THE ORGANIZATION OF LATE DORSET LITHIC TECHNOLOGY AT THE LdFa-1 SITE IN SOUTHERN BAFFIN ISLAND, NUNAVUT

by

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A Thesis submitted to the Faculty of Graduate Studies of
The University of Manitoba
in partial fulfilment of the requirements of the degree of

MASTER OF ARTS

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Abstract

The Organization of Late Dorset Lithic Technology at the
LdFa-1 Site in Southern Baffin Island, Nunavut.

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This study represents the first of its kind to examine an extensive lithic debitage assemblage from a Late Dorset inland occupation. The assemblage derives from an isolated Late Dorset component at the LdFa-1 site, located along the northwest shore of Mingo Lake in the deep interior of southern Baffin Island. A study sample of 7,479 lithic debitage is systematically drawn and analyzed using two methodological approaches: individual attribute analysis and mass analysis. Patterns of variability derived from the analysis are isolated and interpreted within a technological organizational framework to identify Late Dorset lithic reduction and use strategies at the site. Using a multi-scalar approach, these results are then compared to those obtained from two inland Pre-Dorset sites, known as Sandy Point (LlDv-10) and Mosquito Ridge (MaDv-11) to draw some conclusions about how Palaeo-Eskimo populations more broadly organized their lithic technologies and used this terrestrial landscape over time.

Acknowledgements

I would like to use this space to thank all those who helped me throughout the development and completion of my Master's thesis. Of these, utmost thanks are given to my Masters Thesis advisor, Dr. Brooke Milne who gave me every minute of her time when I was in need of guidance. She challenged me to think critically, however she was always quick to remind me of 'K.I.S.S.' (Keep It Simple 'Stupid'), especially when I thought that it would be a good idea to analyze a debitage assemblage sample of around 28,000 pieces of little tiny rocks…

I would also like to thank my wonderful committee members, Dr. Emőke Szathmáry, and Dr. Robert Park for their advice and their quick return of comments from both my proposal and thesis drafts. Their expertise in anthropology and Arctic research has provided me with valuable information and knowledge that I will take with me into my studies and academic career. Whenever I falter in the future, I will always remember the words of Dr. Szathmáry during our long meetings after class. I would also like to thank Dr. Robert Park for the LdFa-1 lithic debitage collection loan, as well as all of his volunteer lab students at the University of Waterloo who helped organize, count, and size grade this massive debitage collection.

I have many friends and family that I would like to thank, including my lab mate, Deanna, who put up with my obsession over tiny pieces of rock for four months. My good friend Nitasha was always there to help get me through my course work, whether it was to take a break and try some new restaurant in Winnipeg or to make sure we kept up with our T.V. shows during the long stretches of writing. Both Amy and Rachel have been there since the start of my M.A. and I would especially like to thank them for their insightful advice about getting through grad school alongside supportive humor.

My Mom, Dad, and my brother Stephen have always been there to support me throughout my academic career choices along with all of its ups and downs. They are deserving of a great thanks for all of the help editing and the constant calls home. If I was ever in need of any help, I always knew where to turn.

A great big thanks goes to Deirdre. She has been there through all of the research, writing, and finishing stages of my Thesis and has consistently given me that lift I needed when I would get frustrated and overwhelmed. She was always there to congratulate me with a big smile after accomplishing a goal in my research. She was always very calm and patient during the few months of writing that would have drove most people up the wall. It is all of this -and more- for which I give my thanks to her here.

Finally, I would like to thank the excavation crews who worked at the LdFa-1 site in 2004, 2007, and 2008 along with Dr. Doug Stenton who was the first to discover the site in 1991. This M.A. Thesis would not have been possible without the aid of the following funding programs: The University of Manitoba Department of Anthropology and Faculty of Arts, The C. Thomas Shay Scholarship, The SSHRC Graduate Enhancement of Tri-Council Stipends Scholarship, and the Dr. Andrew Taylor Northern Studies and Research Award.

One final thanks to anyone I may have missed, and know that I am very grateful. Everyone on this list has helped me to accomplish my goals over the past two years, and I couldn't be happier to have you all around!

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Chapter 1

Introduction

This study represents an unprecedented opportunity to examine a lithic (i.e. stone) artifact assemblage from a Late Dorset Palaeo-Eskimo occupation located in the deep interior of southern Baffin Island. The Dorset people are characterized as coastal-adapted marine mammal hunters who rarely traveled long distances to neighbouring inland terrestrial locations (Darwent 2004; Hodgetts et al. 2003; McGhee 1990, 2001; Maxwell 1985; Murray 1999; Renouf and Bell 2008). However, the identification of several Dorset occupations near Mingo, Amadjuak, and Nettilling Lakes in the interior of southern Baffin Island contradict this.

The LdFa-1 site, which is located on the northwest shore of Mingo Lake and is approximately 70 km from the nearest coastal region, includes one of these known Late Dorset cultural occupations. The site was first investigated by Stenton in 1991, then Milne in 2004, 2007, and Park in 2008. This work yielded an impressive artifact assemblage comprising well-preserved faunal remains and organic artifacts including diagnostic harpoon heads, bone needles, implement handles, among other items (see Milne et al. 2012). The lithic assemblage is extensive and includes dozens of diagnostic Dorset types including burin-like tools, asymmetrical knives, expanding endscrapers, and just under 48,000 lithic debitage.

This study focuses on the lithic debitage assemblage, with the aim of addressing two research issues: (1) to provide a site specific micro-scale explanation of Late Dorset lithic reduction and use strategies at LdFa-1; and (2), to compare these patterns to existing site data from two Pre-Dorset sites located in the same inland region. The Pre-Dorset people are ancestral to the Dorset people in the eastern Arctic and made widespread use of the study area for millennia. Because no similar analyses on Late Dorset inland sites have been done, this macro-regional scale comparison to neighbouring Pre-Dorset inland sites permits some interpretations about land use and technological organization for these related cultures over time. Ultimately, my goal is to understand how the Late Dorset toolmakers organized their lithic technology during their occupation of LdFa-1 to assess how these reduction and use strategies compare to those used by their Pre-Dorset predecessors at neighbouring sites in the region.

To meet my research objectives I use a combined methodological approach (Anderson and Hodgetts 2007; Andrefsky 2001; Bradbury 1998; Bradbury and Carr 2004; Carr and Bradbury 2001; Milne 1999, 2003) that integrates individual attribute analysis and mass analysis to examine a study sample of 7,479 lithic debitage. The sample for this study was drawn from the larger Area 1 debitage assemblage of 47,671 flakes using a systematic statistical sampling strategy described by Milne (2003, 2009). The identified patterns are then interpreted within a technological organizational framework (Nelson 1991) in order to understand what kinds of lithic reduction and use strategies were being used by Late Dorset toolmakers during their occupation of LdFa-1. In turn, this information is used to infer site function and seasonality. Using the Pre-Dorset site data of Sandy Point and Mosquito Ridge obtained by Milne (2003) I will compare the patterns of lithic debitage variability of these sites with those obtained from the analyses of LdFa-1. The results will permit me to infer if the Late Dorset people were using the interior of southern Baffin Island in a similar manner as the Pre-Dorset people.

Pre-Dorset and Dorset Cultures

Pre-Dorset archaeological remains are attributed to the earliest inhabitants of the Eastern Canadian Arctic, whose ancestors migrated east from Alaska approximately 4500 years ago.

Sometime after 600 BC, a new archaeological manifestation emerged and is referred to as Dorset. It is widely accepted that the Dorset culture descended from the preceding Pre-Dorset culture, and more broadly, these two cultures are referred to collectively as Palaeo-Eskimo peoples (Maxwell 1985; Milne et al. 2012). Given the time periods represented by these cultures, archaeologists refer to Pre-Dorset as an Early Palaeo-Eskimo culture, and its Dorset descendant, as a Late Palaeo-Eskimo culture (Maxwell, 1985). The Pre-Dorset appear to have followed a seasonal round moving between inland and coastal locations (Bielawski 1988; Milne 2003) while the Dorset are inferred to have been more sedentary and coastal oriented (McGhee 2001; Maxwell 1985; Milne et al. 2012; Murray 1999). In fact, it is thought that the Dorset rarely if ever ventured to interior regions, choosing instead to focus their attention on the abundant marine resources available in coastal locations (McGhee 2001:116-117).

Raw Material Availability and Lithic Technological Organization

As lithic sources remain fixed and human populations do not (Milne 2003), the findings of lithic analyses are used to interpret human settlement and mobility patterns (Andrefsky 1994, 2009; Bamforth 1991, 2006; Beck et al. 2002; Ricklis and Cox 1993). To satisfy somatic needs (e.g., Milne 2008a) stone-tool-using populations were frequently faced with the challenge of having to move to regions where access to lithic raw material was limited or non-existent. A comparison of Late Dorset and Pre-Dorset reduction and use strategies of southern Baffin Island may show how lithic raw materials were being treated within each culture's respective technological systems.

Chert toolstone is widely available in the study area and is found littering the local landscape (Milne 2011; Milne et al. 2009). This abundance of chert appears to have been an important factor drawing Pre-Dorset people to occupy sites in this area, and given the local inland geology and restricted availability of chert toolstone along the southern Baffin Island coast (Milne et al 2011, 2013), Dorset toolmakers would also have to venture to the interior to acquire such materials. This remains a postulate, however, and indicates why my study is important for understanding what the Late Dorset people were doing so deep in the interior regions. LdFa-1 is also strategically situated to permit the hunting of caribou as they exit the northwest shore of Mingo Lake and are then forced to immediately ascend the steep esker (Milne 2008b). The ability to acquire caribou, an important source of food and hides, during the occupation of LdFa-1 would increase the attractiveness of the site, leading to its repeated use over time.

The way stone-tool using cultures organize their technology is heavily influenced by their ability to find and procure available raw material (Andrefsky, 1994). Proximity, seasonal availability, quality, and abundance of raw material are all factors that impact the technological choices and mobility patterns of toolmakers. Given what we know about the regional landscape and the reliable source of chert in the interior, my thesis research can focus on such factors as quality and abundance in the debitage assemblage in order to make inferences about proximity to sources and seasonal availability of raw material for the Late Dorset occupation at LdFa-1. Understanding the way raw materials influence the Late Dorset technological organization and mobility provides the information needed to infer site function and the kinds of activities that occurred (Andrefsky 1994, 2009).

Figure 1.1 Satellite Image of Southern Baffin Island displaying the locations of LdFa-1, Sandy Point, and Mosquito Ridge (Google 2013a).

Significance of Research

My thesis research represents one of the few detailed and statistically confident debitage analyses that have been conducted for Palaeo-Eskimo sites (eg. Milne 1999, 2003). It is also the only analysis focusing on a Late Dorset debitage assemblage excavated from an inland site. With this analysis of Late Dorset and Pre-Dorset assemblage datasets, my study will provide insights into the technological organization and mobility of the Palaeo-Eskimo culture at the regional level. Finally, with a completed analysis of lithic debitage at this site, my thesis will provide a baseline for future comparisons of all similar Late Dorset assemblages.

Organizational Framework

Chapter 2 provides the regional context of Mingo Lake and its surrounding area. This is followed by a brief discussion of archaeology on southern Baffin Island and the interior occupations of both Pre-Dorset and Dorset cultures. Chapter 3 discusses current interpretations of Pre-Dorset and Dorset land use, settlement, and subsistence patterns. The chapter concludes with an evaluation of the current literature describing Dorset land use, subsistence and mobility.

Chapter 4 presents a detailed discussion on the theory of technological organization and explains how it can be applied to interpret lithic assemblage variability. I conclude the chapter with the presentation of my research hypotheses and related test expectations. Chapter 5 outlines the research methods used in this study including the procedure used to draw my study sample. I also outline the statistical methods used to describe, summarize, and present my data. Chapter 6 presents the results of LdFa-1 Late Dorset debitage analysis and my interpretations of them. Chapter 7 focuses on my comparison of the LdFa-1 data to those from the Sandy Point and Mosquito Ridge Pre-Dorset sites. Lastly, Chapter 8 provides a summary of my study and the evaluation of my research hypotheses. My concluding remarks include a discussion of future research directions on Late Dorset lithic technology from the interior of southern Baffin Island.

Chapter 2

Study Area and Sites

This chapter begins with a description of the study area including the local landscape and available resources. I then discuss previous archaeological work that has been done in the interior focusing specifically on the Pre-Dorset and Dorset sites that have been investigated. I then describe LdFa-1 site and the Late Dorset component there. The chapter concludes with a description of the two Pre-Dorset sites, Sandy Point and Mosquito Ridge, against which I will compare my lithic data.

Mingo Lake and Surrounding Regions

Landscape and Available Subsistence Resources

The interior landscape of southern Baffin Island is dominated by three lakes: Nettilling, Amadjuak, and Mingo (see Figure 1.1). The low-lying, flat, and marshy topography is contrasted by a few isolated glacial moraines and eskers (Milne et al. 2012). Numerous archaeological sites near southern Burwash Bay are situated on or near these features, providing ideal vantage points over the region (Stenton 1989:249; Milne 2008b) (see Figure 2.1).

Annual migratory birds and waterfowl (ex. snow geese (*Chen caerulescens*)) arrive in the interior lakes region during the spring (Milne and Donnelly 2004). As an important resource in the area, caribou (*Rangifer tarandus*) dominate the region during both the late summer and early fall seasons (Boas 1964:26-27; Brody 1976; Soper 1928:64; Stenton 1986:14). Numerous converging rivers connecting the three lakes populate with arctic char (*Salvalinus alpines*) as they travel upstream in the fall returning from the sea. Lastly, seasonal plants grow during the summer months providing a source of vitamin C. Plants known to be traditionally consumed on southern Baffin Island include kelp (*Rhodymenia*), blackberries (*Empetrum nigrum*), mountain sorrel (*Oxyria digyna*), and netted willow (*Salix reticulata*) (Kuhnlein et al. 1991).

Figure 2.1 Satellite Image showing Burwash Bay and the southern mouth of Netilling Lake (Google 2013b)

Caribou are a vital resource for all human populations in the Arctic since they provide meat, raw material in the form of bone, antler, and sinew, and hides which are essential for clothing, tents, and bedding (Burch 1972; Friesen 2013; Stenton 1991b; Stewart et al. 2004). The abundance of these combined resources including the large south Baffin resident caribou herd (Ferguson and Gauthier 1992) makes these regions attractive for subsistence purposes.

Palaeo-Climate

Early Palaeo-Eskimo peoples first entered the eastern Canadian Arctic roughly 4500 years ago during the end of the Postglacial Warm Period (McGhee 2001:110). These populations experienced warmer then present temperatures and reduced annual sea-ice cover (McGhee 2001). The continuation of warmer climatic intervals lasted until approximately 600-800 B.C., when the Arctic went through a dramatic cooling event, resulting in harsher, longer winters, and a more expansive sea-ice environment ideal for hunting marine mammals (Maudie et al. 2005:120-121). Environmental shifts throughout this period in the Arctic are believed to have prompted changes in the way humans adapted to their surrounding landscape. Mobility tended to decrease while settlements became larger with more permanent dwellings built of large boulders (McGhee 2001:131). With the expansive sea-ice cover, people presumably focused their subsistence strategies more intensively on sea mammals since they were more readily available and reliably procured (McGhee 2001:116). The cultural manifestation appearing in the archaeological record at the time when these conditions were present is called the Dorset.

Lithic Raw Materials

Provenance research in the Arctic is in its infancy, meaning that the vast majority of exploited toolstone sources remain unknown. This is problematic when trying to understand lithic technological organization since the first step to reconstructing it is to know from where lithic raw materials were acquired. However, Milne and colleagues (2009, 2011) have been exploring the availability of chert on southern Baffin Island and attempting to characterize it using a new sourcing protocol. Chert-bearing carbonate and siliciclastic formations are located in the limestone bedrock along the western margins of Mingo, Amadjuak, and Nettilling Lakes

(Milne et al. 2009). As such, this region represents an important location for Palaeo-Eskimo toolmakers of southern Baffin Island. Milne and colleagues also note that the surrounding landscape is visibly littered with widespread surface scatters in the form of large boulders and chert nodules, making it easy for humans to collect and build shelters during an extended occupation (Milne 1999; Milne et al. 2009; Milne 2011:135). The location and availability of chert is further supported by the local Inuit oral histories, where the word Amadjuak is an English translation of the Inuktitut "ammaq," meaning "chert" plus necessary suffixes. Therefore the reference to Amadjuak Lake roughly translates as "the place chert comes from" (Milne et al. 2011:122; Stenton and Park 2002:25).

The toolstone from this region consists of poor quality chert displaying many inclusions and fossils (Stenton 1986; Milne 2003). Preliminary geological surveys however, indicate that there is little evidence for alternative chert sources on coastal southern Baffin Island where lithic raw material is readily available (Milne et al. 2013b). The availability of chert may be the reason that toolstone using cultures were occupying sites in the interior regions. Archaeological investigations of these sites are presenting us with new evidence to further support these claims and explain why the interior of southern Baffin Island was so extensively occupied (Milne 1999, 2003).

Archaeology of Southern Baffin Island

During the mid-1980's, Stenton (1989, 1991a/b/c) carried out the first systematic archaeological surveys in the interior of Southern Baffin Island to investigate Thule Inuit occupations. Dozens of sites were identified along the shores of Nettilling, Amadjuak, and Mingo Lakes that had been occupied by Palaeo- and Neo-Eskimo populations. Most of these sites are concentrated at important nexus points for waterways where resources are most abundant. At least 19 of these sites were classified as Palaeo-Eskimo. Stenton (1989:243) noted that Pre-Dorset occupations were located along the west side of the southern Burwash Bay area, and the greatest evidence for Dorset occupation came from near the mouth of the Amadjuak River (Figure 2.2). Through the investigations of Stenton (1989), Milne (1999; 2003) and Milne and Donnelly (2004), the interior of Southern Baffin Island has been interpreted as a place used by prehistoric and historic populations to take advantage of the abundant char, caribou, and bird subsistence resources, along with the important available chert raw material sources that can only be acquired during certain seasons when there is no snow cover.

