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# 'Durable Residues': Addressing the use of microwear, a case study from March Hill

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## Summary

Different cultural and research traditions have led to distinctively different approaches to lithics analysis. An integration of different approaches can often give new 'ways of seeing' artefact assemblages and distribution patterns and provide valuable insights into past activities. Here we present the preliminary results of a project integrating detailed analytical techniques, focused on processes of production and consumption and social dynamics in ethnarchaeological contexts in Tierra del Fuego with existing detailed lithic analysis at Mesolithic sites in the Central Pennines. Such methods, taken from Argentina (Álvarez) and Spain (Briz), that were developed in ethnoarchaeological contexts employed detailed edge morphological analysis and use wear. When applied to site A at March Hill, these techniques yielded interesting new insights about activities at the site, and provided a test case for such techniques.

## Features

- Keywords: microwear; Mesolithic; Tierra del Fuego; March Hill; use wear; form-function; technology; Yamana; lithics; ethnographic

## 1. Introduction

The analysis of lithic artefacts has dominated our interpretations of the Mesolithic in northern England. This is no surprise, as lithics make up the bulk of the archaeological evidence for the period. Many thousands of lithics are found in upland areas and it is these finds that largely constitute our Mesolithic upland 'sites'. Though evidence for the Mesolithic is commonly held to be scarce or limited, the 'worth' of stone tools as a means of interpreting the lifeways of past Mesolithic people is quite remarkable. We have used lithics to make interpretations regarding economy, settlement patterns, landscape use (Milner and Woodman 2005; Conneller and Warren 2006; Donahue and Lovis 2003; Zvelebil 2003) and even the relationship between lithics and personhood (Fowler 2004; Cobb 2005) or gender (Finlay 2003).

Yet with few exceptions (among others Dumont 1988; Finlayson and Mithen 1997; Donahue and Burroni 2004) microwear studies, a key source of analysis across Europe and beyond, has received little recognition with regard to studying stone tools from Mesolithic Britain (for a general vision of Western Europe, Juel Jensen1988; Ibáñez and González 2003). Where microwear has been carried out, there is often a focus on a small number of retouched tools which conform to clear typological categories at the expense of studying less clearly recognisable material, despite the knowledge now available that such pieces were used as tools (Hardy and Shiel 2008). Perhaps there are legitimate reasons for this, such as the nature of the lithic record, but archaeologists are in a better position than most to appreciate the power a cultural tradition can hold. We know that, like the peoples we study, the ways in which we approach the past are clearly defined by our regional and local traditions, the overarching ideology of archaeological research, and what is considered important, timely or topical at any given time. Our research into lithics has been extensive, yet our methodologies have been, quite naturally, limited by both our spheres of experience and by widely accepted ideas.

With these issues in mind, this project makes an explicit attempt to apply a method of analysis from a different research tradition, based heavily on microwear studies, to a 'typical' British Mesolithic site. The method used in this study derives from microwear and form-functional analysis applied to lithic assemblages from Tierra del Fuego, used in work undertaken by an Argentinean team focusing on material from the earliest hunter-gatherer-fisher occupations (Orquera and Piana 1999; Álvarez2003; 2004; Álvarez and Briz 2006) and by an Argentinean-Catalonian team focusing on the historic period (Piana *et al*. 1992; Estévez and Vila 1996a and 1996b; Vila *et al*. 1996; Clemente 1997; Vila *et al*. 1997; Briz *et al*. 2005; Estévez *et al*. 2007).

Here we offer a general outline of the methodology developed for our lithic analysis (Briz 2004; 2005; in press), give some preliminary results, and then reflect upon the process and its outcomes. Analysis and interpretation is ongoing and so only the initial results are presented here.

