What is Still Bay? Human behavioural variability and biogeography reflected in Southern African Middle Stone Age bifacial points

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1. Introduction

1.1 Impetus and aims

The *Still Bay* is a cultural-historic phase within the southern African Middle Stone Age (hereafter "MSA"), which remains critical to our understanding of modern human behavioural evolution, as well as to our understanding of the biogeographic spread of different early modern human groups across the southern African sub-continent. Broadly, this MSA phase is characterized by a series of material indicators of modern behaviour, which cumulatively remain undocumented in preceding MSA phases.

However, this phase is recognised in the archaeological record solely through the identification of bifacial stone points that have a specific and complex overall morphology. The Still Bay is represented in relatively few MSA sites. Importantly, these sites are spread over a vast territory and their contemporaneity remains contentious. Indeed important work has focused on refining the ages and the geographic spread of the Still Bay, and inferences from these parameters include interpreting the degrees to which quasi-contemporaneous groups of early modern humans were culturally connected, or coalesced, across the southern African landscape. Variability within the Still Bay, and the implications for the accuracy with which the limits of this phase can be identified in time and in space have received relatively little to no attention. However, MSA models that rely on the Still Bay hinge entirely on the reliability with which this cultural label can and has been applied to stone tool assemblages.

This dissertation is driven by the pursuit of four objectives furthering our understanding of the nature of the Still Bay as it is currently defined and interpreted. The first and most important is to develop a new and objective method for documenting and interpreting morphological variability in bifacial points, the *fossile directeur* of the Still Bay. This objective is met by adapting and developing high-resolution statistical shape analysis methodologies, traditionally used in physical anthropology, to be useful in stone artefact analyses. The second and third objectives are to use this new methodology to document how Still Bay points vary through time and across geographic space, and to test predictions for why the documented changes in time and in space take the forms that they do. Finally, an objective is to provide a synthesis regarding the parameters within which the Still Bay label can meaningfully be applied and to consider some of the wider implications of this focussed study for the use of Middle Stone Age cultural-historic labels in broader models concerning the dispersal of modern human groups within and out of Africa.

This introduction will start with a short background review of earlier approaches to classifying southern African stone artefacts within culture-historic units and will then discuss the concept of the Still Bay as a cultural/technological label within this framework. The idea here is to contextualize the ways in which cultural historical labels are currently used through reference to aspects of the logic behind their original formulation. The references which initially defined the term "Still Bay" and the logic behind this definition are discussed as this

early work substantially influences the ways in which researchers use the term Still Bay today. I then discuss the broad methodological approach developed within this study and why this approach is appropriate to investigating issues of Still Bay point shape variability in space and time. I go on to discuss the samples studied, the archaeological contexts from which these samples derive, and the logic behind the inclusion and exclusion of certain specimens relative to stone artefact typology discussions in relevant literature. Finally, I outline and summarise the content of the individual thesis chapters in terms of the specific questions addressed and the results of the associated analyses.

1.2 Original formulation and use of Southern African Middle Stone Age Culture Historic units

Today variation in the southern African Stone Age cultural-historic sequence tends widely to be interpreted as reflecting similarities and differences in artefact making 'traditions' (see Mitchell, 2002; Lombard et al., 2012 for an overview). This tendency has its roots in the earliest attempts at classifying southern African artefacts into cultural groupings (Sanderson, 1879; Feilden, 1884; Gooch, 1882), with the prevailing early 20th century tendency being to fit southern African artefact forms into, at the time, relatively well-established European chrono-cultural categories such as the 'Chellean' or the 'Solutrean' (Peringuey, 1911; Johnson, 1912). Similarities between artefacts within local southern African groupings and equivalent groupings in Europe necessarily implied some cultural connection between the two broader locations (Peringuey, 1911). However, perceived cultural similarity between European and southern African stone artefacts was also interpreted markedly differently by certain early researchers. Johnson (1907), for example, had a different conception of technological similarity between African and European Stone Age artefacts to Peringuey. He proposed that similarity in artefact form implied on some level a degree of similarity in stage of cultural evolution, irrespective of whether or not similar looking artefacts in Europe and Africa were contemporaneous.

Goodwin and van Riet Lowe's (1929) foundational work – *The Stone Age Cultures of South Africa* - constituted the first large-scale systematic organisation of southern African stone artefacts. This organizational process relied at the outset on vast collections housed in what is today known as the *Iziko* museum, in Cape Town, South Africa. Goodwin and van Riet Lowe's work, although subject to revisions and refinements given subsequent excavations and the availability of new dating techniques, remains highly influential on cultural-historic approaches to the southern African archaeological record today (Lombard et al., 2012 and references cited therein Appendix A).

Within Goodwin and van Riet Lowe's framework, at the largest scale stone artefact variation was compartmentalized into a three-age scheme: the Earlier, Middle and Later Stone Ages. This formulation was developed as an African equivalent to the broad Lower, Middle and Upper Palaeolithic divisions in Europe (Goodwin and van Riet Lowe, 1929). While Goodwin and Van Riet Lowe's system was modelled broadly on an existing European classification, the fact that it comprised a new locally suited or indigenous terminological framework indicates that it represented a significant departure from previous organisational attempts by

Europeans. The Still Bay collections analysed for this thesis would be considered, within Goodwin and Van Riet Lowe's scheme, to belong to the Middle Stone Age.