Figure 2.2 Sandy Point (LlDv-10) and Mosquito Ridge (MaDv-11) located on the southern shores of Nettilling Lake (Google 2013c).

Pre-Dorset Occupations in the Interior Regions

Archaeological testing of several of the Thule Inuit sites near Nettilling Lake produced Palaeo-Eskimo artifacts thus attesting to the region's use by these earliest peoples (Stenton 1989). Two sites yielded diagnostic artifacts associated with the Pre-Dorset culture. These Pre-Dorset sites are known as Sandy Point (LlDv-10) and Mosquito Ridge (MaDv-11), and they are both located north of LdFa-1 along the western shores of Burwash Bay. They were first excavated in 1986 by Stenton who identified Pre-Dorset diagnostic artifacts mixed in with Thule houses. This prompted further investigation and excavation by Milne in 2000 (1999, 2000, 2003, Milne and Donnelly 2004). The resources in this area are similar to those found near Mingo Lake. Chert toolstone is readily available, as are seasonally abundant subsistence resources including nesting waterfowl, fish, and caribou.

Dozens of Palaeo-Eskimo sites were identified by Milne in 2004 near Mingo and Amadjuak Lakes. Six have been preliminarily tested, including LdFa-1, LdFa-12, LdFa-13, LdFa-14, LdFa-15 and LeDx-42. Of these only two (LdFa-1 and LeDx-42) have been further investigated having yielded extensive lithic and faunal assemblages and radiocarbon dates that fall within the Palaeo-Eskimo cultural continuum (Park 2008:3; see Figure 2.3). Both areas 4 and 5 of LdFa-1 yielded Pre-Dorset artifacts and contain several features further suggesting Pre-Dorset affiliation. Faunal and lithic assemblages have been collected from these areas and include lithic formal tool such as burins, burin spalls, and microblades, all of which are considered diagnostic Pre-Dorset artifacts (Park 2008).

Figure 2.3 Indicating the locations of both LdFa-1 and Ledx-42 near Mingo and Amadjuak Lakes (Google 2013d).

LeDx-42 is located approximately 12 kilometres from LdFa-1 along the shore of Mingo Lake (Milne et al. 2012:418). This single component site is located on a bedrock outcrop that extendis into the Mingo River. Excavations uncovered extensive lithic and faunal assemblages, as well as delicate organic artifacts like bone needles. Of these, most of the formal lithic tools are typologically Pre-Dorset, and include burins, microblades, core fragments, bifaces, and scrapers (Milne et al. 2012:418). Although several of these sites exist in the vicinity of LdFa-1, Sandy Point (LlDv-10) and Mosquito Ridge (MaDv-11) are the only two Pre-Dorset sites that have been studied in detail from this region.

Sandy Point is one of two excavated Pre-Dorset sites near Nettilling Lake. Sandy Point is a small single component site that is divided into three areas: mainland, channel, and island. This separation is the result of long-term erosion breaking apart a once complete site. The aerial extent of the Sandy Point site is defined entirely by its distribution of surface lithics. The assemblage consists of 1,277 lithic artifacts of which 1,176 are pieces of debitage and 101 of them are formal and informal tools. A single radiocarbon date places Sandy Point sometime around cal. 2924 ± 65 B.P. (Stenton 1989:239). Since this date was taken from a layer of peat found above the artifact deposit, the site would in fact be dated relatively earlier than the radiocarbon date indicates.

Mosquito Ridge is a large multi-component site that includes Pre-Dorset, Thule, and Inuit occupations. Located along the top of a gravel esker approximately 10 kilometers away from Sandy Point, Mosquito Ridge is defined by more than 30 features, including tent rings and semi-subterranean winter houses. The Mosquito Ridge lithic assemblage consists of 20,472 artifacts, of which 19,800 are debitage and 672 are formal and informal tools. A radiocarbon date obtained from caribou bone collagen yielded a date of 4290 – 4080 B.P., making this one of the oldest Palaeo-Eskimo occupations on Southern Baffin Island (Milne and Donnelly 2004: 96-97).

Dorset Occupations in the Interior Regions

Four Dorset occupations have been identified near Mingo and Amadjuak Lakes (Stenton 1989; Milne et al. 2012). These sites are known as LlDv-4 and LlDv-5, identified by Stenton near the southern tip of Nettilling Lake; and LdFa-1 and LeDx-42 located by Milne, Park, and Stenton near Mingo and Amadjuak Lakes. The LlDv-4 and LlDv-5 sites are located along the south Burwash Moraine. They are situated across from the bottom of Burwash Bay in Nettilling Lake and perpendicular to the Amadjuak River (Milne et al. 2012).

L1Dv-4 has two components defined by tent rings, one of which was completely excavated. The recovered artifacts include two dozen stylistically Dorset artifacts along with nearly 7,000 pieces of lithic debitage (Stenton 1989). L1Dv-5, the largest of the Nettlling Lake sites has eight components with 155 features extending temporally from Paleo-Eskimo to historic Inuit. Investigations of ‘component B’ resulted in the discovery of both extensive Thule and Dorset occupations. Here, lithic debitage is made up of chert and crystal-quartz, and stylistically Dorset artifacts were collected from Houses 4, 10, and12 (Stenton 1989).

LdFa-1 and LeDx-42 are both located in the Mingo and Amadjuak Lake districts. These sites have been designated as having Dorset components through the use of radiocarbon dates and the identification of various diagnostic artifacts. Area 1 is discussed at full length in the following section, however, located several metres to the south and referred to as ‘the midden’, is Area 2 (Park 2008:12). Excavation in this area resulted in the collection of a high density of artifacts with no architectural features. Artifacts appear to be from both Pre-Dorset and Dorset contexts; however, due to a stream cutting through and a caribou walking path overtop, there is little to no evidence of visible stratigraphic layering (Park 2008:12).

LeDx-42 was occupied by both Pre-Dorset and Late Dorset groups. Along with the Pre-Dorset affiliation, a Late Dorset component was confirmed at the site through radiocarbon dating and the recovery of diagnostic lithic artifacts. Diagnostic Pre-Dorset lithic artifacts include spalled burins and burin spalls while diagnostic Dorset lithic artifacts transverse knife and a broken burin-like tool. Organic artifacts include bone needles, broken implement handles, and a worked antler displaying a gouged hole characteristic of Dorset style (Milne et al. 2012). Radiocarbon dates obtained from caribou bone collagen collected from two test-pits provide Late Dorset dates of 710 A.D. ± 50 to cal. 780 A.D ± 40 (Milne et al. 2012:416).

LdFa-1

LdFa-1 was first identified in 1991 by Stenton. Milne and Park subsequently returned to conduct further investigations in 2004, 2007, and 2008. The site is located approximately 113 nautical miles, or 209 kilometres from the coast of southern Baffin Island, and is situated on the northwest shore of Mingo Lake (Figure 2.4) directly adjacent to the Mingo Lake Esker. Along with the recovery of an extensive lithic debitage assemblage, LdFa-1 yielded a large number of bone debitage, which are the by-product of working and shaping this hard organic material for tool making purposes. Park (2008:30) notes that with the discovery of a Dorset harpoon head from Area 2 and a harpoon foreshaft from Area 1 along with a miniature amulet-style harpoon head, it is possible that harpooning might have been one of the techniques used to hunt caribou. The quantity of organic material remains in this area suggests that organic tool production was an important activity during the occupation of LdFa-1. The finding of numerous bone needles indicates that the manufacture of clothing would have also played a role in daily activities (Park 2008:30).

Area 1 (Figure 2.5) of LdFa-1 consists of an isolated, undisturbed Dorset component that has yielded diagnostic Late Dorset artifacts and several radiocarbon dates. This area of the site was first identified in 2007 after a lone burin-like-tool (i.e. diagnostic Dorset artifact) was recovered from a small test pit excavated by Milne. In 2008, Park further explored this area of the site and completely excavated 9.25 square metres resulting in an extensive lithic debitage assemblage and additional formal and informal stone tools, and faunal remains (Park 2008). Combining the evidence provided by radiocarbon dates, and diagnostic lithic and organic artifacts, Area 1 was designated as a Late Dorset component (Park 2008).

Figure 2.4 LdFa-1, situated on the northwest shore of Mingo Lake (Google 2013e).

Four radiocarbon dates derived from caribou bone collagen were collected in 2004, 2007, and 2008 from Area 1 of LdFa-1. The samples indicate Late Dorset dates with cal. 690 A.D. ± 40 – 880 A.D. ± 40 (Milne et al. 2012). Of those recovered and recorded from Area 1, formal lithic tool types include burin-like tools, transverse knives, side-notched endblades, a transverse sidescraper, a stemmed endblade, an expanding endscraper, and numerous micro-blades (Milne et al. 2012). Formal bone tool types include needles, tool handles, an amulet box fragment, and numerous other bone and antler fragments displaying Dorset stylistic traits including gouged holes (Milne et al. 2012). I am using this site for my study because unlike the other inland Dorset sites, LdFa-1 is well dated, spatially discrete, and provides a large lithic debitage assemblage to work with.

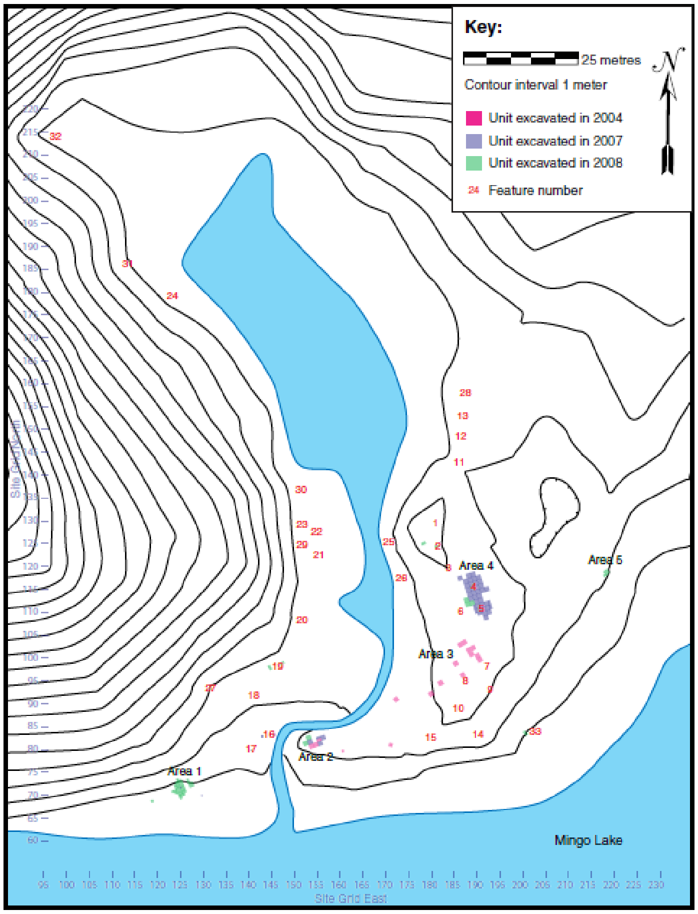

Figure 2.5 LdFa-1 site plan showing excavation Areas 1 to 5 (Park 2008)

Chapter 3

Pre-Dorset and Dorset Land Use, Settlement Patterns, and Subsistence

This chapter outlines current interpretations of Pre-Dorset and Dorset land-use, settlement patterns, and subsistence in the eastern Arctic. My discussion concludes with a presentation of some more recent assessments of these cultural phenomena.

Pre-Dorset and Dorset Culture – Land-Use, Settlements, and Subsistence

Archaeologists refer to the cultural complex characterizing the original inhabitants of North America and Greenland as the Arctic Small Tool tradition (ASTt). People belonging to the ASTt migrated eastward from Alaska approximately 4,500 years ago to occupy regions of the central and eastern Arctic. Once there, they adapted to local conditions, which resulted in regional variations in their material culture. As such, we recognize archaeologically the Pre-Dorset, along with Independence I and Saqqaq as *in situ* regional ASTt manifestations (Maxwell 1985). The Pre-Dorset people are inferred to have practiced a dual-subsistence-economy, moving seasonally between coastal locations in the winter months to inland locations in the summer months (Bielawski 1988; McCartney and Helmer 1989; Maxwell 1985; Milne 1999; 2003). Pre-Dorset people followed this seasonal round so they could exploit seasonal resources in each respective location (Bielawski 1988). Pre-Dorset settlements likely consisted of tent ring structures in the warmer months and snow walled houses during the winter (Ramsden and Murray 1995; Schledermann 1996:71).

In 2003, Milne used a multiscalar approach to examine Pre-Dorset inland and coastal lithic assemblages to delineate meaningful patterns of variability to address two interrelated research questions. She first wanted to test explicitly the theory that the southern Baffin Island Pre-Dorset people moved seasonally between inland and coastal areas. Second, she wanted to determine the function of each site located in inland and coastal areas to understand how lithic reduction varied in relation to seasonally specific activities carried out in each locale. What made her study so effective was the fact that chert toolstone is widely available in the interior of southern Baffin Island but is restricted in its geological occurrence in neighbouring coastal regions. As such, her multiscalar analysis of lithic assemblage variability enabled her to use chert toolstone as a proxy to reconstruct how the Pre-Dorset people were moving across the landscape and to determine how reduction varied at the site level in accordance with other activities. She concluded that the Pre-Dorset people on southern Baffin Island were using seasonal rounds to spend time on the coast during the winter and spring months after which they then travelled to the interior to renew their toolstone supply in the summer and autumn months.

The Dorset people occupied the Eastern Canadian Arctic from approximately cal. 800-500 B.C. to 1200 A.D. and their cultural remains are sub-divided into Early and Late phases (Friesen 2007). The dates recognizing the Late Dorset terminal phase are still contested, however (Park 1993). Success in surviving the sudden shifts in climate, environment, and subsistence availability led to changes in adaptation with new settlements, technology, and subsistence strategies. Dorset groups built large rectangular, semi-subterranean winter dwellings, and smaller tent-ring structures during the summer (McGhee 2001:131). Dorset lithic technology consists of a highly sophisticated adaptive toolkit. Given the constraints of living in the Arctic environment and relying on regional resources, Dorset diagnostic formal tools reflect an assortment of highly adaptable and maintainable technological strategies (McGhee 2001, Maxwell 1985; Schledermann 1996). One of the dominant typological changes associated with Dorset culture is the absence of drilled holes in artifacts such as needles and harpoons (Maxwell 1985; McGhee 2001; Schledermann 1996). Instead, Dorset people made gouged holes by a process of continuous gouging of the same spot over and over until it punctured through to the other side of the object. Gouged holes are often found on needles, harpoon heads, amulets, and other work bone and antler (McGhee 2001:142).

The emergence of the Late Dorset culture comes at the time of another climatic change known worldwide as the Medieval Warm Period. This warming trend lasted for around 500 years in the North American Arctic and was likely experienced by humans in the form of slightly milder winters, and warmer summers. This, however, had a dramatic effect on the annual sea-ice cover and duration (McGhee 2001:197). This likely led to new, unpredictable conditions for the Late Dorset where caribou herds would now be populating previously empty landscapes, and once frozen sea-ice used for hunting marine mammals was no longer available for long periods of the year. During this period, the Late Dorset expanded to much greater distances in the Arctic. Occupations are found as far west as Victoria Island and as far north as Little Cornwallis Island (LeMoine and Darwent 1998). A variety of longhouses became common throughout the Late Dorset landscape in parts of the eastern Arctic, suggesting the possibility of large communal population gatherings (Friesen 2007). Dorset artifacts displaying uniquely artistic features; including animals represented on antler wands, tiny spatulas, bone plaques, and small reproductions of tools and weapons, all become abundant during this time (Maxwell 1985; McGhee 2001:201 Schledermann 1996:80). It is through the material cultural of the Late Dorset that we see the first archaeological appearance of meteoritic iron being used in tool production in the Arctic (McGhee 2001:202). For the Dorset who had access to iron, this changed the way tool technology was produced and manufactured. Iron tools held a long-lasting edge that with the use of sandstone grinding could be re-sharpened many times over. The Late Dorset cultural tradition lasted until approximately 1200 A.D. (Friesen 2007) when the appearance of their material and architectural remains in the archaeological record begins to rapidly decrease.

In 2012, Milne et al. published an extensive article that critically reviewed published interpretations of Dorset mobility, settlement, and subsistence. The literature suggests that Dorset were typically a sedentary and coastally oriented people (Darwent 2004; Hodgetts et al. 2003; McGhee 1990, 2001; Maxwell 1985; Murray 1999; Renouf and Bell 2008). In fact, it is thought that the Dorset rarely ventured to interior regions, choosing instead to focus their attention on the abundant marine resources available in coastal locations (McGhee 2001:116-117). However, as Milne and colleagues note, the identification of several Dorset occupations near Mingo, Amadjuak, and Nettilling Lakes in the interior of southern Baffin Island raise interesting evidence opposing this position.

The Dorset people have been interpreted to rely heavily on coastal resources. Their toolkits are equipped with adapted marine-mammal hunting tools such as composite harpoons and spears. The Dorset hunters do not appear to have used the efficient bow and arrow technology, or spear-throwers (i.e. atlatls) with darts to hunt terrestrial land mammals (Friesen 2013:10). It is suggested instead that these people primarily used lances for such activities. Milne et al. note however that, the evidence from inland Baffin Island and sites such as Bell (NiNg-2) on Victoria Island (Howse 2008), Nungavik 46 and 71, and Satuut (Mary-Roussellière 1976), and data from fifteen Dorset sites at Igloolik (Murray 1999) demonstrate that terrestrial hunting of caribou has in fact been identified as important to the Dorset economy.

<u>Evaluations of Current Literature Regarding Pre-Dorset and Dorset Cultures</u>

Current trends in the literature surrounding Pre-Dorset and Dorset cultural adaptations emphasize several differences, including land use, mobility, subsistence strategies, and technology. Traditionally, the two cultures are easily distinguished based on stylistic differences in technological and material objects (Milne et al. 2012). This section aims to assess the current interpretations of Pre-Dorset and Dorset land use, mobility, and subsistence and provide a critique based on the recent research on southern Baffin Island.