## 2. Aims

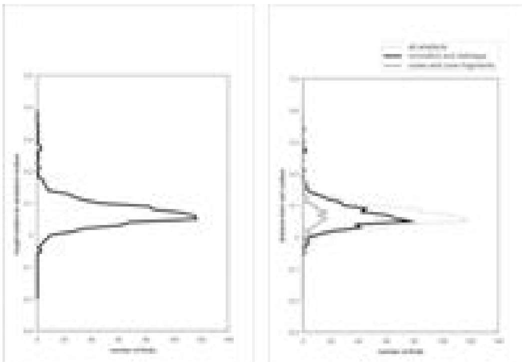
For the purpose of this article, attention is focused on the relationship between use-wear traces (Semenov 1964; Keeley 1980) and morphological features (Laplace1964; 1966; 1972), analysed from a morphotechnical perspective (Vila 1977; 1986). The analysis of raw materials and the refitting techniques have been carried out already by other researchers (Conneller 1996).

The aims of this project are twofold (Briz 2004). Firstly, it aims to uncover the morphologies attached to the creation of specific tools for specific tasks, such as meat processing, at the site of March Hill. In addition, it aims to uncover any morphotechnical attributes that may exist in the production of a given tool, as well as highlight any variation. With the achievement of these aims it becomes possible to address questions regarding and relating to technological changes, social identities or landscape construction. However, only if our aims are achieved will we pursue these avenues.

### 3. March Hill Overview

Figure 1: March Hill Trench A excavations in context

The lithic assemblage from our case study, March Hill site A (Fig. 1), was excavated between 1993 and 1996 (funded by English Heritage and West Yorkshire Archaeology Service, Spikins 1996a). This assemblage was most notable for its high integrity and minimal finds disturbance, as illustrated by detailed stratigraphic modelling (Spikins 2002) as shown in Figure 2. Artefacts recovered from the site were remarkably small and much reduced, mirroring the intensive reduction of small river pebbles and relatively local raw materials typical of the area. The average length of artefacts was only 24mm, with the 79 microliths or fragmented microliths being small (average 12mm). Lithics analysis and refitting was carried out by Chantal Conneller (1996), and indicated a sequence of knapping episodes orientated around a series of four hearths, dated to around 5800 BP by 8 ams and extended count dates (Fig. 3).



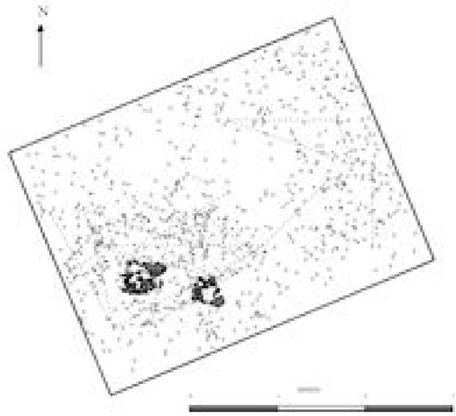


Figure 2: The integrity of artefacts at March Hill according to the modelled stratigraphy (for further details see Spikins *et al*. 2002)
Figure 3: March Hill Carr Trench A finds distributions showing patterns of refitting

The lithics analysis prompted several questions about the use of the site, and of similar sites in the Pennines. Such sites have been typically interpreted as upland hunting camps (Jacobi 1973; 1976; 1978), specifically because of their small size (Fig. 4) and the concentration of microliths among finished tools. However, there appear to be certain biases that may be influencing our interpretations of such assemblages. The small size of such sites typically reflects the difficulty of excavating rapidly deepening plateau peat, for example, and a seeming focus on microliths could stem from the difficulty of knapping 'standard' formal tools from small-scale material (with blades and flakes used for other functions). A detailed analysis thus called initial interpretations into question, suggesting that such sites may have played a more central role in settlement (Spikins 1999), perhaps key points lying between routeways along rivers (Spikins 1996b).

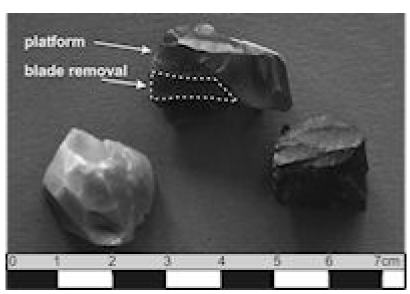



Figure 4: Example of cores recovered from Trench A

What might a new approach to lithic analysis, entirely separated from regional research traditions, and a new technique, that of microwear, contribute to this question?

