Archaeo-geophysical survey on the Ushpitun Landform, Happy Valley-Goose Bay, Labrador

By:

© A.A. Wolfrum

A thesis submitted to the

School of Graduate Studies

in partial fulfillment of the degree of

Master of Arts

Department of Archaeology

Memorial University of Newfoundland

September 2019

St. John’s, Newfoundland

ABSTRACT

This thesis presents the results from a geophysical survey undertaken on the Ushpitun landform, an area of Intermediate period Amerindian occupation This archaeo-geophysical survey intends to test the efficacy of using magnetometry, ground penetrating radar, and magnetic susceptibility/conductivity to locate features on the landform. Additionally, the effectiveness and efficiency of geophysical survey methods will be compared to past non-geophysical methods. The results of this project conclude that magnetometry is the best means of locating features, though this is couched in the failure of the magnetic susceptibility/conductivity instrument and the inability of the ground penetrating radar to identify any near-surface features. Charcoal recovered from three combustion features was analyzed and calibrated radiocarbon dates offer a challenge to previous relative sea level dating in the area. An analysis of surface collected lithic materials supports Neilsen's (2006) assertion that the landform was likely a limited procurement camp and not a long-term habitation site.

ACKNOWLEDGEMENTS

I would first and foremost like to thank the Archaeology Department at Memorial University for their continued and constant support of my project. Specifically, Dr. Scott Neilsen for giving me the freedom to pursue my own independent fieldwork. Additionally, I am also indebted to the town of Happy Valley-Goose Bay, the Innu Nation, and the NunatuKavut Community Council for approving my project and supporting my research interests on their lands and in their community.

Next, I must thank several institutions and companies for their gracious support. All my funding stems from the ISER/JR Smallwood Foundation and the Provincial Archaeology Office (PAO) who provided grants in research. I will be forever indebted to Sensys Magnetometers and Survey Solutions, and Terraplus Inc. for their generous loans of equipment and technical support. Additionally, I must also thank Archaeo-Physics LLC for their assistance in shipping me the magnetometer cart and braving US customs to do so.

My project could not have happened without the tireless aid of several volunteers: Chelsee Arbour, Tasha Miller, Tony Jenkinson, Anatolijs Venovcev, and Dillon Montague who all suffered in the rain to make sure excavations were completed. Tasha is thanked in perpetuity for enduring the over 48 hours of driving between St. John’s and Happy Valley and being a most wonderful travel companion.

Lastly, I would not have had the enjoyable field experience that I did without the hospitality of Ashlee Consolo and Jamie Snook. They were not only exceptional hosts, but great company and archaeologists in their own right—they can make survey ropes.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Chapter 1 – Introduction to research

Project overview

This thesis will discuss the results of a three instrument archaeo-geophysical survey of the Ushpitun landform, an area located approximately 1 km north of the town of Happy Valley-Goose Bay, in central Labrador (Figure 1.1). The survey was undertaken between mid-July and mid-August 2018 and utilized a Sensys five-channel magnetometer cart, a Terraplus KT-20 S/C meter, and a Sensors and Software Noggins SmartCart GPR (see Chapter 3 for more equipment details). The aim of the survey was to locate Intermediate period archaeological features on the landform.

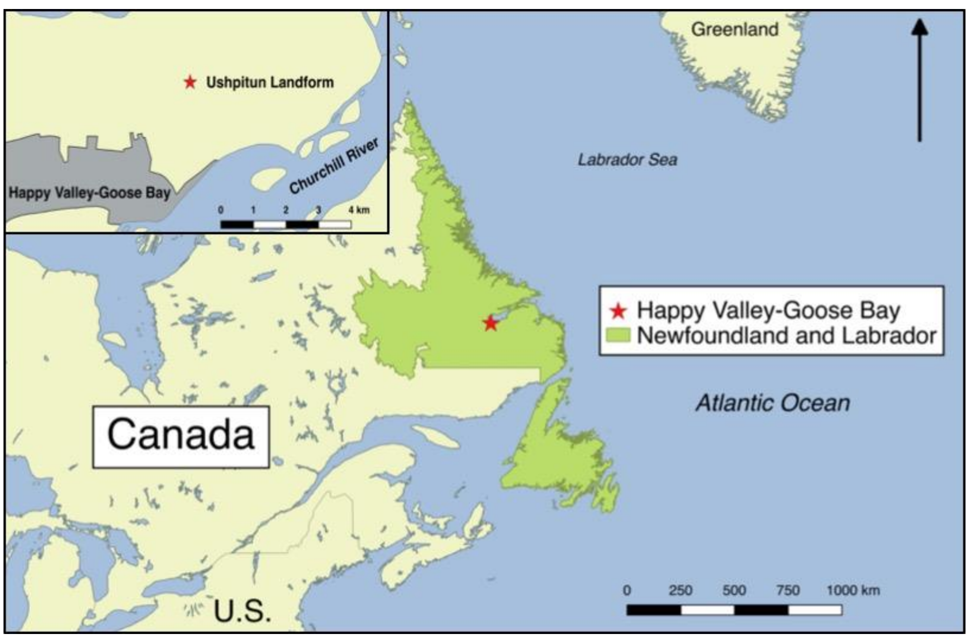

Fig. 1.1: The location of the Ushpitun landform.

Previous research on the landform began with the discovery of archaeological materials in 1998 during pedestrian and shovel-test survey in anticipation of the Lower Churchill Hydro Development project (now Muskrat Falls). Two sites were located, FhCb-

03 and FhCb-04, both of which were classed as being Intermediate period (3500-1800 BP) based on their elevation and lithic artifacts recovered (JWEL/IE 2001, Neilsen 2006). Subsequent excavations were undertaken by Neilsen in 2004, exploring FhCb-04 and inadvertently discovering FhCb-05. In 2013 environmental monitors walking through the area discovered sites FhCb-07, FhCb-08, and FhCb-09 (Neilsen 2015). Lastly, a recent pedestrian survey in 2016 for the T.V. program *Wild Archaeology* led to the recovery of additional lithic artifacts (Neilsen 2016a).

Geophysical explorations at Ushpitun aimed to build upon the previous archaeological investigations performed since the late 1990s. The seeming regularity of new discoveries and the threat of damage by off-road motor vehicle use necessitated a more comprehensive survey strategy to be employed.

Research Objectives

The primary goal of this research project was (1) to test the efficacy of archaeo-geophysical survey in this area of central Labrador. If geophysical survey yielded concrete results, then subsequent questions could be posed: (2) which instrument proved most effective in locating archaeological features? (3) is this approach more efficient than previous pedestrian and shovel testing surveys? and (4) what more can be said about Intermediate period usage of the Ushpitun landform based on this investigation? Below these questions will be elaborated upon:

1. *Can archaeo-geophysical survey be conducted on the Ushpitun Landform effectively?*

As no archaeo-geophysical prospection has been undertaken on the Ushpitun landform, and none in central Labrador, this will be a pilot test of the methodology.

2. *Which instrument proved most effective in locating archaeological features?*

Contingent on the equipment discovering archaeological materials, this question should be straightforward to answer. Quantitatively speaking, whichever instrument finds the greatest number of features will be considered the "most effective." This is of naturally dependent on the types of features present and if they respond to geophysical instruments.

3. *Is this approach more efficient than previous pedestrian and shovel testing surveys?*

As numerous surveys have taken place on the landform since its archaeological discovery, this question addresses whether the use of archaeo-geophysical prospection is more useful in terms of finding sites faster than either shovel or pedestrian surveys have in the past. Further questions related to cost comparisons can be estimated, though the exact figures for either are contingent on several variables not standardized to all archaeological sites, e.g. pay rates, equipment purchase/rental fees, amount of brush clearing necessary, etc. For this reason, "efficiency" will primarily be addressed based on the length of each survey in relation to the number of sites located.

4. *What more can be said about the Ushpitun landform during the Intermediate period based on this investigation?*

It is expected that any additional information regarding the Ushpitun landform will contribute to the existing body of knowledge, but the hope is that the identification of additional sites will provide a more comprehensive understanding of how the area was used by Amerindians. Landscape theory as applied to archaeo-geophysics (after Kvamme (2003) and Thompson et al. (2011)) will be used to interpret the results of the surveys.

Optimistically, this research project will build upon what has been done by Neilsen (2006, 2015, 2016b) to elucidate Amerindian occupation patterns in this area.

Methodologically, the project was split into three distinct parts. The first included establishing the survey grid and surveying with all three instruments. The second consisted of processing all the collected geophysical data and identifying potential archaeological features. Finally, these features were investigated, and a selection were excavated. Post-processing included the analysis of 84 lithic elements surface collected from across the landform, and a comparison between these and the recovered lithics from the Neilsen excavations in 2004.

The methods described above contributed towards answering all four research questions proposed at the start of the project. As the magnetometry survey was successful, an evaluation of instrument effectiveness and the overall efficiency of geophysical survey was made possible. New hypotheses regarding usage of the Ushpitun landform during its brief, intermittent occupation are also offered.

Thesis Organization

This thesis is organized into six chapters, including this introduction (Chapter One). Chapter Two provides a brief culture history of the Intermediate period, with additional information on the present/paleo-environment of the Ushpitun landform and a review of previous archaeological investigations there. Chapter Three consists of a review of archaeo-geophysical literature, an overview of archaeo-geophysical methods pertaining to this project and their technical operation and survey design. Chapter Four details results and discusses each potential anomaly identified by the instruments, as well as any subsequent excavations of those; additionally, the results of a small pedestrian survey are also included. Chapter Five analyzes the results discussed in Chapter Four, specifically the results of radiocarbon dating vs. relative dating, lithics recovered, and the significance of the FhCb-12 Borden designation. Chapter Six addresses whether the research questions posed were answered satisfactorily.

Chapter 2 – Ushpitun background

"The more you know you know you don't know shit"

-*Bastard* by Ben Folds

Introduction

This chapter introduces the Ushpitun landform and the cultural group occupying central Labrador for millennia, the Intermediate period Amerindians.[1] First, a description of the Ushpitun landform's present setting and paleoenvironment as well as a summation of all archaeological investigations in the area (1998-2015) is given. Next, a synopsis of Intermediate period Amerindian culture history will be provided, and contemporary research will be discussed. This discussion will include descriptions of Amerindian lithic tool forms/raw materials, common site locations, and relevant features to better contextualize the 2018 project.

The Ushpitun landform: present and past

Modern environment and usage

As both the contemporary and past environs of the Ushpitun landform (Josephs and Neilsen 2009, Neilsen 2006) and Hamilton Inlet (Fitzhugh 1972) have been discussed extensively only a brief summary will be provided here. The Ushpitun landform is located approximately 10 km inland of the westernmost edge of present-day Lake Melville, on the Goose Bay Peninsula at the termination of Hamilton Inlet (Fitzhugh 1972, Josephs and Neilsen 2009, Neilsen 2006). For context, the area lies due northeast of present-day Happy

[1] Amerindian groups of this time were previously referred to in archaeological literature as "Intermediate Indians" (Brake 2006, Fitzhugh 1972, Nagle 1978, Neilsen 2006).