Pre-Dorset mobility and subsistence is often characterized as a ‘dual-economy’ (McCartney and Helmer 1989) in which an annual round takes place where small groups hunted inland regions during the summer and fall months and then moved to coastal locations for the remainder of the year (Bielawski 1988; Maxwell 1985; Milne 2003; Schledermann 1990). According to Milne et al. (2012), the Pre-Dorset people have been interpreted as having a more narrow dietary breadth while having a higher degree of mobility since they moved from site to site to exploit specific resources in specific locations (Darwent 2004; Fitzhugh 1976; Maxwell 1985; Prentiss and Lenert 2009). Dorset groups, however, are interpreted to have adapted to take advantage of a wider breadth of species while remaining more sedentary (e.g., Darwent 2004; Helmer 1996; Hodgetts et al. 2003; LeMoine and Darwent 1998; McGhee 1990, 2001; Maxwell 1985; Murray 1996, 1999; Nagy 1997, 2000; Odess 1998; Ramsden and Tuck 2001; Renouf and Bell 2010; Ryan 2003a, 2003b; Tuck and Fitzhugh 1986). The Dorset communities are noted to have lived year-round on the coast moving from summer to winter camps (McGhee, 1981), where seal hunting took precedence (Maxwell 1985:122). Our understanding of Dorset subsistence strategies, however, is more focused on research of the exploitation of marine mammals, since most known sites exist in coastal locations (eg. Fitzhugh 1976; Harp 1976;

Hodgetts 2005; Hodgetts et al. 2003; McCartney and Helmer 1989; Maxwell 1985; Renouf and Bell 2010). In fact, even isolated regional studies of Dorset occupations often refer to them as less mobile, year-round sea-ice hunters (Nagy 1997; Ryan 2003b; Renouf 2000; Murray 1999). Darwent (2004) notes in her High Arctic study area, that the Late Dorset seem to remain in one location for a longer period, intensively using all available resources before relocating. With long winters and extended periods of sea-ice cover, it is argued that the Dorset became less mobile through time, relying more steadily on the local sea-ice and food storage strategies, indicating a highly sedentary Late stage Dorset cultural tradition (McGhee 2001; Ryan 2003a; Murray 1999; Darwent 2004; Harp 1976). This is further supported by their lack of transportation technologies such as dogs-sleds or large boats for carrying multiple passengers (Odess 1998:420). There is little evidence to confirm the existence of dogs on Dorset sites or that they were using sleds larger than a small hand-drawn variety (Maxwell 1985) and although there seems to be evidence for the use of a small kayak-like boat for open-water hunting, there is nothing known to indicate the use of larger types, like umiaks, for transporting people and gear. According to Odess (1998), this resulted in a far lower degree of mobility and a greater reliance on walking.

Despite faunal evidence suggesting effective use of terrestrial hunting strategies, Dorset people are rarely described as inland hunters. Several Dorset sites have been noted to emphasize the importance of caribou to their economies (Milne et al. 2012:42). The Bell site on Victoria Island, Nungavik 46 and 71, and Satuut, and a site on Igloolik Island all produced proportionately high quantities of caribou bone assemblages (Howse 2008; Mary-Roussellière 1976; Murray 1999). LdFa-1 provides another strong example of how caribou played a significant role in the subsistence strategies of the Dorset with nearly 98 percent (n=710) of the faunal assemblage thus far made up of identifiable caribou bone (Milne et al. 2012).

Overall, I am not convinced that the differences between Pre-Dorset and Dorset groups that are emphasized in the literature are in fact real. They reflect what has been published; however, the evidence from southern Baffin Island suggests that there is more in common between the two populations than what the past research shows. In fact, if the patterns that are generated among the lithic debitage of the Late Dorset people at LdFa-1 match those of the Pre-Dorset people, I can suggest at least some cultural continuity in regards to technological organization and mobility, meaning that in this region of the Arctic, the Dorset were much more like their ancestors than previously thought.

Chapter 4

Theoretical Framework and Research Hypotheses

In this chapter, I discuss the theoretical framework of technological organization and how it is used to understand lithic technology. Following Nelson (1991), I present technological organization as a way to interpret the conditions that influence ancient tool making strategies. These include a number of levels of analysis that reflect economic, social and technological decision making along with the constraints of the local regional environment. This section is followed by an outline of how a multiscalar approach to technological organization is applied to the study of lithic debitage. The chapter concludes with the statement of my research hypotheses and related test expectations.

Technological Organization

In 1991, Nelson published a comprehensive synthesis of the theory of technological organization. The aim of this theoretical perspective is to provide a way to depict the process by which ancient toolstone using people chose among various approaches to their lithic technologies based on raw material abundance, mobility, subsistence, and time (Nelson 1991; Andrefsky 1994). Variables such as the immediate regional and environmental conditions, culturally specific social and economic motivations, and technological needs contribute in part to how an archaeologist interprets a technological organization (Nelson 1991:57). These factors influence how tool makers develop, change, and sustain particular tool-kits over the course of time. Artifact type and its distribution are two kinds of evidence that remain in the archaeological record today that help us understand and interpret the past. Moreover, because lithic debitage does not easily degrade, it can provide some of the most informative evidence used to interpret technological strategies in an archaeological assemblage (Andrefsky 2009:65). The lithic debitage assemblage represents the final outcome of all combined factors mentioned above and as such, it provides the most reliable record of human activities within a site.

The process by which archaeologists make inferences about a debitage assemblage can be depicted graphically by outlining the various contexts (i.e., levels of analysis) that condition decision-making in lithic tool production (see Figure 4.1) (Nelson 1991:59). Understanding how the Late Dorset toolmakers were using lithic raw material and why, provides important insight into the ways they were using the landscape.

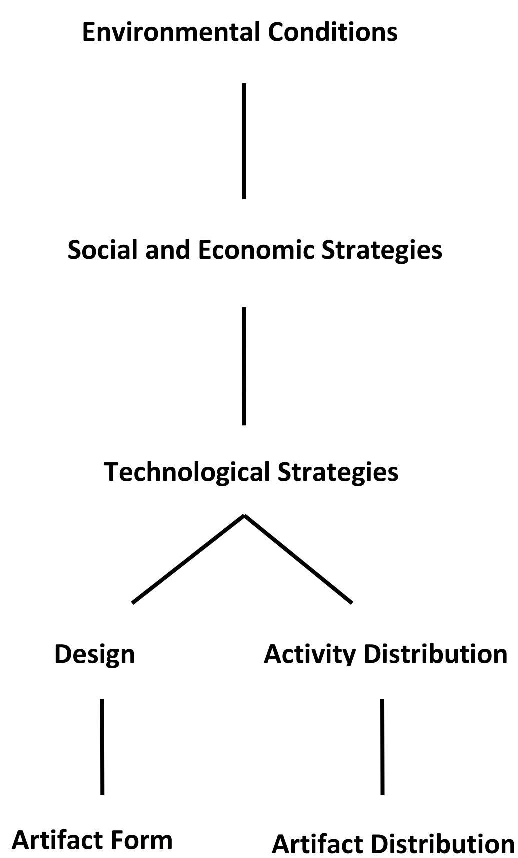

Figure 4.1 The levels of analysis in defining a technological organization (Nelson 1991:59)

Each level of analysis is dynamic and mutually exclusive (Nelson 1991, Andrefsky 2009). Individuals within a population may choose to accept or deviate from a specific strategy depending on the conditions that must be met. This can lead to the use of alternate or often multiple technological strategies (Andrefsky 2009). By interpreting the patterns generated through debitage analysis, I am able to make inferences regarding the contributing factors that formed the overall technological strategy that was in use.

Technological Strategy-Making

Curated Strategies

Two of the most widely interpreted technological strategies for hunter-gatherer groups are curation and expediency (Binford 1973, 1977; Nelson 1991). Curated toolkits are often characterized as including formal tools with generally high levels of retouch in order to conserve higher quality raw materials and produce longer lasting tools (Andrefsky 1994, 2009; Binford 1973). The concept of 'curation' as used in the framework of technological organization was pioneered by Binford (1973, 1977, 1978a/b, 1979). The term has been redefined and used by archaeologists studying lithic assemblages (eg. Bamforth 1986; Andrefsky 1994; Hayden 1993; Parry and Kelly 1987), however, it is often criticized for its ambiguous definition (Odell 1996; Shott 1996). Nash (1996) argues that curation as defined by Binford does not function to explain the technological strategies integrated within a Middle Paleolithic assemblage. The study emphasizes the consideration of such factors as the embeddedness of acquisition strategies, which includes social, religious, and political constraints on raw material procurement (Nash 1996). Shott focuses his argument on the ambiguous nature of the term and states, "ambiguity invites criticism" (Shott 1996:262). Binford's discussion of curation, which includes anticipation of use, transport, use life, recycling, and efficiency, over complicates the definition and invites criticism. Shott (1996) re-defines the term curation to “utility extracted” so as to include the general notion that a lithic tool can have multiple uses over time. The choice to produce such versatile and long-lasting tools contributes to a curated strategy. Shott (1989) notes that curation has a continuous rather than a categorical effect on artifact form and distribution as it responds to the conditions of a specific strategy and can mean that a group either ‘curates’ extensively or not.

For the purpose of this study, I follow Nelson’s (1991:62) definition of the concept, which she describes as, “a strategy of caring for tools and toolkits that can include advanced manufacture, transport, reshaping, and caching or storage.” There is an emphasis placed on the versatility of this definition. The strategy of curating tools can include one, two, or all of the factors listed. For example, Nelson (1991:63), citing Bamforth (1986:38) and Binford (1973, 1977, 1979), notes that curated tools are effective for a variety of tasks and can be recycled to use for secondary purposes. This makes them useful for both immediate and anticipated events and tasks.

Expedient Strategies

Curation is contrasted by a lithic strategy known as expediency. Expedient toolkits are made for immediate use and production of them requires less energy and time investment (Binford 1973; Nelson 1991; Andrefsky 1994). This strategy is associated with informal tool production, where tool form is generally un-standardized, casual, and tends to result in simpler implements without formal shape, or patterning (Andrefsky 1994:22). Time stress is usually not a factor in cases of expedient technology since raw material is likely available for long-periods of time. Binford (1979) notes, that expediency is a strategy used for direct situational responses, without an anticipated future use for the tool. It is seen as wasteful of lithic raw material since expedient cores can be discarded at any time without concern for conservation. This is because raw material is often abundant and accessible when this strategy is used. Expedient strategies involve the production of stone tools where a minimal technological effort is applied under conditions of predictable raw material availability and with little concern for time or future use (Bleed 1986; Parry and Kelly 1987). Caching or stockpiling of raw material has been found in association with expedient technologies and indicates reoccurring or long-term occupation of a site (Parry and Kelly 1987). Expedient strategies have been associated with more sedentary populations, however, environmental, social, and economic variables can change the response to a specific condition and result in the use of a different technological strategy (Nelson 1991).

Opportunistic Strategies

Nelson makes note of a third response to specific conditions referred to as: opportunistic. Usually subsumed under expediency as a situational response (Binford 1979), Nelson instead gives it its own category. Unlike expediency, opportunistic technologies are not planned (Nelson 1991:65). They exist as a response to specific conditional situations where the occurrence was neither expected, nor anticipated (Andrefsky 2009). Opportunistic strategies are a likely indication of time stress, and result in the production of informal tools. Opportunistic behaviour has no prior planning and no projection for future use. As a result, little effort appears to be invested in design, preparation, or finished form (Binford 1979).

Raw Material Abundance and Availability

A research emphasis has been placed on the importance of lithic raw material abundance and availability in determining a wide variety of technological strategies (see Andrefsky 2009:76

for complete list of contributing studies). These factors influence the way lithic material is carried, moved, and distributed by humans throughout a landscape (Andrefsky 2009:75). Both Braun (2005), and Brantingham and Kuhn (2001) have shown cases where a constrained availability of lithic raw material results in a change in technological strategies. Variability of raw material type has been connected to both flake blank mass (Bradbury et al. 2008), and tool form type (Terry et al. 2009). These examples point to a significant relationship between raw material availability and the organization of lithic technology. Human populations are capable of making use of various strategies depending on many factors including regional proximity to raw material, natural elements (i.e. snow cover) constraining the seasonal availability of raw material, and abundance and quality of raw material. Under different conditions each strategy has the potential to act as a response and, therefore, leaves behind traces in the archaeological record that contribute to artifact form and distribution. Researchers traditionally contrast curated tools with expedient tools employing a one-to-one relationship between mobility pattern and technological strategy (eg. Andrefsky 1991; Bamforth 1986; Binford 1979; Kelly 1988; Koldehoff 1987; Parry and Kelly 1987; Shott 198). In essence, populations exhibiting high mobility were often associated with curated strategies in order to fulfill the need to conserve raw material for longer periods of time while away from a source. In contrast, more sedentary populations have been associated with expedient tool making strategies as the need to conserve lithic material is less evident if known resources are nearby (Binford 1979; 1980 as cited in Andrefsky 2009:71).

Researchers now agree however, that there are many factors which can contribute to the use of one particular technological strategy over another (Andrefsky 1994; Bamforth 1991; Bradbury and Franklin 2000; Kuhn 1991; MacDonald 2008; Milne 2008a Wallace and Shea 2006). Andrefsky (1994:30) illustrates formal and informal tool production as the relationship between raw material abundance and quality (See Figure 4.2). The availability and abundance of raw materials are important for understanding how humans manufactured, used, and reconfigured stone tools. With a low abundance of high quality raw material, we expect to find primarily formal tool production, and with a high abundance of low quality material, informal tools tend to dominate. Some situations determine the need to conserve raw materials by making fewer, longer lasting tools, while others do not. Understanding the raw material conditions involved in a particular strategy provides us with insight to human mobility and land use as they are related to technological organization (Andrefsky 2009:75). An analysis of lithic debitage provides the most accurate account of the types of raw materials that were available and used at a particular time and site due to its resistance to change over time and its probability of remaining in situ from the moment of discard.

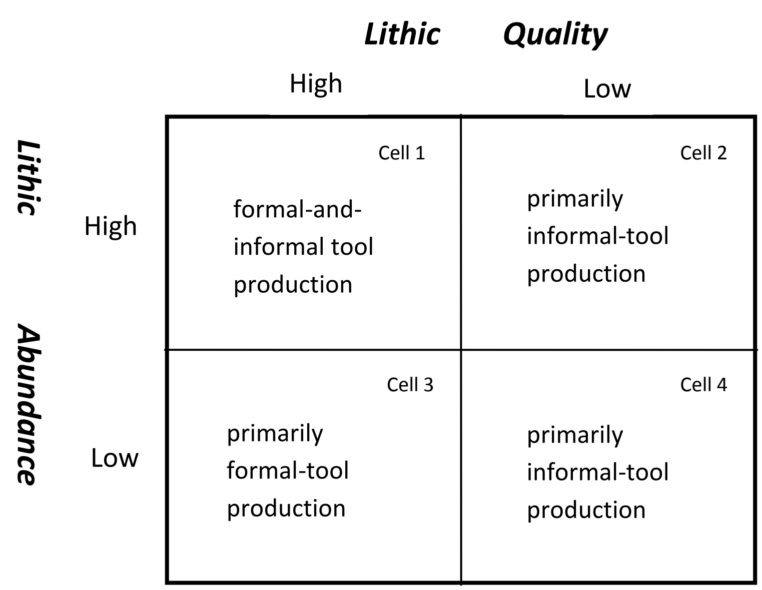

Figure 4.2 The relationship between lithic quality and abundance with the production of formal or informal tools (Andrefsky 1994:30)

The Application of Technological Organization to the Study of Lithic Debitage

The study of technological organization is to understand, “the manner in which human toolmakers and users organize their lives and activities with regard to lithic technology” (Andrefsky 2009:66). Organization refers to the spatial and temporal juxtaposition of the manufacture, use, reuse, and discard of stone tools within a cultural system, in relation to activities, mobility, and raw material type and availability (Kelly 1988:717). Lithic assemblages recovered from archaeological sites represent the outcome of technological strategies as they were implemented by past human populations (Nelson 1991). Therefore, collecting data from specific attributes on lithic debitage and manipulating them allows me to identify these patterns of variability within the isolated assemblage. The patterns are then interpreted based on their relationship to factors that influence the organization of technology. For example, patterns in lithic debitage quality tell us about local source and preferential selection of some stone over others. This information can then be compared to one another to infer about the relationships between a site’s proximity to raw material sources, its diversity, and the choices that are made about raw material selection (Milne 2008a). These relationships can then be interpreted on a larger regional scale to understand possible mobility strategies (Milne 2003). Identified patterns in the lithic debitage assemblage relate to the use of a specific technological strategy in response to the immediate needs of a population. These strategies in turn, are interpreted to understand what the toolmakers were doing at a specific site and why.

Given the extensive lithic debitage assemblage from LdFa-1, patterns of variability should be identifiable. Technological organization then provides the best approach to understanding lithic technology through the analysis of these patterns in the debitage. This can be accomplished at both the micro-site scale, and at the larger macro-regional scale (Milne 2003).

It is well documented that when lithic raw materials are restricted in their distribution, people will conserve their stone as distance from the source increases (Andrefsky 1994; Beck et al. 2002; Morrow and Jefferies 1989; Newman 1994; Tankersley 1995). Related to this is the fact that highly mobile peoples who travel significant distances, like the Pre-Dorset people, did not want to carry excess weight in the form of unusable material. So in theory, they will make blanks and preforms at the source for finishing elsewhere since it enables them to carry more useable toolstone with less bulk (e.g. Beck et al. 2002). As such, we should expect to find very large debitage assemblages at sites located near lithic source areas and increasingly smaller assemblages as toolmakers move farther away. Moreover, the debitage found at the source sites should consist of higher frequencies of early and middle stage reduction materials while in more distant sites, debitage should consist of proportionately more late stage finishing flakes as blanks and preforms are fashioned into finished formal tools.