In fact, all three Age divisions were further classified by Goodwin and Van Riet Lowe into industries or sub-divisions, which they considered to be material signifiers of discrete cultural groups. In order to document rough chrono-cultural relationships between these industries, which were initially differentiated by reference to museum collections only, Goodwin and van Riet Lowe could draw on a number of prominent excavations that were being undertaken at important Western and Eastern Cape South African sites such as Montagu Cave, Peer's Cave, Dale Rose Parlour and Howiesons Poort shelter (Goodwin, 1929; Peers 1927; Stapleton and Hewitt, 1927). The identification of diachronic 'industrial change' in the archaeological record – such as from the "Mossel Bay" to the "Howiesons Poort", for example - was interpreted within this scheme as being a material indicator of the introduction of new migrating cultural groups into the regions where these sites were located.

Within a couple of decades of Goodwin and Van Riet Lowe's seminal work, pressure exerted from research undertaken elsewhere in Africa influenced the expansion of some of the industry terms originally developed for the local South African context to be applied at a pan-African scale (Malan, 1949; Clark 1959). Some industries such as the 'Howiesons Poort' were temporarily replaced with more broadly geographically applicable - and by necessity more generalized - technological definitions, and contingently were given different cultural labels.

However, one of the southern African Stone Age industries which more or less retained its original simple definition and was widely applied by researchers working outside of South Africa, at the broadest pan-African scale, was the *Still Bay* (Anthony, 1972; Wendorf and Schild, 1974; see Kleindienst, 1968 for a critique).Various understandable complications arose with attempts to widen the geographic applicability of cultural labels that were originally designed for the local southern African Middle Stone Age context, most of which fall outside of the constraints and focus of this thesis (however see Mitchell, 2002; Deacon and Deacon, 1999 and Mackay, 2009 [vol.1] for useful overviews of problems associated with culture-history in southern Africa). An experiment with expanding and replacing the "Howiesons Poort" label with the "Magosian", named after the site of Magosi in Uganda, is one example of this tendency (Malan, 1949). The spatial scale of cultural diffusion required to support a definition of the Magosian, which described a cultural tradition that stretched from Cape Town to Uganda, was difficult for many researchers to accept (Clark, 1959).

Clark's (1959) novel focus on deciphering ecological drivers of variation in the archaeological record constituted a departure from cultural-historical approaches as they were previously rigidly applied and likely influenced much of the southern African Later Stone Age research that followed in the 1960's and 1970's. However, the literature suggests that the MSA was a seemingly less interesting time-period in this context than the LSA. This may have been a partial consequence of the lack of reliable dating methods then available for the MSA. How exactly was material cultural variation expected to be influenced by inevitable environmental variation occurring through time and across space? This remains a key question with tracing techno-traditions through space and time today, and a series of

predictions are proposed in Chapter 3 regarding what one might expect to see. Notably, Parkington (1977) and Deacon (1976), although differing markedly in their interpretations of the Later Stone Age archaeological record, both viewed technological variation as the output of a feedback process between tradition and environmental change. Here technologies were expected to vary as adaptive responses but only within parameters predetermined by cultural tendencies.

1.3 Definition and use of the Still Bay label

The *Still Bay* refers to one of the above mentioned (1.2) industrial sub-divisions of the Middle Stone Age. Depending on whether the label is applied in a 'behavioural evolutionary' (e.g. Johnson, 1907; 1912; Clark 1959; Wurz, 2005) or 'cultural-historic' (e.g. Lombard et al, 2012 and references cited therein; Mackay et al., 2014) interpretative context it may also variously be referred to as an MSA "culture", "cultural phase", "sub-stage", "stage", "techno-complex" and more recently as a "techno-tradition" (Henshilwood and Dubreuil, 2011; Wadley, 2007; Lombard et al., 2012; Lombard, 2005; Jacobs et al., 2008; Henshilwood, 2012 among others). Part of the drive of this thesis is to explore which conceptualization of the Still Bay is behaviourally meaningful and at what temporal and geographic scales it remains reliable. It is therefore difficult to select one definition for the Still Bay to maintain throughout this thesis from the outset.

The *Still Bay* is conventionally characterized by finely shaped bifacial points that have a distinctive overall morphology, which is highly bilaterally symmetrical and is generally foliate or lanceolate in form. Still Bay bifacial points are thought to have been manufactured through a sequence of distinct knapping phases. This sequence starts with the predominant production of flake blanks which subsequently were subjected to phases of direct percussion hard-hammer roughing out, then soft-hammer thinning and finally finishing through soft-hammer and/or pressure flaking techniques, potentially with the use of heat-treatment in the final phases of production (Brown et al., 2009; Villa et al., 2009; Mourre et al., 2010; see Soriano et al., 2015 for discussion of variations at Sibudu).

When the Still Bay was first documented in the early 20th century, there was substantial debate concerning its definition and origin, including which bifacial point morphologies should be labelled as *Still Bay* (Goodwin and van Riet Lowe, 1929; Heese, n.d). As mentioned above, in early investigations of Stone Age industries, European researchers tended to explain complex looking southern African lithic technologies by reference to a European origin or analogue (Van Hoepen, 1926; Heese, 1933; Breuil, 1948; also see citations in Henshilwood 2012). The Still Bay is a pertinent example of this tendency in that diagnostic points were considered by many early European researchers to have 'Solutric retouch' reportedly comparable in morphology to actual Solutrean points from eastern France (Arcelin 1890; Malan and Goodwin, 1938). Interestingly South African researchers were sceptical about this Eurocentric perspective at the outset. South Africans' maintained even at this early stage that the origins of the southern African Stone Age, of which the Still Bay was a heavily discussed component, were potentially not European (Goodwin and Van Riet Lowe, 1929; Goodwin, 1953; Goodwin, 1958).