Valley-Goose Bay (HVGB) by approximately 6.5 km and sits about 4.5 km directly north of the Churchill River. The landform itself is an elevated sandy terrace, roughly crescent-shaped that is surrounded by bakeapple bogs to the north, east, and west while a small stream delineates the southernmost edge (Neilsen 2006).

The landscape is comprised of small dunes (ridge and swale) covered with sparse vegetation: moss, red berry (i.e. partridge berry or lingonberry), blueberry, with bakeapples (cloudberry) bogs surrounding the elevated sandy terrace (Neilsen 2006). It is relevant to mention that this area of HVGB has an "iron pan" or propensity to trap iron particles in the substrate, impeding water drainage, but more importantly creating pockets of high local magnetism (St. Croix 2002:8). Small, scattered copses of five to ten thin trees were also present on the site during the 2018 survey and excavations. These were relatively young, not more than 2.5 m tall poplar or spruce a few centimeters in diameter. Small woody shrubs also dotted the landform, these proving to be the greatest hindrance to geophysical survey as they blocked the wheels of various instruments or impeded survey transects. It is worth noting that around 2009 a brushfire consumed most of the caribou moss and other ground-litter (Neilsen 2015, 2016b). This is likely why there was little overall moss, no mature trees, and an abundance of berries—making surface archaeological features more visible than pre-2009. The only fauna spotted on the site were some whooping cranes likely nesting somewhere in the adjacent bog. However, the site was covered in moose tracks, and some bear scat was also spotted.

As mentioned, the area to the immediate south of the site is used by HVGB for the dumping of brush. Historically, the area was also used for the dumping of trash as well, though this was primarily large metal objects like car parts, or bed springs. Neilsen (2006) notes that all marketable wood in the vicinity has been harvested, but the area is still used for firewood collection, especially during the winter. Many trees have been cut over 1 m above the ground surface suggesting they were taken in wintertime via sled or snowmobile. The occasional beer bottle or can, tin of Vienna sausages, and shotgun shell found on the surface demonstrates a continued use of the site for enjoyment or small game/bird hunting. During archaeological fieldwork, the only regular visitors to the site were those individuals either picking berries, walking their dogs, or driving their ATVs both on (and off) the adjacent trail.

The use of ATVs and snowmobiles has been documented as a concern regarding the erosion of the landform and the possible disturbance of archaeological materials, especially given the shallowness of the artifacts and features found at Ushpitun (Neilsen 2006, 2015, 2016b). Presently, no archaeological materials or features have been documented within the trail alignment, but the potential for off-road vehicles damaging archaeological materials is concerning.

Paleoenvironment and usage

Hamilton Inlet is the largest single body of water in Labrador and remains an important travel corridor from the interior of the province to the Labrador Sea. The course of the inlet begins at Indian Harbor in the east and ends at the Goose Bay peninsula on the western edge of Lake Melville (Fitzhugh 1972). From there, Hamilton Inlet gives way to the Churchill River, which connects the interior of Labrador to the coast. Though the present-day position of the Ushpitun landform is far removed from direct association with either Lake Melville or the Churchill River, this was not always the case.

The paleoenvironment of the Ushpitun landform was different from that which is observed today: at the time of cultural occupation conventionally radiocarbon dated to 2810±70 years BP by Neilsen (2006) the area in question was a raised, sandy terrace at the confluence of the Churchill River and Lake Melville (Beta-198378; Josephs and Neilsen 2009; Neilsen 2006).[2] Josephs and Neilsen (2009) assert that the Ushpitun landform at this time was actually part of a small (1.2 km^2) island, separated from the Goose Bay Peninsula by a thin channel; this being 'walkable' during low-tide events, but sitting just 1 m above sea level during high tide. The date that this environmental analysis is based upon is from site FhCb-04 (Ushpitun 2) (Figure 2.1), that would have been located in a somewhat protected cove on the eastern edge of the landform which was likely an active beach during the time the area was in use (Neilsen 2006).

FhCb-04 acts as a benchmark for relative dating of the area as well, as it sits at 17 m above sea level (masl) which corresponds to an age of about 3,000 years BP on Clark and Fitzhugh's (1992) post-glacial relative sea level (RSL) curve (Neilsen 2006:50).[3] In many cases the elevation of archaeological sites in Labrador is tied to the rate of land-emergence after glaciation (Fitzhugh 1972). This occurred in the HVGB area approximately 7600 years BP according to archaeological evidence, though environmental

[2] This date has been subsequently calibrated using OxCal (Calib 4.3.2 with an IntCal 13 curve) software to cal BP 3140-2765 (Neilsen 2006: Beta-198378, Ramsey 2017, Reimer et al. 2013).
[3] This elevation is likely incorrect (handheld GPS-measured) and is discussed in detail in Ch. 5 of this document.

data suggests as early as 10,000 BP (Clark and Fitzhugh 1990; Fitzhugh 1972; Jordan 1975; Josephs and Neilsen 2009).

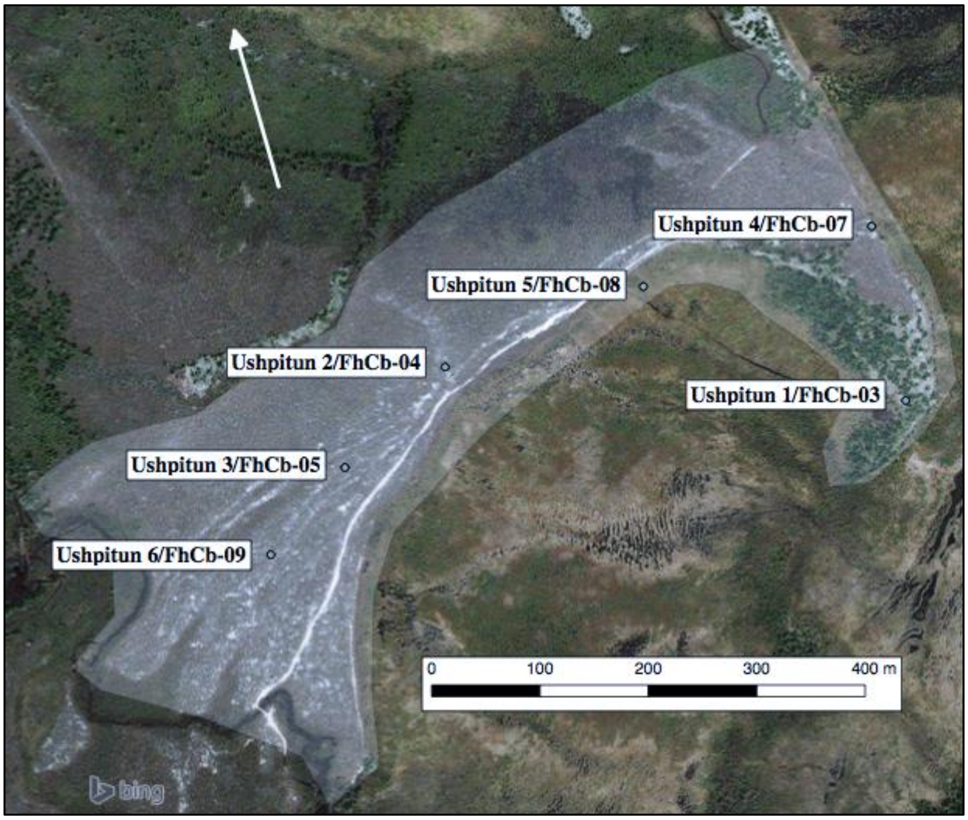

Figure 2.1: The Ushpitun Landform (FhCb-12) with known archaeology sites (n=6).

The western Lake Melville/Goose Bay area rose 135 m rapidly—as much as 100 m in the first 2,000 years post-glaciation—with the 3000 BP paleo-shoreline sitting 15 m higher than the present 50 m contour line (Josephs and Neilsen 2009:106-108). These processes of isostatic rebound and eustatic uplift created the raised terraces like those seen at Ushpitun, though the act of dating sites using sea level curves is tricky due to non-uniform rates of emergence and an assumption that archaeological sites are near shorelines. Despite this, both Fitzhugh (1972) and Clark and Fitzhugh (1990, 1992) demonstrate that older sites in Labrador are found at higher elevations in central Labrador, while younger ones at lower elevations. What are traditionally considered "summer" coastal sites both archaeologically and ethnographically tend to be within 1 to 3 m above the high-tide line (Clark and Fitzhugh 1990:299; Clark and Fitzhugh 1992:190, 198; Fitzhugh 1972:105). FhCb-04 was determined to be occupied likely in summer or early fall to take advantage of fishing, birding, and possible sealing nearby (Neilsen 2006).

The climate during the time of occupation would have been like that of today, though from 3000 – 2500 BP there was a gradual cooling terrestrial and marine trend (Fitzhugh 1972; Fitzhugh and Lamb 1985). It is for this reason that Neilsen (2006) notes the area was unlikely to be occupied during cold weather, as there is little to no cover from either wind or water in the form of trees or other substantial flora. Western Hamilton Inlet would have been mostly spruce forests mixed with lichen woodland and would have provided more favorable conditions for occupation nearby (Jordan 1975). This, in combination with the lack of lithic material sources and limited animal resources in the peri-tidal environment likely made the Ushpitun landform more of a stopover, a "specialized procurement camp" according to Neilsen (2006:88), after Fitzhugh (1972:137).

Previous archaeology on the Ushpitun landform: 1998 – 2015

Much has been discovered in the 20 years since the Ushpitun landform was first identified, surveyed, and excavated. The area of the landform, undefined in the past, is now bounded by a contour line and considered one Borden number: FhCb-12.[4] This section will

[4] The significance of this new Borden designation is discussed in Ch. 5.

overview the brief history of Ushpitun, from its inception into the archaeological record of Labrador in 1998, to the most recent archaeo-geophysical survey and excavations conducted there in 2018.

The Lower Churchill Hydro Development Project - 1998

Archaeological resources were discovered in the area that would be called the Ushpitun landform during part of the extensive Heritage Resource Impact Assessment for the Lower Churchill Hydroelectric Project (Neilsen and Wolfrum 2019). Investigations at Ushpitun occurred between September 23rd and September 25th, 1998. During this time, and under the supervision of Dr. Fred Schwarz, lithic elements were recovered from shovel testing and possible hearth cobbles were identified emerging through the substrate (IEDE/JWEL 1999; JWEL/IE 2001; Neilsen 2006).

A total of 832 shovel test pits were excavated across the landform, beginning at the "hook" or northeastern edge of the area (see again Figure 2.1 above), at the former mouth of the Churchill River. At this location, one flake of quartzite was recovered, and additional testing revealed fire cracked rock. This locale would be identified as Ushpitun[5] 1, later identified as FhCb-02. Ushpitun 2 (FhCb-04) would be discovered shortly thereafter, with numerous lithic elements and several fire cracked cobbles appearing during testing (JWEL/IE 2001).

In total, 39 artifacts (almost entirely flakes) of multicolored chert and one quartzite were recovered, including one small broken biface fragment (JWEL/IE 2001; Neilsen

[5] The toponym for the landform was coined during this part of the project, when a crewmember pointed out that the sandy terrace looked like an outstretched arm, or "ushpitun" in the Innu-aimun language (Neilsen and Wolfrum 2019).