Multiscalar Approach

Duke (1991:35) states that a multi-scalar approach provides an organizational tool to help understand how phenomena of different duration and intensity interact with each other to create the past. Lithic technology is amenable to multi-scalar analysis because it is a reductive medium and reduction is a continuous process across space and time (Bradbury 1999; Bradbury and Carr 1999; Gero 1989). Following Milne (2003), I also define my micro-scale at the site level. Therefore, the Late Dorset debitage assemblage from LdFa-1 is the focus of my micro-scale analysis. Using Milne’s (2003) data on Pre-Dorset land use in the interior of southern Baffin

Island as my comparative study, I define my macro-regional-scale as the interior of southern Baffin Island. This will enable me to compare my identified patterns at LdFa-1 to other local Pre-Dorset sites to infer if the Late Dorset people were using this inland area in a similar manner.

Using the technological organizational framework within a multiscalar approach provides a way to make inferences about the site assemblage, how resources were managed, and how the Late Dorset managers moved throughout the landscape of Baffin Island.

Statement of Research Hypotheses and Test Expectations

Based on the information presented thus far, we know that the Dorset culture has been interpreted as a mostly sedentary one that relied heavily on coastal and marine resources. Evidence from southern Baffin Island, however, indicates that several Late Dorset sites are located in the deep interior regions, where terrestrial resources were abundant for subsistence. We know that chert raw material is abundant in the interior of Baffin Island and that it is restricted throughout the coast. The Dorset people use a small, easily transportable toolkit, as noted based on the kinds of diagnostic formal tools present on Dorset sites. The following section presents three hypotheses and related text expectations, which were constructed using the information presented thus far. Testing them against the data generated through my lithic debitage analysis will provide explanations for the patterns of variability identified and, in turn, enable me explain how the Late Dorset people organized their lithic technology during their occupation of LdFa-1.

Hypothesis One and Test Expectations

This hypothesis states that the Late Dorset at LdFa-1 were seasonally occupying the site during the late summer/early fall when caribou could be easily exploited during the migration. At this time of year, local chert raw material sources would also be available for toolmakers to acquire and transport from near-by regions making this site an ideal location to occupy. The Late Dorset toolmakers were implementing a curated lithic technological strategy, which focused on raw material acquisition so toolmakers could renew their toolkits while near a source area and "gear-up" (Binford 1978, 1979) in anticipation of moving away from this source for the remainder of their seasonal round. Once basic performs were made, the toolstone could then be transported and completed at a later time, presumably at or near a coastal site during the winter months. This technological strategy is used to conserve energy by preparing smaller packaged preforms for transportation and use at a later time. Moreover, the Late Dorset people would have been finishing and resharpening some tools for their everyday use. Hypothesis one would conclude that the Late Dorset were following a similar mobility and subsistence pattern as their Pre-Dorset ancestors.

If this hypothesis is true, I would expect to find (1) a large lithic debitage assemblage that displays attribute patterns reflecting the use of a single reduction strategy at LdFa-1. If the Late Dorset were using the abundant local raw material in the interior region and travelling to the coast, they would make preforms at sites near the source so that they can finish and use the tools further away (Beck et al. 2002). This technological strategy would be embedded in their mobility practices as they make rounds between seasonal sites (Morrow and Jeffries 1989; Milne 1999; 2003; Newman 1994). If the lithic raw material was being procured solely from the local sources, I would also expect (3) a high degree of similarity between the raw material type, quality, and texture. The strategy would (4) consist mostly of early and middle stage reduction debitage with a lower proportion of late stage reduction (Beck et al 2002). Early and middle stages represent the reduction strategy where cores and preforms are manufactured to carry to another site in anticipation of future use while the lower frequencies of late stage reduction would represent the shaping of tool blanks and preforms done before the tools were removed from the site. Some of the late state reduction may also be associated with the need for daily tool-use and hunting activities during occupation of the site. Given the earlier stages of reduction, it is expected that (5) heavy force loads, and those attributes that reflect them would be identifiable among the lithic debitage (Whittaker 1994).

Hypothesis Two and Test Expectations

This hypothesis states that the Late Dorset people were living in the interior during both the summer and winter months, and that the occupation of LdFa-1 was essentially year-round. The Late Dorset would be able to take advantage of the abundant lithic raw material littering the landscape during the late summer/early fall and local subsistence resources year-round. It necessarily implies that these peoples did not travel seasonally to the coast. That said, if the Late Dorset were living inland year-round, they would likely still have to travel shorter distances to find food and toolstone as near-by raw material scatters would eventually become depleted and because the local caribou herds fluctuate in size and can move to new locations unpredictably. Given these patterns, I would expect to find evidence of an expedient technological strategy dominating the LdFa-1 assemblage since the Late Dorset would be able to acquire local toolstone easily and stockpile it if their mobility was reduced. I might expect to see preferential selection of better quality chert used for hunting and fishing and the use of lower quality lithic material for other less demanding tasks (Andrefsky 1994).

If this hypothesis is true, I would expect to find (1) evidence of the entire tool reduction sequence at LdFa-1. Early through late stage reduction should be present, meaning that tools were being acquired, shaped, finished, and possibly resharpened. The toolmakers could stockpile large quantities of lithic raw material for the winter months; however, they would still likely make some formal tool types for hunting (i.e. bifaces). If only some middle-to-late stage reduction is evident, it may suggest that the Late Dorset toolmakers were initially flaking raw material cobbles into preforms away from the site and bringing those pieces back to LdFa-1 to finish at a later time. If the Late Dorset people are using the abundant local raw material, (2) I would be expect a higher proportion of good quality flakes and for raw material testing to occur. This strategy would also result in (3) lower quantities of advanced platform modification due to the use of an expedient tool-making strategy year-round.

Hypothesis Three and Test Expectations

This hypothesis states that the Late Dorset occupation of LdFa-1 was a one-time, opportunistic event. They would have likely arrived on site following caribou herds. The result would indicate no evidence displaying consistent patterns of reoccupation. This is the null hypothesis.

If this hypothesis is true, I would expect to find (1) a very small lithic assemblage since it is a one-time occupation and potentially short term. I would expect to find (2) patterns in the debitage that display some lithic reduction activities of the local chert for expedient purposes and possibly a high degree of variability in raw material if this is not the main source of chert. This would reflect a toolkit that is made of non-local stones that are being heavily curated and conserved for future use. Similarly, I would not expect (3) a high degree of tool deposition since they would be holding on to what they had already brought to the site given the focus was not to stay and "gear-up." Of the reduction activities occurring, it would result in small late stage resharpening debitage from existing tools and possibly some early and middle stage reduction reflecting expedient tool production. Within a shorter temporal context, I would expect (4) the overall quantity of the debitage to be proportionately lower than those of recurring occupations, with relatively shallow deposits concentrated within a small area.

Chapter 5

Research Methodology

This chapter begins with an explanation of the sampling strategy used in this study and my rationale for choosing a 90% confidence interval to determine the size of my study sample. I then describe my two methods of analysis: mass analysis and individual attribute analysis. Finally, I outline the statistical methods used to isolate and evaluate patterns of lithic assemblage variability.

Debitage as an Artifact Category

According to Andrefsky, debitage can be defined as "the by-product of stone tool production and resharpening" (2007:392). Lithic debitage analysis can be further defined as "the systematic study of chipped stone artifacts that are not cores or tools" (Sullivan and Rozen 1985:755). Because lithic technology is a reductive medium, the size of the detached flakes decreases along the reduction continuum until the desired object being made is achieved. As such, larger pieces of debitage are often associated with the early stages of reduction while smaller pieces are associated with late stage reduction including the final shaping and thinning of a tool, and even its maintenance once it has been used. The overall size of flakes detached in a reduction continuum is dependent on the initial nodule size and shape of raw material (Andrefsky 2007; Bradbury and Franklin 2000). Because debitage is rarely if ever removed from a site once the occupants leave, it provides an enduring and accurate record of lithic reduction and use strategies (Andrefsky 2009:80). As such, my debitage analysis of the LdFa-1 Late Dorset occupation will provide important insights on what toolmakers were doing in this area of the site.

Debitage Sampling Strategy

Working with an assemblage of 47,671 pieces of lithic debitage provides the opportunity to examine and record a number of attributes on a relatively large total sample size. The lithic debitage assemblage recovered from Area 1 at the LdFa-1 were excavated over the span of two field seasons in 2007 and 2008 (Milne 2008b; Park 2008). While there are examples of published studies where analysts examined assemblages consisting of hundreds of thousands of flakes (e.g. Root 1997), Milne (2003, 2009) notes that in most instances, this is not feasible or even necessary to do. She outlines an alternative sampling strategy devised specifically for measuring debitage variability where statistically valid results can be obtained from a smaller study sample when a more rigorous sampling strategy is used (Milne 2009:41). Milne continues to note that the practice of drawing random samples of only 5% or 10% of a lithic debitage assemblage can in fact skew site interpretations (Milne 2009). By implementing the following systematic sampling strategy, I reduced my study sample to a manageable size and can state with 90% confidence that it reflects patterns of variability present in the larger parent population.

Drawing the Sample: Determining Confidence Intervals and Sample Size

The entire Late Dorset debitage assemblage from Area 1 was counted and size graded by student volunteers supervised by Park at the University of Waterloo. There are seven size grade categories that are based on American Standard nested mesh screens, which include:

≤3.35mm (1/8 inch)
3.35> ≤6.3mm (1/4 inch)
6.3> ≤12.5mm (1/2 inch)
12.5> ≤19mm (3/4 inch)
19> ≤25mm (1 inch)
25> ≤31.5mm (1 ¼ inch)
>31.5mm (1 ¼ inch)

It is important to recognize that these mesh sizes do not always “catch” elongated, or odd shaped debitage, and that some larger size pieces can fall through into smaller screens below during the sorting process. This is a phenomenon discussed by Andrefsky (2007) and which I address later in this chapter. When the size graded assemblage was shipped to me at the University of Manitoba, Park advised me to be aware that some flakes might be in the wrong size grade categories (see Appendix B). As such, I made every effort to correct this. A total of 77 unit bags were received and sampled for this study (see Appendix C).

It should be noted that data collected from the analysis of the two smallest size grade categories (i.e. < 3.35mm and $3.35 > \leq 6.3$mm) were combined so as to facilitate comparisons between my data and those collected by Milne (2003) for the Pre-Dorset sites included in this study (see table 5.1). In fact, the seventh size grade category used by Park is the ‘catchment’ bin at the bottom the stacked sieves and includes all of those tiny flakes and pieces of debris that are most commonly the result of flake attrition post-excavation and other debris with little to no analytical value. Published mass analyses of lithic data (e.g. Ahler 1989a, 1989b; Bradbury and Franklin 2000; Milne 2003; Root 1997) more commonly use 1/8” as the cut-off for analysis. Flakes smaller than 1/8 inch are argued to be of little analytical utility (Bradbury and Franklin 2000:43). Figure 5.1 illustrates the steps involved in calculating and drawing the particular study sample size necessary for my analysis.

Table 5.1 The process of combining size grade 1 and size grade 0 into one category.

Borden: Catalog Bag #	SG6 Bag	SG5 Bag	SG4 Bag	SG3 Bag	SG2 Bag	SG1 Bag	SG0 Bag	Area	Unit
LdFa-1:1703	0	0	0	4	31	41	11	Area 1	A3
LdFa-1:1705	0	0	3	8	61	64	19	Area 1	B3
LdFa-1:1709	0	0	2	8	59	57	16	Area 1	B3
LdFa-1:1715	0	0	0	0	6	6	4	Area 1	B3

Borden: Catalog Bag #	SG6 Bag	SG5 Bag	SG4 Bag	SG3 Bag	SG2 Bag	SG1 Bag	Area	Unit
LdFa-1:1703	0	0	0	4	31	52	Area 1	A3
LdFa-1:1705	0	0	3	8	61	83	Area 1	B3
LdFa-1:1709	0	0	2	8	59	73	Area 1	B3
LdFa-1:1715	0	0	0	0	6	10	Area 1	B3

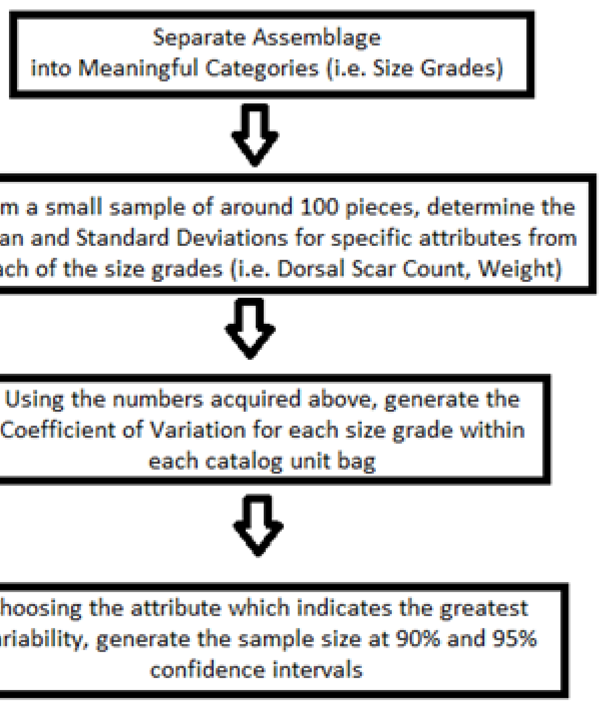

Figure 5.1 Flow chart illustrating step-by-step process to conduct statistical sampling strategy.

The first step in this procedure is to divide the assemblage into meaningful size grade categories provides initial information regarding the phenomena under investigation (Andrefsky

1998:59). Following Bradbury and Franklin (2000), and Milne (2003; 2009), I use size grade to measure the degree of technological variability present in the lithic assemblage. Size grading provides an immediate sense of frequencies of flake sizes present, an absolute count of their numbers within each size, and a preliminary measure of the stages and types of reduction present (Ahler 1989a; 1989b; Bradbury and Franklin 2000; Milne 2009; Root 1997). This information is essential for calculating the size of my study sample.

Step two is to calculate the sample size for each size grade category. I began with a small random sample of 100 pieces, including at least one specimen from each category. Two continuous attributes were selected that represent sensitive measures of technological variability (i.e. weight, dorsal scar count). They were recorded for each debitage piece and mean values and standard deviations were generated for each total size grade category within the small sample. Next, the coefficient of variation was calculated for each size grade category, and used to compare the degree of variability exhibited by each attribute state. Always selecting for the attribute that provides the greatest amount of variation in each size category, I calculated the total sample size for each size grade category at both 90% and 95% confidence intervals. It should be noted that since larger sized grade flakes are often fewer in number given the nature of a reduction continuum, they tend to be more variable in their weights. As such, one can expect to analyze more of them as a result (Milne 2009). In a number of cases for this analysis, it resulted in a complete 100% sample of larger size grade bags. In turn, the smallest size grades often showed less overall variability, resulting in the need to draw fewer of them for analysis resulting in a smaller sample. Overall, at 95% confidence the total assemblage sample size would have been 28,583 pieces of debitage, and at 90% confidence the total sample size was 7,479 pieces. My goal was to draw a statistically sound sample that was manageable in terms of overall size since I intended to examine 14 attribute states on each individual flake. While it is always preferable to aim for 95% to 100% confidence interval, it was decided that 90% would suffice given the level of detail the analysis of the selected attributes would provide. With each catalog bag containing separated size grade bags and totals, this statistical procedure needed to be repeated for each one. It is noted by Milne (2009) that a study sample for assemblages this large is generated to reduce redundancy of collected data. This also decreases the overall time required for conducting the analysis.

Drawing the Sample: Procedure

Following Milne (2009:49), a two-way soil-splitter was used to randomly divide all lithic debitage in order to acquire the desired sample size. The soil-splitter is a device consisting of a series of evenly spaced slots that randomly divides pieces poured through it and deposits them into two separate trays. Each tray was fitted with a protective layer of padding (conventional paper-towel) in an effort to eliminate flake-breakage as flakes were poured through the splitter and deposited in each respective tray. Once a sample is poured into the top opening tray of the soil-splitter, pieces collected in the padded tray marked ‘2’ were discarded back into their appropriate provenience bag and those collected in the tray marked ‘1’ would be counted. This procedure is repeated until the required sample total for each size grade is acquired. Each individual sample is placed in a smaller re-sealable bag with the provenience, size grade, and sample total written on the front in permanent marker. The result of this meticulous process is an entirely random yet statistically determined study sample.

Methods of Analysis

My analytical methodology is modeled, in part, on Milne's (1999, 2003) and combines two approaches: individual attribute analysis and mass analysis. Because lithic debitage is variable along multiple dimensions and specific methods of flake analysis tend to focus only on isolated aspects of it (Bradbury 1998:263), use of these two complementary analytical methods is strongly encouraged since the data they respectively generate will either strengthen inferences or highlight ambiguities (Andrefsky 2001).

Individual Attribute Analysis

Individual attribute analysis focuses on defining discrete attributes on flakes or tools. These attributes are related to raw material, technology, function, morphology, and post-depositional modification (Handly 1994:75; as cited in Milne 1999:42). These attributes are then examined at the assemblage level with the intent of identifying specific flake types, based on their combined attribute states (e.g. Ahler 1989 a/b; Andrefsky 2009; Milne 1999, 2003; Sullivan and Rozen 1985). Once attribute frequencies are identified, inferences about the kinds of reduction and use strategies used at a site can be made.

Individual attribute analysis has been criticized as being subjective given inconsistencies in the attributes some analysts choose to examine and their ability to decipher and record them (Milne 1999). Milne (1999) notes that this approach can be further complicated by the number of diagnostic attributes that can only be recorded on complete or proximal flakes (i.e. platform modification, percussion features etc.; see e.g. Fish 1981:375; Hayden and Hutchings 1989:241; Raab et al. 1979:171; Towner and Warburton 1990:314). This inevitably leads to studies that focus less on medial, distal and shattered pieces, which may bias the results of the site interpretations (Ahler 1989a). Providing clear definitions of the attributes and explanations of how they are observed helps to resolves this issue (Ahler 1989a, 1989b, Andrefsky 2001; Baumler and Downurn 1989; Henry, Haynes, and Bradly 1976; Milne 1999; 2003; Patterson and Sollberger 1978; Raab et al. 1979).

