

The Keatley Creek Deer Scapulae: Tool Manufacture and Use-Wear Analysis

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Introduction

Nine deer scapulae have been recovered from the Keatley Creek site. They are unusual in that most deer bones found at the site are highly fragmented (Vol. I, Chap. 10), whereas the scapulae are relatively complete although most have been specifically modified. In addition, they are of interest because some of them were recovered in association with specific archaeological features (Vol. I, Chap. 10, Appendix III). It is possible that these scapulae represent a particular activity at Keatley Creek. The problem addressed in this paper is: 1) to determine if the Keatley Creek scapulae show identifiable tool manufacturing/use-wear characteristics or other indications of tool use; and, if so 2) to determine the likely function of these tools. Markings on faunal remains are not always reliably identifiable as to cause. In this analysis, examination and investigation of artifact modifications and markings will be supplemented by studies of artifact shape, experimental analysis, and ethnographic and other archaeological evidence.

Of the identifiable scapulae recovered at Keatley Creek, all but one, which is from a smaller ungulate, are from the mule deer (Vol. I, Chap. 10).

Recovery Location of Scapulae

Three scapulae artifacts were recovered from floor pits within HP 7 (Table 1). These features are thought to have been interior storage and

refuse pits. They would originally have been used to store salmon, then at some later point have been filled in with garbage and soil containing bones.

Three scapulae were recovered from three other pit features in HP 7 (P88-3, P88-4, and P88-5). These are large, shallow, basin-shaped features which have been described as roof-beam foundations.

The other two scapulae from HP 7 were both found in roof deposits; one identified as from the roof surface and one only as "roof deposits."

The last of the nine scapulae was recovered from HP 47 (Table 1). This artifact is surmised to have been deposited at the housepit site, along with many other bones, "through a series of dumping events" when the housepit depression had been abandoned and was used as a refuse dump (Vol. II, Chap. 10.10).

Artifact Shape

The general shape of the artifacts is illustrated in **Figure 1**. There are two artifacts (EeRI 7:2179 and EeRI 7:2181) which have a distinct shape compared to the other seven. The scapula blade on only one side of the spine remains; this is the broader infraspinous fossa, and only part of it is present (**Figs. 1A and 1C**). The thin edge of this portion of the blade is very straight, and is 7 cm long on No. 2179 and 11 cm long on No. 2181. The neck, head, coracoid process, and glenoid fossa of each of the scapulae are also present. On the basis of these attributes, they have been categorized as Group I (Table 2).

Four of the HP 7 artifacts (Nos. 1972, 1982, 1975, 1974, **Figs. 2, 3, 4, and 5**) have shapes which are distinctly different from the others. The blade, or part of it, is present on both sides of the spine. Missing areas are more

prominent toward the proximal end of the blade. The neck, head, coracoid process, and glenoid fossa are present on the more complete artifacts (Nos. 1972, 1975, and 1982). Part of the neck on No. 1974 is present. These artifacts are categorized in Group II (Table 2).

There are two fragments where only part of the "body" of the scapula remains (No. 1973, **Fig. 6** and No. 2180, **Fig. 1B**). In both, the spine runs down the middle, with portions of the blade remaining on either side. They are very similar in general shape, although No. 1973 is much more weathered than No. 2180. These two fragments are categorized as Group III (Table 2).

The last fragment (No. 1971) is illustrated in **Fig. 7**. It is a portion of the infraspinous fossa.

Artifact Markings and Modifications

There are four categories of artifact markings and modifications that can be identified:

- 1) markings produced by natural causes;
- 2) markings which are human-made, but not tool-oriented;
- 3) modifications produced in tool manufacturing, and;
- 4) use-wear markings resulting from an artifact being used as a tool.

Natural Causes

Bones are subject to a number of processes as they lie on or in the ground. They are subject to the taphonomic processes of weathering, and plant and animal disturbances. However, the scapula artifacts from Keatley Creek, on the whole, do not seem to have been greatly affected by these processes. Most of the scapulae show relatively few weathering marks or

cracks. The three smallest fragments (Nos. 1971, 1973, and 1974) are the most weathered; No. 1974 is also root-etched.

There is no unequivocal evidence of animal disturbance of any of the scapulae. Binford (1981:69) describes scapulae which have been gnawed by animals as having three basic characteristics: (a) the acromion is chewed away; (b) the coracoid process and supraglenoid tubercle are usually chewed off, and; (c) the edges of the proximal border are chewed, sometimes to the extent of nearly removing the scapula blade and producing a denticulated blade edge. The blade edges of some of the Keatley Creek scapulae could be construed to be denticulated, and therefore chewed by animals, but there are no tooth punctures or gnawing marks on the neck, coracoid process, or glenoid fossa, except perhaps on artifact No. 1974. The condition of this scapula suggests that it might be more likely to have been chewed than the others, as it meets all three of Binford's criteria: the acromion process of the spine, the coracoid process, and the tubercle are missing, and the proximal border is partly denticulated (**Fig. 3**). There are also some indentations near the broken (chewed) edge of the neck, which are possible tooth marks.

Human Modifications, not Tool-Oriented

Human modifications, but not for the purpose of making tools, can include cooking, burning, breaking for marrow, and butchering. There is no evidence of cooking or burning of any of the scapulae. The scapulae are not marrow-filled and would not be broken for this reason. There are, however, as would be expected, some deep cuts which were most likely produced during butchering. These are found on the neck and blade edge of three of the scapulae (Nos. 1972, 1975, and 2181), locations where greater force

might have been used to cut the meat and tendons from the joint and to separate the scapula from the humerus. There are also longer, longitudinal striations on several of the scapulae blades. It is possible that some of these could have been caused by filleting of meat for drying (Binford, 1981:98)--compare **Figure 8 to Figures 2, 4, and 9**.

Manufacturing and Use-Wear Modifications and Markings

It can sometimes be difficult to assign specific markings and modifications to either tool manufacturing or tool use. However, they can be compared with results from experimental studies that were carried out.

The most likely manufacturing modification on these scapulae is the removal of the spines (Table 3). The fact that the spine is cut down to within about 1.0 cm from the base on all artifacts except Nos. 1974 and 2180, strongly supports the interpretation that it was purposefully cut and/or broken off. For the scapula to be useful as a tool, it would be desirable to remove the spine. Once the spine is removed, the neck and head form a natural handle and the artifact is comfortable to hold.

Deep cut marks where the base of the spine was cut through in the process of making the tools are also likely manufacturing marks on the Group I artifact (No. 2181, **Fig. 10**), (Table 3). It appears that the spine was probably first cut off, but the base of it still had to be cut through to make the tool. The other probable manufacturing attribute is grinding of the blade to form a beveled edge (Nos. 2180, and 2181). These two artifacts were previously assigned to Groups I and III on the basis of shape alone (Table 2).

Three of the artifacts (Nos. 2179, 2180, and 2181) also have small chips, or possible microflaking, along the sharpened blade edge (**Figs. 1, 10, 11, and 12**) (Table 3). There are two possible causes of this: one from natural weathering and breakage, and one from use as a tool. These possibilities will be discussed further in the section on experimental work.

There are two other distinct types of markings on the scapulae: wide, straight striations, and; thinner, irregular striations (Table 3). The wide, straight striations are all found on the scapulae which were characterized by shape as Groups I and III (Table 2), while the irregular striations are all found on the scapulae characterized by shape as Group II. Some straight striations found on these Group II artifacts are generally thinner than those found on Group I and III artifacts.

Artifact Nos. 2181 and 2180 (**Figs. 10 and 12**) have straight striations running parallel to the blade edge near the thin edge and on the flat surface of the blade itself, up to the point where the scapula thickens at its anterior margin (No. 2181) or to the base of the spine (No. 2180). Artifacts No. 2180 (**Fig. 12**) and No. 1973 (**Fig. 6**) have similar straight striations in similar parts of the blade. It is not clear if the striations on these three artifacts are filleting, manufacturing, or use-wear markings, or some combination of all three.

Four artifacts (Nos. 1971, 1982, 1972, 1975—**Figs. 2, 4, 7, and 9**) have irregular striations. These are thinner and not as obvious as the straight striations of artifacts in Groups I and III, but they all run longitudinally from the broken distal edges mainly on the ventral side of the scapulae. Miller (1975:221–222) discusses the possibility that such striations, rather than being caused by the abrasive use of a tool, could be caused by dragging on

the ground. However, he maintains that "a much greater force [than dragging] is needed to produce scratches on fresh bone" for "it is extremely difficult to work and does not scratch easily."

The similarity of location, direction and type of striation supports the hypothesis that the striations were produced during use of the scapulae as a tool. The similar wear pattern of the blade, as mentioned in the discussion of artifact shape, also supports this hypothesis. These artifacts have therefore been placed in the same group as those categorized by shape to Group II (Table 2).