2006). These came from a total of five test pits with extremely shallow profiles: 2-5 cm of duff and 3-10 cm of A-horizon overlying the B (sterile) horizon (JWEL/IE 2001). During this time, the site was determined to be of Intermediate period origins based on the lithic material culture recovered. Importantly, Schwarz notes that the “whole area has great [archaeological] potential” and that “rocks are otherwise absent in these soils” apart from those of cultural significance—two points that have impacted the interest in, and nature of further investigations at Ushpitun (JWELE/IE 2001:18).

The Euinuat Mista-Shipu Archaeology Project (EMSAP) - 2004

The name for this project was taken from an Innu term describing the mouth of the Churchill River, formerly where Ushpitun was located (Neilsen 2006:2). This project excavated two Intermediate period sites in July and August of 2004, Ushpitun 2 (FhCb-04) and Pmiusik^u 1 (FhCc-01). As Pmiusik^u is not on the Ushpitun landform, it will not be discussed further in this thesis.

Approximately 17 m^2 were excavated during the EMSAP project, resulting in the recovery of 2,886 lithic elements (Neilsen 2006:63-66). Interestingly, these artifacts were predominantly microdebitage (defined as less than 1 cm in dimension) with a nearly equal number of flakes and flake shatter (~300 elements each). Table 2.1 (from Neilsen 2006:66) breaks down the quantity and type of lithic artifact found at FhCb-04, per Andrefsky (1998) and Kooyman (2000). Additionally, these materials are almost exclusively made of chert (n=2815) as compared to quartzite (n=51) (Neilsen 2006:63).

Table 2.1 (From Neilsen 2006:66): lithic artifacts recovered at FhCb-04 (Ushpitun 2).

Specimen	Number	Percentage
Biface	8	0.28%
Biface Fragments	17	0.59%
Utilized Flakes	17	0.59%
Flakes	311	10.85%
Flake Shatter	304	10.61%
Shatter	28	0.24%
Microdebitage	2202	76.83%
Total:	**2866**	**100%**

Taking this one step further, Neilsen determined that there was a spatial element to the distribution of artifact types. West of the W4 grid line (see map in Neilsen 2006:67) was where the majority of debitage (93.57%) and microdebitage (91.83%) and eight bifaces were found; conversely, east of W4 saw only 6.43% of the total debitage recovered, but over twice as many bifaces (n=17). The location of Feature 1 was to the east of the W4 line and thought to have been a cooking/food preparation area, while to the west lithic maintenance and production was likely occurring (Neilsen 2006:81-82).

A total of two features were associated with FhCb-04: Feature 1, the cooking/food preparation area, and Feature 2, a "secondary work area." These features were thought to have been directly associated with the brief occupation of the site (Neilsen 2006:83).

Feature 1 was comprised of a semi-circular ring of stones, a pit with adjacent earth mound, and fire cracked rock deposited in a secondary location. Some stones may have been used for radiant heat, while others may have been used in the boiling of water for cooking/processing activities (Neilsen 2006). Again, the lack of debitage materials, and presence of what one Innu crewmember described as a possible sand pit (for the making of bannock, a type of bread) suggests that this was a food preparation and/or cooking zone (Neilsen 2006:86; S. Neilsen personal communication, August 2018). One radiocarbon sample was recovered from charcoal present in this feature and was dated to 3140-2765 cal. BP using OxCal v. 4.3.2 and the IntCal 13 atmospheric curve, placing it within the Intermediate period (Beta-198378; Ramsey 2017; Reimer et al. 2013).

Feature 2 was made up of at least two areas of intensification in terms of lithic processing. These are delineated based on the types (color and material) of stone reduced or re-sharpened there. The first area is associated with processing implements like knives, that are made up of white and pink cherts. The second area has reduced numbers of white and pink cherts and is dominated by purple and grey cherts, without the processing implements found in Area 1. The possible third area is where most of tan quartzite is found in the assemblage (Neilsen 2006:87).

Importantly, Neilsen notes that based on his findings at FhCb-04 that stones on the landform were likely transported there, as they are almost always in association with cultural features on the landform and the landform itself is naturally devoid of them. He furthers this point by suggesting that these stones could be evidence of activity that is "otherwise archaeologically invisible," a key point to be addressed in the discussion section of this thesis (Neilsen 2006:88).

Using Fitzhugh's (1972) definition, FhCb-04 was deemed a "specialized procurement camp" with discrete areas within it specific to different tasks (Fitzhugh 1972:137; Neilsen 2006:88). These tasks are inferred based on the distribution of lithic artifacts, and their proximity to certain archaeological features. What is emphasized and significant for future interpretations is that the Ushpitun landform was, during the time of occupation, an undesirable location for long-term occupation. Environmental analysis by

Josephs and Neilsen (2009) supports this claim, and will be discussed next, though the actual sampling for the micromorphological thin sections took place during the 2004 excavations.

Geoarchaeological investigations (Josephs and Neilsen) - 2009

During the excavations at FhCb-04 several sediment samples were taken from the western profile walls of units for later analysis. A total of 14 thin sections were prepared from samples taken in the field at Ushpitun (an additional six were prepared from excavations at Pmiusiku^{u}). From these thin sections both sedimentological and micromorphological analysis could occur. The results of these investigations revealed the state of the landform during Amerindian occupation (Figure 2.2). This research furthers the assertion that sites on the landform, which at 3,000 BP was an island, were likely ephemeral in nature and not associated with any kind of long-term habitation strategy as the area would have been unsuitable for such a proposition (Josephs and Neilsen 2009).

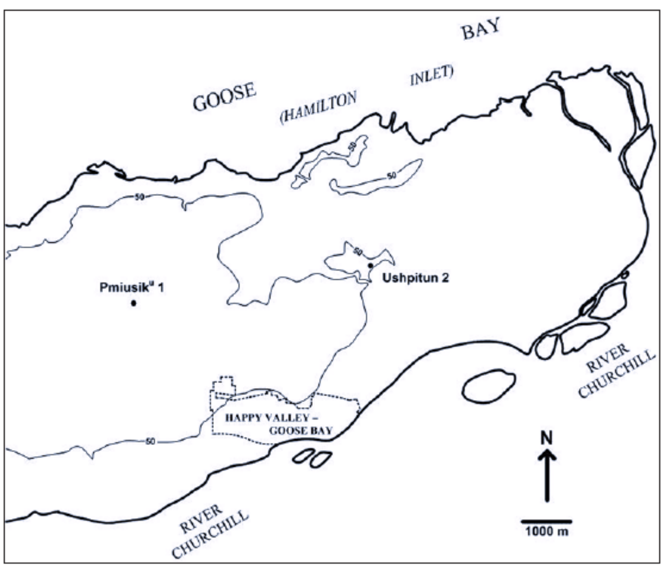

Figure 2.2: Location of Ushpitun 2 at 3,000 BP at the present 50 m contour (Josephs and Neilsen 2009:94).

Emergency investigations near FhCb-04 and FhCb-03 – 2013

In October of 2013, during a landscape training session for Innu Nation environmental monitors, several archaeological artifacts and features were identified. In response to these discoveries, Neilsen visited the area to document with GPS what was found, and to collect one quartzite biface. This resulted in the identification of three new sites: FhCb-07, FhCb-08, and FhCb-09. Additionally, two cobble features, one lithic scatter, and the biface were all attributed to the previously excavated site FhCb-04 (Neilsen 2015). Table 2.2 summarizes the results of this investigation and which objects/features are associated with which sites.

Table 2.2: Artifacts and their site affiliations from 2013 emergency investigations.

Object(s)/Features Discovered	Associated Site on Ushpitun Landform
Biface 1	FhCb-04 (Ushpitun 2)
Cobble Feature 4	FhCb-04 (Ushpitun 2)
Cobble Feature 5	FhCb-04 (Ushpitun 2)
Flake Scatter 2	FhCb-04 (Ushpitun 2)
Flake Scatter 1	FhCb-07
Cobble Feature 1	FhCb-07
Cobble Feature 2	FhCb-08
Cobble Feature 3	FhCb-09

Summarizing the 2013 investigations in a report to the Provincial Archaeology Office (PAO), Neilsen (2018) offered observations that directly influenced the decision to undertake a geophysical survey. First, because of monitoring activity it became apparent that there are still extant archaeological resources on the landform that remain undiscovered. Second, the sampling strategy employed previously—intensive shovel testing at 5 m intervals—was not a fine enough sampling resolution to locate ephemeral features in this kind of environment. Neilsen (2016a) echoes this statement after monitoring activity in Sheshatshui, Labrador uncovered archaeological material after a previous shovel testing survey returned limited findings. Third, and most importantly, Neilsen advocated for the application of archaeo-geophysical methodologies, saying the landform "is an excellent candidate for [magnetometry and GPR]" (Neilsen 2015:10). Additionally, Neilsen proposed here that the *entire* landform be considered for archaeological designation, rather than the individual sites within it, as ATV and snowmobile activity was, and remains, a source of concern (Neilsen 2015).

Pedestrian survey for "Wild Archaeology" – 2015

In July of 2015 a "contrived" pedestrian survey was conducted for the purposes of filming the television program "Wild Archaeology" (Neilsen 2015:1). The broad premise of the show was to better understand the peopling of North America by visiting archaeological sites across Canada. A survey of known (though not to the viewing audience) archaeological features was prepared to facilitate a discussion of the Indigenous inhabitants of central Labrador. The survey area included sites FhCb-05 and FhCb-08 and revealed two additional lithic artifacts (both recovered) and one possible archaeological feature (Table 2.3). Photographs of collected bifaces are shown in Ch. 5 of this thesis.

Table 2.3: Artifacts and their site affiliations from 2015 *Wild Archaeology* survey.

Object(s)/Features Discovered	Associated Site on Ushpitun Landform
Fire-cracked Cobble	FhCb-05
Split Cobble (collected)	FhCb-05
Debitage <10 elements	FhCb-05
Biface (collected)	FhCb-08

The parameters of the project were as follows: the five members involved in the pedestrian survey walked straight transects approximately 3 m apart from one another. They made three passes over the area (in the vicinity of FhCb-05) to cover a total area of about 3240 m^2 (Neilsen 2015). Neilsen notes that the split cobble reinforces the observation that that few, if any, natural cobbles are present, and this one was likely brought in by those utilizing the area. Once again, it was recommended that further protection of the area must be implemented to curb damage done by ATV and snowmobile use in the area (Neilsen 2015).

Archaeo-geophysical survey – 2018

It has been made evident via past archaeological inquiries on the Ushpitun landform that both features and artifacts are still intact and undiscovered there. The shovel testing at 5 m intervals in the late 1990s failed to identify the scope of archaeological materials present, and subsequent projects have supported this with their own discoveries. It was for this reason that a different, archaeo-geophysical focused approach was proposed. The methodology, results, and a discussion of this survey are described in the Chapters 3, 4, and 5.