Mass Analysis

Mass analysis, or flake aggregate analysis, complements the data generated from individual attribute analysis (Carr and Bradbury 2001) because it focuses on the differential characteristics of size, weight, and cortex (i.e. outside surface of the stone) observed among flake groups within an entire assemblage (Bradbury and Franklin 2000:42). Mass analysis is a form of debitage population study that looks at patterns produced in the debitage of experimental lithic replications and compares them to patterns found in the archaeological debitage assemblage (Andrefsky 2007; 2009:81). In 2007, Andrefsky published an article discussing the limitations of mass analysis where three main criticisms were presented: replicator variability, raw material size, shape, and composition, and debitage mixing.

The replicator of a lithic tool contributes their own source of variability due to style, technique, and skill. Supported by Redman's (1997 as cited in Andrefsky 2007:395) findings, these factors produce the greatest source of debitage assemblage variability and as Andrefsky points out, even the patterns generated from four different replication studies show variation in the debitage produced (2007:394). Raw material size, shape, and composition are important factors which influence debitage in my Master's research since the package size of most parent material nodules used to produce lithics in this area consist of small, rounded cobbles (Milne et al. 2011). This must be accounted for in relation to size grades as higher proportions of debitage produced from smaller parent material will inevitably fall within smaller size categories. Lastly, debitage mixing is argued to cause problems with mass analysis since the production of multiple technological strategies is not accounted for in the assessment of the debitage. This issue can be assessed by combining debitage from two or more manufacturing sequences and comparing them to the signatures in the archaeological assemblage (Andrefsky 2007:396).

Bradbury and Carr (2009) published a response to Andrefsky's (2007) concerns with mass analysis. The authors argue that replicator variability is an issue concerning all types of lithic studies (2009:2789). Ahler (1989) tried to control for this variability in the experimental program that reproduced a number of technological reduction sequences by having people of all different skill levels included in the project. They note that these replication studies work due to the constraints physics impose on flintknapping (Bradbury and Carr 2009:2791). Raw material size, shape, and composition are issues that are being assessed with new replication studies that use a wide array of raw materials and initial shapes and sizes. Some studies have shown that as long as raw material type and initial package size were similar, analyses of different types of reduction and production are possible (Bradbury and Franklin 2000). Debitage mixing is still a concern even when combining replication debitage signatures. Other approaches include subdividing debitage assemblages even further to relate them more clearly to the archaeological assemblage (Larson and Finley 2004). However, future work is still needed to understand more fully the impact of debitage mixing on archaeological lithic assemblages.

Attributes Selected for LdFa-1 Debitage Analysis

The attribute list used to analyse the debitage artifact type from LdFa-1 is a modified version of Milne's (1999:153-197; 2003:356-416). The lists were condensed based on Milne's

(1999) assessment of what attributes were most effective for isolating patterns of variability in Palaeo-Eskimo debitage assemblages. In total, 14 attributes are observed for each flake included in the study sample. These attributes are grouped according to the following three categories: Raw Material Attributes; Technological Attributes; and Post-Depositional Attributes. (See Appendix A for complete attribute list.)

Raw Material Attributes

These attributes are use to evaluate the raw material type, texture, quality, and cortex cover of each piece of debitage. These attributes provide insights on lithic procurement strategies, raw material diversity, and preferential treatment of some stones versus others. Cortex cover reflects the form of the parent material particularly if it consists of smaller nodular pieces of chert. The percentage of cortex remaining on flakes can be equated with different stages of reduction since early stage flakes will retain more of it since they derive from the exterior surface of a nodule while late stage flakes retain proportionately less, if any (Magne 1989). Cortex can also provide details on whether or not raw material testing occurred off site. Specifically, if the raw material available in a region consists of small nodules or cobbles, yet the debitage on site retains little cortex, one can infer that off-site testing occurred since it allows toolmakers to select better quality material for transport back to a site for further reduction. It also eliminates unnecessary bulk while carrying rocks (see Beck et al. 2002).

Technological Attributes

These attributes include flake size, weight, dorsal scar count, platform modification, platform battering, bulb of percussion, compression rings, and eraillure scars. The information that all of these attributes provide is about stages of reduction and techniques used in manufacture. Size grade, weight, and dorsal scar count information is used to detect both reduction stages at the site and variation in knapping technique. Moreover, this provides an understanding that different sizes of lithic debitage relate to early and late stages of reduction and that these same differences in size are also impacted by hard or soft percussion techniques (Ahler 1989a). As such, it is important to consider initial package size, shape, and composition of the raw material when interpreting these attributes (Andrefsky 2007). Weights should directly relate to size grade and reduction stages (Ahler 1989a). Heavier flakes fall within larger size grade and lighter flakes within smaller size grades. Dorsal scar count refers to the number of flakes removed from the exterior and relates to the overall size of the flake (Mauldin and Amick 1989). It is noted that dorsal scar counts should increase the smaller the flake becomes as it would represent later in the reduction process (Magne 1985:113), however, this is not entirely accepted (Mauldin and Amick 1989:67). Morphological features surrounding the striking platform (i.e. platform battering, bulb of percussion, compression rings, eraillure scars) provide information about the force loads involved in flaking, the stage of reduction, along with the time invested and effort placed in the production of tools (Cotterell and Kamminga 1987). Platform modification is recorded on a scale from zero modification (i.e. cortical platform) and investment of time to advanced modification (i.e. multiple flake scars on platform), investing a greater degree of time and effort. Attributes such as bulbs of percussion, compression rings, and eraillure scars are used to detect the force of impact on the flake and relate either hard or soft hammer techniques (Dibble and Pelcin 1995; Hayden and Hutchings 1989). This type of information can also provide information regarding flintknapping skill level (Shelley 1990).

Post-Depositional Attributes

These attributes measure both the environmental and the human interactions with flakes after the time of discard. These attributes include the debitage completeness index (Sullivan and Rozen 1985) and distal termination states. This information provides insights into what Schiffer (1987) refers to as natural transformations and cultural transformations. These are the instances after deposition where artifacts can be disturbed through processes such as weathering, changes in landscape geomorphology, or interaction and transport by animal or human intervention (Barnes 1939). These attributes are also used to detect raw material failure, and act as an indicator of successful detachments.

Data Evaluation and Statistical Procedure

Archaeologists summarize their data in such a way where patterns are easy to isolate, summarize, describe, and interpret (Banning 2000:17). Accordingly, I use a variety of statistical procedures to evaluate the data generated from this analysis of lithic debitage including: descriptive statistics, measures of central tendency, and measures of dispersion.

Descriptive statistics refer to the numeric summaries of interval or ratio-scale data (Banning 2000:17). These measures are used to present in only one or two numbers, the ‘typical’ or ‘central’ characteristics of the data. They are used to illustrate the amount of ‘spread in the data’ (Banning 2000). For example, a normal distribution is expected to display as a high frequency of data concentrating one area with generally equal parts of data falling to either side. Data can spread in many different distribution types, however, the most common is the normal or unimodal distribution (Banning 2000). These distributions provide the data with typical or central characteristics. Typical and central characteristics of data refer to measures of central tendency. The most common of these measures is average or arithmetic mean. This statistic presents the area of a frequency distribution where most data fall and is essential for displaying and comparing general patterns from archaeological assemblages. The mean is calculated for a population using the following equation:

$$\mu = \frac{\Sigma X_{\mathrm{i}}}{N}$$

where μ is the population mean (average), ΣX_i is the sum of all data values in the population and N is the number of observations in the population (Banning 2000:17). When analyzing a sample of the population, such as in this study, a similar equation is used to estimate the population mean

$$\overline{x} = \frac{\Sigma \chi_{\mathrm{i}}}{n}$$

where $\overline{x}$ is the mean, Σx_i is the sum of the values in the sample and n is the number of observations in the sample (Banning 2000:17). Other modes of central tendency include mode, which is the central peak of a frequency distribution, and the median which represents the divided half of the entire distribution.

Measures of dispersion are also used in the study in order to understand how the data are being distributed within this sample. Both variance (s^2) and standard deviations (s) are useful statistical tools for measuring variability (Banning 2000:20). As Banning (2000:19) states "variance indicates the sum of the squared differences from the mean, providing a value indicating relative homogeneity or heterogeneity of the population". Its value is given in square units often making it difficult to visualize within the raw data. Standard deviation resolves this issue by taking the square root of the variance (Banning 2000:20). The resulting values can be evaluated based on its distance away from zero, meaning that populations that produce values close to zero display less variability and those with values farther away from zero show higher variability (Banning 2000:20). When making predictions on the basis of archaeological samples, however, Banning (2000:20) insists that use a measure known as standard error (SE) instead. The standard error of the mean is the ratio of the standard deviation to the square root of the sample size (n).

$$SE \frac{s}{\sqrt{n}}$$

We use standard error for archaeological samples because we can only estimate the total population of an artifact assemblage (Banning 2000:20). These measures of dispersion tell us about the variability of a population or sample. If two sample mean estimates are several standard deviations/errors apart, then it is likely that the two populations are different. In the case of this study, the alpha level selected is '1' (90% interval) meaning that the normal distribution is slightly larger than if the alpha selected was '2' (95% interval). If there is very little variability between the sample populations, then the standard errors would fall within the same range of the distribution (Banning 2000:123).

All of these statistical procedures are used to manipulate large amounts of data to understand and make inferences in a clear and meaningful way. Using these to compare and contrast intra- and inter-site lithic assemblage patterns informs us of the similarities and differences of activities that once took place. For example, if I wanted to compare the lithic densities of one site with another I could use standard error from density means taken from the two sites to tell me by how much they differ. The reason these statistical procedures have been presented thus far is to explain how to make confident predictions and interpretations about any recovered archaeological assemblage population.

Chapter 6

Debitage Analysis, Statistical Results, and Interpretations

This chapter summarizes and interprets the results of the debitage analysis conducted on the LdFa-1 Late Dorset component lithic assemblage. I present first the patterns identified for all of Area 1 (i.e. all excavated units) (Figure 6.1). Thereafter, I discuss patterns that appear to identify three discrete activity areas. Lastly, I present the overall descriptive statistics for Area 1, followed by the comparative patterns identified between the three spatially defined areas. Finally, functional interpretations are provided for the entire Late Dorset component at LdFa-1.

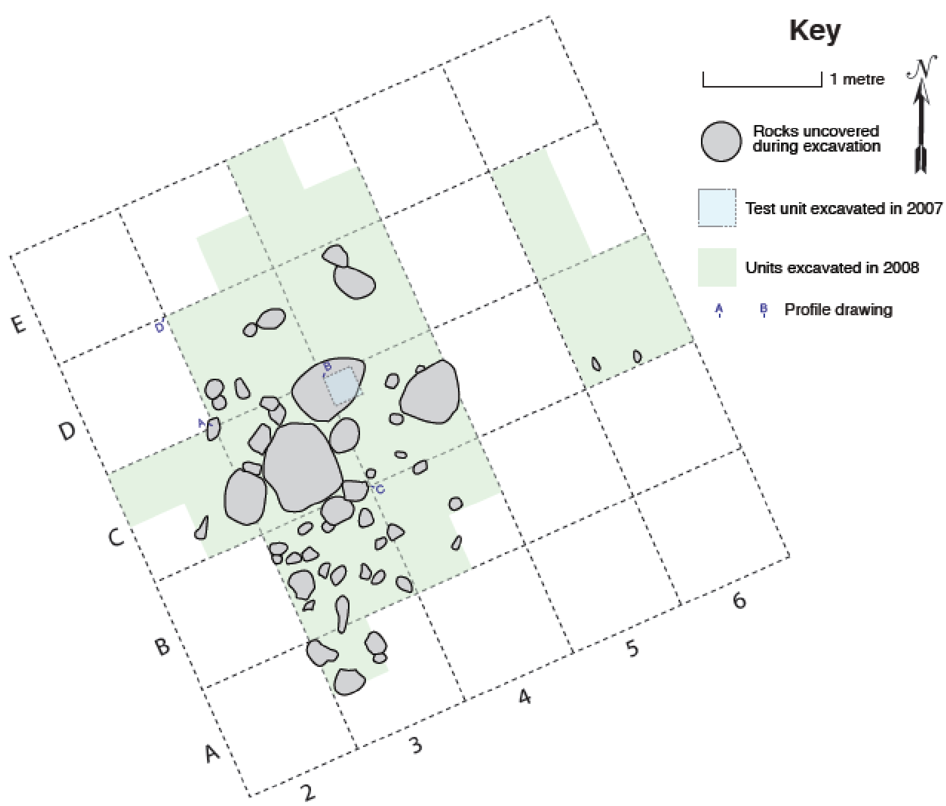

Figure 6.1 Plan view, Area 1 LdFa-1 All excavated units (Park 2008)

Area 1, LdFa-1 – Raw Material Information

Of the overall study sample consisting of 7479 flakes, 99% are identified as chert. Raw material quality and texture are consistently poor with 99% of the assemblage displaying coarse-grained textures and nearly the entire sample showing evidence of vugs, voids, fossils, and/or inclusions (see Table 6.1). This is indicative of the local parent material in the inland region where chert deposits are found in the form of small angular pieces and rounded cobbles due to constant weathering processes affecting larger chert bearing bedrock formations (Milne et al. 2011). These data suggest evidence for off-site testing and that preferential treatment of raw material was highly likely. These patterns are consistent with other sites in this region.

Table 6.1 Raw material frequencies separated by type and texture.

Raw Material Type	Frequency	% of Sample
Chert	7424	99.26
Chalcedony	27	0.36
Crystal Quartz	7	0.09
Quartzite	19	0.25
Slate	1	0.01
Ramah Chert	1	0.01
Nephrite	0	0.00
Total	7479	100.00
Raw Material Texture		
Vitreous	7	0.09
Fine Grained	55	0.74
Coarse Grained	7417	99.17
Total	7479	100.00

Area 1, LdFa-1 – Technological Information

The LdFa-1 debitage study sample is assessed using six separate size grade categories. The frequencies for flake size in the study sample are compressed into the smallest categories with over half, 57.4% (N = 4290) falling within size grade 1 and 36.2% (N = 2706) of the study sample within size grade 2. The larger categories of 3, 4, 5, and 6 combine for 6.5% (N = 483) of the entire study sample. The local raw material appears to occur consistently in small nodules and cobbles, therefore, it is not surprising that there are fewer large size flakes. This is supported by the evidence that shows only 5.4% (N = 403) of all flakes in the sample that exhibit cortex. Of this, 3.6% (N = 271) fall within the smallest size grades, indicating that they were working smaller cortical nodules since even some small flakes retain cortex. Raw material pieces were likely transported to the site from known inland sources where the abundant nodules could be tested, removing most cortex from the objective piece, or it is possible that the chosen nodules exhibited little cortex in the first place.

Flake weights are unimodal in distribution with the highest frequencies recorded in the smallest categories. Flakes weighing between 0.01 and 0.5 grams total 85.8% (N = 6420). Heavier flakes (i.e. those that weigh >0.5 grams; N = 1059) are more variable (s^2=5.86). This reflects the lower proportionate frequencies of the larger sized flakes in the overall assemblage. Lastly, the distribution for dorsal scar counts is unimodal and peaks at an average 3 scars with 34.5% (N = 2579) of flakes recorded in this category. Dorsal scar count is the quantification of flake scars appearing on the dorsal (i.e. outside) surface of the flake. High numbers of dorsal flake scars on debitage often suggests later stages of lithic reduction (Magne 1985). The relationship between the two is based on the premise that exterior flake scars will increase in number as the objective piece decreases in size over time. If initial material testing is occurring on nodules, this may result in increased numbers of dorsal scar flakes appearing on large size flakes in the assemblage. However, of those flakes with 3 scars, 94.6% (N = 2439) fall within size grades 1 and 2. Of all larger flakes sizes, 49.3% (N = 238) occur with < 3 dorsal scar counts, and only 21.7% (N = 105) occur with > 3 scars (see Figure 6.3). This suggests that testing of raw material was happening with more frequency off site.

Together, the size grade, weight, and dorsal scar count data all display similar unimodal distributions indicating the use of a single reduction strategy focusing on the early and middle stages of the overall reduction continuum (see Figure 6.2). Ahler notes (1989:205), unimodal distributions for these attribute states represent the gradual progression of a lithic reduction continuum from start to finish. However, the actual stages of reduction completed at a site will ultimately influence the way these distributions curve. Given the high frequency of small flakes with low weights and moderate dorsal scar counts, along with evidence that shows low numbers of cortex cover, it appears that Late Dorset toolmakers were testing the raw material off site and then transporting better quality pieces to LdFa-1 for further production and modification into blanks and preforms. These are similar results noted by Milne (2003) for some Pre-Dorset sites located in this region. These results and interpretations are further confirmed by my individual attribute analysis for the overall site of LdFa-1.