Polish and residues are two other attributes of tool use. There are some smooth, seemingly polished, areas on some of the artifacts (Nos. 1971, 1975, and 2181) in areas where the tool might have been held. However, the smoothness could be due to the natural surface of the bone in these areas. The main "residue," found on the Group II artifacts, is dirt, which is often embedded in the blade and perhaps is an indication of tool use. Group I and III artifacts do not have any visible residues. Root-etched artifact No. 1974 has plant fibers attached.

Experimental Use-Wear Analysis

By simply studying the artifacts it is not easy to discern if striations, cut marks, and wear patterns are caused by natural or butchering events, or by purposeful tool manufacturing and/or tool use-wear processes. By carrying out manufacturing and use-wear experiments, it was hoped that these processes could be more definitely differentiated.

Two deer (one White-tail, one Mule) shoulders with intact scapulae were obtained. The meat was removed from both scapulae with basalt

flakes and with a metal knife. Both tools worked well in removing the bulk of the meat, but the basalt was best for removing the meat close to the bone and for removing the periosteum. No butchering marks were made on the bone, since the meat was easily removed and great force was not necessary. The two scapulae were very close in size (11 x 19 cm and 13 x 20 cm) to some of the Keatley Creek artifacts.

Tool Manufacture

In order to remove unwanted portions of the scapula, a deep groove was made, using basalt flakes and a basalt graver, near the base of the spine, across the spine at the base of the neck, and along the length of the infraspinous fossa to the proximal end of the scapula. In the process of making this groove, other cuts parallel and at angles to the main groove were inadvertently made, since the stone tool did not always stay in the previously made cut. This produced cuts some of which were similar to some of those on artifact Nos. 2180 and 2181 (**Fig. 10**). These grooves, as well as the two deep cuts on No. 2179, exhibit special characteristics which appear to be caused by cutting with a stone flake. They have squared, even edges and ridges inside the groove.

The bone proved to be very tough and hard and it was not possible to cut through the spine or through the thicker part of the blade near the neck using only the stone tools. Nor would the bone break along the groove. It was therefore necessary to use a saw. In this way, a scapula tool similar to No. 2181 was obtained, as well as another useful tool from the other part of the blade (**Fig. 12**). The blades of these tools were sharpened a bit using a sandstone slab, although they were already thin and sharp.

Tool Use-Wear

Both fresh scapulae were used in experimental use-wear studies. The knife-like edges produced by cutting one scapula, as previously described, were used to cut fresh, frozen and cooked meat and fresh and frozen fish. They were also used to cut up broccoli, carrots, celery, potatoes and onions, and to cut off a small tree branch (approximately 1.0 cm diameter). They worked equally well in all cases, and could be compared in quality to a good Chinese carbon-steel cleaver. They did not seem to dull very quickly.

It was very easy to cut through all the meat samples by using a sawing motion. The natural structure of the bone seems to provide a finely serrated edge, which is not particularly sharp when the finger is rubbed along it, but which is very effective when a sawing motion is used. The vegetables, however, cut very nicely by simply pressing down on them.

The neck and head form an excellent handle, very comfortable to hold, with the head fitting nicely into the palm of the hand, and the forefinger pressing down on the top, flat, smooth edge of the scapula. Comfort was increased, and grip improved, by wrapping a thin piece of soft leather around the neck and head.

The other fresh scapula was modified only by removing the spine (again by sawing it off). It was then tested for efficiency as a shovel (or trowel) by digging in the garden with it. It proved to be very functional. A hole about 20 x 20 cm was easily dug, and the "corners" of the proximal end were found to be very good for digging into packed dirt and loosening it up, so that it could then be scooped out. The scapula also worked well to scrape dirt aside.

The scapula did not show signs of wear, even though the garden soil contained many small rocks, which were encountered during the digging process.

Some digging was also carried out in more gravelly, sandy soil and a few striations similar to those on artifact Nos. 1975 and 1982 were produced. The digging lasted for only a short time, but it would seem that the scapula is quite a tough, hard bone and one would be able to perform a great deal of digging before the tool was worn out. Perhaps, once the proximal edge is worn through, the rest of the blade, which is very thin, might wear down quite quickly. This could easily produce the wear/breakage pattern seen in artifact Nos. 1972, 1974, 1975, and 1982. Again, the neck and head made a comfortable handle, especially if wrapped with a thin piece of leather.

In performing these experiments, it was not possible to reproduce the straight striations found on the blades of artifact Nos. 2180 and 2181, except during the manufacturing process, when cutting the groove with the basalt flake produced striations similar in appearance and direction to those on Nos. 2180 and 2181. However, this does not seem to adequately explain all of the striations on the blades, which cover the surfaces up to the thicker edges or spine of the scapulae. Perhaps some were produced from filleting as previously described, and some from use-wear, but it is not clear what contact material would have caused such striations.

The same is true for the chips and microflakes removed from the blade edges of the Keatley Creek artifacts. They were not reproduced in the experiments. However, similar chips and microflakes are not found on any other edges of the scapulae, even other very thin edges, and this points to formation by tool use-wear.

Only artifact No. 1974 does not have several of the attributes of the others. It is most similar to the Group II artifacts, but the heavy weathering and root-etching, the presence of the spine, the missing acromion and coracoid process, and the possible tooth marks leaves its position open to question.

It becomes apparent at this point that there are two distinct types of scapula artifacts from Keatley Creek (Table 4). One type consists of artifact Nos. 2179, 2180, 2181, and 1973, which have been classified by shape into two groups (Table 2, Groups I and III). Shape, tool manufacture and use-wear studies, and experimental evidence indicate probable tool use as knives. However, there may be two types of knives (Table 4), although they may have been used in similar ways on similar materials.

The other major type of scapula consists of artifact Nos. 1971, 1972, 1975, and 1982, which were classified by shape into Group II (Table 2). This study indicates their probable use as shovels or trowels (Table 4).

Artifact No. 1974 is classified as "non-tool" for reasons previously discussed.

Ethnographic and Other Archaeological Evidence

There is ethnographic and archaeological evidence for scapulae used prehistorically as scrapers, knives, hoes, and possibly net gauges. Two kinds of scrapers from the Thompson River region in British Columbia are mentioned by Smith (1900:411, 420, Figs. 339, and 356). One is a skin-scaper made from a deer scapula, the other a sap-scaper. However, neither of them resembles any of the scapulae artifacts from Keatley Creek. Scrapers "made from the sides of the superior ends of bison scapulae" have been

found in the Plains of central South Dakota (Lehmer 1952b:333). Again, these appear to be quite different tools from the Keatley Creek artifacts.

Bone knives are mentioned ethnographically, but they are not always made from the scapula, and they are constructed and shaped differently from the Keatley Creek knives. Lehmer (1952b) found bone knives with hooked ends ("possibly for cutting squash") in South Dakota. These were cut from scapulae, but judging from the illustration, they were cut out from the very large bison scapula blade and the head was not needed as a handle.

Stewart (1977:155–56) found that useful knives could be made from a deer ulna bone. She refers to these as herring knives, but found that they were also good for cutting nettle-fiber string and cedar bark. The experimental knife made for this project was fairly good for filleting fish, but did not cut fish skin very well. Magne and Matson (1984:213, 224) reported several archaeological examples of modified scapulas from Eagle Lake (Chilcotin, B.C.) similar to those at Keatley Creek. They state that the function of these artifacts is unknown, but suggest that they were used in hide processing. This seems unlikely.

Scapula knives with scalloped edges made from bison scapulae have also been found in the southern Plains of the United States (Johnson 1982:152). These knives again are not made, or shaped, like the Keatley Creek knives. Serrated deer scapula knives were apparently used for cutting tule reeds in the Great Basin (Southworth-Kidder 1993) and some of the Keatley Creek scapulas might have been used for cutting tule reeds to make mats although they lack serrated edges.

A bone knife used by the Blackfoot Indians of the Plains had the grip wrapped with calf skin, making it more comfortable and providing a better

grip (Wissler 1975:32), much as was found with the experimental deer scapula knife made for this project.

Bone knives and bone flakes with sharp edges have been found in experimental work by Stanford et al. (1981) to be very satisfactory for slicing through either warm or frozen flesh, but worked best on the latter. Experimental bison butchering demonstrated that bone tools could work better than stone ones for some tasks. The edge was durable and the tools easily severed the neck and muscle attachments (Johnson 1985:217). Frison (1974:200–201) has proposed the use of frozen meat caches as a winter food supply on the northern Plains, and the use of bone tools to free an amount of frozen meat from the caches. The experiments done in this study show that the deer scapula knives cut frozen meat. However, it was probably not common for Keatley Creek provisions to be kept frozen.

Scapula hoes are also reported. They were found at the Fort Pierre site, central South Dakota, where they were made from bison scapulae, with the head removed during the Stanley Focus period, but left on during the Monroe Focus (Lehmer 1952b).