The Intermediate period: 3,500 – 1,800 BP

In "A Comparative Approach to Northern Maritime Adaptations" Fitzhugh (1975) designates three broad periods in Labrador history: *Early* (5500-3500 BP), *Intermediate* (3600-1400 BP), and *Late* (1400 BP to present).[6] Though both the terms *Early* and *Late* would later undergo further dissection and refinement, the *Intermediate* has continued to describe Amerindian populations in Labrador during that time. Research since this publication has adjusted these date ranges to reflect the Intermediate period in Labrador as

[6] All radiocarbon (RC) dates are calibrated years before present (BP) unless otherwise specified.

between the 'disappearance' of the late Labrador Maritime Archaic (LMA) tradition who existed between 8000-3500 BP and the 'emergence' of the Late Precontact/Recent Amerindians (RA) (Point Revenge and Daniel Rattle culture groups) around 2000-1800 BP in Labrador (Brake 2006; Fitzhugh 1987, 2006; Loring 1992; Neilsen 2006) as seen in Figure 2.3.[7]

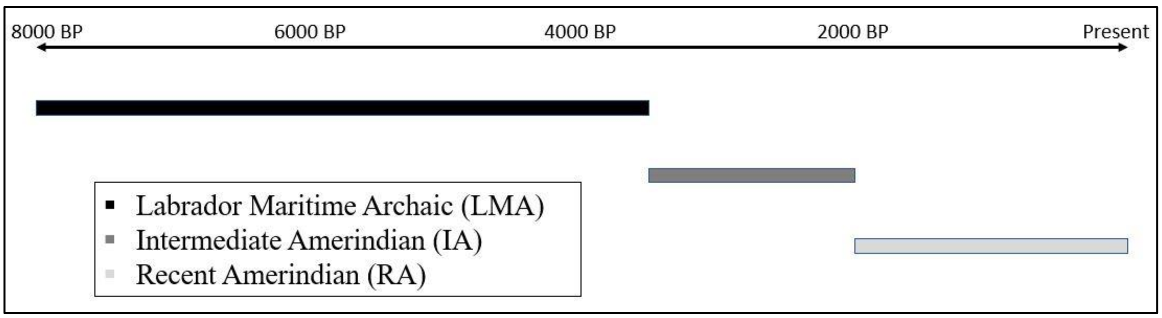

Figure 2.3: Archaeological cultures in Labrador throughout time.

The Intermediate period is further broken down into smaller cultural units: phases, complexes, and components. Fitzhugh (1972) describes each of these in turn, with phases constituting stand-alone spatial distinctiveness from other phases, complexes being made up of many similar components though lacking the comprehensive information that define phases, and components being the least understood as individual cultural units (Fitzhugh 1972:112-113; Neilsen 2006:21-22). Intermediate period Amerindian culture was originally described as consisting of three components, two complexes, and two phases, though recent reevaluations have condensed these to just two phases based on lithic evidence (Neilsen 2006:21).

[7] These periods are similarly described by modern Labrador Innu as *Tshiash Innu* (old Innu from long ago), *Shashish Innu* (Old Innu), and *Ancestral Innu*, respectively (Loring 2010).

Intermediate period cultural units have been simplified by Nagle (1978), and by Neilsen (2006) during the EMSAP project in 2004 into the Saunders and Northwest River phases, respectively. Neilsen questions the validity of Fitzhugh's (1972) established archaeological timeline, as some cultural units were determined using small artifact samples (e.g. the Little Lake Components is just one site), via collections recovered by amateurs (e.g. David Michelin Complex excavated by BRINEX Co.), or from disturbed contexts (e.g. The Road Component was bulldozed) (Fitzhugh 1972:77; Neilsen 2006:31). These changes have been summarized in Table 2.4 which have been adapted from Neilsen (2006:124); Table 2.5 describes each phase, complex, and component archaeologically based primarily on chronology and lithic typology. The dotted line separating the Saunders Complex and Northwest River Phase indicates the lack of distinction between (and among) Intermediate period sites, and Neilsen's (2006) hesitance to designate two separate cultural groups within the period.

Table 2.4: Intermediate period cultural sequence 1972-2006.

RESEARCH TIMELINE	REGION					BROAD DESIGNATION	
	WESTERN LABRADOR	SOUTHERN LABRADOR	NORTH-CENTRAL LABRADOR	HAMILTON INLET	TIMELINE	LABRADOR	BEYOND LABRADOR
PRE-EMSAP	UNKNOWN	(early) LATE PHASE	LITTLE LAKE COMPONENT		3600-3200 BP	INTERMEDIATE INDIANS	UNASSIGNED
			SAUNDERS COMPLEX	BRINEX COMPLEX	3200-3000 BP		SHIELD ARCHAIC TRADITION?
				CHARLES COMPLEX	3000-2700 BP		
				ROAD COMPONENT	2700-2300 BP		
			DAVID MICHELIN COMPONENT		2300-1800 BP		
			NORTHWEST RIVER PHASE		1800-1400 BP		SHIELD ARCHAIC TRADITION
POST-EMSAP	UNKNOWN	(early) LATE PHASE	SAUNDERS COMPLEX		3500-2700 BP	INTERMEDIATE AMERINDIANS	POST-ARCHAIC
			NORTHWEST RIVER PHASE		2600-1800 BP		

Neilsen's (2006) broadened view of the Intermediate period as less discrete than Fitzhugh (1972) or Nagle (1978) is reaffirmed to some degree by the complications encountered during Stassinu Stantec's annual recovery excavations on the Churchill River.

Table 2.5: Intermediate cultural unit descriptions from Neilsen 2006.

Name	Initial Cultural Unit	Number of sites*	Time Frame (BP)	Lithic Materials	Distinctive Characteristics	Elevation (masl)	EMSAP Re-designation
Little Lake	Component	1	3800-3600	Quartzite	Stemmed biface	21	(late) Labrador Archaic period
Brinex	Complex	4	3200-3000	Red + white quartzite, quartz, cherts	Side-notched points, red ochre	24 - 17	Subsumed within Saunders Phase
Charles	Complex	5	3000-2700	Multi-color Seal Lake cherts, quartz	No stemmed points or ochre; scraper and linear flaking, prepared cores	18 - 13	Subsumed within Saunders Phase
Road	Component	1	2700-2300	Multi-color cherts, quartz, quartzite + Ramah	Ramah chert, side-notched bifaces, triangular end scrapers	13	Element of Charles Complex
David Michelin	Complex	2	2300-1800	Multi-color cherts, quartz, quartzite + Ramah	Wide and tapered stemmed points, large bifacial knives, flake scrapers	9	Component of Northwest River Phase
Northwest River	Phase	8	2500-1400 (date changed to 1800)	White/brown quartzite, Ramah, banded lava, red quartzite, quartz	Asymmetric bifaces, stemmed bifaces, core-scrapers	11-8	N/A
Saunders	Complex	35	3500-2700	Multi-colored cherts, quartzite	Single-shouldered + broad bladed knives, side-notched bifaces, variety of scraper + knife types	24-17	Saunders Phase

(early) Late Phase	Phase	2 (others present, this number refers to sites dug by Madden in 1976)	3500-1800	Local quartzites, cherts	Side-notched bifaces, flake scrapers, abraders, linear flakes, large + multiple hearths, lack of Ramah. Occupation spans entire Intermediate period	7	N/A: Southern Labrador continuum

*Site number based on initial designation of cultural unit by Fitzhugh (1972), except Saunders Phase which uses data from the PAO (2004). Majority of information gleaned from Brake (2006:13-19), Fitzhugh (1972), Madden (1976), Nagle (1978), and Neilsen (2006:19-45).

Most sites recovered between 2011-2017 were dated to the Intermediate period but outliers in raw materials or tool styles combined with unexpected radiocarbon dates caused challenges in interpretations. Stassinu Stantec (2014:193) describes the sites as "highly idiosyncratic" and likely palimpsests of occupation with little to differentiate between instances of use. One source of confusion stems from the utilization of Fitzhugh's (1972) seriation of Amerindian sites in Labrador, and the inclusion of the Brinex/Charles as well as David Michelin complex rather than Neilsen's (2006) simplified Saunders/Northwest River dichotomy.

It is important to note that the name of each phase or complex holds a broader cultural context even within Labrador itself. For example, the use of "Post-Archaic," or "(early) Late Phase," or even "early Precontact period" indicates that while these cultural units themselves are strictly defined they nevertheless remain fluid based upon differing interpretations (Madden 1976; Neilsen 2006; Stassinu Stantec Consultants Limited 2011, 2014). Stassinu Stantec (2011:27) notes that the use of Fitzhugh's (1972) classification system in the interior of Labrador is lacking as the variety of raw material types and tool typologies is greater than on the coast. It is the opinion of the author that continued archaeological discovery, particularly within the interiors of Labrador and Quebec, will shed further light on Amerindian occupation and will allow for additional revisions to the cultural history as currently understood. This will likely manifest as moving away from discrete cultural affiliations and adopting a similar system to McCaffrey's (2006) Late/Early separation. Considering recent discoveries that cast further doubt on what precisely defines Intermediate period, culture no subdivisions (e.g. Brinex, Charles, Saunders, etc.) will be used in the analysis portion of this thesis.

Site location, lithics, and features

The Intermediate period has been described as the "least well-known," archaeological timeframe in Labrador history (Brake 2006:13; Neilsen 2006:1). What information is available comes in the form of site location, lithic artifact seriation, and the few types of pit or combustion features present. During Stassinu Stantec's Churchill River excavations (2011-2017) they note these data are often lacking, as the continuous reoccupation of sites, diversity in lithic material types, dearth of formal tools, and ephemeral nature of features make interpreting Intermediate period archaeology difficult.

Site locations

Intermediate period sites are found in roughly similar distributions to LMA sites e.g. from the Straits of Belle Isle in the south, to Hamilton Inlet, and in northern Labrador as well (Brake 2006). In terms of their use of coastal sites, the key difference between the two groups is the apparent preference of Amerindian peoples during the Intermediate period to choose sheltered bays and inlets near interior waterways for occupation, compared to LMA sites found on more exposed exterior islands, etc. (Brake 2006; Fitzhugh

1972; Nagle 1978; Neilsen 2006). Supporting this theory are the locations of sites that are found almost equally between coastal and interior Labrador. Brake (2006:22-23) asserts that 44% of Intermediate sites are found on or near the coast (less than 30 km away from the coast), while 56% are classed as interior (greater than 30 km from the coast).[8] However, it is crucial to note that the majority of interior Labrador has not been archaeologically investigated to create a truly representative sample of the density of inland vs. coastal sites.

Excavations by Stassinu Stantec in the Churchill Valley region (Muskrat Falls, Gull Lake, and Sandy Banks) in interior Labrador have revealed several Intermediate period sites. These sites either sit near, or on top of, a historic portage trail terrace along the Churchill River or are on the banks of Gull Lake (Stassinu Stantec 2014). This work represents the largest exploration of archeological resources in the interior to date, though the area covered still only represents a small fraction of Labrador (Stassinu Stantec 2011, 2013, 2014, 2015, 2016). It can be surmised that other interior waterways like rivers and lakes linked by portages also contain traces of Amerindian presence, though more exploration is needed to confirm the existence or extent of additional sites. For this reason, the actual volume of Amerindian archaeological sites is still unknown and continues to skew any comparison with coastal occupations.