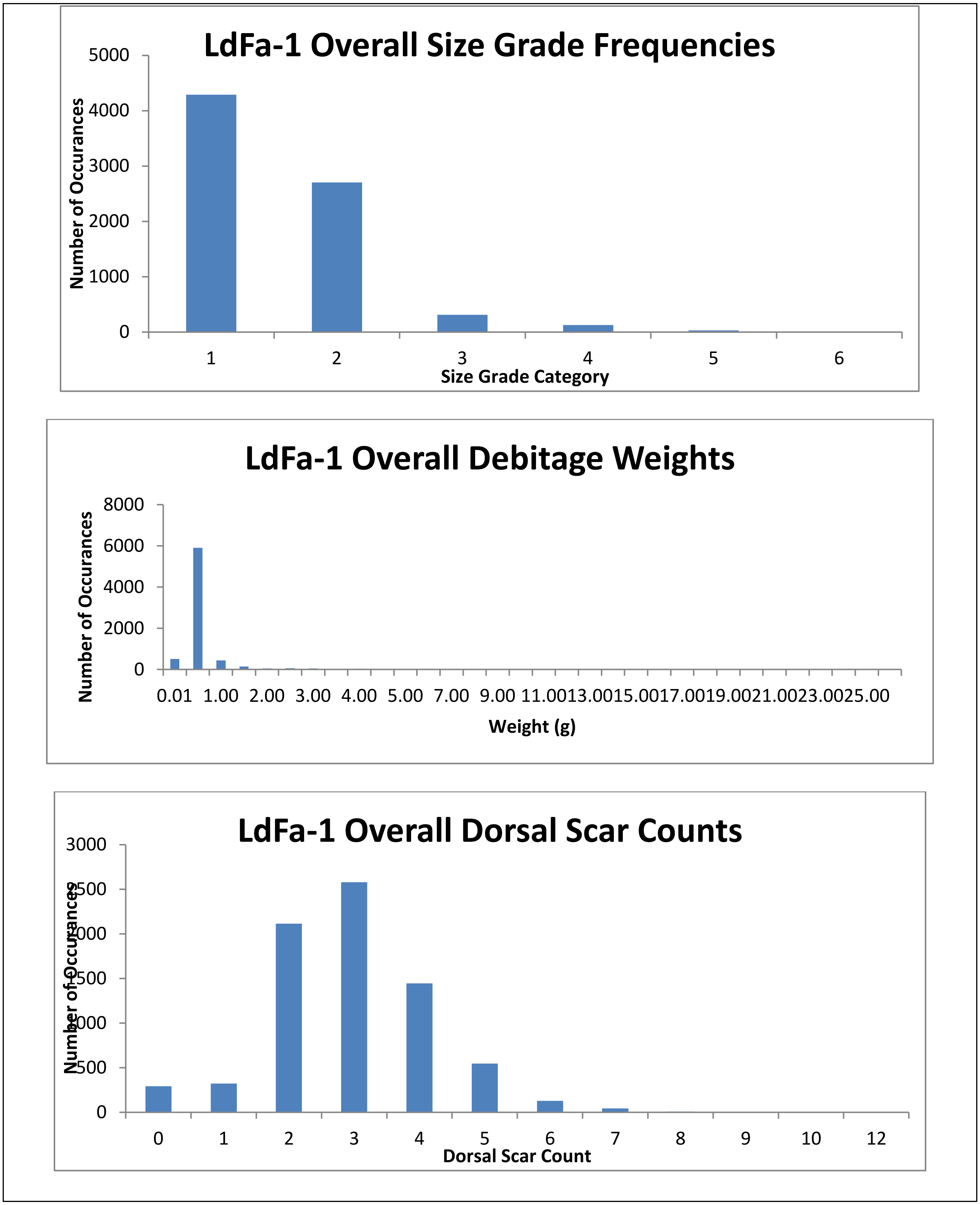

Figure 6.2 Frequency of overall size grades, weights, and dorsal scar counts.

Among those flakes that are complete with intact striking platforms (N = 4192), 62.7% display minimal modification correlating them with early and middle stage reduction (Whittaker 1994:100-105; Milne 2003:141; Tomka 1989:146). Comparatively fewer flakes exhibit moderate (N = 1462) or advanced platform (N = 101) states (see Figure 6.3); however, their presence does suggest some tool shaping and early stage finishing occurred at the site, most likely in association with the production of bifacial blanks and preforms (Milne 2003). For the purpose of evaluating the lithic reduction continuum based on three meaningful categories (i.e. minimal; moderate; advance), complete flake platform modification states were assessed noting that those flakes exhibiting unprepared and indeterminate platform states were combined within the minimal modification category.

Minimally modified platforms consist of a single flake or the combination of a single flake removal and evidence of a cortical striking platform. These states require little effort, time, or skill to prepare (Whittaker 1994:100-105; Milne 2003:141), and also suggest earlier stages of reduction (Tomka 1989:146). In direct contrast, few flakes displayed any evidence of advanced platform modification which would have required more time, effort, and a greater degree of skill to produce (Whittaker 1994:100-105; Milne 2003:141). The number of moderately modified platforms, a state indicated by one or two flake scars present on the striking platform with possible trimming or grinding, is an indication that some platform preparation was still being conducted on site. Since flakes exhibiting minimal and moderate modification dominate this assemblage, it appears that toolmakers were not commonly finishing blanks and preforms or resharpening tools on site. That said, the presence of a few advanced flakes (N = 125) does indicate some late stage reduction was carried out.

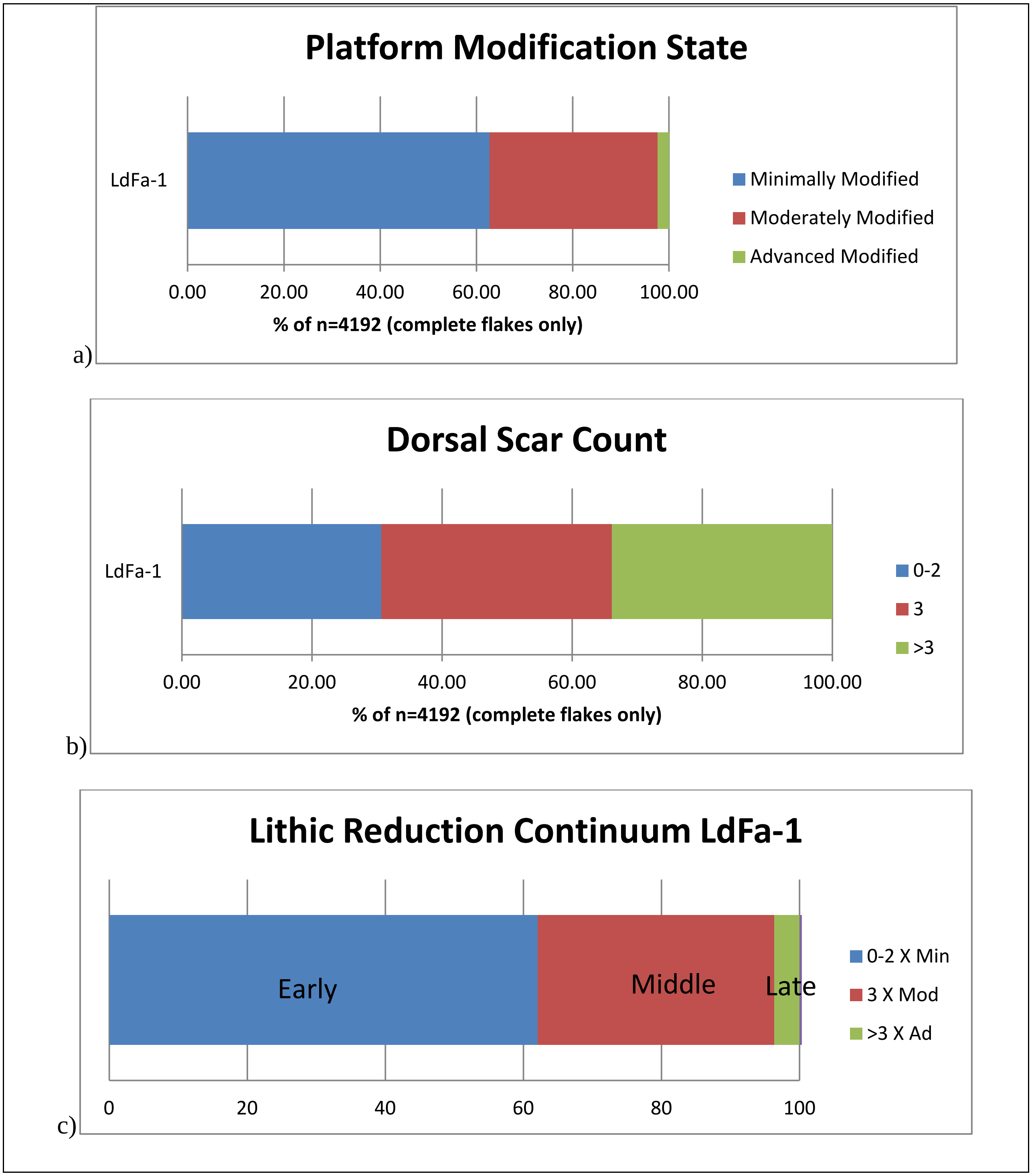

Figure 6.3 Cumulative percentages of lithic a) platform modifications states, b) dorsal scar counts, and the overall c) lithic reduction based on the cross tabulation of dorsal scar counts and platform modification on completed flakes with intact striking platforms.

When platform modification states are cross-tabulated with dorsal scar counts to infer stages of reduction, these data, again, corroborate those patterns presented thus far. Specifically, 62.1% (N = 2603) of complete flakes are associated with early stage reduction; 34.2% (N = 1434) are associated with middle stage reduction, while only 3.7% (N = 155) area associated with late stage reduction (see Figure 6.3).

Lastly, evidence shows that hard hammer percussion techniques were being used extensively throughout the site. This is attributed to 27.5% (N = 1151) of all complete flakes showing evidence of eraillure scars, 35.2% (N = 1477) showing evidence of heavy compression rings, prominent blubs of percussion appearing on 61.7% (N = 2587) of completed flakes, and 12.2% (N = 512) having stacked terminations below the striking platform. These attributes are often associated with early stage reduction further supporting all other evidence thus far.

<u>Area 1, LdFa-1 – Post-Depositional Information</u>

Feathered termination states are recorded for 61.3% (N = 4586) of all flakes, which is high and indicates a high incidence of successful flake detachment. Hinged terminations account for 8.68% (N = 2893) of the remaining flakes while 30.0% are indeterminable (see Table 6.2). As consistent feathered terminations on complete flakes represent successful detachment, and there are high frequencies of heavy force loads, there is a possibility that this represents a higher degree of skill in knapping (Milne 2005a). Hinged and indeterminate terminations are more likely the result of failed detachment, which could be related to the lower quality of the local lithic raw material. There is a higher likelihood of a flake to hit an inclusion or imperfection while detaching when the raw material is of lower quality (Whittaker 1994). Of the flakes exhibiting feathered terminations, 94.2% fall within size grades 1 and 2. The mean total of dorsal scars on these successfully detached flakes falls just over 3.1 per flake and 30.0% also display evidence for moderate platform preparation. The indication of proportions of small, moderately prepared successful flakes with 3 dorsal scars suggests that a certain degree of skill, care and time investment was placed in manufacture at this site.

Table 6.2 Frequency of distal termination states.

Distal Termination States	*Frequency*	*%of Sample*
Indeterminable	2244	30.00
Feathered	4586	61.32
Hinged	649	8.68
Total	**7479**	**100.00**

Area 1, LdFa-1 – Conclusions

The data from this analysis indicate that the Late Dorset at LdFa-1 used a single reduction strategy focusing on early and middle stage reduction of blanks and preforms. The absence of late stage reduction and finishing suggests that these implements were then transported elsewhere for final finishing and use. Given the high frequency of small flakes with low weights and moderate dorsal scar counts, along with evidence that shows low numbers of cortex cover, and taking into account the initial size and quality of the local raw material, and the need for daily activities that require stone tool use, these data demonstrate that the Late Dorset toolmakers were first testing abundant raw material off-site to ensure the suitability of pieces that were brought to LdFa-1 for reduction into blanks and preforms.

Units A, B, C2

This spatially defined cluster of 4 units in the south-west portion of Area 1 is referred to as Activity Area 1 (referred to as AA1) (See Figure 6.4). It yielded 1,604 pieces of debitage, of which 926 are complete flakes. The spatial organization of the following discussion is used to isolate patterns in of variability to infer specific activity areas within the entire Late Dorset component.

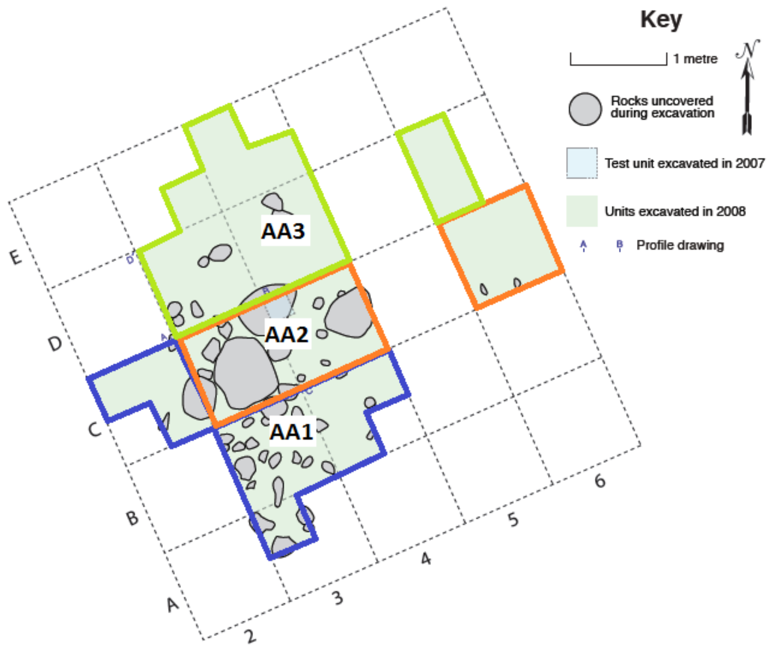

Figure 6.4 Plan view of Area 1, showing the separation of Activity Areas 1, 2, and 3 (modified plan view from Park 2008).

AA1 displays unimodal distributions in size grade frequency with 94.5% (N = 1516) falling within sizes 1 and 2. Similarly, 86.5% (N = 1387) of the debitage from AA1 fall between 0.01 grams and 0.5 grams. Like the overall assemblage, dorsal scar counts peak at 3. The differences that are evident spatially from the overall study sample, however, are found in the modification of striking platforms and frequency of late stage reduction debitage. Of the completed flakes from Activity Area 1, 53.3% (N = 494) have a moderate or advanced striking platform which clearly differs from the total assemblage and spatially differs from units in other portions of Area 1. As such, 84.2% (N = 85) of the all flakes exhibiting advanced modification on the striking platform are found within AA1. AA1 has 54.1% of its flakes as part of the early stage reduction continuum, 35.1% fall within the middle stage and lastly, 11.4% of the debitage from this small area represent late stage reduction. It appears that late stage reduction was localized within these units in Area 1: A3, B3, B4, and C2.

<u>Units C3, C4, C6</u>

This grouping of excavation units, referred to now as Activity Area 2, is located along the medial line of Area 1 and consists of the following units: C2, C4, and C6 (See Figure 6.4). AA2 consists of 2,740 total pieces of debitage of which 54.5% (N = 1494) are complete flakes. Like AA1, this central grouping of units displays unimodal distributions in both size grade frequency and weight. Of the flakes from this group, 92.96% (N = 2547) fall within size grades 1 and 2 and 84.9% are between 0.01 grams and 0.5 grams. These remain consistent with the other Activity Areas and the overall site values. Here we see a much higher frequency of minimally modified platform states with 60.0% (N = 897), however, while flakes with moderately modified platforms are still abundant at 39.0% (N = 582), flakes that show advanced platform modifications are down to only 1.0% (N = 15). This is only 14.9% of the total assemblage flakes showing any advance preparation. AA2 displays a more similar reduction continuum to the overall assemblage where 60.1% are showing evidence of early stage reduction, 38.4% show evidence for middle stage reduction, and 1.9% shows evidence of late stage reduction.

Activity Area 2 displays similar patterns to the overall assemblage. This small centre area provides evidence for a single reduction sequence were early and middle stage reduction is the main focus with very little attention to late stage production of stone tools.

Units D, E

The final group, referred to now as Activity Area 3, used for this intra-site data comparison is associated with the most northern units of Area 1: D3, D4, D6, E3, and E4 (see Figure 6.4). This group of units consists of 3,131 pieces of debitage with 56.5% (N = 1769) complete flakes. Again, the size grade and weight mass analysis data match those of the overall assemblage with two unimodal distributions. Of the total pieces from Activity Area 3, 93.6% (N = 2929) fall within size grades 1 and 2, and 86.3% (N = 2702) weight between 0.01 grams and 0.5 grams. Dorsal scar counts peak at 3 scars and striking platform modification shows an interesting opposition to AA1 as it is dominated by flakes with minimally prepared platforms 73.4% (N = 1300), whereas those exhibiting moderately modified flakes encompass 26.6% (N = 471), and we find nearly zero flakes in this group that show evidence of advance modification of the striking platform 0.06% (n=1).

The reduction continuum provides me with the evidence I need to interpret this northern section of Area 1. With 70.0% of the sample exhibiting early stage reduction, and 29.8% having features of middle stage reduction, it leaves only 0.02% of this debitage displaying any late stage activity in this area. The distinct spatial distribution identified in the Activity Areas is quite interesting to note (see Figure 6.5), however, with further statistical testing, including difference-of-proportions test conducted between each pair of Activity Areas, I was not able to confirm these assertions.

The purpose for conducting these three Activity Area analyzes was to determine if there were any discrete working areas that could be isolated from the entire site. Patterns in the debitage do in fact indicate the possibility of a specific late stage tool-working area. AA1 showed the highest frequency of late stage reduction of all Activity Areas whereas AA2 and AA3 had very little late stage reduction occurring and were dominated with early and middle stage reduction. This led me to believe that the southern-most Activity Area was where any late stage tool manufacturing was being conducted. However, when statistically comparing AA1 with AA2 the difference between SE_{1-2} was 0.006 and when comparing AA1 with AA3 the difference between SE_{1-3} was only 0.009. This indicates that the populations of each Activity Area sample were not significantly different from one another, meaning that collectively, the three areas were more homogeneous than previously thought. This ultimately leads me to believe similar reduction activities are occurring throughout the entire site with no discernible spatial distribution of Activity Areas.

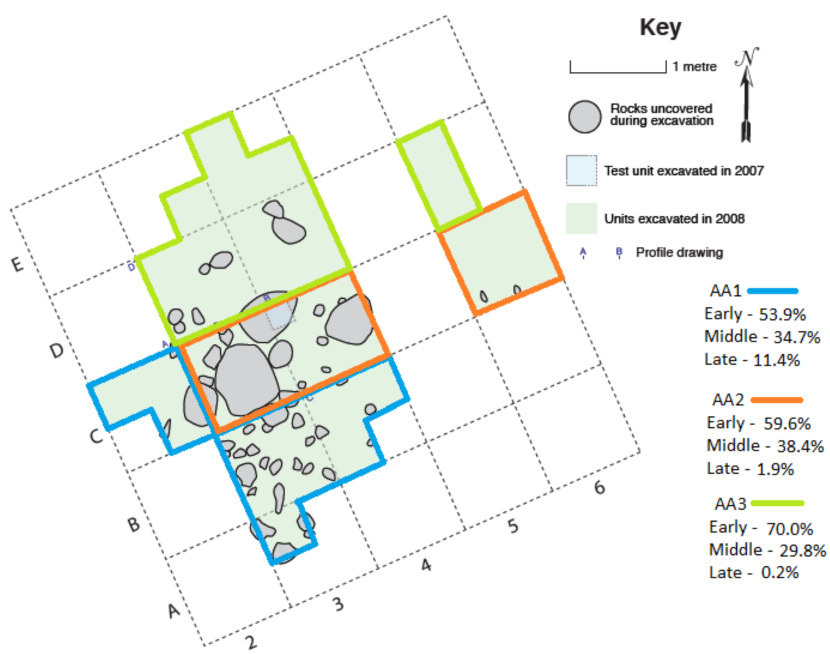

Figure 6.5 Plan view of Area 1, showing reduction continuum stages for Activity Area 1, 2, and 3 (modified plan view from Park 2008).