Problems associated with the definition and interpretive implications of the Still Bay label resurfaced in the 1950s through a drive to formalize many of the industrial concepts proposed in Goodwin and Van Riet Lowe (1929) into frameworks applicable at a pan-African scale (Alimen, 1957; Clark, 1959; Leakey, 1936). Discussions at the 1965 Burg-Wartenstein conference demonstrated that the definition of the Still Bay and many other Stone Age industries documented initially by Goodwin and Van Riet Lowe were in need of substantial revision and, importantly, *clarification* in terms of their cultural/behavioural connotations (Inskeep, 1967; Mitchell, 2002; see also Clark (1959) for critical discussion preceding Burg-Wartenstein).

Certain researchers questioned the applicability of the Still Bay label to MSA bifacial industries in eastern and central Africa (Kleindienst, 1968). This resulted in a subsequent decrease in the use of the label. Indeed, in his 1974 synthesis Sampson questioned not only the chrono-cultural status of the Still Bay but whether in fact it even existed as a culturally meaningful unit (1974: 205).

Recognition in the 1990s that modern human anatomy and behaviour evolved on the African continent - probably within the Middle Stone Age period - resulted in renewed interests in seemingly behaviourally precocious industries like the Howiesons Poort and Still Bay. Henshilwood's work at Blombos Cave (Henshilwood and Sealy, 1997; Henshilwood et al, 2001; 2002; 2004) placed the Still Bay at the global forefront of debates concerning which African Stone Age industries were associated with the earliest evidence for behavioural modernity, as well as with the subsequent migration of early modern humans out of Africa (Mellars, 2005; 2006).

Well controlled excavations by Henshilwood and others have now documented an array of other material indicators of modern human abstract thought and complex behaviour such as bone-tools and engraved ochre, in association with the Still Bay (Henshilwood and Dubreuil, 2011; Henshilwood et al, 2001; 2002; 2004). Cumulatively these non-lithic markers of modernity are not documented in MSA phases preceding the Still Bay. However, the frequency and nature of these non-lithic markers are highly variable from site to site. In probable consequence, today, specifically shaped bifacial points constitute the only feature by which instances of the Still Bay are recognized in the archaeological record. Interestingly, the prevailing tendency within cultural-historic approaches is to define industries based on the recognition of distinctive or distinctive sets of blank production or core reduction strategies. However, in the context of the Still Bay the focus remains on the definition and recognition of a single, specific type of tool. A number of arguments are presented in the following chapters that suggest that when one looks at this specific tool type more closely, significant technological variation is in fact evident at various scales.

Importantly we know relatively little about non-bifacial blank production strategies associated with Still Bay point assemblages and whether commonalities in these strategies have the potential to unite Still Bay assemblages into a cohesive entity in the absence of characteristic bifacial points. In fact, Still Bay assemblages tend to be entirely dominated by flake blanks associated with bifacial roughing-out and shaping (Porraz et al., 2013a; Soriano et al., 2015). Blade production in the Still Bay at Sibudu accounts for an extremely minor

component in this assemblage, and the relatively large collection from Blombos (~20,000 pieces) remains unstudied and looks to constitute a compositional exception relative to the other admittedly smaller available Still Bay assemblages. The lack of information on blank production in less meticulously excavated Still Bay collections like Dale Rose Parlour and Umhlatuzana makes effective comparison of the non-bifacial components of these collections difficult. New methods are being developed that document 'invisible' bifaces in the absence of bifacial pieces, which logically may be applicable to collections from the time interval associated with the Still Bay in the future (Goren-Inbar and Sharon, 2006; Presnyakova et al, 2015). It is conceivable that some MSA assemblages which have not been called Still Bay may, through the use of these new methodologies, be shown to contain evidence of biface production.

A range of well dated MSA sites across southern Africa are now generally accepted as Still Bay. These include Blombos, Diepkloof Rockshelter, Apollo 11, Hollow Rock Shelter, Sibudu Cave and Umhlatuzana (Wadley, 2007; Jacobs et al., 2008; Högberg and Larsson, 2011; Lombard et al., 2010; Soriano et al., 2015). Perhaps as a partial consequence of excitement over the availability of new dating techniques for late MSA bifacial industries, there is today far less critical discussion concerning which bifacial industries fall within the Still Bay definition than there has been in the past.

After initial widespread acceptance of Jacob's (2008) framework concerning the ages and the contemporaneity of geographically separated Still Bay occupations, issues with the applicability of this framework arose. The drastically conflicting dates for the Diepkloof Still Bay layers and the statistical modelling associated with the dating of the Sibudu Still Bay comprise the two central problems (Mackay et al., 2014; Jacobs et al, 2008, 2015; Tribolo et al., 2009, 2012; Guérin et al., 2013; Feathers, 2015; Murray-Wallace, 2015). Problems concerning conflicting dates proposed by different laboratories and the results of the application of different trapped charged dating methods to the same archaeological layers are summarised below in the discussion of the individual study samples. However, despite these issues, the wider agreement amongst dating specialists remains that the Still Bay is associated with a chronological period broadly ~70-77ka (Jacobs et al., 2008; Högberg and Larsson, 2011; Lombard, 2010; Conard et al., 2013, 2014; Murray-Wallace, 2015). Importantly, there are a small number of sites with evidence for human occupation during this period but without bifacial points (Wurz, 2002; Brown et al., 2012; Stewart et al., 2012). This situation raises a challenging question concerning how all ~77-70ka assemblages actually link geographically, and how the presence of bifacial points relates to this network. This issue is discussed in connection with the data presented in Chapter 3.