Use of deer scapulae as hoes is reported for the Mound Builders of the Mississippi Valley. These people are said to have “commonly fitted the shoulder blades of deer to wooden handles for use as hoes” (Young 1956:5). This would seem to support the idea that deer scapulae are quite strong, since these hoes would likely have been well-used in the agricultural communities of the Mound Builders.

Of special interest, is the report by Lehmer (1952a:317) of bison scapulae from an Oklahoma site with “the scapula spine . . . removed.” Also of interest is his comment that “these pieces show excessive amounts of

wear, cutting edges often being well up toward the neck of the bone.” Both the cutting off of the spine and the pattern of wear are typical of the Keatley Creek trowels.

Curwen (1926) describes remains of scapulae in Europe with spines removed, longitudinal striations, and which are very worn, suggesting use as shovels. He also gives a detailed description of the etymological evidence for “the wide-spread use of shoulder blades for digging.” This, of course, does not apply to the native Indian situation in North America.

Finally, Larson (1995:10–26) suggests that a deer scapula with markings on one edge may have been used as a net gauge on the Washington Coast. This seems a plausible use, but could have been made more easily with wood. The markings are quite different from anything on the Keatley Creek scapulas, although the spinous process has been removed as at Keatley Creek.

Conclusion

This brief survey of ethnographic and archaeological literature supports the use of scapulae as tools by prehistoric peoples. The unique context of the Keatley Creek scapulae, recovered largely from particular features of the site, and their relative completeness, makes them especially interesting. The evidence obtained in this study of shape, manufacture/use-wear and other markings, and experimental evidence, supports the probability of manufacture and use of tools, specifically knives and trowels, made from ungulate scapulae by the aboriginal people of Keatley Creek.

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Figures

- Figure 1: Scapulae artifacts 2179, 2180, 2181: dorsal view.
- Figure 2: Artifact 1972.
- Figure 3: Artifact 1974: root-etching; weathering.
- Figure 4: Artifact 1975.
- Figure 5: Artifact 1982.
- Figure 6: Artifact 1973.
- Figure 7: Artifact 1971.
- Figure 8: Filleting marks on scapula (re-drawn from Binford, 1981).
- Figure 9: Artifact 1975 and 1982.
- Figure 10: Artifact 2181: A: ventral; B: dorsal.
- Figure 11: Artifact 2179: A: dorsal; B: ventral.
- Figure 12: Artifact 2180. Note that the spine was not removed and thus could be used as a point for pressing down with the index finger. On the ventral side there was also a depression suitable for thumb placement.
- Figure 13: Side view of experimental mule deer scapula with spine, and of artifact scapula with spine cut down; (s = spine).

Photographs

- Photo 1: Item 2180.

Table 1. Artifact Recovery Locations

HP*	#Scapulae	Location	I.D. #
7	3	floor pits	EeRI 7: 2179/2180/2181
7	3	roof-beam pits	EeRI 7: 1971/1972/1975
7	1	roof surface	EeRI 7: 1974
7	1	roof deposits	EeRI 7: 1973
47	1	refuse dump	EeRI 7: 1982

Table 2: Categorization of Artifacts by Shape

HP*	#Scapulae	Group	I.D. #
7	2	I	2179,2181
7,47	5	II	1972/74/75/82/(71)
7	2	III	2180,1973

Table 3: Categorization of Artifacts by Manufacturing/Use-Wear

Shape group	I	II	III
Spine removal	2179,2181	1971/72/75/82	1973
Deep cuts thru spine	2179,2181		
Blade ground	2181		2180
Chips/flakes	2179,2181		2180
Straight striations	2179,2181		1973,2180
Irregular striations		1971/72/75/82	
Similar wear pattern		1971/72/74/75/82	

Table 4: Artifact Types

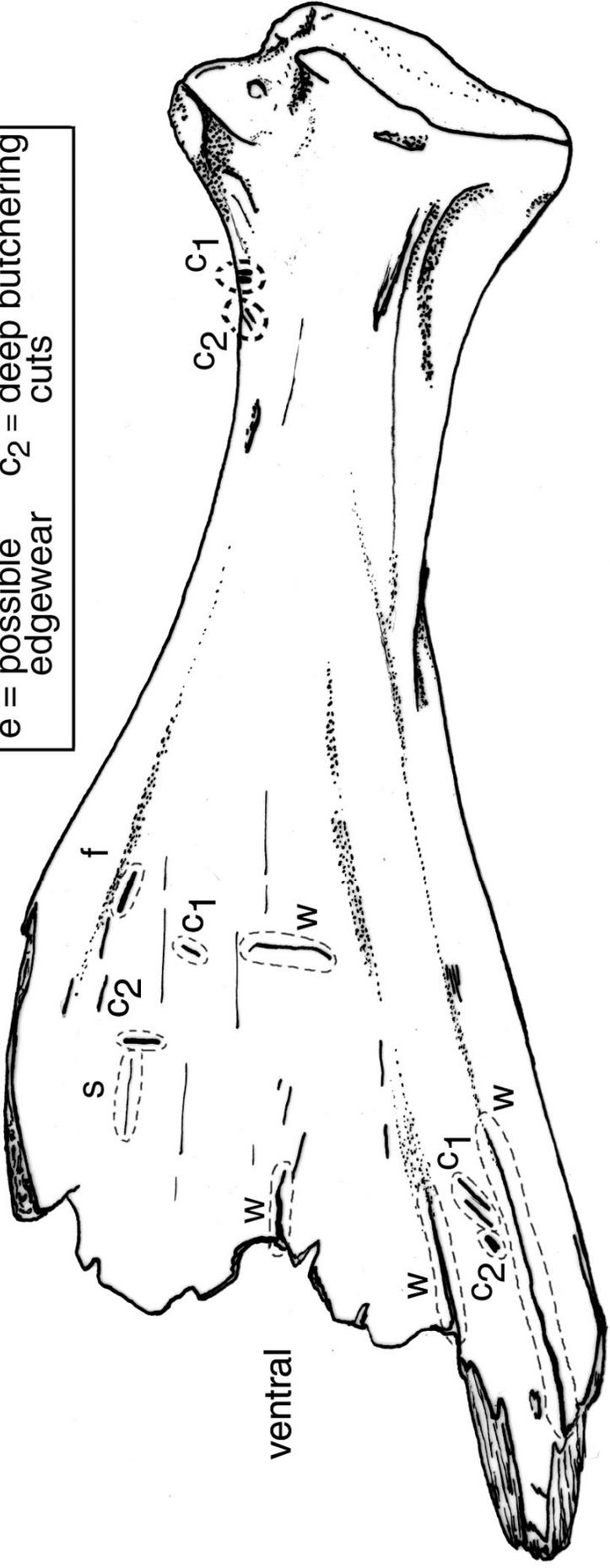
Type	Artifact Number
Knives: blade cut away, remains on one side of spine	2179,2181
Knives: blade remains on both sides of spine	1973,2180
Trowels	1971/72/75/82
Non-tools	1974



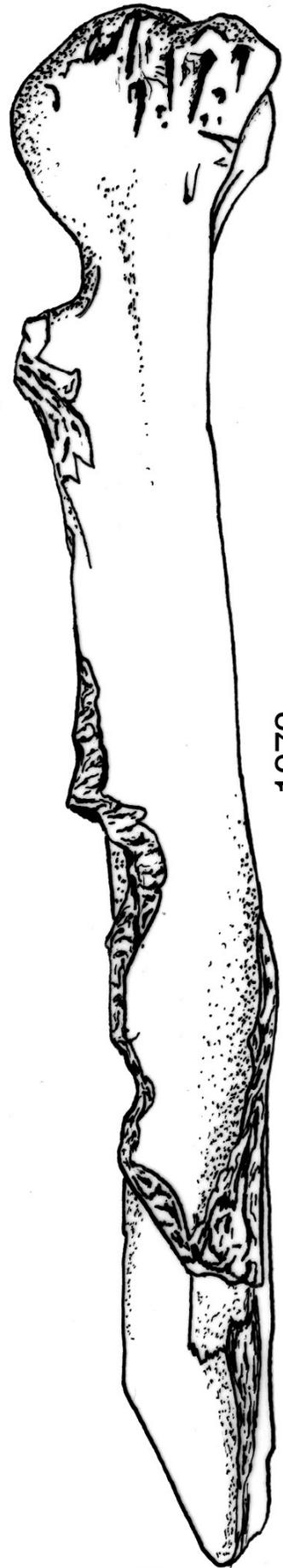
Figure 1. Scapulae artifacts 2179, 2180, 2181: dorsal view.