<u>Conclusions and Interpretation of Debitage Analysis</u>

The resulting data have shown that the Late Dorset component at LdFa-1 was being used as a lithic preform and blank manufacturing site. The raw material is being initially flaked and tested off site, likely near the source, and brought back to Ldfa-1 for further reduction. The data represent a single reduction strategy taking place here with an emphasis on early and middle stage reduction. There is limited evidence for late stage reduction on site, the majority of lithic reduction is associated with early and middle stages indicating that little time was spent on finishing or resharpening tools. The evidence of a spatially linear separation of reduction activities is not evident. Instead, the data point to all activity areas having extensive distributions of early and middle stage reduction with little evidence for late stage reduction throughout.

Chapter 7

Regional Comparisons with Inland Pre-Dorset Data

This chapter provides a summary of the existing Pre-Dorset datasets from Sandy Point and Mosquito Ridge (Milne 1999; Milne 2003; Milne and Donnelly 2004). These inland sites have been interpreted by Milne based on their organization of technology and are compared with similar patterns identified in this study.

Sandy Point Assemblage Data

These data come from the Sandy Point debitage assemblage, analysed by Milne (1999; 2003). The lithic assemblage is small and includes 1176 flakes of which 99.6% (N = 1171) are the poor quality, cortical chert found in the interior, and 84.4% (N = 993) are of fine-grained material. The incidence of cortex among the Sandy Point assemblage is high at 20% but this relates to the interpretation that the site is a location where raw material testing was conducted thus accounting for the higher frequency of large cortical flakes. This means that the Pre-Dorset of Sandy Point were collecting and using local chert while occupying the site. The distributions for mass analysis data from Sandy Point are unimodal for size grade, weight, and dorsal scar counts indicating the use of a single reduction strategy. Flake sizes peak in size grade two, and dorsal scar counts fall among the lower values with 65.5% of all flakes possessing between zero and two scars. Among complete flakes at Sandy Point (N = 744), 72.3% of them are associated with early stage reduction given they are minimally modified. Many of these flakes also possess low dorsal scar counts and moderate to extensive cortical cover, which further indicate the presence of early stage reduction at this site.

Of all flakes exhibiting remnant striking platforms 72.3% are associated with early stage reduction. In this assemblage, 25.6% (N = 190) of the debitage displays more advanced platform modification, however, of those, 30.5% (N = 58) occur on moderate to large sized flakes and do not represent late stage reduction or tool finishing. Overall, the debitage from this site displays evidence for a single, early stage reduction strategy occupation.

Mosquito Ridge Assemblage Data

The Mosquito Ridge debitage assemblage is larger than Sandy Point and includes 19,800 flakes. Using the same sampling strategy that I did for the present study, the Mosquito Ridge study sample comprises 15,628 of which 97.6% (N = 15,257) are the local poor quality, fine-grained, cortical chert. Cortex frequencies are moderate with 12.3% (N = 2,430), and of these 25% (N = 348) occur in moderate to large size grade categories. This suggests that they were removed from larger objective pieces with extensive cortical cover. Mass analysis data for flake size, weight, and dorsal scar count are all unimodal indicating the use of a single reduction strategy. Size values cluster within the size grade one category, and approximately 65% of the entire assemblage exhibits between zero and two dorsal scars (N = 7,022).

Among complete flakes with remnant striking platforms at Mosquito Ridge (N = 9,533), 65.6% are minimally modified and reflect the presence of early stage reduction activities. Relatively few flakes (15.8%) of smaller sized flakes display advanced platform modification and high dorsal scar counts, suggesting that very little late stage reduction or finishing was occurring at this site. Mosquito Ridge does have a higher proportionate frequency of advanced platform states alone associated with late stage reduction; however, bifacial blank production recorded in formal tool analysis data, seems to have been an important activity at this site thus accounting for this pattern.

Consistent Patterns and Comparative Interpretations

Having presented summary data for these two sites, some consistent patterns emerge. Both Sandy Point and Mosquito Ridge toolmakers were exploiting the locally available chert. It appears that raw material testing was carried out at Sandy Point as they were taking advantage of the local raw material sources, while the toolstone brought to Mosquito Ridge was in a more reduced state given the lower incidence of cortex identified. The mass analysis data for flake size, weight, and dorsal scar counts are all unimodal indicating the use of a single reduction strategy. Lastly, minimally modified platform states dominate both sites and indicate tool making activities were focused on early stage reduction. In general, Milne (2003) interprets these patterns as indicating the Pre-Dorset at these sites came to acquire lithic raw material and to renew their toolstone supply such that when they moved back to the coastal areas of southern Baffin Island, they had a sufficient supply of chert to get them through the remainder of their seasonal round.

The patterns of reduction and use identified for the Late Dorset toolmakers at LdFa-1 are nearly identical to those from Sandy Point and Mosquito Ridge. The Late Dorset people appear to have been using a similar preferential treatment strategy to the Pre-Dorset groups at Mosquito ridge in that raw material nodules were being tested off site prior to returning for further production. As such, it would appear that at the regional scale, the Late Dorset people were using the deep interior of southern Baffin Island for similar purposes: to acquire lithic raw material for use elsewhere, possibly along coastal locations. Since both Sandy Point and Mosquito Ridge have been interpreted as using dual-economies (Milne 2003), the Late Dorset evidence at LdFa-1 suggest they too may have been using the inland for parts of the year to re-supply lithic tool raw material and travelling back to the coast during the remainder of the year, meanwhile taking advantage of both local terrestrial and marine resources.

Milne et al. (2013a) have published preliminary faunal data from the Late Dorset occupation at LdFa-1, which indicate that these peoples were intensively hunting caribou while at the site. This conforms to patterns found at the two Pre-Dorset occupations (Milne et al. 2013a) and seems to further support the idea that Late Dorset populations were in the interior during the late summer and autumn to renew their toolstone supply and acquire caribou meat, hides, and raw materials for use elsewhere. Based on these similarities, it would appear the Late Dorset toolmakers were indeed using the deep interior region of the island in the same manner as their Pre-Dorset ancestors thus raising questions about the accuracy of the current model that depicts these ancient hunters so narrowly as coastal adapted marine hunting specialists.

Chapter 8

Summary and Conclusions

This concluding chapter provides a brief summary of the research objectives presented early in this study, the methods used to meet them, and the results. I then discuss the significance of this research within the context of archaeology in the Arctic, and conclude with a proposal of future directions for research on lithic debitage with the goal to expand on our understanding of Late Dorset inland sites.

Summary: Research Objectives and Results

At the onset of this Masters research project, I stated in my objectives that I will assess and provide evidence for the kinds of lithic reduction strategies being used at LdFa-1 and show how patterns of debitage variability can be arranged and interpreted to understand site function and mobility. My aim to meet these objectives was laid out in three steps (1) to analyse and isolate patterns of variability from the site-specific lithic debitage assemblage; (2) to use the framework for the organization of technology to interpret the data, and finally (3) to compare the Late Dorset activities at LdFa-1 to two regionally similar Pre-Dorset sites from southern Baffin Island to suggest the similarities and differences of interior land use and mobility patterns.

Through the extensive analysis of lithic debitage assemblage consisting of 7,479 pieces, I was able to isolate, present, interpret the identified patterns and discuss their meaning in terms of human activities and technological strategies. These patterns were interpreted to understand how this human population organized their technology at this site, and how they made use of their local landscapes and resources. It is now evident that the data generated through this analysis and the information used to understand the local southern Baffin Island interior context including raw material abundance and availability, supports Hypothesis 1, as stated in Chapter 4:

> *This hypothesis states that the Late Dorset at LdFa-1 were seasonally occupying the site during the late summer/early fall when caribou could be easily exploited during the migration. At this time of year, local chert raw material sources would also be available for toolmakers to acquire and transport from near-by regions making this site an ideal location to occupy. The Late Dorset toolmakers were implementing a curated lithic technological strategy, which focused on raw material acquisition so toolmakers could renew their toolkits while near a source area and "gear-up" (Binford 1978, 1979) in anticipation of moving away from this source for the remainder of their seasonal round. Once basic performs were made, the toolstone could then be transported and completed at a later time, presumably at or near a coastal site during the winter months. This technological strategy is used to conserve energy by preparing smaller packaged preforms for transportation and use at a later time. Moreover, the Late Dorset people would have been finishing and resharpening some tools for their everyday use. Hypothesis one would conclude that the Late Dorset were following a similar mobility and subsistence pattern as their Pre-Dorset ancestors.*

Two methods of analysis were used to isolate patterns of variability in the lithic assemblage: individual attribute analysis and mass analysis (Milne 1999; 2003). This combined approach provides multiple lines of evidence from which I could then isolate meaningful patterns of lithic assemblage variability. Milne's (2009) sampling procedure was used to obtain an accurate sample size that was drawn systematically so as to reduce statistical error and to achieve a 90% confidence interval. My study used a multiscalar approach to interpret and compare patterns of debitage variability at the site and regional levels to understand what the Late Dorset people were doing at LdFa-1, and to facilitate comparison of these activities to those identified for Pre-Dorset peoples occupying two sites near Nettilling Lake. In turn, this allowed me to make some interesting interpretations regarding cultural continuity in terms of technological organization and land use between the Pre-Dorset and Dorset cultures in the interior of southern Baffin Island.

The evidence from this study suggests that the Late Dorset people were using the interior of southern Baffin Island as a place to acquire chert raw material and LdFa-1 as a site to produce extensive amounts of preforms and blanks. These preforms and blanks were likely carried to another location for finishing since comparatively little evidence of late stage reduction was identified in Area 1. The few finished and resharpened tools, however, as evidence of the late stage reduction present, are likely being used to complete daily tasks and to take advantage of the abundant subsistence resources in the region. These flakes were likely produced by resharpening tools brought to the site or from some later stages shaping of blanks. With no discernible tool-making activity areas identified, these finishing and resharpening tasks were being conducted along with the preform and blanks production. Given the low quality of the raw material with high frequencies of early and middle stage reduction throughout the site, the Late Dorset occupants at LdFa-1 may have been transporting quantities of pre-tested lithic raw material from known local sources to this site during a seasonal travel. Once arriving to LdFa-1, which also appears to have been an ideal location for hunting for caribou, the toolmakers would be able to take advantage of the time they could spend preparing blanks and preforms from the raw material while waiting for these animals to arrive. It is at this time that the Late Dorset people would have been employing a curated strategy in response to the anticipated need to store less bulky lithic blanks that could last the remainder of the year.

Integral to interpreting these data on a regional scale, research of Pre-Dorset people at Mosquito Ridge and Sandy Point provided a comparison to make sense of the identified patterns from the Late Dorset people at LdFa-1. It is suggested that at both LdFa-1 and Mosquito Ridge, the raw material nodules were flaked and tested off site as a way to find better quality stone, which then was transported back to these respective sites for further reduction. Milne (1999) notes such raw material testing was occurring at Sandy Point thereby providing evidence in support of this activity. Making the choice to use higher quality pieces of chert from a poor quality source conforms to Andrefsky's table (see pg. 32) where when raw material is not available in abundance; and when the source is not made up of the best quality material; people will make greater efforts to find good quality chert for those tools they cannot afford to have fail during use. Knowing that the Late Dorset were choosing to make a more reliable toolkit supports the idea that they had to travel long-distances from the raw material source for the remainder of the year.

Results from this study do not support the idea that the Late Dorset people were occupying the site year-round. As proposed by Beck et al. (2002), people travelling long distances reduce their chert to facilitate carrying the most usable amount of toolstone with the least amount of bulk. The data conform to this being the case for the Late Dorset toolmakers of LdFa-1. Moreover, comparing existing datasets of similar Pre-Dorset sites in the area proves that the patterns of lithic data generated from Sandy Point and Mosquito Ridge are consistent to those from Area 1, LdFa-1. Using the interpretations of Milne (1999, 2003) indicating that the Pre-Dorset people were once occupying inland sites seasonally to acquire and renew lithic toolstone supply, I can tentatively suggest that the Late Dorset toolmakers at LdFa-1 were travelling the landscape of southern Baffin Island in similar ways to those of the Pre-Dorset people, and ultimately doing the same kinds of activities once in the interior. This however, remains uncertain until future research and debitage analyses are conducted on coastal Late Dorset to compare new data to those of LdFa-1.

Implications of this Study for Archaeology in the Arctic

This study provides additional insights on how the Late Dorset people were using the deep interior of southern Baffin Island. Based on the data presented that support 'hypothesis one,' it appears that the Late Dorset populations were, like the Pre-Dorset ancestors, making long distance seasonal travels to the interior of southern Baffin Island in order to acquire locally available lithic raw material. While at the LdFa-1, the Late Dorset were focusing their lithic reduction activities on the production preforms and blanks using the abundantly available chert while at the same time taking advantage of local subsistence resources, namely caribou. The results of this study suggest that existing interpretations of Dorset land use and subsistence should be to include greater consideration of how the terrestrial ecosystem was used by these peoples. My study provides an important contribution to the understanding of Late Dorset lithic technological organization on southern Baffin Island, and ultimately adds to the current limited Arctic research that has been conducted on Dorset inland occupations (see Milne et al. 2012). These patterns for Dorset mobility can be further supported with future research of Late Dorset sites in the interior and along the coast of southern Baffin Island. This way, a multiscalar approach can be conducted to make inter-site and -regional comparisons to other Late Dorset occupations to further our understanding of their mobility and technological organization on southern Baffin Island.

Future Directions and Final Remarks

Mass analysis of large quantities of debitage is not an easy task and requires patience and many long hours in a laboratory setting. It has shown, however, to be a useful tool when combined with other analytical methods such as individual attribute analysis for understanding how humans organize the toolkits (Anderson and Hodgetts 2007; Andrefsky 2001; Bradbury 1998; Bradbury and Carr 2004; Carr and Bradbury 2001; Milne 1999, 2003). As such, my analysis of lithic debitage provided data that can be easily compared and interpreted by other archaeologists, and I strongly suggest this type of research continues into the future. The statistically sound results generated for this analysis are based on the overall patterns of a confident sample population using Milne's (2009) sampling procedure. I believe this statistical sampling procedure to be extremely useful for lithic researchers who are conducting detailed analyses on large debitage assemblages, and I highly recommend that it be performed for all analyses of large size lithic assemblages in the future. With more studies of this kind, larger comparative datasets will make interpreting Late Dorset mobility, land use, intra-regional site activities, and technological organization, much easier and more accessible, thus resulting in more comprehensive interpretations of Late Dorset lifeways throughout all Arctic regions.

For over two decades now, the research of Milne, Park and Stenton has benefitted our understanding long term human land use on southern Baffin Island. This study contributes to this body of work by providing some insights into Late Dorset technological organization in this unique region. Ultimately, my research goals have been achieved through the analysis and interpretation of a lithic debitage assemblage from LdFa-1. The inland Late Dorset people of southern Baffin Island were using the deep interior region and the site of LdFa-1 for a few important reasons, two of which I can confirm: to acquire and resupply lithic raw material, and to manufacture and prepare numerous preforms and blanks from this local chert for future elsewhere.

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Appendix A

Lithic Debitage Attribute List and Definitions

Introduction

This debitage attribute list and definitions is a modified version of Milne's 1999 Masters Thesis and 2003 PhD Dissertation. Amendments have been made in order to suit the parameters of my own project, along with the removal of attributes that show very little to no interpretive power as documented by Milne. All artifacts represented in this analysis are considered archaeologically as debitage (Sullivan and Rozen 1985). The size grades are measured in declining intervals using millimetres. The weight of each piece has been taken using a digital precision scale, measured in grams and rounded up to the nearest .01. Depths are all recorded in centimetres below surface level, unless otherwise noted. All pieces of debitage come from the borden numbered site LdFa-1, therefore all debitage site designations are the same for this research project. All pieces of debitage come from the site component designated Area 1. As such, all debitage component designations are also the same. It should be noted that some of the collection depths were misplaced/erased due to inclement weather conditions and/or human error when originally recorded. In these cases, 'not recorded' will apply and it will be numerically recorded as (0). In some cases, artifacts type designations are changed post-field collection. Therefore, it is noted that single point depths have been relocated to within the depth interval with which it coincides. Lastly, size grade intervals are slightly different than those presented in Milne's dissertation. The U.S standard sieves have been used to separate debitage into seven size grades instead of six. The largest size grade was added to this debitage collection.

<u>Debitage Identification</u>

Site Designation: This entry indicates the site assemblage that the debitage has come from. All lithics in this study come from the same site, therefore all site designations are recorded as:

(1) LdFa-1

Component Classification: This entry refers to the area of the site that the artifact has been collected from. All lithics in this study come from the same designated area, therefore all component classifications are recorded as:

(1) Area 1

Bag Number: This entry refers to the sequential number given to each bag of debitage.

Unit Classification: This entry indicates the site unit where the artifact was located (see Page 103). As the site and area remain unchanged, the unit will be recorded as:

(1) A3
(2) B3
(3) B4
(4) C2
(5) C3
(6) C4
(7) C6
(8) D3
(9) D4
(10) D6
(11) E3
(12) E4
(13) Test

Artifact Number: This entry refers to an arbitrary number given to each piece of debitage as it is being analysed. The artifact number will be used to help ordinate the debitage pieces within the entire collection during the statistical analysis. This number will not maintain any value after the project is completed.