1.4 Selection of methodological approach

Previous approaches to documenting variation in Still Bay point technologies can be classified within two general categories (simplified in this introductory summary). The first, referred to by some as 'chaîne opératoire' approaches (e.g. Villa et al., 2009; Mourre et al., 2010; Högberg and Larsson, 2011; Porraz et al., 2013b; Soriano et al., 2015), comprises studies that reconstruct tool manufacturing and recycling processes through observation of the points themselves along with the flake debris and through replication of tool

morphologies. The second group, usually focussing on different questions, rely broadly on a combination of linear measurements and attribute analyses (e.g. Wadley, 2007; Lombard, 2010; Mackay et al., 2010). An alternative which remains untested on Still Bay collections until now is geometric morphometric and three-dimensional geometric morphometric analyses of bifacial point shape. Important recent papers have focussed on the geometric morphometrics of various South American bifacial point industries (González-José and Charlin, 2012; De Azevedo et al., 2013; Okumura and Araujo, 2014), and bifacial industries in other parts of the world (Buchanan and Collard, 2010; Velhagen and Roth 1997, Monnier and McNulty, 2010). However these studies were undertaken in a two-dimensional analytical context only. Consequently, shape information associated with three dimensional aspects of the bifacial point's interior surfaces was not considered in these studies. Still Bay points often have one or more highly convex surface, and in addition stemmed points have a substantially larger number of homologous landmarks than Still Bay points. The methodology used in this dissertation builds on these innovative approaches by focussing on variation in three-dimensional bifacial point shape.

In this thesis a three-dimensional geometric morphometric approach to analyzing Still Bay point variability is developed and advocated. This approach is designed to isolate shape information at the detailed resolution required to investigate issues of bifacial point variation in space and time addressed in this thesis. Three dimensional geometric morphometrics (3DGM) largely concerns the analysis, visualization and relationship of shape and size variation with other potential predictor variables. 3DGM is one of the more sophisticated approaches to investigating biological shape variation of bones and teeth, and proceeds through the analyses of landmark configurations that closely approximate the overall shapes of objects (for reviews see Mitteroecker and Gunz, 2009; Gunz and Mitteroecker, 2013). Critically, in 3DGM all landmark configurations are scaled, translated and rotated onto one another using Procrustes superimposition. Effectively shape in a given dataset is isolated, and the influence on shape of the 'nuisance parameters' of size, position and rotation is removed.

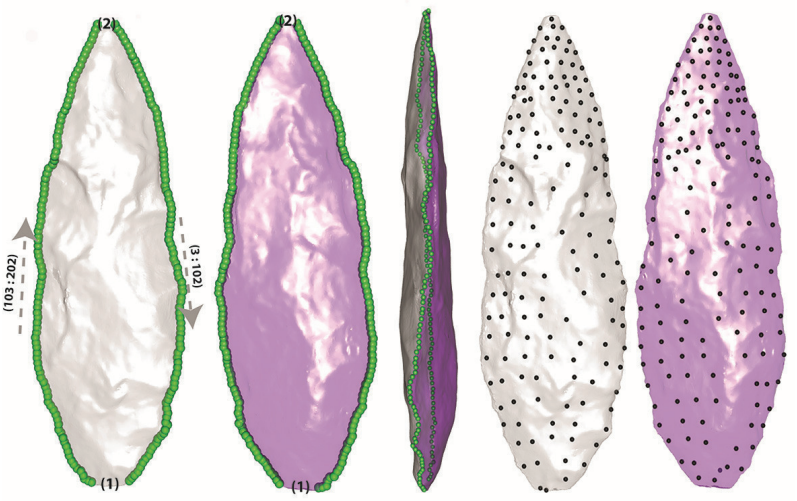

Figure: An example of the landmark configurations comprising the individual cases within the analyses which follow.

However, the quantitative study of stone artefact size and shape in general has thus far relatively exclusively been undertaken through analysis of linear measurements, otherwise known as traditional morphometrics. In traditional morphometrics measurements often covary strongly because, when a specimen has a larger size, all linear measurements of that specimen are larger. In traditional morphometrics one therefore needs to be very aware of monitoring the effects of size on shape.

The central problem with applying geometric morphometric techniques to analyse bifacial tools is the paucity of available homologous landmarks. Several attempts have been made to develop 3DGM approaches to analysing overall stone artefact morphologies (e.g. Lycett et al, 2006; Lycett and von Cramon-Taubadel, 2008; Lycett and Gowlett, 2008; Lycett and von Cramon-Taubadel, 2013). However, a method that captures all potentially important stone artefact curves and surfaces in three dimensions has remained elusive. In this thesis I outline a protocol that uses geometric morphometric techniques to document bifacial point shape variability. As stone artefacts have few homologous landmarks in comparison with biological organisms, I developed automated ways to orient artefacts in terms of homologous technological axes, and then defined geometrically correspondent landmarks in accordance with these axes. Individual bifacial pieces are oriented in terms of their tip/base axis using Principal Components Analysis. Equidistant semilandmarks are then defined along each edge of each bifacial tool. Surface landmarks are then defined equidistantly on the surfaces (the biface 'faces') of a single template specimen. These surface points are then 'warped' from this template specimen onto each specimen studied using each target specimen's already defined edge semilandmarks as a reference for each warp. Then the already warped template configurations of landmarks are projected onto the actual target mesh surface. This data capture process and associated applications are described and discussed in detail in Chapters 2 and 3.