Lithic materials and tools

As Intermediate sites in the interior of Labrador are still relatively unexplored a meaningful comparison of lithics between interior and coastal sites during this period is

[8] There is no explanation for why this sized buffer was chosen to conduct Brake's study—considering that a 30 km trek is no small feat even by today's standards.

limited in significance. What can be said with confidence is the noticeable difference between LMA and Intermediate groups in terms of their preference in lithic style and material types. Where the former utilized Ramah chert and ground stone implements Amerindian groups abandoned ground stone tools completely and used Ramah selectively, while also making use of various interior cherts, quartzes, and quartzites (Fitzhugh 1972; Brake 2006; Madden 1976; Neilsen 2006; Stassinu Stantec 2014). Neilsen (2006) effectively summarizes this change in lithic tool style:

> Bifaces, scrapers, abraders, linear flakes, singular, multiple and linear stone hearths and lithic materials all occurred in forms not known in the preceding [LMA] portion of the sequence. The stemmed bifaces of the Labrador and Maritime Archaic gave way to side notched bifaces. Flake and thumbnail scrapers, not previously common, increase in abundance, as do abrading stones. Linear or blade-like flakes, not previously known in Amerindian assemblages, become one of the most common tool forms (Neilsen 2006:37).

Madden (1976) notes that Intermediate period (described as "early Late Phase" in her writing) stone artifacts in southern Labrador shift from early use of low-quality, coarse cherts to higher quality ones later, with Ramah becoming more prevalent after 2900 BP—perhaps indicating increased travel or trade with pre-Inuit groups occupying the northern Labrador coast?

A variety of lithic artifacts have been recovered from Stassinu Stantec's Churchill River excavations, but the limited number of formal diagnostic tools hinders interpretations. The proportion of finished tools compared to debitage is small, and further complicates any kind of seriation either between individual sites or regionally (Stassinu Stantec 2014). Additionally, Stassinu Stantec (2014:191) describes finished tools and preforms as being almost always made of local quartzite, with some sites clearly emphasizing the production of preforms and sharpening of tools. Outliers in projectile point styles further confuse attempts to label sites chronologically.

Features

The only identified features from the Intermediate period are combustion features like hearths or other aggregations of anthropogenically heated stones, and some pit features. Combustion features are areas of burned earth/sand usually associated with stone arrangements, though the exact purpose of these stones is not fully understood.[9] Nagle (1978:140) notes that presumed hearth features can occur in numbers as great as 30 on central shoreline sites, while Madden (1976) documented linear hearths in southern Labrador up to 1.5 m by 4.0 m in size (Brake 2006). Excavations by Stassinu Stantec in 2015 also noted several linear shaped hearths, though there is the possibility these are merely several smaller hearths "blended" together either by proximity, post-depositional factors, or both. Similar linear-shaped hearths have been found during excavations in Sheshatshui by Neilsen (2013) at FjCa-51, and in Kameshtashtan (Mistastin Lake) by Jenkinson and Loring (2011) (Stassinu Stantec 2015:132). Generally, combustion features can take a circular/oval or linear shape and occasionally appear adjacent to one another in "pairs," suggesting dwelling sites of dual occupation, perhaps by kin groups (Stassinu

[9] For this reason, the term "combustion feature" is more appropriate than "hearth" as it does not presume a purpose/function, but they will be used synonymously here in keeping with previous research.

Stantec 2013, 2014, 2015). Alternatively, hearths from this period can also appear in mounded sand varieties (interior Quebec), or as cobble pavements (Labrador coast) (Denton 1989; Pintal 1998; McCaffrey 2006; Stassinu Stantec 2016). Combustion features are crucial sources of charred material used in radiocarbon dating (often the only source of preserved organic matter from Intermediate sites) and are argued to present some of the only samples untainted by forest fires (Fitzhugh 1972:105).

It has been suggested that recent recovery excavations by Stassinu Stantec (2014) have unearthed boulder-filled pits that suggest canoe manufacture/repair, as well as one extended and unusually deep pit feature that may have been used for cooking, or alternatively, for smudging or in ceramic firing as well. Two such features were located on opposite ends of the Muskrat Falls portion of the portage and may indicate that the fabrication of new watercraft was preferred to maneuvering them around the falls, though this is purely speculation (Stassinu Stantec 2013, 2014:192-193; Schwarz and Skanes 2013). Jenkinson and Loring (2011) also note a linear cobble arrangement and large red ochre stain during excavations at Kameshtashtan they have tentatively identified as being associated with canoe manufacture, though likely more recent than the Intermediate period (Jenkinson and Loring 2011:92).

Some outliers in Intermediate period features and artifacts do exist, the first being red ochre, the second pottery. While red ochre is not anomalous in archaeological settings it is certainly not ubiquitous in Intermediate period sites and is worthy of mention. Its presence at Intermediate Amerindian sites might allude to some element of rituality, though the extent or nature of this is unknown.[10] Most notably at the appropriately named Red Ochre site (FjCa-38) in Northwest River, a red ochre deposit was discovered in addition to a basalt grindstone likely used to prepare it (Fitzhugh 1972:81). Red ochre was also discovered during excavations at FjCa-51 in Sheshatshui and on the Ushpitun landform (FhCb-12), though this will be discussed in later chapters (Neilsen 2013). Stassinu Stantec has also unearthed several elements of precontact dentated Amerindian pottery near a "conspicuous" 1x2 m area of red ochre at site FfCh-02 (Schwarz et al. 2017:229). As decorated pottery is rare in Intermediate contexts the proximity of red ochre raises further questions.

The discovery of pottery at nine separate sites recovered by Stassinu Stantec between 2012-2017 is unique to interior sites and new to the Intermediate period in Labrador. These sherds (no complete vessels were found) are coarse earthenware and grit-tempered made using a coil method and smoothed both on the interior and exterior. Examples of decoration include punctate marks on both the rim and body (FfCi-02), and linear dentate patterns (FfCh-02) (Stassinu Stantec 2016; Schwarz et al. 2017). Based on their construction techniques, it has been inferred that they would be akin to Middle Woodland pottery from between 2000-1000 BP, though the decorative scheme is not consistent (Stassinu Stantec 2016:180-181). Microscopic analysis of two sherds undertaken by Wilton (2016) at Memorial University found that these elements were not likely manufactured at their respective sites (Stassinu Stantec 2016:178). The presence of

[10] Alternatively, as red ochre has been documented elsewhere as a glue hardener for hafting lithics this may demonstrate a more utilitarian function (see Lombard 2006 or Wadley et al. 2009).

pottery at Amerindian sites in Labrador is novel and begs further research investigating the source of their manufacture and how this impacted group mobility.

Intermediate period culture summary

Described as a time of "great change" in Labrador, the Intermediate period saw a shift away from the primarily marine resource procurement strategy associated with the LMA tradition (Brake 2006:9). By migrating seasonally from the coast to the interior of Labrador, Intermediate Amerindian groups developed their own generalized toolkits to adapt to both marine and terrestrial subsistence strategies (Neilsen 2006). This toolkit opportunistically incorporated various lithic raw materials and utilized numerous tool forms. Intermediate sites are found near waterways in both coastal and interior Labrador, though the interior is still relatively unexplored archaeologically. Further, these sites are described by both Stassinu Stantec (2011) and Neilsen (2013) as "palimpsests" representing multiple episodes of occupations difficult to differentiate due to ephemeral combustion features and lithic scatters being the primary archaeological elements available for interpretation. The near-total absence of organic remains (due to acidic soil conditions), and lack of evidence of mortuary practices or habitation structures further complicates interpretations and creates a bias in research (Neilsen 2006).

Historically, the dearth of Intermediate period archaeological research suffers from sites discovered in poor contexts: artifacts collected by non-archaeologists in years prior to formal investigation, or simply a lack of consensus on what constitutes Intermediate Amerindian affiliation (Neilsen 2006). Investigations by Stassinu Stantec have revealed a greater diversity in artifact stylization and raw material usage than has been seen on coastal sites—these coastal sites having exclusively represented Intermediate Amerindian culture up to this point.

Chapter 3 – Archaeo-geophysical methods

Introduction

This chapter introduces the application of geophysical instruments within the discipline of archaeology, the scientific theory behind their functionality, and their use in the context of the investigations on the Ushpitun landform. A brief literature review is included to support the decision to perform a large-scale, multi-instrument survey in the province. Next, the operation of magnetometry[11], ground penetrating radar (GPR) and magnetic susceptibility/conductivity will be explained as these were the three techniques used. Additionally, the overall survey design and subsequent ground-truthing strategy will also be discussed.

Applying Geophysics to Archaeology

Broadly speaking, the use of geophysical instruments in archaeology can be described as the analysis of spatial contrast. For example, an object/feature may possess or lack some measurable physical property that will make it "stand out" from the surrounding soil matrix. This results in the visual separation of that element from its background during digital processing (Figure 3.1) (Kvamme 2003). Varying levels of electric resistivity, magnetic susceptibility, and dielectric permittivity all influence how geophysical instruments interact with, and can detect, archaeological remains. Not all subsurface

[11] As a point of clarification: all gradiometers are magnetometers, but not all magnetometers are gradiometers. Magnetometry is the process of measuring the total (the earth's and local anomaly) magnetic fields, while gradiometry is the subtraction of the difference between two fields (see Figure 2.2). Both terms are often used synonymously.

features are of direct interest to the archaeo-geophysicist as utility lines, pipes, trash, and other modern (pre-archaeological) intrusions can litter project areas and obscure interpretations. It is for this reason archaeo-geophysical practitioners use the blanket-term "anomaly" to represent a difference between locations of interest and the surrounding sterile soil, whether ancient or modern; anthropogenic or natural.

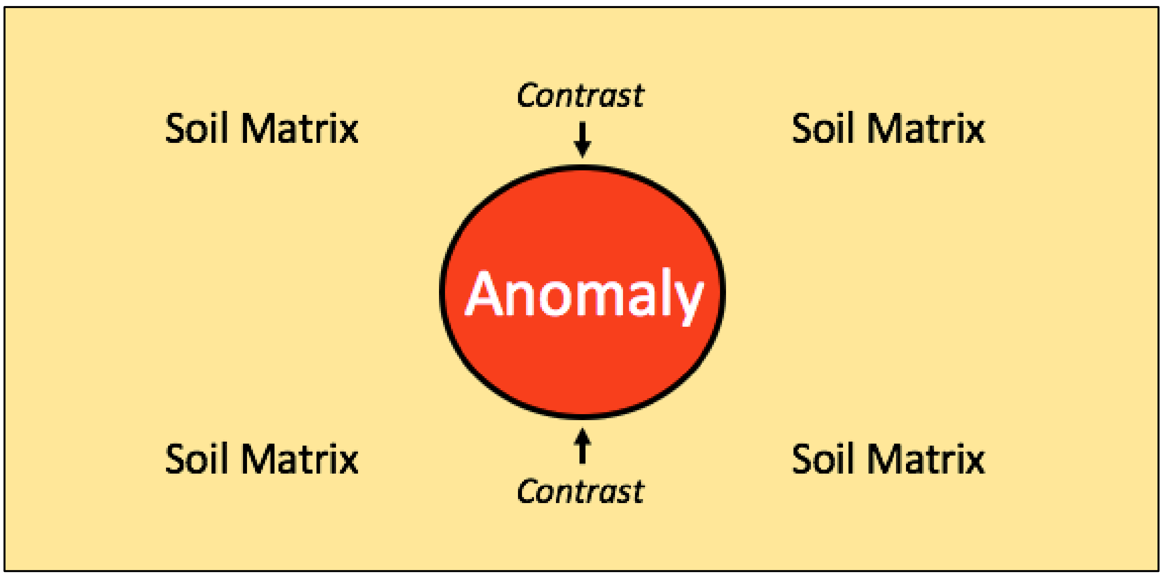

Figure 3.1: The visual separation (contrast) between anomalies and sterile background material.