## 4. Methodological Background: the origins of the technique

Microwear analysis, as touched upon earlier, is most often used in a targeted fashion, with only a relatively small sample ever being studied. In our research, microwear analysis has been used to assess the complete lithics collection from March Hill, an approach which has not been attempted on any other Mesolithic site. Not only is this approach significant to March Hill, but its success could highlight a new technique that could be adopted at other sites. The methodology, developed by the Catalan-Argentine team, is based on a detailed form-functional analysis of lithic artefacts, drawing on a theoretical perspective derived from a Marxist focus on 'labour' integrated within recent approaches to social identity.

In this approach technology is viewed as a sphere of production deeply embedded in social practice; it comprises physical actions carried out by knowledgeable human agents acting and making decisions conditioned by their social context (Ingold 1997; Dobres 2000). Therefore, technology is considered to have an active role in social reproduction: it participates in the appropriation of indispensable resources for human life and it requires the transmission of knowledge about production and use of objects (Álvarez 2003). This implies that technological practices have an economic dimension, as they involve the organisation of human effort in order to transform the environmental conditions to fulfil social requirements. Labour is regarded as a key element of every economical dynamic, thus forming a basic element in the analysis.

Similarly, 'landscape' is created by transformations of environments by human societies. In this context recent approaches to lithics have focused on social identities, their relations, and landscape generation (Warren 2006), within which work strategies (or the energy invested by different individuals in producing and using materials) can be understood as social and economic elements.

This approach to lithic analysis has developed from recognition of the limitations inherent in traditional approaches, particularly those focused on formal tool categories, in developing an explanatory framework regarding past social dynamics (Finlay 2000b; 2003; Young 2000; Warren 2006). In contrast, rather than focus on finished tools and traditional typological categories, as a targeted approach would do, artefacts are considered based on the relationships between form, function, production and use.

## 5. Microwear Analysis

As one would expect, much of the variation in lithic assemblages appears to be related to the tasks for which the artefacts were intended and used. Indeed, the continuous feedback between manufacture, use, design and human agency produces changes in technological organisation (Schiffer and Skibo 1997; Ingold 1997). With this in mind, it would seem a priority to consider the activities for which stone artefacts were designed and employed.

The perspective used here attempts to provide greater insights by focusing on the context of use of the tool, which includes several dimensions: a) the working material and its state; b) the operations in which tools are involved; c) the spatial and the temporal order of the activities in which a tool is employed; and d) the technical processes related to tool usage (Álvarez 2003). By relating use-wear traces back to context of use, it becomes possible to explore different aspects of technological practice, such as the organisation of labour, distribution of activities, time investment and skill and cognition in stone tool usage.

## 6. Use-wear Methodology

The use-wear method applied in this research is based on the combination of four kinds of features: a) edge rounding; b) edge-scarring or edge damage; c) micropolish; and d) striations (Keeley 1980; Mansur 1999). Each feature includes clusters of attributes that are considered as a whole in order to interpret the worked material, the kinematics and the use-time. Of all the features, micropolish traces can be used with the most confidence to determine the worked material (see discussion in Juel Jensen 1988). For the purpose of this study, the pieces from March Hill were examined with an incident-light microscope and a stereomicroscope. The incident-light microscope was a Nikon model with magnifications ranging between x50 and x500. The stereomicroscopes are useful when three-dimensional observation and perception of depth and contrast is critical to the interpretation of sample structure. Therefore, they are suitable for observing edge-scarring and edge-rounding. In contrast, the advantages of reflected-light microscopes rely on their resolving power and bright field illumination technique that provides bright light evenly dispersed across the plane of the field of view of the focused sample, appropriate for observing micropolishes and striations.

Perhaps the main problem encountered when undertaking micro-wear analysis of the March Hill lithic assemblage was that the finds had been labelled on the ventral face and varnished, with varnish sometimes extending across the entire artefact, obscuring observations of the surface (see Figs 5, 6 and 7). The varnish could not be removed and consequently 45% of pieces (N=804) could not be used in the study. The remaining pieces were studied following the aforementioned procedures. Before observation was undertaken the pieces were cleaned with mild soap and water and then wiped with alcohol.

