3  Hunting meat and scavenging marrow? 
a seasonal explanation for Middle Stone Age 
subsistence at Klasies River Mouth

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INTRODUCTION

The interpretation of the Klasies River Mouth ungulate bone assemblage has been a major point of controversy for over a decade. Over this time, there have been attacks and counter-attacks passed between Lewis Binford and Richard Klein. Just about every major name in the field has published comment on the issue, but to no clear resolve.

In 1976 Richard Klein published his interpretation of the Klasies River Mouth faunal assemblage. For the purpose of studying anatomical part representation Klein split the ungulate remains into five animal size classes (Klein 1976, Binford 1984). Class I represented small ungulates such as grysbok and the like, weighing between 15 and 50 pounds. Size class II referred to small-medium ungulates like springbok weighing up to around 110 pounds. Class III were medium-large ungulates such as wildebeest and hartebeest reaching a weight of about 400 pounds. Large ungulates, class IV, represented eland and cape buffalo, animals of around 2000 pounds. The now extinct giant buffalo, Pelorovis, formed the fifth, 4000 pound, class.

Of particular interest was the pattern that emerged from scrutiny of the anatomical part frequencies. There was a clear disparity between smaller and larger animals. Size class I and II animals were represented with a bias towards bones of the upper limbs, a pattern quite common and expected for hunted animals on an archaeological site. Size class IV and V animals, however, had an assemblage dominated by elements from the head and

![Graph showing the skeletal part abundances (%MAU) for size class I and II mammals at Klasies River Mouth. Figures from Binford (1984, table 3.5).](image)
lower limbs, whilst size class III animals displayed aspects from both the patterns of small and large animals. Head and foot bones are of marginal use and preference in transporting these to a site, rather than the meat-bearing upper limbs, seemed alien to the current theories of hunting practice. This strange pattern would have to be explained.

These patterns are expressed in terms of Minimum Animal Units (MAUs), calculated by Binford (1984), in graphic form in Figs. 3.1, 3.2 and 3.3.

**Fig. 3.2** Graph showing the skeletal part abundances (%MAU) for size class III mammals at Klasies River Mouth. Figures from Binford (1984, table 3.5).

**Fig. 3.3** Graph showing the skeletal part abundances (%MAU) for size class IV and V mammals at Klasies River Mouth. Figures from Binford (1984, table 3.5).
Klein found his initial solution in the "schlepp effect" developed by Perkins and Daly (1968) while analysing the Neolithic site of Suberde in Turkey. A similar pattern had been encountered at this site and explained in terms of method of meat transport. They suggested that such meat was being dragged, or "schlepped" (from the German verb), back to the site inside the animals' hides, with the lower leg bones still attached and acting as handles. This theory neatly explained the excess of foot bones.

The theory attracted much criticism and now is largely considered discredited. Binford, in his 1984 analysis of the Klase River Mouth faunal remains, suggested that the "schlepp effect" went against all his observations of hunter-gatherer societies. He had recently published an in-depth study of the Nunamiut Eskimo peoples (Binford 1978). Those studying the Hadza of Northern Tanzania (O'Connell et al. 1988, 1990) were similarly deeply critical. The "schlepp effect" was charged with being unfounded and simply convenient. The final blow came when Alan Turner (1989) drew attention to the vast number of bones discarded at the Suberde site during excavation. He argued cogently that this recovery bias rendered any detailed analysis useless.

Binford's (1984) new explanation for the anatomical part frequencies struck against the traditional views of hominid development. He argued that the concentration on parts of marginal utility in larger animals, the heads and lower limbs, was indicative of scavenging. His interpretation was that size class IV and V animals were beyond hominid hunting capabilities. Size class III animals, showing both sets of characteristics, were considered borderline, and possibly subject to both hunting and scavenging. It was argued that hominid scavenging of large animal carcasses was taking place after they had been largely eaten out by previous non-human predator/scavengers. Animal predators tend not to eat much from the head and lower limbs; hence, it would be these that would survive for hominid utilization of edible parts such as brains, mandibular pulp tissues and bone marrow.

Binford supported his scavenging theory with evidence from cut and hack marks found on the bones. He argued, extremely convincingly, that the marks on small animals are consistent with butchery for fresh meat. Large animals, on the other hand, showed a pattern consistent with disarticulation of lower limbs from stiff, semi-dried, not freshly hunted carcasses. Such bones show extensive breakage associated with marrow processing. This is not the case with the smaller animals. Furthermore, animal gnaw marks have been found on larger animals' bones underlying later hominid cut marks.

Klein (1989) defended his position, stating that even if the "schlepp effect" were no longer acceptable then the answer still lay with differential transport. He provided little firm support for the continuation of this view, however, and Binford's theory seemed more persuasive.