The jargon surrounding this subject matter is potentially troublesome for the novice as there are many names for archaeological survey employing geophysical instruments. These include: "archaeophysics," "archaeogeophysics," "archaeological prospection," "geophysical survey," and simply "geophysics" to only name a few (Wynn 1985). For the purposes of this discussion, the author has chosen 'archaeo-geophysics' because this term firmly situates the archaeological component with the geophysical, after Kvamme (2003). Further, the terms 'survey' and 'prospection' will be used interchangeably to mean the same process of using an instrument across a landscape to collect data.[12] Additionally, for further study there are numerous manuals and guidelines for using geophysical instruments in archaeological contexts (e.g. Campana and Piro 2009; Clark 1996; Ernenwein and Hargrave 2009; Johnson 2006; Oswin 2009; Schmidt et al. 2016) that offer practical, technical, and scientific instruction for the operation of various instruments in different environments.

Arguably, the three most popular applications of geophysical instruments in archaeology are: magnetometry, GPR, and earth resistance (Johnson 2006). These instruments fall into two basic categories: "active" and "passive." Active instruments send out a physical signal such as a magnetic field (EMI/metal detection), electromagnetic pulses (GPR), or electric current (resistivity) into the ground to collect data based upon a response to those signals. Examples of passive instruments are magnetometers and gradiometers as these machines measure an already existing physical property, the earth's magnetic field, to determine anomalies within it (Ernenwein and Hargrave 2009:10-12; Johnson 2006:206; Oswin 2009:31).

Archaeo-geophysics literature review and precedents for research

The archaeo-geophysical survey at Ushpitun will be based on three categories of geophysical survey: (1) large-scale[13] multi-instrument surveys, (2) surveys attempting to

[12] 'Remote-sensing' will be separated from archaeo-geophysics to delineate the split between ground-based instrumentation from satellite, airplane, and drone-based imaging. Other sources may further separate or conflate these terms, but as there is no industry standard these parameters will suffice for this thesis.

[13] For the purpose of this thesis 'large-scale' will be defined as anything greater than 1 ha in survey area. This is an arbitrary designation as there is no standard for describing survey size.

locate ephemeral hunter-gatherer features, and (3) past geophysical surveys conducted in Newfoundland and Labrador.

Arguably the most high-profile example of a large-area survey comes from the Stonehenge Hidden Landscapes Project, which utilized a multi-instrument survey including GPR, magnetometry, earth resistance, EMI, and other remote sensing techniques to expand the current understanding of Stonehenge's site extent over a (collectively between instruments and over three seasons) area of ~1200-ha (Gaffney et al. 2012). Similarly, surveys like that conducted at Double Ditch Historic Site also used magnetometry, earth resistance, GPR, and EMI combined with aerial-based remote sensing to identify additional fortifications, storage pits, and house pits in an Amerindian village over 11-ha in area in North Dakota (Kvamme and Ahler 2007). Filzweiser and others (2013) also combined magnetometry and GPR over a 61-ha area to successfully understand the location of features like earth ovens, storage pits, and houses within several Viking settlements in Norway. The success of these surveys in integrating multiple geophysical instruments suggests that a similar approach could work at Ushpitun.

Archaeo-geophysical surveys explicitly focusing on ephemeral features (especially combustion features) are few, but these do offer hope that by applying similar instruments and methods quality data can be recovered. Most pertinent is a study by Jones and Munson (2005) that successfully located numerous Amerindian hearth features and teepee rings using magnetometry on 21 sites in Wyoming and Montana. Similarly, Fanning and others (2009) also used magnetometry to both locate and evaluate heat-fractured stones thought to be associated with Aboriginal Australian earth oven constructions—these being both buried and visible on the surface. Related to eastern Canadian precontact sites, Landry (2018) and Landry and others (2015, 2018) successfully used GPR, magnetometry, and EMI to locate Dorset activity areas related to a chert quarry in Baffin Island, Nunavut. Though limited in number, these studies encourage the use of archaeo-geophysical survey in locating ephemeral hunter-gatherer features.

While the use of archaeo-geophysics in archaeology is well documented and spans several decades Johnson (2006:3) describes the use of geophysical instruments in North American archaeology being behind Europe archaeology, specifically the U.K., by at least 10 years (Clark 1996). It is no surprise, then, that its use in Newfoundland and Labrador, is limited to a few examples from recent history. Investigations by Eastaugh (2002) and Tudor (2013) at Point Riche and Port aux Choix, used magnetometry, resistivity, and ground penetrating radar in Newfoundland, while Kelvin and others (2017) has used GPR in Hopedale, Labrador. Additional explorations are limited to the use of GPR and magnetometry to identify features within a possible Beothuk house pit by Wolff and Urban (2012) and an attempt to use GPR to identify both graves and buried airplane parts by Grimes and Lear (2016). Grimes and others (2017) conducted a GPR survey of the Foxtrap-2 (CjAf-10) cemetery prior to excavations and were able to locate some burials in the resultant data. A GPR survey to locate possible grave locations at Ferryland was also undertaken by Gaulton and Lacy (2017) though this proved unsuccessful. Finally, the author also attempted a magnetic susceptibility/conductivity survey at Ferryland shortly before the Ushpitun project began, but no identifiable features were located (Gaulton and Teasedale 2018).

These surveys have met with mixed success but do offer some encouragement for future archaeo-geophysical investigations. Eastaugh (2002) was able to locate several Dorset house pits and possible refuse pits; Tudor (2013) identified numerous archaeological features within Dorset house pit depressions using a high-density survey; Wolff and Urban (2012) discovered what appear to be several architectural features at Stock Cove (CkAl-3) in a mixed occupation context, though these have yet to be ground-truthed. Grimes and Lear (2016) were able to locate a large anomaly consistent with an airplane engine, as well as probable internments in the Tors Cove cemetery, though these anomalies were untested due to sensitivity (graves) and depth (airplane engine over 2 m below surface). Kelvin and others (2017) used GPR, but only over a 5x5 m area, where one possible grave was located, and this anomaly also remains untested. Gaulton and Lacy (2017) were unable to locate any internments at Ferryland using GPR, this being in part due to a limited survey area, and a rocky subsurface environment that obscures data clarity. Grimes and others (2017) did manage to identify some grave locations prior to excavation, though a greater number of internments were not identified, likely due to (again) a rocky subsurface.

Topography is arguably the most limiting factor in archaeo-geophysical prospection. Survey areas must be clear of obstructions and relatively flat for most instruments to be successfully operated. Newfoundland and Labrador offer few locations like this, and can be further limited by rocky subsoil, and thick scrub and tree cover. For this reason, the Ushpitun landform offers a unique case of ideal topography to evaluate a large-scale, multi-instrument geophysical survey focusing on locating ephemeral hunter-gatherer archaeological features.

Magnetometry

In use since the 1960s, magnetometry remains one of the speediest, and most useful methods of archaeo-geophysical data acquisition (Armstrong and Kalayci 2015). As mentioned above, magnetometry is a passive means of data collection that measures localized variations to the earth's magnetic field (Figure 3.2). Variations, in the archaeological sense, are features that stand out in contrast to their surrounding matrix by virtue of being either substantially more or less magnetic (Kvamme 2006). The degree of this magnetic value is measured in nanoteslas (nT= $10x^{-9}$ Tesla), which are a measurement of magnetic flux density, or magnetic field strength (Armstrong and Kalayci 2015:2; Aspinall et al. 2008). For reference, the earth's magnetic field is approximately 50,000 nT, though this varies based on proximity to the equator or either magnetic pole (Milsom 2013).

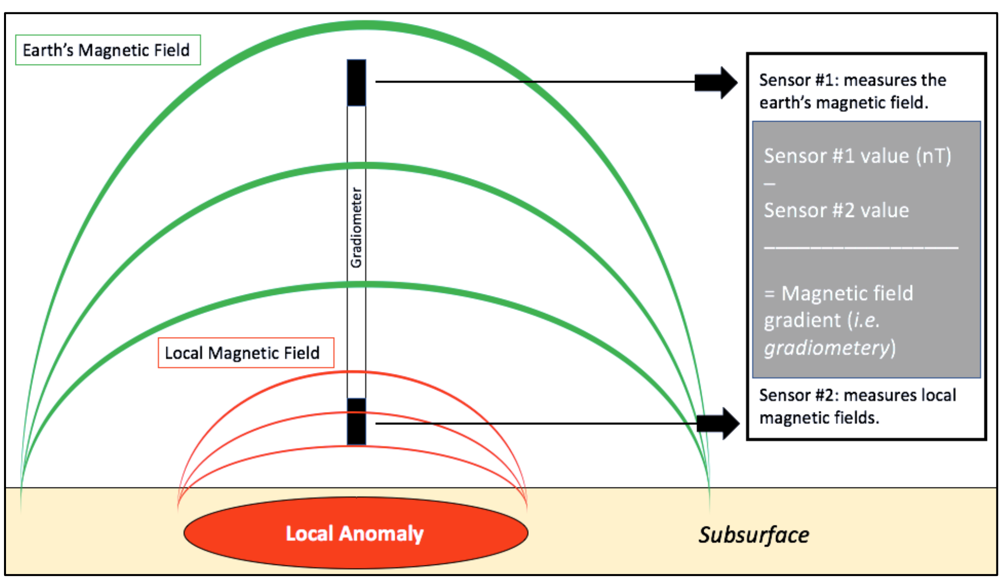

Figure 3.2: How gradiometry identifies buried features.

Anthropogenic and natural action can influence the local changes to the earth's magnetic field that would be discoverable via magnetometry. These are separated into either remnant or induced magnetization. Remnant, or permanent, magnetism, is a level of magnetization that has 'remained' after the initial process that created it has been removed (Kvamme 2006). Induced magnetization is a product of magnetic susceptibility, which is the degree to which a material can be magnetized. Both remnant and induced magnetization are essentially products of the iron mineral (hematite, magnetite, or maghemite) content of a material e.g. the soil being modified by humans in an environment. Commonly, archaeological objects or features exhibiting remnant magnetism are either made of naturally magnetic stone like basalt or other igneous rock, magnetic elements like iron, cobalt, or nickel and their alloys, or have been heated (Kvamme 2006). The application of heat introduces what is known as thermoremnant magnetism. Thermoremnant anomalies are created by the burning of soil past the Curie Point (approximately 100-600 degrees Celsius depending on the material) that noticeably realigns magnetic fields in certain features like those of long extinguished campfires, or artifacts like pottery sherds that have been fired in a kiln (Maki et al. 2006; Milsom 2013; Schmidt 2007). Further, magnetotactic bacteria in soil may produce magnetic minerals in areas used by people in the past—effectively creating a higher level of magnetization in topsoil relative to subsoil (though this is also impacted by natural pedogenesis e.g. dry/wet periods) (Aspinall et al. 2008: 24-25; Fassbinder et al. 1990; Kvamme 2006: 207-210; Linford 2005; Schmidt 2007).