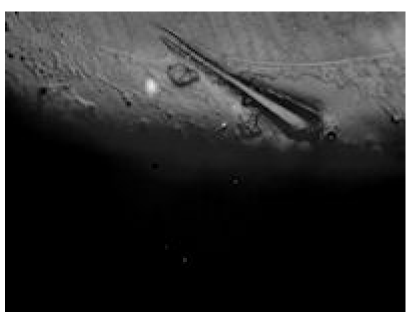




Figure 5: (left) Lithic artefacts covered with varnish. Magnification x200
Figure 6: (middle) Lithic artefacts covered with varnish. Magnification x200
Figure 7: (right) Lithic artefacts covered with varnish. Magnification x200

### 6.1 The morphotechnical analysis

The analytical proposal created by Georges Laplace (analytical and structural typology) was applied to the March Hill assemblage (Laplace 1956; 1972; 1974; 1981; Laplace and Livache 1975; Laplace and Sáenz de Buruaga 2000). His structure offers the possibility of creating new variables without breaking the whole coherence. And, at the same time, it is a multi-scale method: it is possible to adjust the dimension of the analysis for each variable, each piece, each assemblage, etc. Insofar as the different applications of the method share the structure as well as the variables, it is possible to compare assemblages.

Through the concrete application of this approach, developed by A. Vila (1981; 1986), comes the analytical and structural typology that allows us to recognise and quantify the pieces as products of labour, and of the variables resulting in different edge morphologies. This sequence, which follows a relational formula through a specific syntax based on specific rules, represents the inter-relation of the variables that make up the edge; on a greater hierarchical level, the correlation between the different edges can be achieved. In this way, the morphology can be represented in a unique formula including qualitative and quantitative variable values. Thus, each piece is analysed at two levels: a broader level (which includes the inter-relations already mentioned) and a specific level according to its own traits. The analysis includes all the edges of an artefact, based on the calculation of every one of the morphological variables and their inter-relationships. These variables are (Briz2004):

| |
|---|
| *Type of edge*. Retouched; angle, for unretouched edges; fractured, etc. |
| *Mode*. Edge-angle: abrupt, simple, etc. |
| *Amplitude*. (Only for retouched artefacts). Level of invasiveness of the retouch on the faces of the piece: marginal, profound. |
| *Direction*. Surface where the retouching occurs: direct, inverse, etc. |
| *Alignment*. Morphology of the global edge-shape: rectilinear, convex, etc. |
| *Orientation*. Direction of the edge in relation to the axis of the piece: convergent, divergent, etc. |

For example, an edge formed by a simple, sinuous angle, that tends to converge with the axis of the piece, would express itself at the level of a codified formula in the following way:

[aSsincvg]

The 'a' indicates the presence of a 'natural' edge without fracture or retouch. 'S' designates the angle measurement: between 30 and 44°. 'Sin' means that the edge is aligned (in relation to the percussion axis of the artefact) with a series of approaches and separations. Finally, 'cvg' indicates the general orientation of the edge: convergent in relation to the percussion axis of the artefact.

If the piece (a flaked stone) continues with an abrupt, rectilinear, transversal distal fracture followed by a plane, divergent, rectilinear angle on the right edge, the complete formula would be the following:

[aSsincvg+ fArecttrans+aPrect div]

If distal edge is abrupt, profound, direct, convex, transversal retouched of the previous example, the result would be:

[aSsincvg+rApdcxtrans+aPrect div]

### 6.2 Form-function relationships: dynamics of the structural sequence

In contrast to other attempts to analyse the form-function correlations following the traditional lithic typologies (for example, and from different archaeological contexts, Barton 1990; Calvo 2002; Dibble 1987; Finlayson and Mithen 1997; Knecht 1988; Kuhn 1992; Meltzer 1981; for a general compilation, Juel Jensen 1988), the aim was to move away from the assumptions of typological reasoning. The data were structured by employing the defined dimension of the context of use: they are the referential elements to contrast the hypothesis of significant association. The steps consist of: a) selecting the cases of a specific production process (for example, bone cutting); b) quantifying all variables already mentioned.

The algorithm employed (Laplace 1974; 1975; 1978; 1981) calculates the levels of homogeneity and the internal dynamic of the structure of the morphological groups that make up an archaeological lithic assemblage (for example: Sáenz de Buruaga 1991; Laplace and Sáenz de Buruaga 2000).