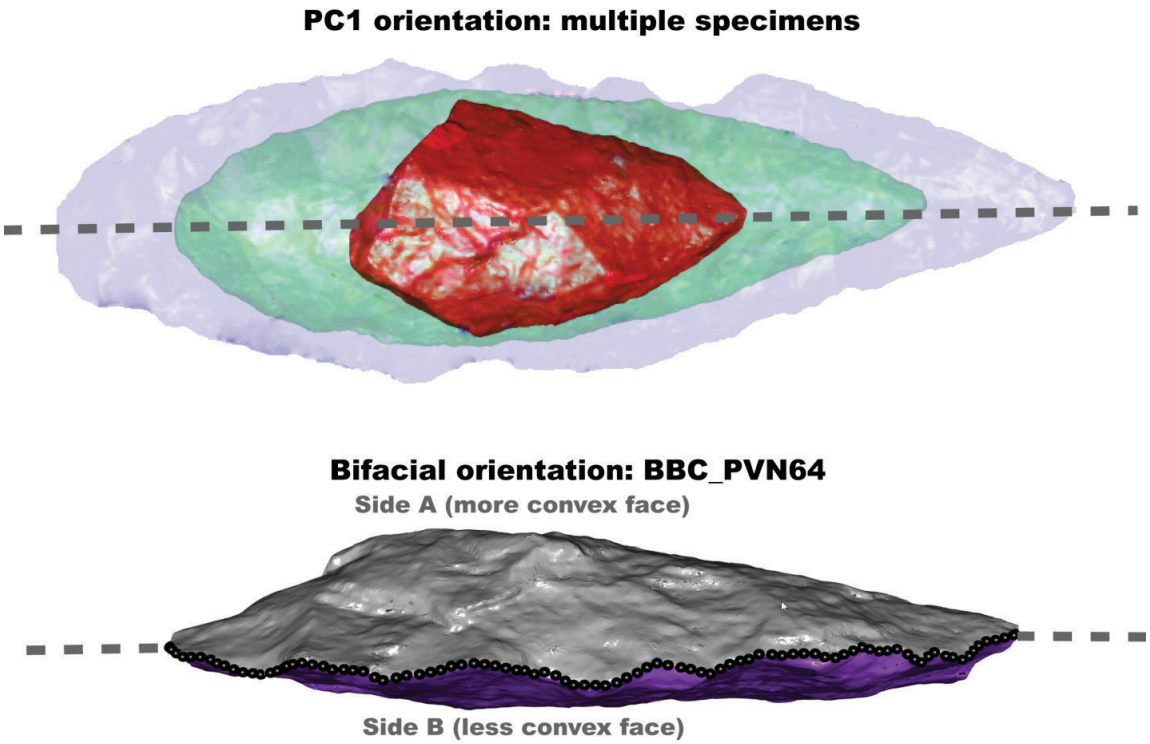

Figure: An example of the first homologous axis, against which all points were initially oriented, prior to the landmark configurations being developed and imposed.

1.5 STUDY SAMPLES

The analyses presented in the following chapters are based on a sample of 230 complete, unbroken Still Bay bifacial points from southern African sites that include Blombos, Diepkloof, Sibudu (Lyn Wadley excavation), Umhlatuzana, Dale Rose Parlour, Clanwilliam Dam East and Hollow Rock Shelter (hereafter "BBC", "DRS", "SIB", "UMH", "DRP", "CW" and "HRS"). Apollo 11 is the only dated proposed Still Bay locality not represented in this thesis; however, whether the points from Apollo 11 are Still Bay has been questioned (Vogelsang et al., 2010). The collections studied are targeted here because: (1) these points originate from the widely accepted key Still Bay sites (Lombard et al., 2012; see Soriano et al., 2015 for a recent different view concerning Sibudu), and (2) these sites form the backbone of an ongoing program aimed at dating and tracing the distribution of the Still Bay across southern Africa (Jacobs et al., 2008).

Certain scholars suggest that a small number of points within the chosen collections are not "typically" Still Bay in overall morphology despite being recovered in stratigraphic and contextual association with more typologically representative specimens (Lombard et al, 2010; Villa et al., 2009:442; Soriano et al., 2015:23). This tendency to emphasize similarity is a classic example of the "Texas sharpshooter fallacy", which is pertinent to analysing diversity in Still Bay points or any other sphere of lithic variability. It really goes to the heart

of the unavoidable ambiguity associated with selecting lithic samples based on typological criteria. The logic behind sample selection in this thesis is that there is an element of circularity in selecting specific bifacial points from layers that are labelled as being representative of the Still Bay industry while disregarding other bifacial points from these same layers that are deemed not to be characteristic of the Still Bay based on qualitative observations of their overall morphologies. If only bifacial points that some would call classically Still Bay were selected across the sites of interest, there would probably not be substantial morphological variance within the data.