s = striations
 f = foramen
 g = gouge
 e = possible
 edgewear

w = weathering
 p = polishing
 c1 = shallow cuts
 c2 = deep butchering
 cuts



ventral



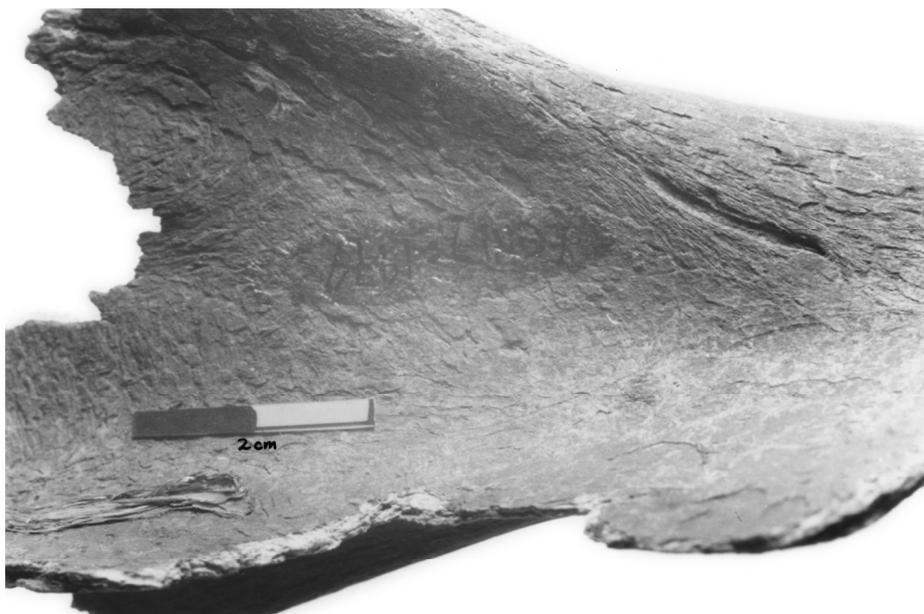
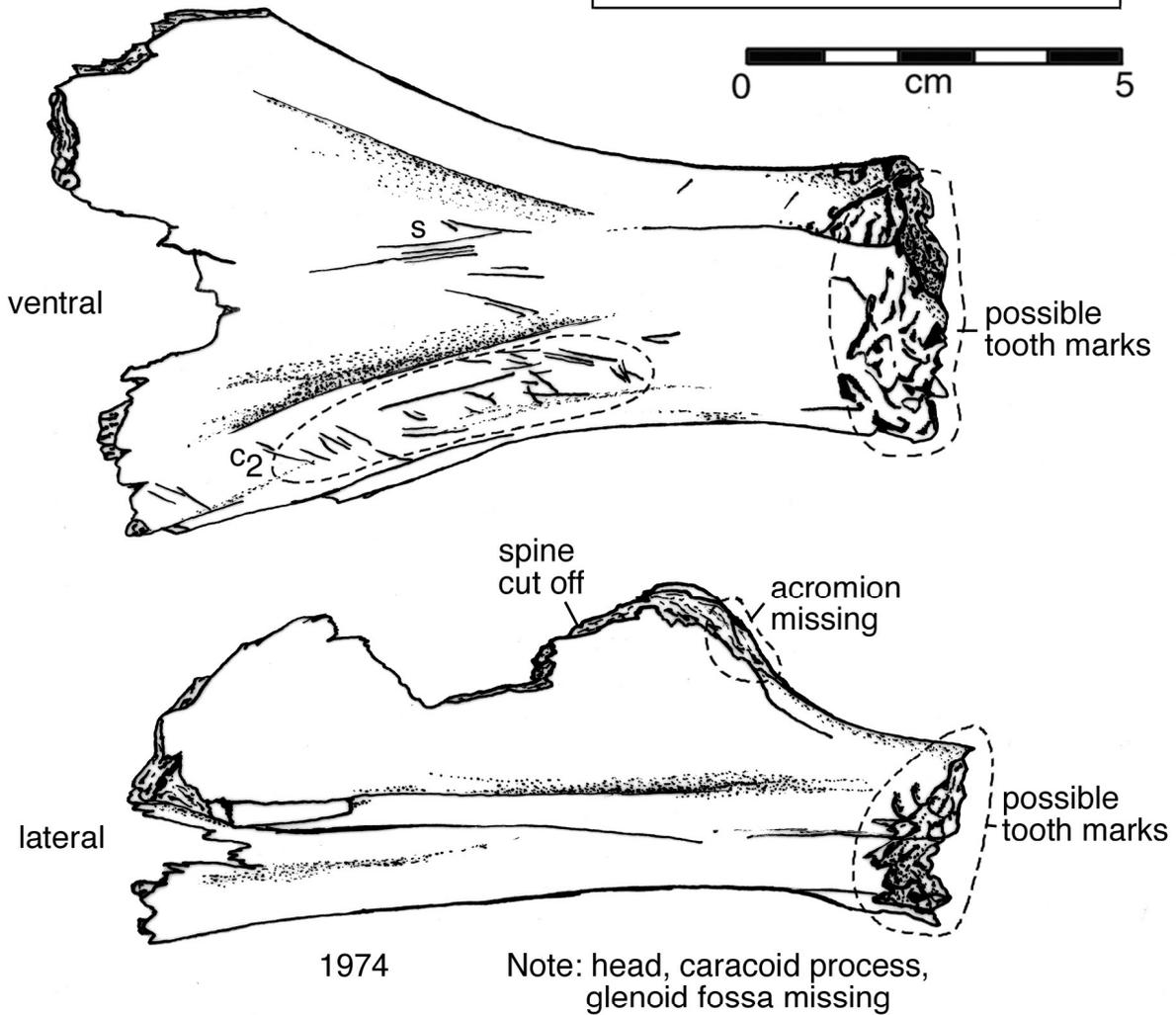
lateral

1972



Figure 2. Artifact 1972.

s = striations	w = weathering
f = foramen	p = polishing
g = gouge	c ₁ = shallow cuts
e = possible edgewear	c ₂ = deep butchering cuts



A 1974, dorsal

Figure 3. Artifact 1974: root-etching, weathering.