The method links the hierarchical recognition of different groups based on the number of individuals that form them and then analyses the mathematical significance of the existing differences between these groups, employing the distance from X2 (or Pearson's reduced quadratic deviation) as a meaningful reference. The final result is an evaluation in relation to the empirical appraisal of the whole assemblage analysed. The identification of differences is obtained and the calculation of their significance: the identification of ruptures significant enough to break the homogeneity of the assemblage. As they break off we can see the significant groups that exist in relation to the global whole, and we identify their relationship in respect of the total and the rest of the groups. We can then recognise the existing internal hierarchies: that is the articulation of the structural sequence (Laplace 1974).

The structural sequence offers us a representation of the variability of a given morphological trait; it expresses how this trait is articulated in the assemblage: it identifies the presence of predominant traits, and the intensity of its difference. For example, in Figure 8, we can see five hierarchical levels:

```
FAU A     F     MX    TDA   XAR   A0
    37    8     6     4     0     0
       ///
              _____________/
                    _______/
                          _____________
                                ________
```

Figure 8: Results for type of edges used for faunal material processing from Túnel VII site, Tierra del Fuego, Argentina (Briz 2004). Edge types: A: Angle; F: Fracture; MX: Mixed edges; TDA: Angular tendency. XAR: Overhang (in the distal portion of the flake); A0: angle 0. In the graphic (Vila 1986) the interruptions are represented by the symbol '/' and the repetitions indicate an increase in their intensity. The symbol '____' indicates continuity.

The algorithm is also designed for the recognition of existing dynamics between different groups: under the same parameters of mathematical calculation, the change, the movement and its intensity can be observed. Organised under context of use criteria that act as independent variables (every work process), the absence of movement indicates an absence of inter-relation: the hierarchisation recognised is not a product of the selected functional variable. The following example (Fig. 9) correlates the types of cutting edges and the material worked:

```
GLOBAL X² 21.47702                20  FREE DEG.
DYNAMIC OF STRUCTURAL SEQUENCE

      MEAT    ANIM    SKIN    BONE
TDA  .0286 = .0727 = .0000 = .0317 = .0294 INCREASE  NOT SIGNIFICANT
A    .6000 = .6727 = .5517 = .5952 / .3824 DECREASE  NOT SIGNIFICANT
F    .0857 = .1455 = .2759 = .1825 = .2353 INCREASE  NOT SIGNIFICANT
MX   .2571 = .1091 = .1379 = .1746 = .3235 INCREASE  NOT SIGNIFICANT
A0   .0286 = .0000 = .0345 = .0079 = .0294 INCREASE  NOT SIGNIFICANT
XAR  .0000 = .0000 = .0000 = .0079 = .0000 STABILITY
```

Figure 9: Table of the dynamic of the structural sequence. Túnel VII site, Tierra del Fuego, Argentina (Briz 2004)

In this inter-relation, the only significant interruption is not relevant enough. Consequently, there is no significance in the selection of the types of cutting edge to the function of the worked material. The null hypothesis is the correct one.

This procedure will be repeated with each morphological variable, recognising the dynamics of the whole assemblage by ranking them. These diverse and complex dynamics can be near or far from a morphological specialisation.

### 7. Preliminary Results and Discussion

One of the most striking results obtained from the analysis of the March Hill lithic collection is the high frequency of unused artefacts (Fig. 10). Within the studied assemblage, 92.5% (N=912) did not exhibit recognisable use-wear traces; there was no formation of micropolish areas and the higher parts of the microtopography near the edges appeared unmodified. Moreover, the edges looked fresh and neither edge-rounding nor edge-damage has taken place in the greater part of the pieces.