For the purposes of documenting the full spectrum of regional and temporal variability in the analysed samples, in the studies presented here all available complete points from layers documented as or containing elements of "Still Bay" were studied. Points suggested by previous analysts not to be morphologically representative, despite being recovered in association with so-called classic Still Bay points, include the serrated specimens from the 71 ±5ka layers at Umhlatuzana (Lombard et al., 2010) and certain specimens in the Blombos collection that were separated during curation of the collection (Villa et al., 2009:442; Soriano et al.,2015:23). The objective here is to document variability in bifacial point shape and size, and it is unclear whether these atypical looking bifacial points are meaningful discrete types or whether they fall on the same morphological continuum as more classic-looking specimens. However, for demonstration purposes, in Chapter 3 additional analyses are included with a dataset where certain specimens identified as atypical are removed. A table of the dates and associated references of the points studied is provided in Chapter 3; however, these data are expanded on below.

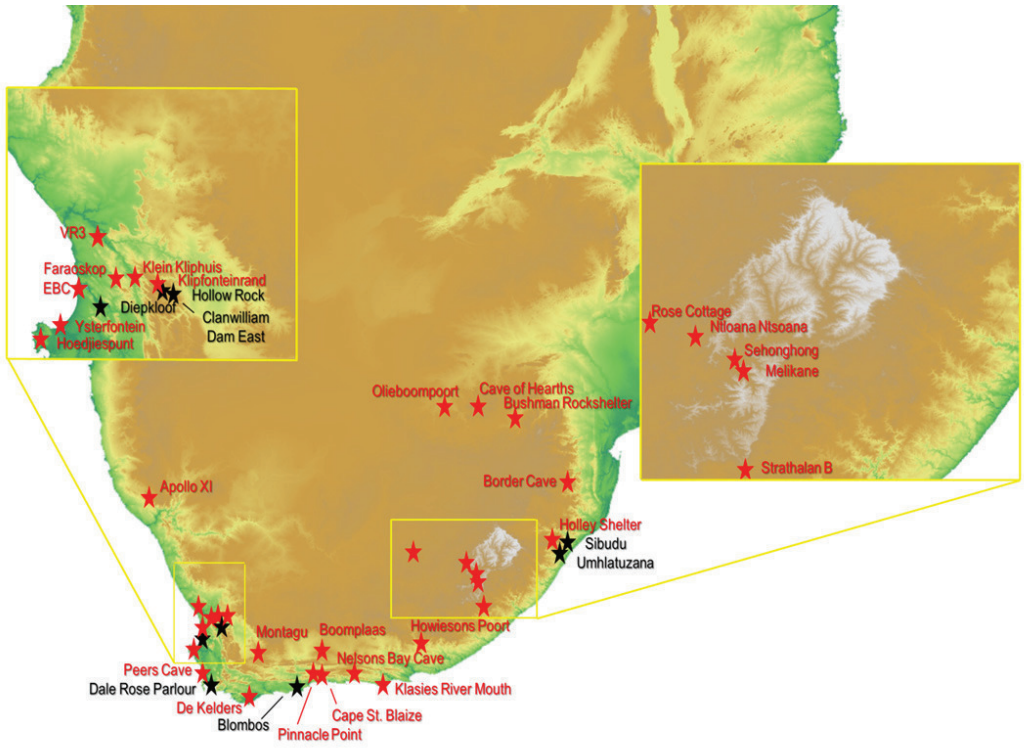

Figure: Key Middle Stone Age sites in southern Africa. Sites analysed in this study are marked with black stars. Stars representing sites in close proximity on the expanded drawing on the left are merged on the smaller scale map.

1.5.1 Blombos collection

Blombos is a rock shelter on the south-east coast, 34m above sea-level in the Eastern Cape province of South Africa. Blombos contains an extensive MSA sequence that is capped by a short late Holocene sequence. The site has been excavated by Henshilwood and colleagues since 1994, and the analysed bifacial points come from an excavation of sixty-six, 50 cm by 50 cm sub-squares, from two unconnected excavation areas, eight squares of which are located outside of the cave drip line. The bifacial point bearing deposits from the site are broadly distinguished within chronological phases M1 and M2, and each chronological phase is subdivided into sequential stratigraphic layers based on the composition, colour and compaction of associated sediment (Henshilwood et al., 2002).

The individual points have provenience information that relates to these sequential layers, and the vast majority of Still Bay material derives from the M1 phase layers (Villa et al., 2009; Henshilwood et al., 2001). Two Optically Stimulated Luminescence (OSL) ages associated with the Still Bay at Blombos come from layers within the archaeological sequence, whereas one age comes from a sterile, aeolian deposit which directly overlies the point bearing horizons. The latter deposit yielded an age of 67.8±4.2ka. An age of

72.7±3.1ka was calculated for the M1 point bearing layers and an age of 76.8 ±3.1ka was calculated for the lower point bearing layers (Henshilwood et al., 2002; Jacobs et al., 2003a; Jacobs et al., 2003b; Jacobs et al., 2006). The shelter was therefore occupied by groups who manufactured Still Bay points by the end of MIS 5a, and was likely relatively continuously occupied until the start of MIS 4.

1.5.2 Umhlatuzana collection

Umhlatuzana is a shelter inland from the coast, in the KwaZulu-Natal province of South Africa, at 531m above current sea-level, and on the Umhlatuzana River (Lombard et al., 2010). Umhlatuzana contains cultural industries associated with both the Middle and the Later Stone Ages.

The site was originally the target of a well but rapidly conducted cultural resource management rescue excavation in 1985 (Kaplan, 1990). Six 1m by 1m squares were excavated in 28 stratigraphic levels. The lower layers from which the bifacial points derive are not finely stratified, at least in terms of their visual and textural characteristics (Kaplan, 1990), and so these layers were excavated by Kaplan in 5-10cm spits. The site has not been excavated subsequent to Kaplan's dig, although the layers associated with the Still Bay, Howiesons Poort and Post-Howiesons Poort collections have relatively recently been dated with OSL techniques (Lombard et al., 2010).