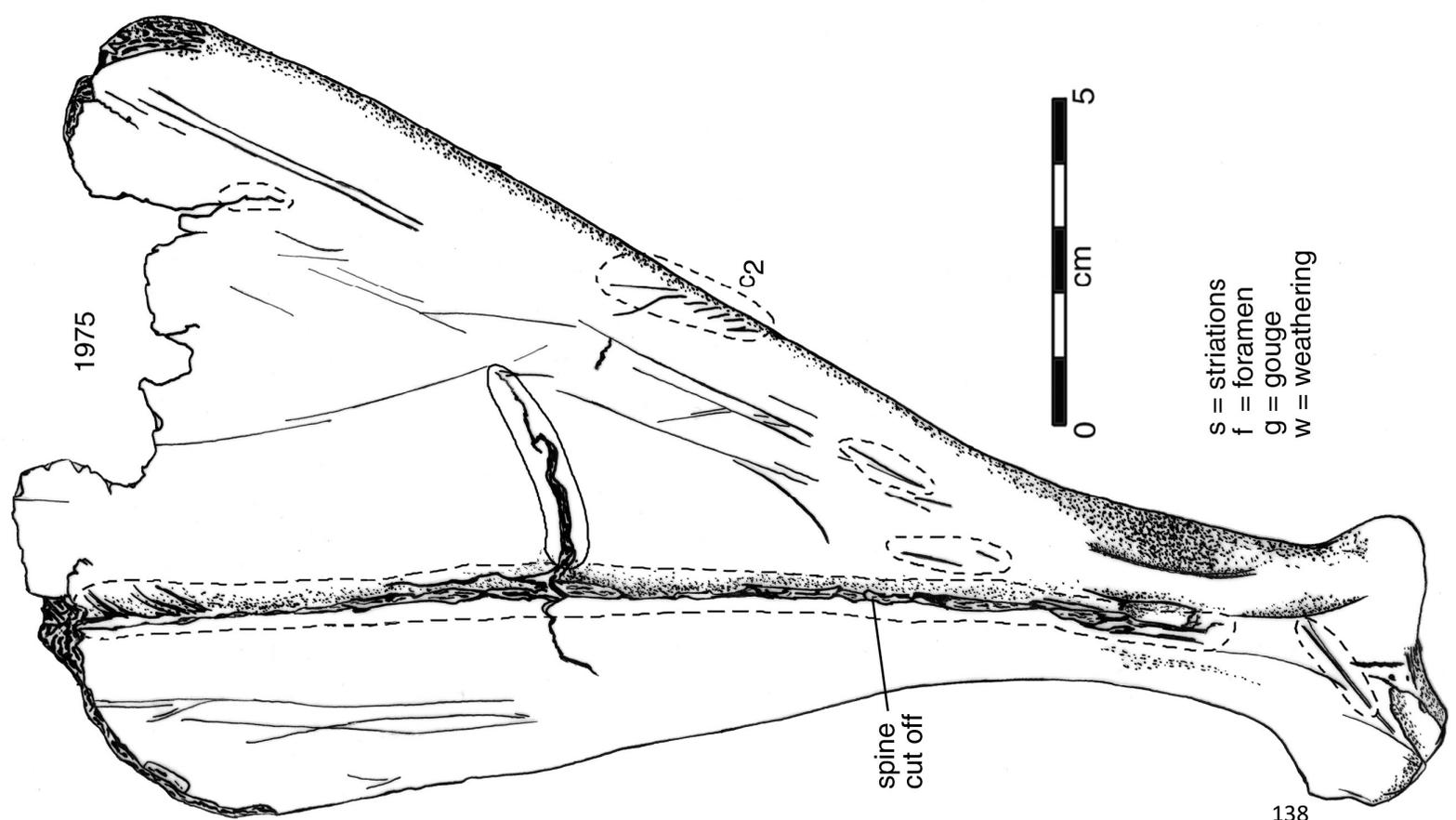
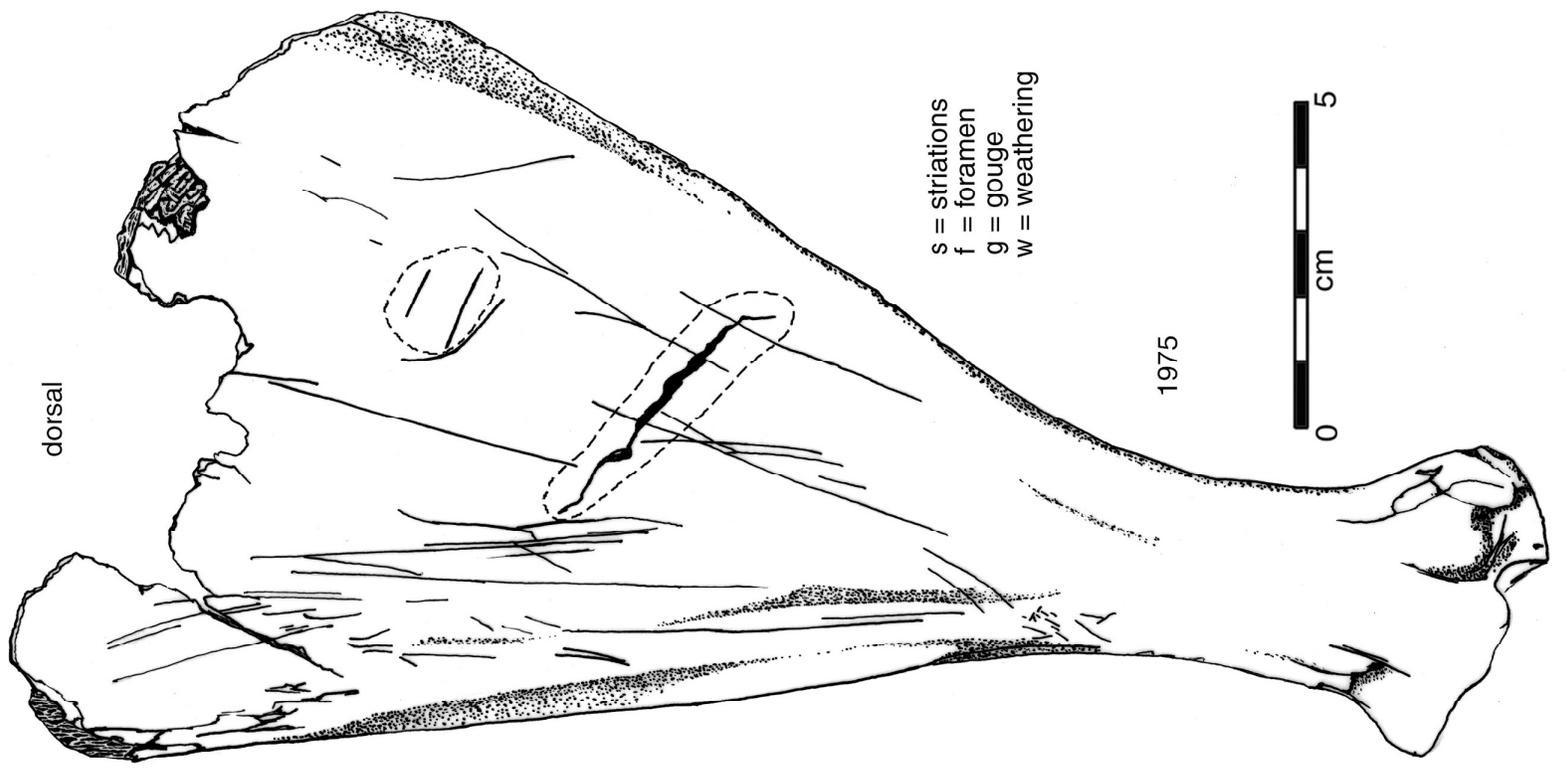
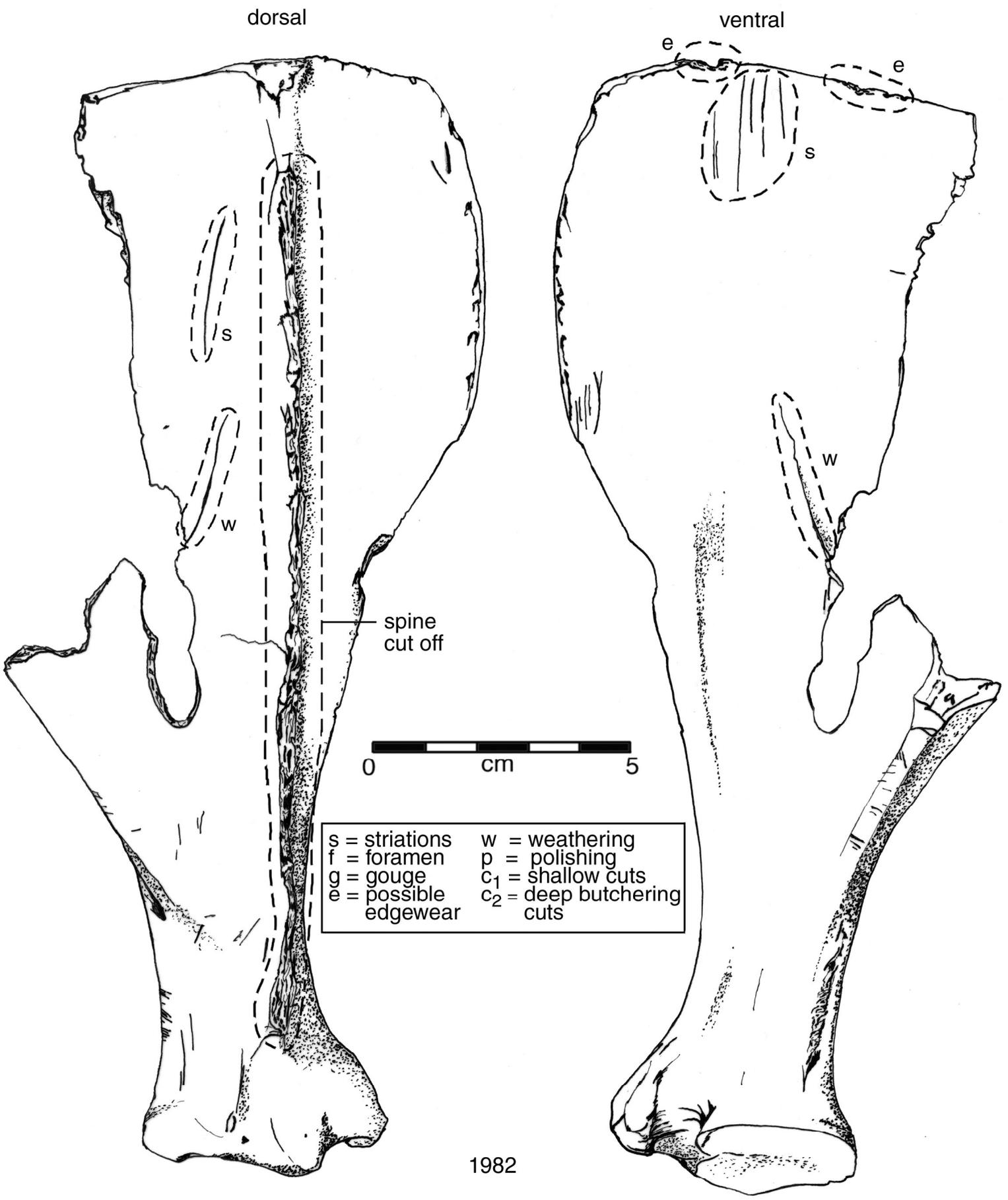


Figure 4. Artifact 1975.



dorsal

ventral

spine
cut off

0 cm 5

s = striations	w = weathering
f = foramen	p = polishing
g = gouge	c ₁ = shallow cuts
e = possible edgewear	c ₂ = deep butchering cuts

1982

Figure 5. Artifact 1982.

s = striations	w = weathering
f = foramen	p = polishing
g = gouge	c1 = shallow cuts
e = possible edgewear	c2 = deep butchering cuts