The most common type of magnetometer used in archaeological surveys is the fluxgate gradiometer. This kind of instrument contains two sensors, usually in a vertical arrangement where they are separated by 0.5 to 1 m. These sensors (fluxgates) are made of two cores made of a highly magnetic material wrapped in clockwise and counterclockwise coiled wires, with a third "detector coil" wrapped around both sensors. If an alternating electrical current is passed through the coils it effectively creates a hysteresis loop that cancels out the net magnetization of the cores in the absence of an external magnetic field. When magnetic fields such as that of the earth are introduced to this system the sensors are differently influenced and are no longer "cancelled" out magnetically, thus, the output voltage from the detector coil can be measured and the frequency of this is directly proportional to the magnitude of the introduced magnetic field (Aspinall et al. 2008; Linford 2006: 2225). Simply, both sensors are influenced by the earth's natural magnetic field, but their physical separation allows for the measurement of local derivations in magnetic fields directly below them as the lower sensor (closer to the earth) will be influenced to a greater degree than the upper (Kvamme 2006). The subtraction of this difference is the vertical magnetic gradient at a fixed location, typically recorded to a magnitude of 0.01 nT.

Ground Penetrating Radar (GPR)

GPR is perhaps the most relatable form of archaeo-geophysical prospection as the general principles of radar are comprehendible to the public. Like airborne radar or marine sonar, energy is emitted from a known point and the return, or reflection of that energy is used to measure distances from objects in space. It is an active form of prospection that uses pulses of electromagnetic waves to record reflections off changes in either electrical conductivity or dielectric permittivity in the subsurface (Linford 2006). Electrical conductivity quantifies the ease of passage of an electrical current through a medium (the inverse to this property being resistivity, or earth resistance), while dielectric permittivity is the ability of a material to store electrical charge and/or alter the frequency of electric waves—which results in the reflection of energy (Linford 2006: 2234). These waves are generated via an antenna that operates at a specific frequency that may range from 50 to 1000 MHz (Conyers 2004). When a wave changes its velocity a portion of that energy is reflected towards the surface and the antenna's receiver. As the velocity of the waves and relative dielectric permittivity of most soils are known the depth of buried features can then be calculated. The time between emitting and receiving radar waves (millions of pulses per second) is measured in nanoseconds (nS) and is used as a proxy for depth below surface (Conyers 2004).

As electromagnetic energy is propagated into the ground it is absorbed at a differential rate based on the material it is passing through, and the waves change velocity accordingly. This occurs at the transition between natural stratigraphic layers e.g. sandy soil to clay to gravels, or with the presence of any number of buried features e.g. graves, boulders, house floors, voids, etc. Eventually, the wave energy will be entirely dissipated as reflections are attenuated with depth or impermeable mediums like metal or bedrock. Low frequency antennas (e.g. 50-250 MHz) generally penetrate deeper into the earth than higher frequency antennas (e.g. 900+ MHz) though the ability of the wave to effectively resolve small objects is far reduced. Conversely, higher frequency antennas require a denser sampling strategy for archaeological purposes and can delineate thinner strata, but at a reduced depth (Conyers 2004). As the effectiveness of GPR relies on the physical or chemical difference between mediums, a significant contrast between strata and/or features must exist for meaningful interpretation to occur.

Radar antennas are moved across the landscape in transects, or straight paths, with millions of reflections being recorded over the course of the transit. As the radar unit is a moving entity, and waves are emitted in a conical shape, the reflections are recorded before, during, and after the antenna has passed over reflective objects or materials (Figure 3.3). This causes distinctive hyperbolic shaped anomalies for objects (as the waves appear to "wrap" around them) as well as sloping or flat line anomalies that represent linear surfaces. These transects can be surveyed in a regular grid, and then interpolated can occur between transects to create a plan-view image. The advantage of this is the ability of GPR software to take thin sections, measured in nanosecond or centimeter slices to effectively peel the subsurface away and reveal potential features. Three dimensional models of subsurface features can then be constructed, as depth and relative size of anomalies are known, making GPR unique compared to other methods of geophysical prospection (Conyers 2018).

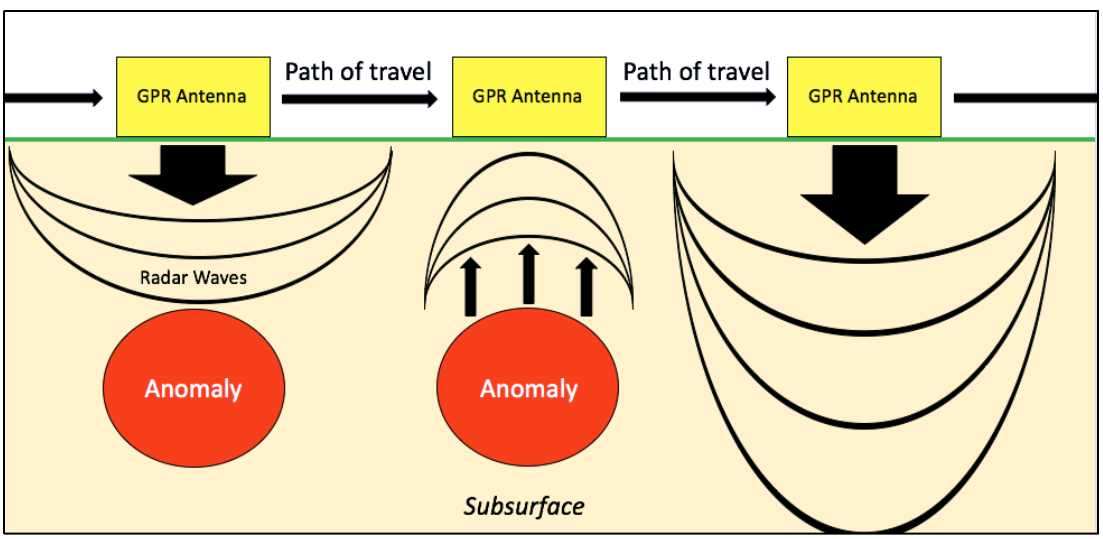

Figure 3.3: How GPR finds buried features.

Electromagnetic Induction (EMI)

Magnetic susceptibility and conductivity are typically paired in geophysical contexts because the instruments used to measure both physical properties can often do so simultaneously. This is the case with the KT-20 3F S/C meter used in this research project. Magnetic susceptibility measured volumetrically as susceptibility per unit volume (k) is simply the degree to which something can be magnetized—mathematically speaking this equates to the ratio of magnetization compared to that of the inducing magnetic field (Dalan 2006). The KT-20 measures susceptibility using the SI (International Units) system with varying frequency bands related to the frequency chosen during survey. These are dimensionless units measured in a range of 0.001 $x10^{-3}$ to 1999.99 $x10^{-3}$ SI for the 10 kHz scan mode used during this project (Dalan 2006, Terraplus 2016). Electromagnetic conductivity (Siemens/meter) can be described as the inverse of electrical resistivity. The effective conductivity range of this instrument is 1-100,000 S/m (Terraplus 2016). There are three stages to the operation of EMI instruments: a transmitter, a receiver, and a subsurface response i.e. collected data.

Linford (2006) uses an electric circuit analogy to explain how an electromagnetic field is created by running current through the transmitter, which induces current in the magnetically susceptible aspects of the subsurface (features), which is then measured by the receiver. Simply, the instrument records the response of the soil to a small, manufactured magnetic field (Figure 3.4). The variation in received EMI response are described as the “in-phase” and “out-of-phase (quadrature)” components, which represent magnetic susceptibility and conductivity, respectively. The advantage of magnetic susceptibility is that it allows the detection of features only visible when induced by a magnetic field, contrary to a magnetometer that detects elements with remnant magnetic properties (Dalan 2006:162). The advantage of using EMI during archaeo-geophysical survey is a speed of data collection close to that of magnetometry, while simultaneously taking both susceptibility and conductivity readings.

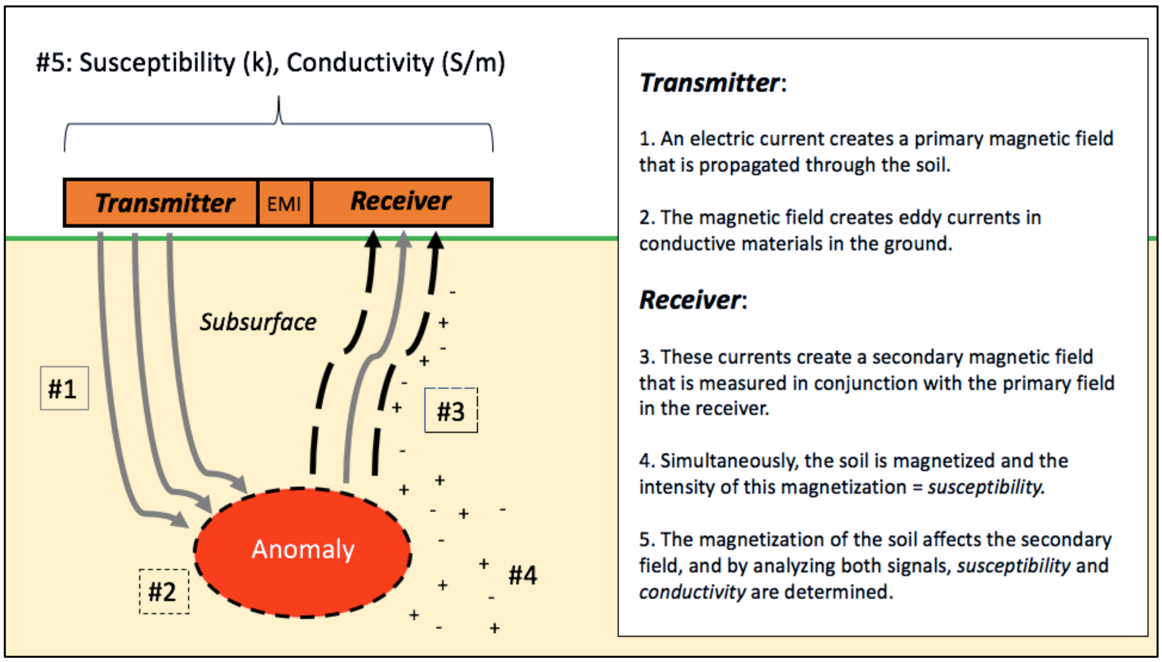

Figure 3.4: How EMI functions to find magnetically susceptible and/or conductive features.

Survey Design

The objective of any survey is the systematic collection of data—with conscientious choices being made regarding that survey's level of coverage. This is a practical consideration, as areas are often simply too large, or time/money are lacking to achieve 100% coverage either by pedestrian, shovel test, or archaeo-geophysical survey (Bonsall et al. 2014:87-88). The simplest way to guarantee the regularity of data collection is to grid the area of interest. Several hectares may then be broken into several smaller (e.g. 10x10 m to greater than 50x50 m) grids in Cartesian fashion that are individually surveyed to create a composite of the whole site. As in pedestrian survey, transects, or regularly spaced lines of travel, are employed within each grid to guide the machine operator in collecting geophysical data. As each grid is of a uniform size and is comprised of the same number of transects, and all other variables being equal the data will be collected in a replicable way that ensures the regular spacing of collected data points within the larger site.