The bifacial points analysed in this thesis derive from layers 25-28. A single age estimate for these layers has been published at 71±5ka (Lombard et al., 2010), which corresponds closely with the layers labelled as Still Bay in the relatively nearby Sibudu site (Wadley, 2007). However, inferences regarding the duration of the Still Bay occupation at Umhlatuzana cannot be drawn.

1.5.3 Diepkloof collection

Diepkloof rock shelter is located 120m above sea level, just 14km inland from the west coast, in the Western Cape Province of southern Africa. The site was originally excavated in the 1970s and 1980s by Parkington and Poggenpoel, wherein they focused on the later LSA deposits and associated rock-paintings on the shelter walls. Subsequent to these initial seasons, the site was excavated by a French team from 1998-2014 with a focus on the deeply stratified MSA deposits. These excavations were undertaken in three 1 by 1m squares near the entrance of the shelter. The MSA at Diepkloof is broadly distinguished into two different temporal phases based on micromorphological observations on the frequency of anthropogenic combustion features throughout the sequence (Miller et al., 2013). A further 57 individual MSA stratigraphic layers were documented within this sequence.

Very few complete bifacial points were recovered from the Still Bay layers at Diepkloof. Further, these particular layers have been the subject of dating controversies which are discussed in following chapters. Consequently, it was never an objective to incorporate Diepkloof as a significant component of this study, prior to a consensus on the dating and the availability of a larger complete bifacial point sample. To summarize, Jacobs et al. (2008)

and Jacobs and Roberts (2008) originally provided OSL single grain age estimates for the Still Bay at Diepkloof of 70.9±2.3 and 73.6±2.5ka (quasi-contemporary with the other Still Bay sites). However, the younger layer dated by Jacobs et al. (2008) was subsequently interpreted, through a closer study of the cultural remains, as being associated with the Howiesons Poort rather than the Still Bay (Porraz et al., 2013a). In contrast, using thermoluminescence techniques, Tribolo et al. (2009) initially provided age estimates of between 99±10 and 129±11ka for the Still Bay at Diepkloof. The same team subsequently generated OSL ages for the Still Bay of 109±10ka (Tribolo et al., 2013) (potentially importantly though, the latter calculations were not based on a single-grain sample). In short, the ages of the Still Bay at Diepkloof remain debated.

1.5.4 Sibudu collection

Sibudu is a large shelter in the KwaZulu-Natal province of South Africa. It is approximately 15km inland from the Indian Ocean coast and overlooks the perennial Tongati River. The site contains a long MSA sequence as well as overlying Iron Age deposits, but significantly, no LSA occupational layers have thus far been documented. The bifacial points studied here derive from the 'RGS' and 'RGS2' layers which were documented in a series of 50cm by 50cm squares excavated by Lyn Wadley's team. Wadley's excavation ran from 1998-2011, and overall, she excavated a relatively large area encompassing 21m^2.

Subsequent excavations by a Tübingen University team have focussed on deepening the main trench. They have apparently found additional layers with bifacial points, including some morphologically atypical Still Bay points within the layers defined as such by Wadley. These layers nonetheless tend to be referred to as Still Bay (Conard et al., 2013; Shmid et al., 2015). However, the lower bifacial point baring layers currently remain unpublished. Sibudu is well-known for the exceptional organic preservation in the MSA layers including extensive bone, charcoal and seeds in association with the lithic remains (Wadley, 2007). The available ages for the Still Bay at Sibudu of 70.5±2.0ka are very similar to the ages for the bifacial point bearing layers at the relatively nearby Umhlatuzana site (Jacobs et al., 2008; Wadley, 2007).

1.5.5 Hollow Rock Shelter

Hollow Rock Shelter is an inland site on the edge of the Cedarberg Mountain range, where this mountain range borders on the Karoo Plain and associated biome, in the Western Cape province of South Africa. It is not a conventional cave, but is a tiny shelter that exists under a detached large block of quartzitic sandstone bedrock and overlooks the ephemeral Brandewyn River.

The site was initially identified and excavated by Ursula Evans in 1993 (Evans, 1994). The archaeological sequence contains *only* Still Bay MSA material (however, see Wurz, 2002 for an alternate view of the artefacts in the basal deposits). The sequence comprises a lag deposit wherein much of the organic material and finer sediments have leached out of the deposit, and few to no stratigraphic layers are distinguishable. Hollow Rock Shelter was consequently originally excavated by Evans with six 5cm thick stratigraphic spits.

The site was later re-excavated by Larsson and a team from the University of Lund (Sweden) in 2008 (Högberg and Larsson, 2011), and although they provenienced all finds in three-dimensions using a total station, they did not dig within the stratigraphic divisions followed by Evans. Högberg and Larsson (2011) have published a preliminary 72-80ka date for the deposits based on OSL. However, given taphonomic complications with reconstructing the accumulation of sediments in the shelter, this figure should be considered a broad and preliminary estimate for the Still Bay occupation there.