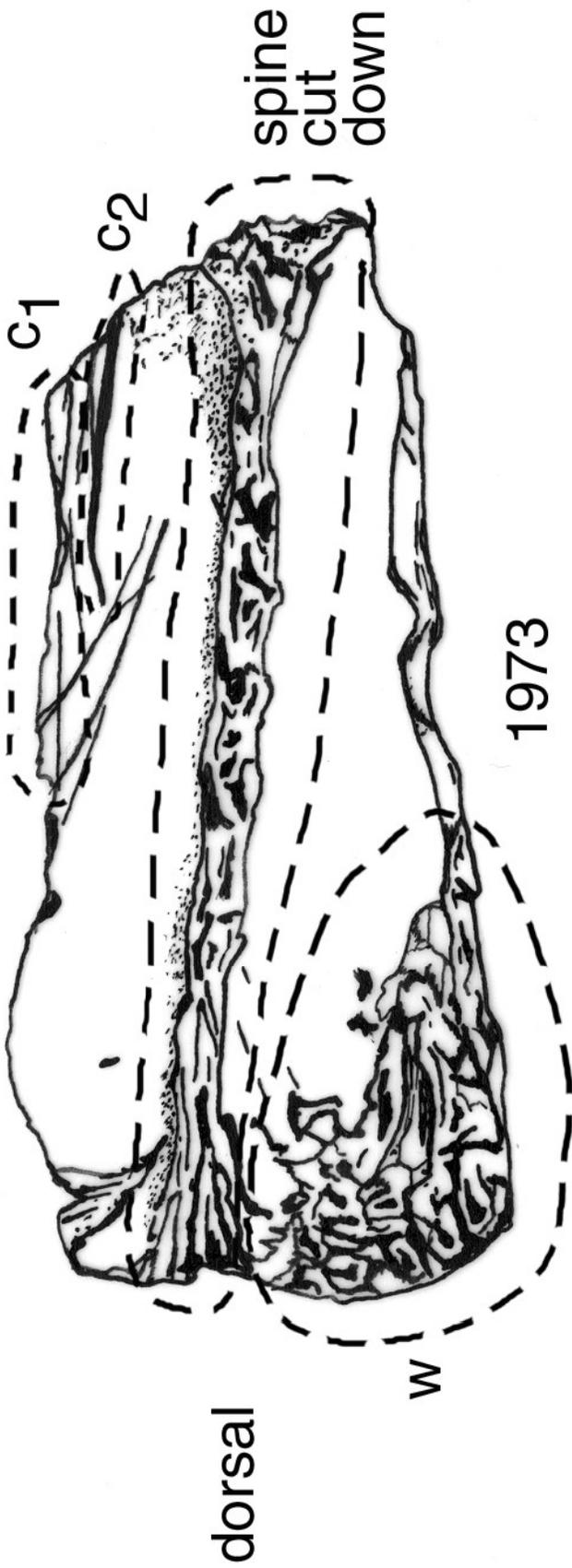
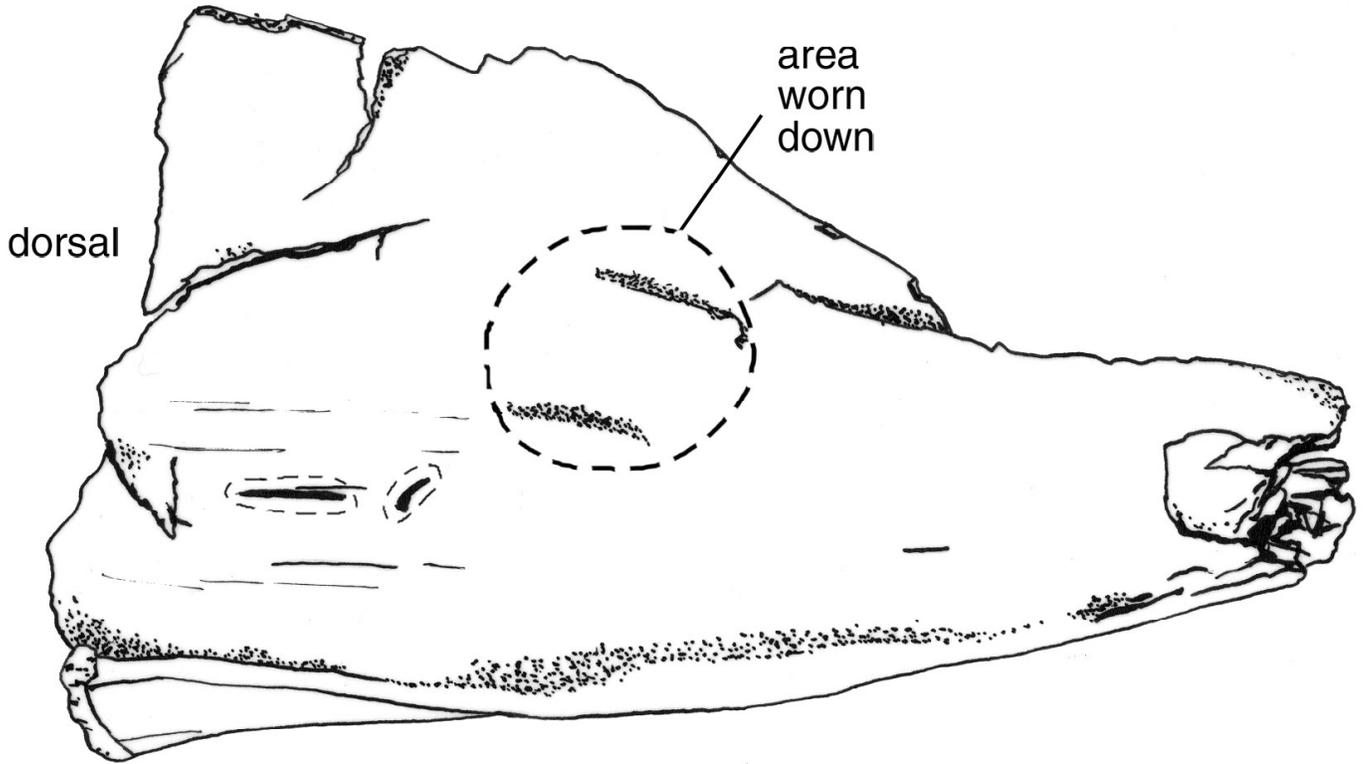


Figure 6. Artifact 1973.



- | | |
|-----------------------|---------------------------------------|
| s = striations | w = weathering |
| f = foramen | p = polishing |
| g = gouge | c ₁ = shallow cuts |
| e = possible edgewear | c ₂ = deep butchering cuts |