Very recently, however, an extremely thorough re-examination of the butchery evidence at Klase River Mouth (Milo 1998) came up with very different conclusions to Binford. Milo (ibid.) carried out his re-examination of the bone assemblage with the aid of a wide-field stereomicroscope. He was able to find many butchery marks that had previously gone unnoticed. Butchery marks appeared to be just as common on the high utility elements of large animals as on the more distal elements and there was very little evidence of carnivore damage. This suggests that the Klase River Mouth hominids had first access to high utility elements of large animals and, therefore, were probably hunting them (ibid.). Furthermore, Milo (ibid. p. 123) found the end of a stone point embedded in the cervical vertebra of a specimen of *Pelorovis*. This implies the use of a projectile weapon and is strong evidence for active hunting of class V animals. Milo, however, does not offer any convincing argument which could account for the usual pattern in the skeletal part abundances.

A FURTHER PROBLEM WITH BINFORD'S ARGUMENT

Binford suggests that the extraction of marrow from bones of larger animals was only taking place with the radius, metapodials and phalanges and not with the humerus, femur or tibia (Binford 1984, 123–160). This raises the question of why these upper marrow-bearing bones were ignored if hominid scavengers were reduced to such marginal food sources. Binford's argument is that lower limbs were not attacked to the same extent by previous non-human predator/scavengers, because all the meat is to be found on the upper limb bones. This would seem to be true with regard to meat eating predators (Brain 1981), but what we are examining is marrow utilization: the large marrow cavities of these upper limb bones would remain unaffected even though the predators stripped them of their meat.

Furthermore, in his study of carcass consumption sequences Blumenschine (1986) argues strongly against the idea that marrow-seeking non-human scavengers would tend to attack just upper limbs. Although he finds that not all species behave in the same way, none of them has greater preference to starting with the upper limb. The most common sequence of marrow consumption in animal scavengers was as follows: femur, tibia, hind phalanges, metatarsals, humerus, fore phalanges, radius and finally metacarpals. This order is a mixture of upper and lower limb bones. Blumenschine (1986, 653) concludes:

"...there is no empirical basis for expecting foot bones to be more frequently available to a scavenger than upper (defleshed) limb bones from carcasses fed on initially by non-human carnivores."
BONE MARROW INDICES

For his study of Nunamiut hunting and butchering techniques, Binford constructed an index of marrow utility for different skeletal parts of both caribou and sheep (Binford 1978, 23–28). He studied several carcasses and calculated marrow cavity volume for different bones and analysed marrow composition. His marrow utility index was quite complex. It included not only the volume of marrow from different bones, but also its quality and a measure of extraction efficiency. Binford also made several mathematical adjustments.

The complexity of Binford’s index has recently been criticised (Jones and Metcalfe 1988, Marshall and Pilgram 1991). Jones and Metcalfe carried out a re-examination of Binford’s marrow utility index as applied to the Nunamiut (Jones and Metcalfe 1988, 415–423). Although Binford had obtained a positive statistical correlation between his complex marrow index and the actual marrow processing decisions of the Nunamiut, Jones and Metcalfe gained a higher statistical correlation than Binford’s own. However, the real problem is that Binford was incorrect in saying that the choice of bones can be predicted on the basis of marrow cavity volume, then Binford’s theory explaining the skeletal part abundances at Klasies River Mouth cannot be justified by a marrow utility argument.

If one compares marrow cavity volumes with skeletal part abundances for size class IV animals (both standardized as a percentage of their highest values) (see Fig. 3.4), it is evident that there is little correlation. If Jones and Metcalfe (1988) and Marshall and Pilgram (1991) are correct in saying that the choice of bones can be predicted on the basis of marrow cavity volume, then Binford’s theory explaining the skeletal part abundances at Klasies River Mouth cannot be justified by a marrow utility argument.

In addition, the disarticulation marks Binford cites as being for the removal of the lower limbs would only be necessary if the upper limbs remained largely intact. There does not seem to be a satisfactory explanation for hominin selection of lower limb bones as a result of the feeding patterns of previous non-human predator/scavengers. It should also be noted that the Hadza have been observed to exploit marrow from all the limb bones of ungulates (O’Connell et al. 1988, 135).

If there is no way of demonstrating why hominids should choose to ignore the potential food resource of marrow in the upper limb bones then Binford’s theory, as it stands, is severely weakened. It is for this reason that I shall go on to consider bone marrow indices and the nature of marrow content in different bones of the appendicular skeleton.

Despite this, it is indeed of some value to the present study to consider the extra factors Binford was concerned with and how he incorporated them into his marrow utility index. Previous critics of the Binford index have noted that it was too complex but have failed to examine the precise nature and effect of the inclusion of the extra factors and also, very importantly, the two mathematical functions Binford applies as a modification. A study of these is very revealing.