Artifact Provenience: This entry refers to the location relative to the unit where the lithic debitage was recovered during excavation. Artifact provenience is divided into two sub categories: Quadrant; Depth (cm).

Quadrant will be recorded as:

(1) NW
(2) NE
(3) SW
(4) SE
(5) W

Depth will be recorded as:

(0) Not Recorded
(1) Surface
(2) 0-5
(3) 0-10
(4) 5-10
(5) 8-10
(6) 7-14
(7) 8-14
(8) 10-20
(10) 12-14
(10) 0-4 above sand horizon
(11) 4-10 below sand horizon
(12) 0-10 above sand horizon
(13) 0-10 below sand horizon
(14) Below 10

Raw Material Attributes

Lithic Raw Material Type: This entry refers to the type of lithic raw material from which the artifact is made. These raw materials are distinguished at a macroscopic level and fall within the range of these types:

(1) Chert: A compact, cryptocrystalline or microcrystalline, siliceous sedimentary rock composed primarily of quarty and displaying a glassy, lustrous, or waxy surface (Andrefsky 1998:xxii; Luedtke 1992:149).

(2) Chalcedony: A variety of chert in which quartz particles take the form of fibres (Luedtke 1992:149) whose intercrystalline pores are very small thus giving it an amorphous appearance (Whittaker 1994:71). It is frequently characterized by concentric rings and is usually light coloured and translucent (Andrefsky 1998:xxii).

(3) Crystal Quartz: A type of hard, clear, glassy rock formed of essentially pure silicon dioxide (SiO2). This type of quartz forms in prismatic crystals that were often used as raw material for the manufacture of stone tools (Stenton 1997:65).

(4) Quartzite: A type of rock consisting of metamorphosed (transformed by heat and pressure) sandstone. It ranges from coarse to fine grained and individual grains are visible with the naked eye (Whittaker 1994:72). Quartzite was used as a raw material for stone tool manufacture although it is more difficult to work than other types of stone and often yields crude looking tools (Stenton 1997:65).

(5) Slate: A relatively soft, fine-grained and typically dark coloured metamorphic rock that can be broken into thin plates and shaped by grinding into tools and weapons (Stenton 1997:73)

(6) Ramah Chert: A Precambrian age variety of chert that is sedimentary to volcanic in origin (Gramly 1978) found in localized distribution in the Ramah Bay Region along the Labrador coast. Ramah chert is similar in texture and composition to chalcedony and varies in colour from jet-black and greenish-black to translucent grey or white (Gramly 1978).

(7) Nephrite: A hard, fine-grained metamorphic stone that is relatively rare in its worldwide distribution and often found as small nodules in alluvial deposits (Stenton and Park 2002:14). This stone occurs frequently in different shade of green and can be referred to as Jadeite.

Lithic Raw Material Texture: This refers to the texture of each raw material type observed. Texture considers the macroscopic and microscopic appearance of a rock (Luedtke 1992:154). Three states are observed and recorded as:

> (1) Vitreous: When the individual grains making up the rock are so homogeneous, small, and tightly packed together that they are not visible with a 10x hand lens.
>
> (2) Fine Grained: When the individual grains making up the rock are larger and less homogeneous in size, shape, and arrangement, and are visible with a 10x hand lens but not with the 'naked eye'.
>
> (3) Coarse Grained: When the indivisual grains making up a rock are heterogeneous in size, shape, and arrangement thus making them visible with the 'naked eye'.

Lithic Raw Material Quality: This entry indicates the presence (1) or absence (0) of inclusions, vugs, voids, and/or fossils within the raw material from which the flake is made.

Cortex: This entry refers to the amount of cortex present on the dorsal surface and or/platform of an individual flake. Cortex is defined as "any observable rind of outer surface of the original piece of raw material that can be distinguished from a surface created by human flake removals of fracture processes" (Ahler 1989:90). Cortex will be recognized and recorded in the following three states:

(0) Absent
(1) Present
(2) Only on Platform

<u>Technological Attributes: Debitage, Used Flakes, and Informal Tool Categories</u>

Size Grade: This entry indicates the maximum dimension of an artifact, in millimetres, measured using wire mesh stacking screens. Seven size grades are recorded:

(0) ≤3.35mm (1/8 inch)

(1) 3.35> ≤6.3mm (1/4 inch)
(2) 6.3> ≤12.5mm (1/2 inch)
(3) 12.5> ≤19mm (3/4 inch)
(4) 19> ≤25mm (1 inch)
(5) 25> ≤31.5mm (1 ¼ inch)
(6) >31.5mm (1 ¼ inch)

Weight: This entry refers to the weight of each individual debitage piece, rounded up to the nearest decigram (Bradbury and Carr 1999).

Initiation Face or Striking Platform Modification: This entry refers to whether or not the striking platform of the debitage flake has been modified prior to flake removal or during flake removal. Six states are recognized and recorded as:

(0) Absent/Indeterminable

(1) Unprepared (i.e. cortical): The striking platform is unmodified cortex, commonly, associated with initial core reduction or testing of nodules (Andrefsky 1998:93; Fish 1981:374).

(2) Crushed, Shattered, or Pointed: The striking platform displays evidence of crushing or fragmentation. This state indicates bipolar reduction and/or hard hammer percussion or, more rarely, soft hammer percussion used with excessive force and speed (Ahler 1989:210; Hayden and Hutching 1989:247; Kuijt et al. 1995:119).

(3) Minimally Modified: The striking platform is a single flake scar (i.e. flat platform) or a combination of single flake removal and cortical striking platform. This state is a common indication of earlier stages of lithic reduction (Tomka 1989:146).

(4) Moderately Modified: One or two flake scars are present on the striking platform with the possibility of trimming or platform grinding. This state indicates the appearance of some platform preparation.

(5) Advance Modification: Two or more flake scars are present on the striking platform. Or, the platform surface has been faceted where the platform retains the lateral juncture of a bifacially retouched edge (Milne 2003). An advanced modification state covers any combination that includes multiple flake scars with, grinding, abrading, or cortical platform surfaces. To produce these states, the lithic would normally require a greater investment of time and energy and are indicative of later stages or reduction (Cotterell and Kamminga 1987:690; Will 2000:106).

Flake Detachment Below Striking Platform: This entry refers to the presence of flake detachment below the striking platform on the dorsal surface of the flake. These flake scars may result from the use of excessive force loads during detachment resulting in stacked, step, or hinge terminations below the platform. This state is associated with low skill level and results when successive blows are applied in the same location (Shelley 1990). Trimming the platform overhang also results in flake detachment below the striking platform; however, there scars are not stacked, they typically have feather terminations, and are more localized directly below the platform (Shelley 1990). Three states are recognized and recorded as:

(0) Absent/Indeterminable
(1) Stacked terminations resulting from successive blows using excessive force loads
(2) Feather terminations resulting from platform trimming.

Eraillure Scar: This entry refers to the presence (1) or absence (0) of a small scar detached from the bulb of percussion on the ventral surface, located just below the striking platform.

Dorsal Scar Count: This entry refers to the number of flake scars observed on the dorsal surface of the debitage or tool artifact. This attribute is measured as a continuous variable. The lowest value is zero indicating dorsal scars are absent or indeterminable.

Bulb of Percussion: This entry refers to the subjective appraisal of the presence and location of a bulb of percussion on the ventral side at the proximal and/or distal end of a flake. Salient bulbs of percussion are typically the remnant part of a Hertizan cone commonly produced in hard hammer percussion. Two states are recognized and recorded as:

(0) Absent/Indeterminable
(1) Proximal end only

Compression Rings: This entry refers to the presence (1) or absence (0) of pronounced ripples radiating from the point of applied force or the initiation surface (Crabtree 1972:52). They can be both positive (protruding out) and negative (protruding in) on the ventral surface.

Post-Depositional Attributes: Debitage Categories

Debitage Completeness Index: This entry refers to the completeness of debitage as defined by Sullivan and Rozen (1985), Sullivan (1987), Prentiss and Romanski (1989), and Rozen and Sullivan (1989a, 1989b). Five subclasses are recognized and recorded as:

(1) Debris: No discernible interior surfaces
(2) Medial/Distal Flake: A single interior surface is discernible, but lacks a platform surface.
(3) Split Flake: A single interior surface is discernible, but the platform surface is sheared axially.
(4) Proximal Flake: A single interior surface is discernible. A proximal platform is present, but the flake lacks a distal termination.
(5) Complete Flake: A single interior surface is discernible. Both the proximal and distal margins are present and complete, including platform surface and distal termination.

Distal Termination Type: This entry indicates the type of flake termination that is produced along the distal end of the debitage piece. Three termination states are observed and recorded as:

(0) Absent/Indeterminable
(1) Feathered
(2) Hinged

Appendix B

Flakes sorting and counting instructions (Dr. Robert Park – University of Waterloo – 2010)

Procedure

1. Select the next available bag of flakes from the tray of unprocessed bags

2. Write the Borden number from that bag in the space at the top of a counting sheet.

3. Arrange the sieves so that the Size Grade (SG) numbers go from “0”at the bottom to “6” at the top

4. Dump all of the flakes from the bag into the top of the column of sieves and then put the lid on

5. Gently shake the column so as to allow the flakes to all fall to the appropriate levels

6. Open up the lid and, for each of the larger sieves in turn, gently attempt to put elongated flakes through the sieve to the next level (i.e., flakes whose shape may have made it unlikely that they would fall through on their own)

7. For each sieve in turn, dump out its contents into a Styrofoam tray. Check to make sure that no flakes are stuck in the mesh. Count the flakes from that sieve. Some of the bags will contain hundreds of flakes. Don’t worry too much about your countbeing exact—for those larger bags a number that is within plus or minus a few of the actual number or flakes will be fine.

8. Write the count for that size grade (SG) on the counting sheet. Write “0” (zero) if there are no flakes in that size grade.

9. Make an extra note on the Counting sheet of any flakes make of quartz crystal— they will look just like small flakes of broken clear glass.

10. Put the counted flakes from each sieve into a small bag. Using a Sharpie, write the Borden number on the small bad and, below that, the size grade.

11. Put All of the small bags into the original bag, along with the counting sheet, and put it on the tray of processed bags in numerical order according to the Borden number.

Appendix C

Sample Sizes of Data

Sample Size (by Size Grade) 90% Confidence

Borden: Catalog Bag #	SG6 Bag	SG5 Bag	SG4 Bag	SG3 Bag	SG2 Bag	SG1 Bag	SG0 Bag	Ar.	U.	Q.	Depth(cm)
LdFa-1:1703	0	0	0	4	31	41	11	Area 1	A3	NW	0-10cm
LdFa-1:1705	0	0	3	8	61	64	19	Area 1	B3	NE	0-10cm
LdFa-1:1709	0	0	2	8	59	57	16	Area 1	B3	NE	10-20cm
LdFa-1:1715	0	0	0	0	6	6	4	Area 1	B3	NE	Surface
LdFa-1:1717	0	0	3	5	58	60	19	Area 1	B3	NW	0-10cm
LdFa-1:1719	0	0	0	8	61	59	16	Area 1	B3	NW	10-20cm
LdFa-1:1721	0	0	0	1	6	12	5	Area 1	B3	NW	Surface
LdFa-1:1723	0	0	0	4	54	57	18	Area 1	B3	SE	0-10cm
LdFa-1:1727	0	1	0	7	43	56	16	Area 1	B3	SW	0-10cm
LdFa-1:1732	0	0	3	5	34	46	15	Area 1	B4	NE	0-10cm
LdFa-1:1734	0	0	2	6	66	65	19	Area 1	B4	NW	0-10cm
LdFa-1:1745	0	1	1	6	44	56	19	Area 1	B4	SW	0-10cm
LdFa-1:1749	0	0	0	3	36	44	16	Area 1	C2	NE	0-10cm
LdFa-1:1752	0	0	0	1	8	21	10	Area 1	C2	NW	0-10cm
LdFa-1:1755	0	2	1	4	42	54	17	Area 1	C2	SE	0-10cm
LdFa-1:1757	0	0	0	2	11	12	1	Area 1	C3	NE	0-10cm
LdFa-1:1760	0	1	3	6	72	66	19	Area 1	C3	NE	10-20cm
LdFa-1:1767	0	0	0	4	31	43	12	Area 1	C3	NE	20-30cm
LdFa-1:1769	0	0	0	0	0	0	1	Area 1	C3	NW	
LdFa-1:1771	0	0	1	2	36	54	17	Area 1	C3	NW	10
LdFa-1:1776	0	0	3	8	73	61	15	Area 1	C3	NW	0-10cm
LdFa-1:1778	0	0	0	0	0	0	1	Area 1	C3	NW	10-20cm

LdFa-1:1783	0	0	0	0	0	1	1	Area 1	C3	NW	Surface	
LdFa-1:1785	1	0	3	4	59	59	18	Area 1	C3	SE	0-10cm	
LdFa-1:1789	0	2	3	16	76	68	19	Area 1	C3	SE	10-20cm	
LdFa-1:1792	0	2	1	6	54	61	19	Area 1	C3	SW		
LdFa-1:1798	0	2	2	7	53	58	17	Area 1	C3	SW		9
LdFa-1:1804	0	0	0	0	1	0	0	Area 1	C3	SW	10-20cm	
LdFa-1:1807	1	1	3	4	33	49	17	Area 1	C4	NE	0-10cm	
LdFa-1:1809	0	0	2	2	22	22	9	Area 1	C4	NE	10-20cm	
LdFa-1:1814	0	1	4	13	57	58	17	Area 1	C4	NW	0-10cm	
LdFa-1:1816	0	0	0	2	26	29	9	Area 1	C4	NW	10-20cm	
LdFa-1:1822	0	1	2	2	28	40	17	Area 1	C4	SE	0-10cm	
LdFa-1:1824	0	1	2	7	54	58	18	Area 1	C4	SE	10-20cm	
LdFa-1:1830	0	1	7	9	65	59	19	Area 1	C4	SW	0-10cm	
LdFa-1:1833	0	3	3	7	50	58	17	Area 1	C4	SW	10-20cm	
LdFa-1:1843	0	0	0	0	0	53	16	Area 1	C6	NE		
LdFa-1:1844	0	1	6	8	53	48	13	Area 1	C6	NE		
LdFa-1:1857	0	0	0	0	45	57	19	Area 1	C6	NW	0-10cm	
LdFa-1:1858	0	0	2	2	61	47	1	Area 1	C6	SE		
LdFa-1:1860	0	0	0	0	8	64	19	Area 1	C6	SE	0-10cm	
LdFa-1:1861	0	1	8	11	54	54	15	Area 1	C6	SW		
LdFa-1:1876	1	0	0	2	26	43	17	Area 1	D3	NE		10
LdFa-1:1878	0	0	0	1	19	37	11	Area 1	D4	SE	10-20cm	
LdFa-1:1880	0	2	1	4	34	54	18	Area 1	D3	NE	10-20cm	
LdFa-1:1882	0	0	0	0	10	17	7	Area 1	D3	NE		
LdFa-1:1883	0	0	0	3	40	51	15	Area 1	D3	NE	12-14cm	
LdFa-1:1887	0	0	0	1	4	18	12	Area 1	D3	NE		
LdFa-1:1895	0	0	0	0	1	8	2	Area 1	D3	NW	0-10cm, above sand horizon	
LdFa-1:1898	0	0	5	11	73	61	19	Area 1	D3	NW	0-10cm, below sand horizon	

LdFa-1:1905	0	3	4	9	69	64	19	Area 1	D3	NW	Below 10cm
LdFa-1:1907	0	0	1	4	23	40	14	Area 1	D3	SE	0-10cm
LdFa-1:1910	0	0	0	0	4	14	11	Area 1	D3	SW	0-4cm, above sand horizon
LdFa-1:1912	0	2	0	3	31	52	18	Area 1	D3	SW	4-10cm, below sand horizon
LdFa-1:1919	0	0	0	0	0	1	0	Area 1	D4	NE	0-10cm
LdFa-1:1932	0	0	2	2	18	43	15	Area 1	D4	NW	0-10cm
LdFa-1:1936	1	0	4	8	47	57	18	Area 1	D4	NW	10-20cm
LdFa-1:1942	0	0	8	9	64	62	19	Area 1	D4	SE	0-10cm
LdFa-1:1955	0	0	3	8	55	58	19	Area 1	D4	SW	0-10cm
LdFa-1:1956	0	0	0	0	0	2	0	Area 1	D4	SW	10-20cm
LdFa-1:1963	0	0	0	6	68	51	2	Area 1	D6	W	
LdFa-1:1974	0	1	1	7	23	25	7	Area 1	D6	W	0-5cm
LdFa-1:1980	0	5	13	15	68	66	19	Area 1	D6	W	10-20cm
LdFa-1:1984	0	0	4	10	59	63	19	Area 1	D6	W	5-10cm
LdFa-1:1986	0	0	1	2	17	26	14	Area 1	E3	SE	0-10cm
LdFa-1:1988	0	0	3	2	38	45	16	Area 1	E3	SE	10-20cm
LdFa-1:1992	0	0	0	2	22	39	16	Area 1	E4	NW	0-10cm
LdFa-1:1994	0	0	0	0	2	6	5	Area 1	E4	NW	10-20cm
LdFa-1:1996	0	0	0	0	24	39	17	Area 1	E4	NW	8-10cm
LdFa-1:1999	0	1	4	5	41	51	18	Area 1	E4	SE	0-10cm
LdFa-1:2002	1	0	0	1	14	28	15	Area 1	E4	SE	10-20cm
LdFa-1:2006	0	0	4	4	51	58	19	Area 1	E4	SW	0-10cm
LdFa-1:2008	0	0	0	0	28	41	15	Area 1	E4	SW	10-20cm
LdFa-1:2010	0	0	0	1	43	57	19	Area 1	E4	SW	7-14cm
LdFa-1:2011	0	0	0	0	34	51	18	Area 1	E4	SW	8-14cm
LdFa-1:2013	0	0	0	0	1	3	0	Area 1	Test	NW	0-10cm
LdFa-1:2296	0	0	3	6	35	46	17	Area 1	D4	NE	10-20cm