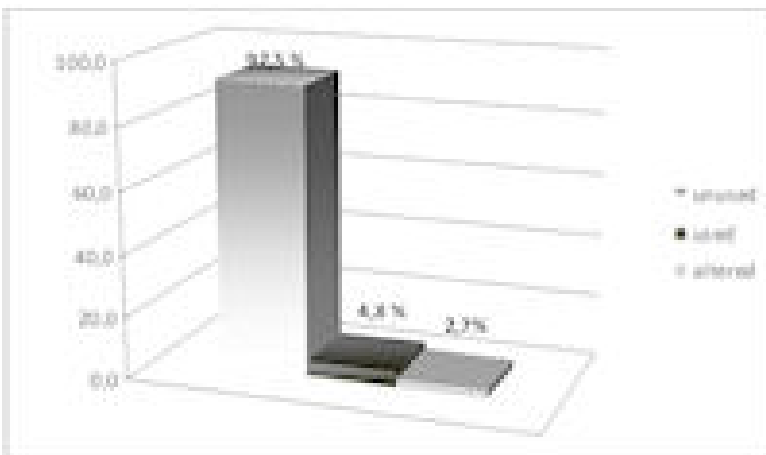
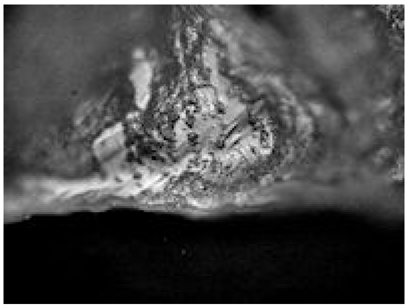



Figure 10: Relative frequencies of used, unused and altered pieces

Some of the artefacts (2.7%: N=27) showed post-depositional surface modification that prevented us from assessing whether or not the piece had been used. This group exhibited soil sheen that appeared as bright continuous lines along the edges, the ridges and on the higher portions of the lithic surfaces that came into contact with the sedimentary matrix first. Many authors have pointed out that this sheen constitutes a previous stage to the formation of patinas and it occurs when the concentrations of chemical agents are too weak to infiltrate into the fissures or holes of the rock (Rottlander 1975; Lévi-Sala 1993). Several artefacts also appear to have been burned.

Of the sample examined, 4.8% (N= 47) showed visible wear from use. The most commonly used motion, represented by some 85.1% of the sample, was cutting/sawing, followed by 8.5% of the sample that exhibited scraping (or transverse motions), and in the remaining 6.4% of the assemblage it was impossible to determine the kinematics of the tool.

According to our observations, the working of bone (Figs 11 and 12) and processing of hard materials were the most common tasks performed at the March Hill settlement (see Table 1). For hard materials, the traces are not developed enough to offer more accurate definitions. Almost all the tools carried out sawing activities. In contrast, wood (Fig. 13) and hide working, as well as soft materials working, are represented by only one example used in a transverse motion.



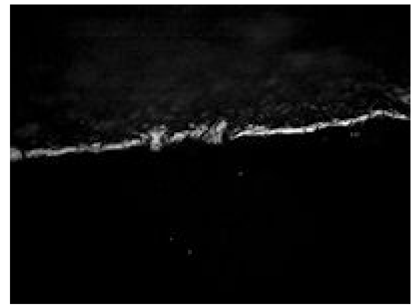


Figure 11: (left) Use-wear traces produced by bone cutting. Magnification x200
Figure 12: (middle) Use-wear traces produced by bone cutting. Magnification x200
Figure 13: (right) Use-wear traces produced by wood scraping. Magnification x200

### Table 1: Use-wear results

| **Use-wear results** | **Motions** | | |
|---|---|---|---|
| **Worked materials** | **Longitudinal** | **Transverse** | **Undetermined** |
| Bone | 7 | - | - |
| Wood | - | 1 | - |
| Hide | - | 1 | - |
| Hard material | 11 | - | - |
| Soft material | - | 1 | - |
| Undetermined | 22 | 1 | 3 |
| **Total** | **40** | **4** | **3** |

The rest of the artefacts (45%) did not exhibit clear enough traces to allow identification of contact material. Two factors may account for this problem: a) these artefacts were used for a short time only; b) they were affected by post-depositional processes which masked the use-wear features. In fact, it does appear that the formation of use-wear traces is a dynamic process resulting, in part, from the amount of time invested in undertaking a task. Each kind of worked material required a different length of time to establish their diagnostic patterns. Moreover, micropolishes resulting from different worked materials exhibit diverse levels of resistance to the attack of environmental factors (Plisson and Mauger 1988). All these factors may have produced or contributed to our results. Future studies of sedimentary matrix could shed further light on this subject.