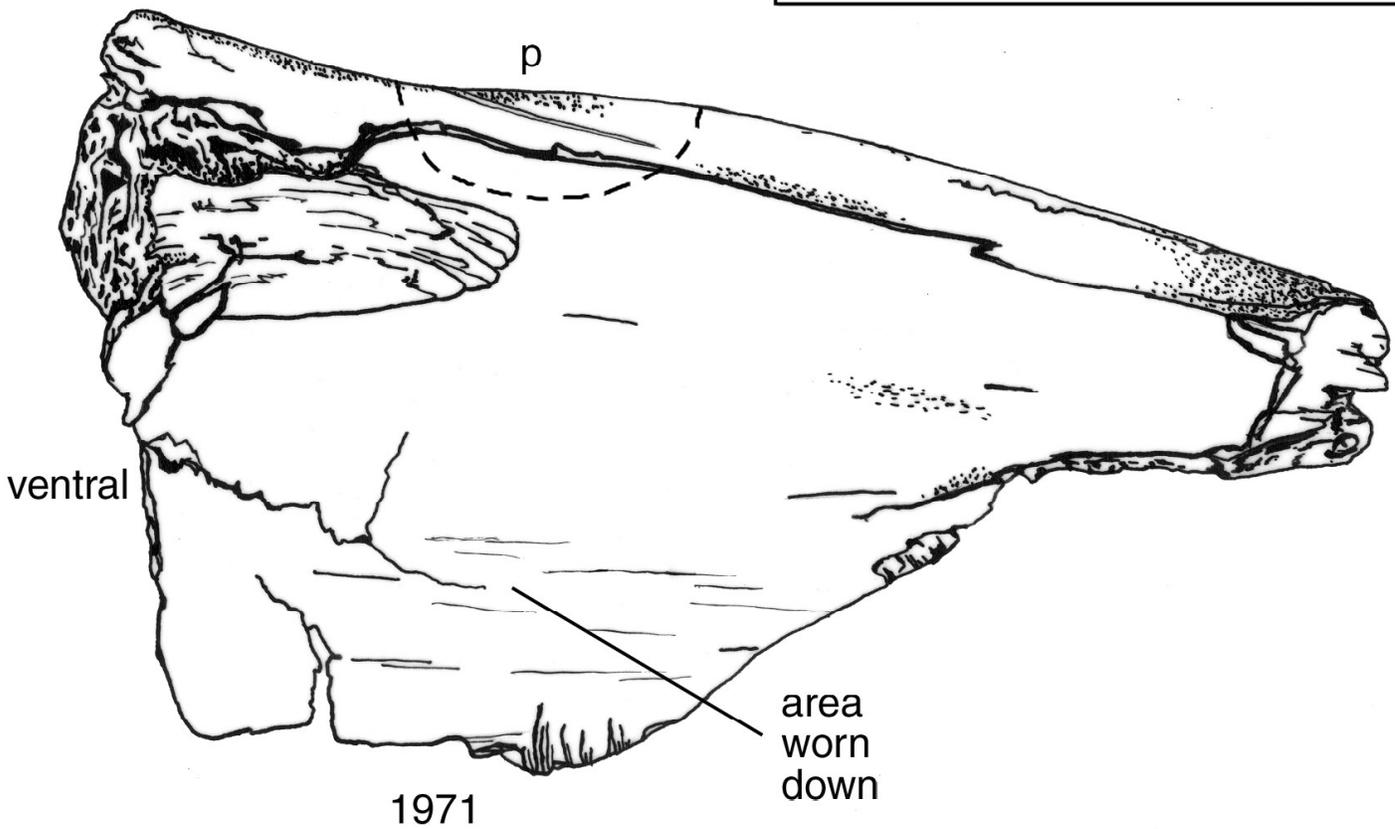


Figure 7. Artifact 1971.

Figure 8. Filleting marks on scapula (re-drawn from Binford, 1981).

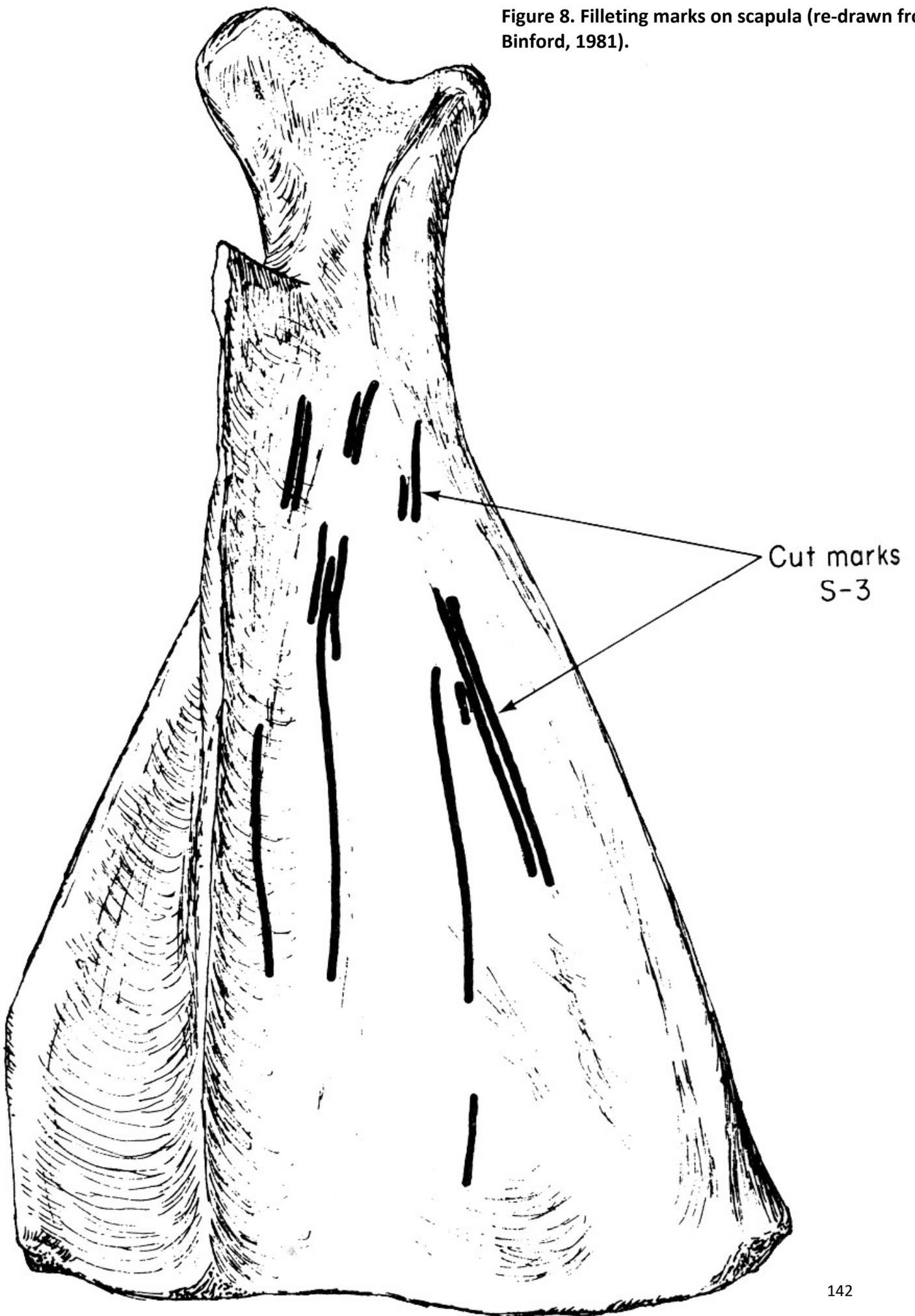


Figure 9. Artifact 1975 and 1982.



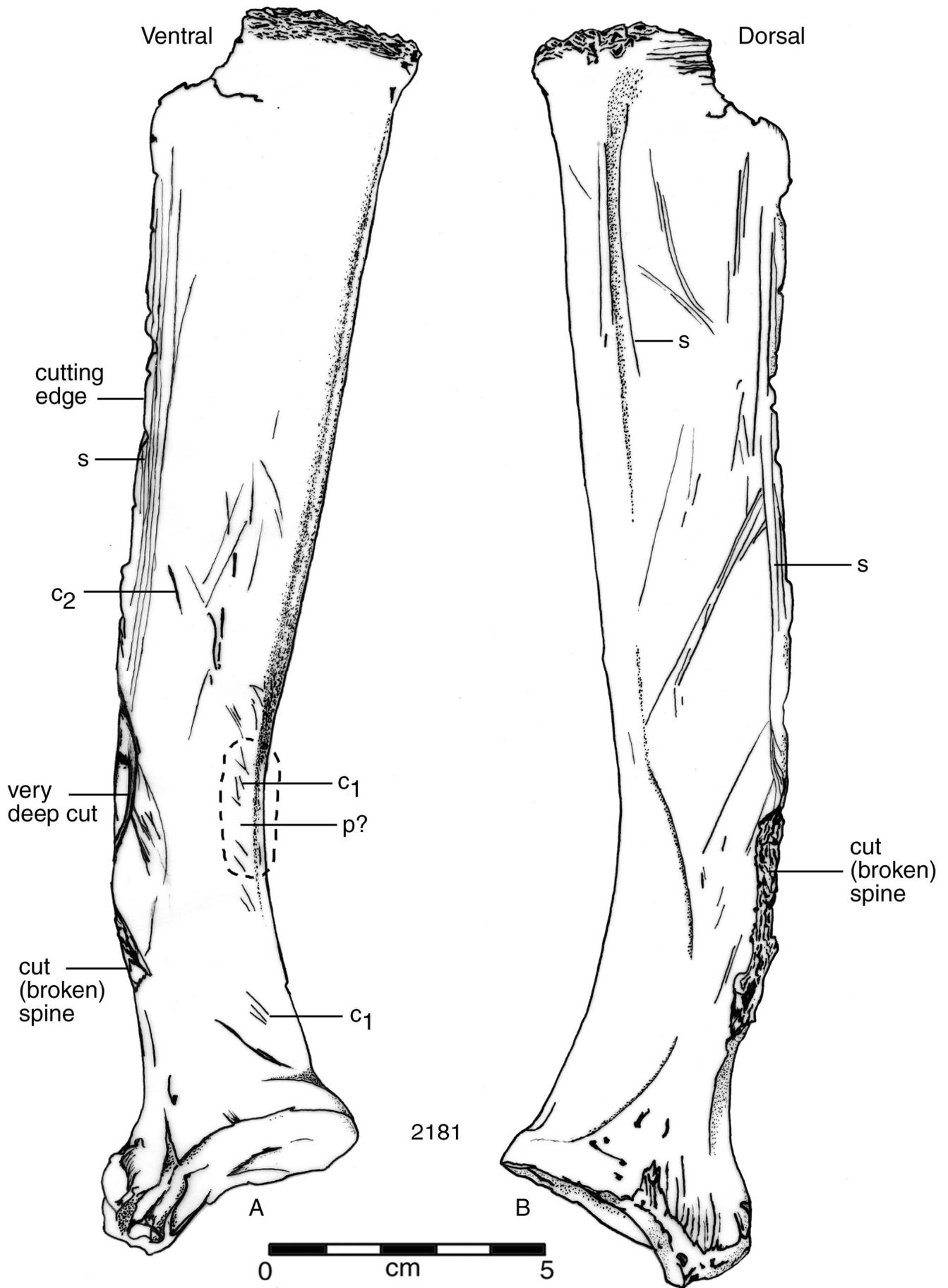


Figure 10. Artifact 2181:
A: ventral; B: dorsal.