1.5.6 Clanwilliam Dam East and Dale Rose Parlour collections

Dale Rose Parlour and Clanwilliam Dam East are two identified Still Bay collections that currently remain undated, and neither has yet been subjected to systematic conventional lithic analyses. Dale Rose Parlour (Schirmer, 1975) is a coastal site near to Cape Town, very near to the famous MSA site of Peer's Cave (Peers, 1927). The bifacial points from Dale Rose Parlour have been suggested as technologically comparable to classic Still Bay specimens from Diepkloof and Hollow Rock Shelter (Henshilwood et al., 2001b; Texier et al., 2008; Tribolo et al., 2009). Clanwilliam Dam East is a recently identified locality situated in close proximity – within 5km but across a mountain pass - to the already dated Hollow Rock Shelter sequence (Högberg and Larsson, 2011), but it is currently unpublished.

1.6 OUTLINE OF THESIS CHAPTERS

Chapter 2 – diachronic variability – documenting stone tool morphological variability and linking it with high resolution stratigraphic and chronological information at a single site

Much attention has been devoted to identifying the initial appearance and the temporal duration of the Still Bay in the southern African MSA record, as well as to the demographic implications associated with these findings. Little to no attention has been given to investigating potential temporal variability within the Still Bay, which has led researchers in many cases to treat the Still Bay as a static or homogeneous technological and cultural entity.

In chapter 2, a protocol is required to generate and analyse three-dimensional shape information from bifacial points. Here an original methodology is outlined for analysing shape differences among Still Bay bifacial points using three-dimensional geometric morphometrics. It is demonstrated that the method designed for orienting, segmenting, registering and land-marking bifacial point scans works extremely well. This method is then applied to investigate patterns of variation in bifacial points at the multi-layered and well-dated Still Bay sequence of Blombos Cave, South Africa.

Importantly, multivariate regression techniques are then used to interpret the documented geometric morphometric results in ways that have until now not been applied in the field of lithic analysis. The role of the independent variables of time, raw-material and tool size in driving patterns of shape variation in the Blombos Cave point assemblage are discussed. It is demonstrated that at a single, stratified Still Bay site, points undergo significant changes in tool morphology and standardization through time. This study demonstrates that the Still Bay, which previously was classified as a single techno-traditional phenomenon in time, on

closer inspection has a far more complex structure. This set of analyses cautions against treatment of Still Bay occurrences as stable short-lived cultural-historic entities.

Chapter 3 – geographically structured variability – using stone tool morphological variability to test models of modern human cultural coalescence and fragmentation at the scale of southern Africa

A substantial amount of work has focussed on identifying the geographic spread of the Still Bay, as well as on the demographic implications associated with these findings. Assumptions within the labelling of different sites and assemblages as Still Bay are also fairly rigid in their demographic connotations. Different Still Bay sites across southern Africa are inferred to represent instances of a common technological and cultural tradition, and the occupants of these sites are assumed to have been constituents of a shared social network. The Still Bay points themselves are inferred to be representative of interactions within this geographic network and the consequences of the cultural transmission of complex technological ideas or the movements of specific early modern human groups across vast regions of southern Africa.

It is argued in Chapter 3 that this general interpretation is likely related to a preoccupation by many MSA lithic analysts to (1) focus on identifying similarities between Middle Stone Age bifacial point collections and further, to (2) use these inferred similarities to classify spatially separated assemblages within the same cultural label, in the face of substantial inter-site variability. Potential variability between geographically separated Middle Stone Age bifacial point collections has thus far not been investigated, which by default has led to many researchers treating the Still Bay as a homogeneous cultural entity across southern Africa.

The above mentioned assumptions are tested using a quantitative approach to documenting tool life histories, using Elliptical Fourier Analysis and three-dimensional geometric morphometrics. Further, in order to isolate behaviourally important drivers of shape, a series of corrections are applied to modify bifacial point shapes within the analyses. These corrections essentially remove components of shape variation that appear associated with specific behavioural or ecological parameters. It is demonstrated that bifacial points vary significantly and discretely across geographic space. This geographically structured variation is interpreted through questioning the previously suggested cultural association of certain sites with one another and by questioning the inferences implicit in subsuming these sites under the same cultural label. It is argued in this chapter that the shape data support a scenario of the convergent emergence of MSA bifacial points in different regions across southern Africa, rather than a process of the common descent of a single MSA bifacial point making techno-tradition.

Chapter 4 – broader implications – using stone tool morphological variability to track the biogeography and dispersal of modern humans within and out of Africa

If there is evidence for convergence or independent invention at the geographic scale of southern Africa, does this have implications for models that rely on features of the Still Bay and Howiesons Poort to map the emergence and movement of modern human groups within and outside of Africa? In Chapter 4 a long-held idea which has direct implications for early modern human behavioural evolution and cultural geography is critically discussed in light of

the results presented in Chapters 2 and 3 and related sites and studies. The idea is that a Middle Stone Age cultural group can be identified in the archaeological record, uncritically, through the presence of a specific type of material culture. These identifications tend to be made, and probably will continue to be made, in the face of internal variability that inferred types of material culture (types constructed by archaeologists) exhibit on closer inspection. Geometric morphometrics is one objective means of documenting this variability.

The well-known stratigraphically successive Still Bay and Howiesons Poort industries in the southern African MSA are discussed as broader examples in light of dating, genetic and archaeological evidence that confound their utility in broader models of modern human evolution and dispersal. Many of these models have their conceptual roots in the southern African Middle Stone Age and in the characteristic cultural repertoires of the Still Bay and Howiesons Poort. Further, a series of broader issues associated with the interaction between spatio-temporal scale and behavioural/cultural inference are raised and discussed.

Chapter 5 – Conclusion

The last chapter of this thesis provides a synthesis of the main accomplishments and conclusions of this project and integrates the questions posed in Chapters 2 and 3.

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