Due to the small number of pieces with use-wear traces, it is difficult to assess the correlation between the context of use of lithic implements and their morphology. However, this does not detract from the validity of the technique but does highlight the need for a stone tool series with a higher level of utilised stone tools than exhibited at March Hill. This problem may perhaps have been reduced had the entire collection been suitable for analysis. Despite these complications, the results obtained from the March Hill assemblage are of interest.

The most remarkable result from this analysis is perhaps the high frequency of unused artefacts in the collection. Almost all of them are unretouched flakes or of very small size and they are likely the result of edge configuration. There may be good reasons to suggest that the March Hill inhabitants developed a provisioning strategy (*sensu* Khun 1992) and that they were producing tools that could, and likely would, be used elsewhere. It is perhaps justifiable not only to think of March Hill as an isolated site but also as part of a wider chain of sites that made up part of the life of prehistoric people. Further analysis from other sites could begin to tease out relationships between sites that a targeted approach may have missed.

Of those tools that have been used, two use-processes are identified clearly: the cutting of bone and the cutting of hard material. Although the size of both samples is very small, in a previous application of the method (an assemblage from the 19th century with an excellent level of conservation), the number of tools for bone working was 762, or 3.66% of the total assemblage of some 20,814 artefacts (Briz in press); this ratio is lower than that observed in the March Hill sample. This result leads us to think about accurate scales to make statistical inferences in form-function research and to offer an identification of the dynamics of used edges.

The tools used for cutting bones do show some patterns:

- A high level of use of retouched edges (54.5%).
- A clear selection of abrupt angles (>45°) for retouched and unretouched tools.
- The preponderance of direct retouch.
- A predominantly rectilinear alignment for retouched tools (consequently, the rectilinear artefacts were selected for a second level of investment of work by retouching).

In the case of tools for hard material, the patterns are:

- A low level of used retouched edges (only 18%) but it is interesting to note the presence of retouched edges without use.
- From the small sample (2), we cannot identify any pattern from retouched edges.

- On unretouched tools there is a tendency for an abrupt angle (>45°) with rectilinear alignment.

A more thorough assessment of the activities performed at the site requires further study of artefact distributions, something currently ongoing. Nevertheless, these initial results provide some grounds for optimism with regard to the importance of the proposed method in developing insights about the dynamics of past societies, and providing answers to associated questions.

## 8. Conclusions

Considering a lithic assemblage and its use without recourse to traditional categories is both liberating and informative, but also challenging. This case study has perhaps been disappointing in some respects, as it revealed a lack of association between the form of the cutting edge and the material used. However, the results have also been revealing as they point to a preponderance of wear suggesting the cutting of bone and hard material, and the possibility that some tool production was destined for use elsewhere – both of which are significant in supporting the 'traditional' hunting camp interpretation of the site. Further, use of this technique both at March Hill and other sites can only build on these promising initial findings. Of key significance, and something a 'classical' approach would likely have missed, is the number of unworked tools from the site. This offers a possible window into the minds of past people and could be used to infer desires or routine, whether related to movement or stockpiling habits.

A traditional microwear analysis of the March Hill assemblage would most probably have focused on a few 'finished' tools or pieces with clear use wear. The approach from the Argentine-Catalan perspective has generated new insights at this preliminary stage which, it is hoped, might be useful for other sites and assemblages. A morphotechnical approach also opens up new and exciting avenues for addressing social processes in considering the spatial distribution of structural patterns in the assemblage, which lie beyond traditional typologically based interpretations.

Not only has the Argentine-Catalan team's method been an inspiration to us, the theoretical position from which it stemmed, that of a Marxist interpretation of labour and identifying technological artefacts as objects pivotal in the social sphere, is also of interest. While it is perhaps premature to apply this in depth at this early stage to the aforementioned results from March Hill, it is hoped that future work will facilitate the incorporation of this interesting theoretical position into what has proven here to be a useful and liberating methodological approach. Our ultimate goal is to see the marrying of the robust scientific methodology here outlined with theoretical concepts to produce a cohesive, informative whole which, it is hoped, will allow us to uncover further interesting insights from March Hill.

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