s = striations	w = weathering
f = foramen	p = polishing
g = gouge	c ₁ = shallow cuts
e = possible edgewear	c ₂ = deep butchering cuts

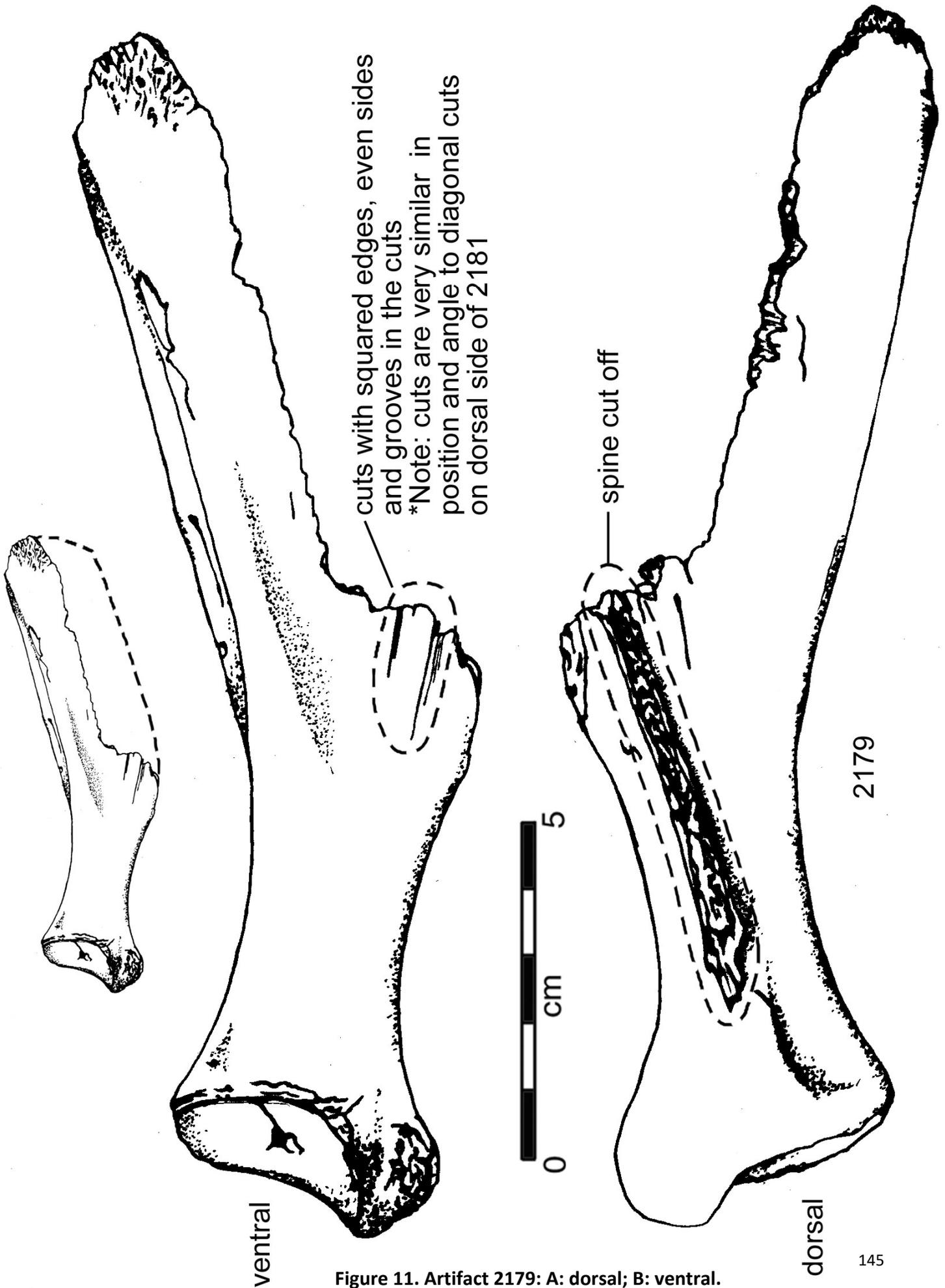
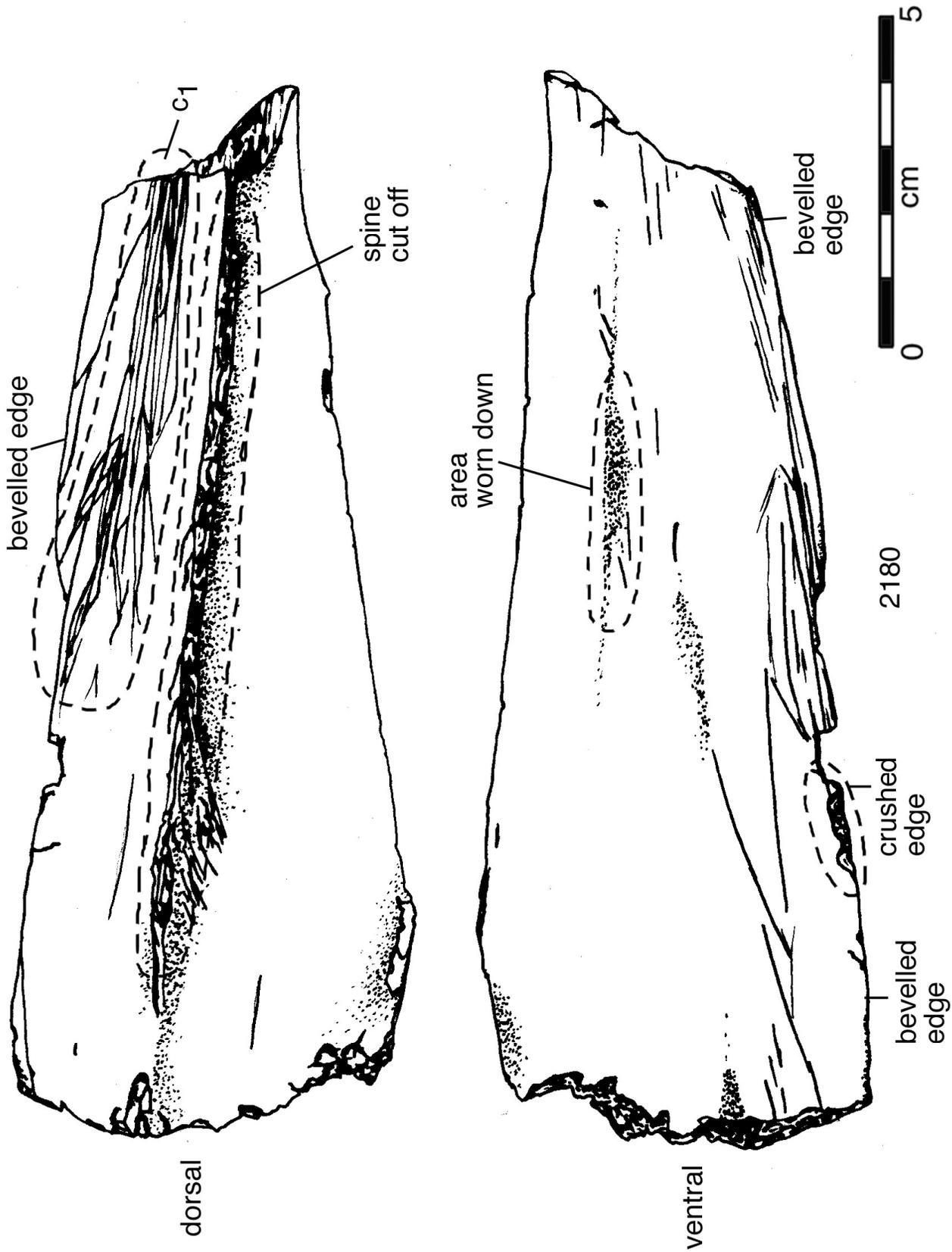


Figure 11. Artifact 2179: A: dorsal; B: ventral.



s = striations	w = weathering
f = foramen	p = polishing
g = gouge	c ₁ = shallow cuts
e = possible edgewear	c ₂ = deep butchering cuts

Figure 12. Artifact 2180. Note that the spine was not removed and thus could be used as a point for pressing down the index finger. On the ventral side there was also a depression suitable for thumb placement.



Figure 13. Side view of experimental mule deer scapula with spine, and of artifact scapula with spine cut down; (s = spine).



Photo 1. Item 2180.