The marrow cavity volumes calculated by Binford (1978) show that the upper limbs, on the whole, contain the most marrow, yet his marrow utility index greatly favours the lower limbs. The first modification Binford makes concerns marrow quality. He maintains that marrow containing a large amount of oleic fatty acid was preferred by the Nunamiut. The lower limb bones have the higher oleic acid content. Before using this to modify his index, Binford squared the oleic acid data, to have the effect of “...comparing or lowering the scale of variability” (Binford 1978, 25). In fact squaring has the opposite effect. As a result his modification favoured the lower limbs even more greatly.

Binford’s second modification was with regard to extraction efficiency. This data, if applied as it stands, has little effect on the overall picture, but Binford first applied a square root to it. Since the lower limbs have low efficiencies the square root had little effect on them, but the effect of a square root on the high efficiencies of the upper limbs was much more drastic. Hence, the lower limbs were favoured again. Binford, in fact, admits to “a bias in informant evaluation in favour of grease quality...” (1978, 26). The final utility index bears no resemblance to the original marrow volume figures (Figs. 3.4 and 3.5). Binford’s mathematical modifications make his index misleading and hard to treat as anything other than his opinion on the matter. This does not, however, entirely discredit his conclusions.

If one compares marrow cavity volumes with skeletal part abundances for size class IV animals (both standardized as a percentage of their highest values) (see Fig. 3.4), it is evident that there is little correlation. If Jones and Metcalfe (1988) and Marshall and Pilgram (1991) are correct in saying that the choice of bones can be predicted on the basis of marrow cavity volume, then Binford’s theory explaining the skeletal part abundances at Klasies River Mouth cannot be justified by a marrow utility argument.

If Binford’s marrow utility index (1978) is compared in a similar manner (Fig. 3.5) there is a notable correlation. It has just been demonstrated, however, that Binford’s index has been modified too much to form an objective basis of support to his theory. For Binford’s theory to remain in any way viable there needs to be some reason why greater utility can be assigned to the marrow of the lower limbs.

Binford (1978) talks of marrow with high oleic acid content being more desirable in taste. Mere flavour would not seem a strong argument when considering an adaptation based around scavenging. Oleic acid proportion is, however, not the only possible reason for exploiting the marrow of the lower limb. Another reason is strongly related to seasonality.
Fig. 3.4 Graph comparing skeletal part abundances for size class IV mammals at Klasies River Mouth with the marrow cavity volume of caribou elements. Data derived from Binford (1978, table 1.6; 1984, table 3.5).

Fig. 3.5 Graph comparing skeletal part abundances for size class IV mammals at Klasies River Mouth with Binford's Marrow Index for caribou elements. Data derived from Binford (1978, table 1.9; 1984, table 3.5).
RESOURCE STRESS AND SEASONALITY

Work has recently been carried out on variability of marrow yield in East African ungulates (Blumenschine and Madrigal 1993). This study is more relevant to this discussion than Binford’s caribou marrow index because it deals with species present at Klasies River Mouth, and also used a larger sample. Blumenschine and Madrigal present a breakdown of marrow yields of different skeletal elements, usefully expressed in kcal. They noted that stressed animals were much more fat depleted in the upper limbs than in the lower ones. This effect is in fact quite widely documented in zoological papers (Cheatum 1949, Brookes et al. 1977, Davis et al. 1981, Peterson et al. 1982). It has had little zooarchaeological consideration until recently (Speth 1987, Bunn and Ezzo 1993). The effect is summed up well by Peterson, Allen and Dietz (1982, 550, emphasis added):

“Fat mobilization was first evident in the limbs of moose in the femur and humerus, then the tibia and metatarsus, and finally the radius and metacarpus. Differences among bones caused by progressive fat mobilization were not as great in moose as in some African ungulates (Brookes et al. 1977) and white tailed deer (Cheatum 1949). Those studies indicated that femur marrow could be fat-depleted and the animal dead from malnutrition with distal bones still containing considerable fat”.

The importance of this to the present study hardly needs to be pointed out! The fat depletion pattern is clearly visible in Blumenschine and Madrigal’s statistics. It is shown in graphic form in Fig. 3.6, where standardized calorific values of marrow of a stressed and unstressed animal are compared. The stress of animals is commonly measured as a percentage of femur fat. In the example, the relatively unstressed animal has 63.1% femur fat, the stressed example 30.3%. It can be seen that in the stressed animal the metacarpal becomes more important than the humerus and the metatarsal more important than the femur. The middle leg bones (radius and tibia) remain of highest value in both cases.

The species of animal used in this example is a wildebeest. Unfortunately this is a size class III animal and, therefore, borderline in Binford’s scavenging theory. Blumenschine and Madrigal did not study any animals of size class IV or V. The pattern is, however, likely to be general.

