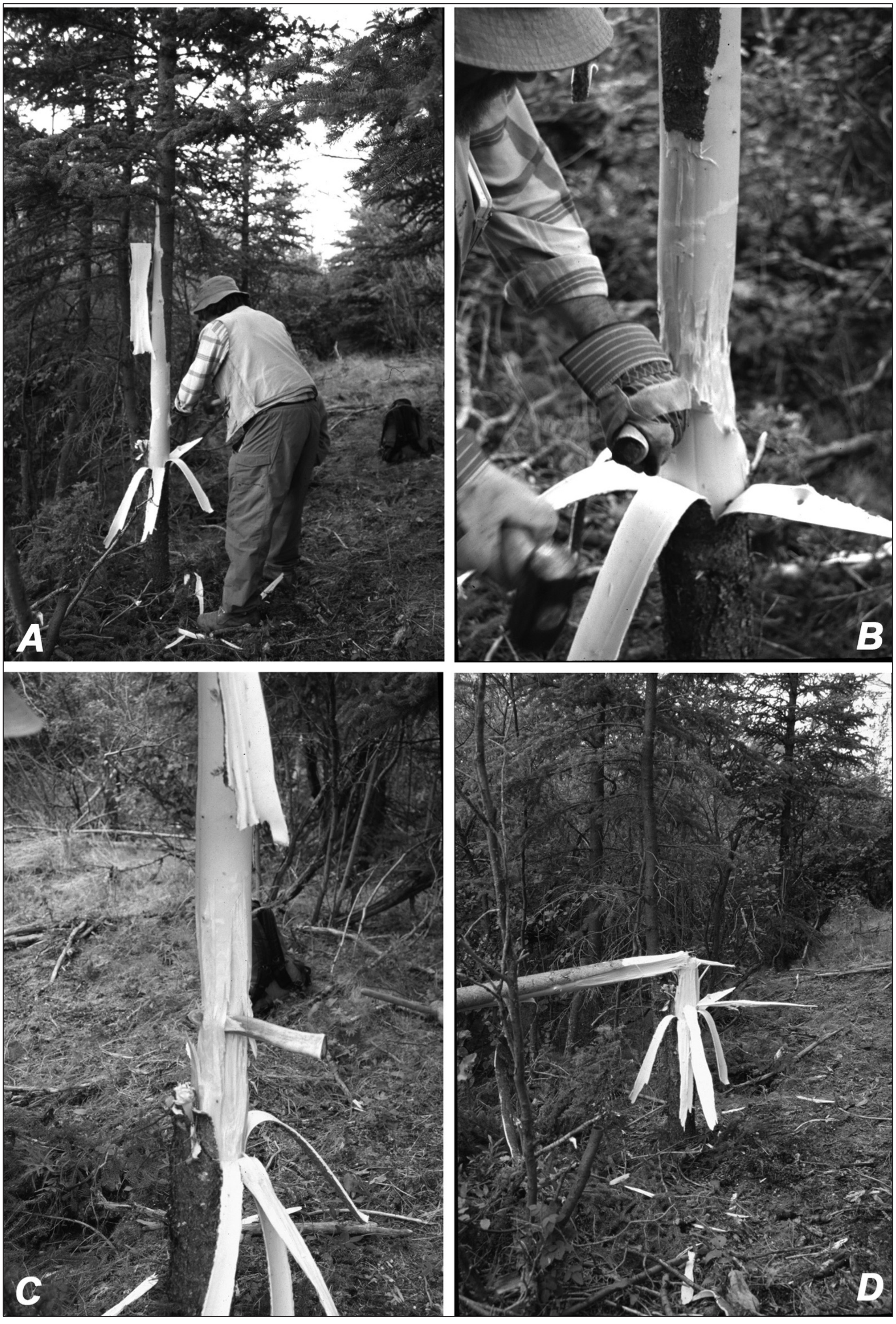

Figure 10: Experiment 1: (A) end of the bark stripping and beginning of the wedge work; (B) view of the first go-around; (C) second go-around with the wedge in place, ready to be used in order to pull another slab off the tree; (D) end of the tree-felling sequence.

Figure 11: Detailed view of Experiment 1 stump and log. The height of the stump is 53 cm.

from the trunk rather than chopped from the trunk. The wedge-induced facets also tend to be much longer than those resulting from chopping actions.

CONCLUSIONS

Pecked and ground stone adzes or axes (i.e., celts) have been reported for late Prehistoric sites in the northern Yukon (Le Blanc 1984:Pl. 41; Morlan 1973:Pl. 9). They are comparatively rare, and frequently consist of "exhausted" specimens that, through prolonged use, are rather stubby and no longer have cutting edges on the tool ends. Instead, the bits that were once bevel-ground to shape now exhibit deep flake scars and evidence of pounding or battering, possibly through recycling for use as hammering tools at the end of their effective use-lives as cutting implements. Based on our experiments, and the archaeological evidence from surviving stumps and logs, it seems reasonable to conclude that these stone implements may not have played a direct role in tree-felling. This conclusion is supported by the absence of any tool-cutting marks on the archaeological examples, not to mention on the stumps and logs resulting from our experiments. Nonetheless, the presence of these heavy-duty tools in the northern Yukon suggests that they were once used for some type of cutting activity. One possible function is for delimbing tree trunks after felling. The logs used in construction of the Fishing Branch cache (Fig. 5) were obviously stripped, but unfortunately no observations were made on the branch remnants, so we cannot comment on how the logs were cleaned. Another possible function for the stone celts was as woodworking tools for production of snowshoe frames, or any other one of the numerous wood items that were necessary to successful survival in the western Subarctic (cf. Osgood 1940). Celts may have also played a role in butchering activities, possibly in processing frozen carcasses.

Whatever the case, it seems evident from our limited investigation that antler wedges could have been effective logging tools. Future experiments paralleling ours would be useful on different softwood species as well as on hardwoods. It would also be instructive to conduct experiments at different times of year, particularly during cold-weather periods. Lastly, it is possible that antler wedges were used for tree-felling in other areas of the world and at different time periods, though the presence of a supply of caribou or reindeer antler may have been a precondition, because of its superior strength as compared with other types of antler (Albrecht 1977; Guthrie 1983; MacGregor 1985). In this respect, large quantities of wedges have been reported from various Upper Paleolithic contexts, especially from southwestern France. The few of these that have been examined exhibit the same morphological attributes as

Figure 12: Experiment 2: (A) bark stripping followed by the first go-around with the wedge in place for pulling the first slab from the tree; (B and C) positioning of the wedge in the first go-around; (D) the stump and the felled log.

those found on the northern Yukon ones, although they are mostly made of red deer (*Cervus elaphis*) antlers and they tend to be much smaller.

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