Blumenschine and Madrigal also draw attention to the variability of bone marrow yields between animals of different species, age and sex. Differences in locomotor characteristics are said to be of particular importance. It is clear that size class is not the only issue. There is a need, therefore, for further fieldwork.

Having established the importance of stress to the study of bone marrow utility, it is now necessary to discuss the occurrence of stress in animals. Stress is often governed by seasonal climate. This is very clear in the East African Serengeti where much work has been carried out (Houston 1979, Blumenschine 1987, Speth 1987). In the Serengeti most ungulate deaths occur in the later half of the dry season and most of these are the result of...
malnutrition. In fact, stress related deaths account for as much as two thirds of the entire death toll (Houston 1979, 266–267). These carcasses are consumed by many different hunter/scavengers.

Blumsenschine (1987, 388) points out that this abundance of carcasses in the later dry season means that there is little competition between scavengers. Around 40% of carcasses therefore remain with scavengeable resources on them. Since these animals died of malnutrition they will display the effects of differential fat depletion, retaining most fat in their lower limbs.

Speth (1987) has also examined hominid subsistence needs in seasonal environments. Stressed animals have extremely lean meat. If lean meat is ones only food source the body has trouble breaking down all the protein, which is far harder to process than fat. Such a diet, according to Speth, is bad for the metabolism and can result in protein poisoning. He therefore suggests that "...hunter-gatherers would avoid a high intake of lean meat" (1987, 20) and that the "...acquisition of fat rather than meat may have been more critical" (Speth, 1987, 13). Bunn and Ezzo (1993, 387) do not consider this to be so important, and suggest that a seasonal imbalance in fat intake could be made up for by building up a fat reserve in less stressed times. Speth does, however, give ethnographic precedents for the importance of the point he makes. If hominids were in need of fat in a seasonally stressed environment they may well have looked to the lower limbs of scavengable carcasses. Even if Bunn and Ezzo’s opinion that meat would still be more important were correct, scavenged marrow may still have had a significant role in the diet.

Clearly all this discussion is relevant to the Serengeti, but is it also relevant to Klasies River Mouth in the Southern Cape? Unfortunately I have not encountered any studies of this area comparable in zooarchaeological value to those carried out in the Serengeti.

The present ecological biome at Klasies River Mouth is known as fynbos (Binford 1984, Klein 1976, Kruger 1979), which can be compared with the coast of Chile, the South Australian heathlands and even some areas of the Mediterranean (Binford 1984). The soil tends to be poor and podsolized with a low turnover of new growth (Kruger 1979, 19–81) and is, as such, not good for supporting large numbers of ungulates. The temperature sees little seasonal variation (Kruger 1979, Binford 1984) but there is a dry season (Kruger 1979, Bigalke 1979, 81–97). According to Bigalke (1979, 94), "...summer aridity imposes particular stresses." Although a precise study needs to be undertaken, it seems likely that animals might become sufficiently fat depleted in the dry season to make seasonality an important factor.

A few miles North, over the Cape Folded Mountains, the environment is of karoo type (Binford 1984). Karoo is an arid-land ecosystem (Leistner 1979, 109–145) which is likely to exhibit a great deal of seasonal stress. The nature of the Klasies River Mouth environment in the

CONCLUSIONS

Based upon the above discussion, it is my contention that a new theory for the subsistence strategies at Klasies River Mouth should be considered. I suggest that size class I and II animals were hunted and that, in the face of Milo’s (1998) butchery study, that class III, IV and V animals were also hunted to a certain extent. The explanation for the presence of excessive numbers of lower limb bones of larger animals (size classes III, IV and V), showing signs of marrow processing, could be the need to find fatty marrow to supplement the hunted meat diet in periods of seasonal stress. Therefore, the high utility elements and some of the low utility elements of large animals are present as a result of hunting. More distal elements were introduced to the assemblage as a result of opportunist scavenging of marrow resources left behind by carnivores after they had finished with large animal carcasses.

I am fully aware that this argument suffers from a lack of fully relevant data, and, as such, it should remain a tentative suggestion. There are several areas where further research and fieldwork would be of great use:

1. Marrow yield variation amongst large ungulates of Africa in relation to stress and anatomical part.
2. Stress related ungulate deaths within fynbos and karoo biomes, examined with scavenging utility and degrees of fat mobilization in mind.
3. The availability of non-ungulate food resources available to hominids in fynbos and karoo biomes, examined with seasonality in mind.
4. A better chronology of past environments of the Southern Cape of South Africa.

I would also like to point out some methodological problems encountered during this study. Firstly, it is advisable that any indices be calculated to reflect specific measurements, and not be so far modified that they become meaningless. Secondly, care should be taken when classing animals into size groups because of the large possible variation between different species of the same size in such matters as bone marrow.

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REFERENCES