Fieldwork

Fieldwork began on the Ushpitun landform on July 13th, 2018. The first step in the project was to establish an arbitrary grid from which smaller (30x30 m) grids could be individually surveyed. This allowed on-the-ground decisions to be made based on suitability of terrain and the likelihood of finding new sites with respect to those already marked. The magnetometry survey was next, covering the total survey extent of 22,500 m^2 (25 grids). Next, the KT-20 S/C 3F meter was used, covering 15,750 m^2 (17.5 grids). Finally, the GPR was used, covering 11,700 m^2 (13 grids). After all the data was collected, it was processed, and the imagery uploaded into Quantum Geographic Information System (QGIS) v. 2.18 software and georeferenced. Anomalies were identified from the data and locations were chosen to investigate with 1x1 m excavations, in addition to other locations deemed "areas of interest" that would be excavated should time allow. The physical setting up of the excavation units occurred simultaneously with opportunistic field collection of surface lithic materials located during pedestrian and geophysical surveys. The last day of fieldwork was August 12th, 2018, which concluded all excavations.

Setting up the grid

The methodology employed by the author to survey the Ushpitun landform was adopted from a system learned during fieldwork with the National Park Service's Midwest Archaeological Center (S. De Vore and A. Wiewel personal communication, 2017). First, a grid was established using QGIS, overlaying 30x30 m gridlines on an aerial photo of the project area (Figure 3.5). This grid was oriented in the software towards "grid north" or simply the top of the page on the computer screen, which is approximately 21 degrees east of magnetic north. The far-most bottom left grid point was arbitrarily determined North 500, East 500 (500N,500E) and each grid point was numbered in relation to this datum. The coordinate points for these grid corners were then sent to Anatolijs Venovcevs, the HVGB GIS technician, who then uploaded them into a Trimble Real Time Kinematic (RTK) GPS unit as navigable waypoints. Once in the field, these grid corners were navigated to and a wooden stake pounded into the earth at that location (accurate to ±2 cm) and further marked with neon flagging tape and their grid coordinates and surveyors spray paint. The grids were then numbered, beginning with the bottom left-most grid at #1, and moving east, starting the next number at the upper leftmost grid of each new row, for a total of 41 marked grids.[14] After the stakes were placed and the grids numbered, their number was then spray-painted adjacent to the corner stake in the southwestern corner of each grid (Figure 3.5). At the end of the project a large piece of metal rebar was hammered

[14] There is a grid 28.5 which is to the right of grid 28, before grid 29 on the next row to the north. This was added after the establishment of the overall grid, hence the fractional designation. Additionally, no grids north of 32 were surveyed, so these are omitted from Figure 3.2.

into the ground at the 500N 500E marker to allow future work on the site to use the same system. This gridding formed the foundation for the subsequent instrument surveys.

Brush clearing

Of the three instruments used in this project, both the GPR and the magnetometer-

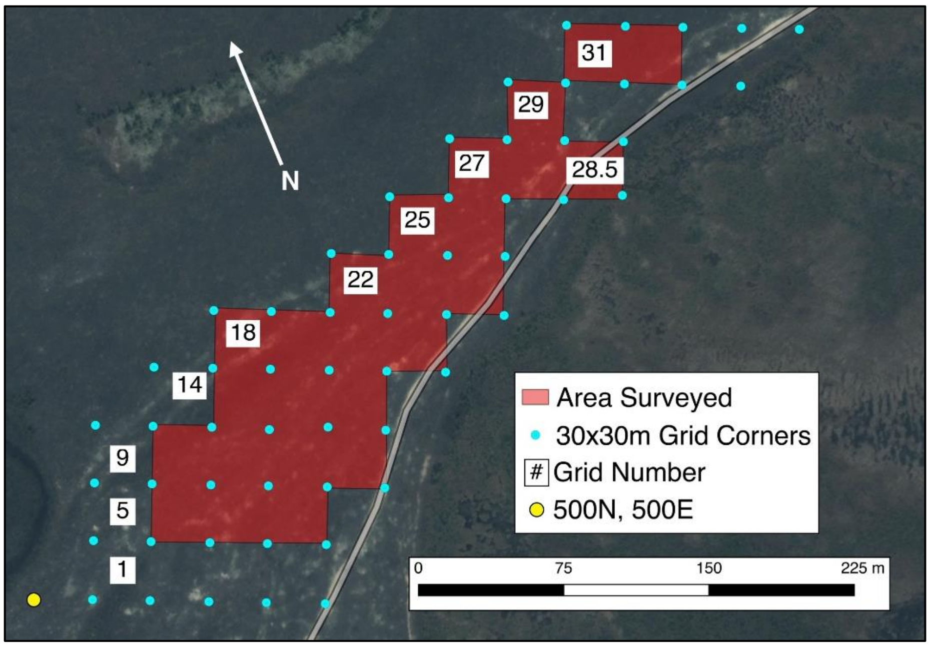

Figure 3.5: Ushpitun survey grids.

cart required constant contact with the ground (the GPR antenna, and the magnetometer cart's wheels), necessitating the clearing of a substantial amount of brush from the surface of the site before the actual surveys could take place. The KT-20 S/C 3F operated similarly to a metal detector, in that it was held just above the ground and panned from side-to-side to take readings—though some of the woodier foliage was a hindrance to this as well. In efforts to combat this issue, Scott Neilsen came out to site on three separate occasions with a gas-powered saw to cut down brush to the surface, thus keeping the root systems intact and allowing for re-vegetation in the future.

Brush was cut by Neilsen (Figure 3.6) as needed and cleared by the author and other volunteers (Figure 3.7). The decision to remove the shrubs and a few trees on the landform was made after arriving on site and realizing that the foliage had grown up substantially since the area was visited in August of 2017 when the site was selected for archaeo-geophysical survey—largely due to its flatness and relative sparseness of vegetation. Any surface trash, especially ferrous metal objects like beer cans or shotgun shells were collected as they would impact the data as visible magnetic anomalies.

Figure 3.6: Scott Neilsen cutting brush – notice the density of shrubbery over the area.

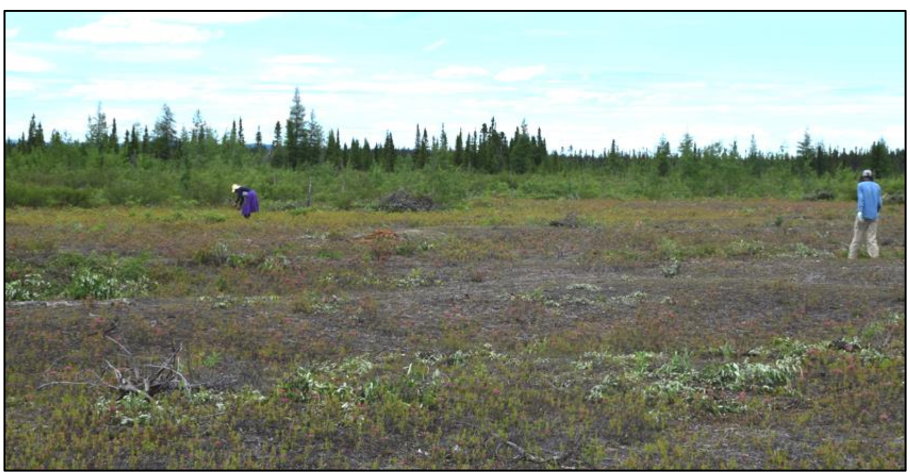

Figure 3.7: Volunteers moving brush – notice the cleared ground in the center of the image.

Individual survey grid set up

Once the overall grid was established and brush was cleared the individual survey grids themselves could be set up using specially measured ropes. These ropes were marked every 0.5 m with alternating duct (silver) and electrical (black) tape marks, each rope being 30 m long and looped on both ends. The loop ends were then placed over the corner stakes for each grid, forming a boundary line on four sides. Transect ropes were then run north/south and used as guidelines for walking or pushing the equipment systematically over the landscape. Each instrument used a different transect width, specific to its ability to collect data, so ropes were adjusted accordingly. As a grid was being surveyed, volunteers would move completed transect ropes to the next grid to facilitate quick transitions between grids. Alternatively, it was found to be useful to simply lay out an entire grid's worth of transects ahead of time, thus allowing a single individual to survey a whole grid without stopping.

Magnetometer cart survey

A Sensys MAGNETO five-channel MXPDA Measurement System was used to collect magnetometry data. This instrument mounts five individual fluxgate gradiometers to a pushcart configuration (Figure 3.8). The cart setup for this project utilized a sensor separation of 0.25 m and a wheel-based odometer to record transect distance and to mark when measurements would be taken. A total of ten measurements were taken per linear meter automatically by each sensor, so every 10 cm each sensor would record its own measurement. Each 30x30 m grid was surveyed in a zig-zag pattern beginning with the first transect in the southwest (0,0) corner of the grid, finishing on the end of the line, and moving the instrument over 0.25 m to begin the next transect surveying towards the opposite end line (Figure 3.9).

Figure 3.8: The author with the Sensys MXPDA magnetometer cart.

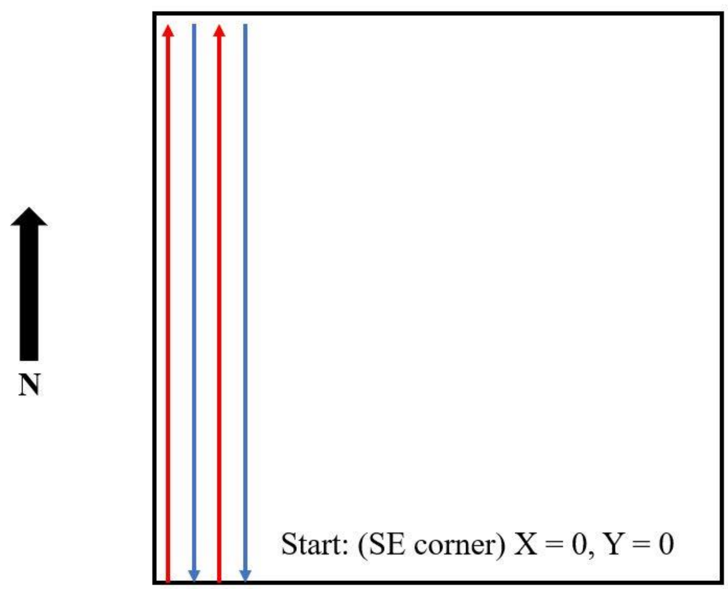

Figure 3.9: Zig-zag survey design.

Overall, 22,500 m^2 were surveyed with the magnetometer cart which amounted to 25 30x30 m grids. These grids were chosen based on suitable topography, proximity to known archaeological sites, (though these sites were recorded with a handheld GPS and their exact location is at best ±15 m) and the ease by which transect ropes could be moved from one grid to the next. It was found that if grids were completed in a north/south pattern then the ropes could be pivoted and the northern end line of one grid then became the southern end line of another, etc. At this rate, each grid took approximately 15 minutes to survey, and between 25-45 minutes to set up, depending on if the previous grid was contiguous to the first and the number of volunteers available to help.

Electromagnetic induction survey

It is essential to mention that this was the pilot test for the KT-20 S/C meter, as it had never been beta tested in the field to this degree. Additionally, it is not generally recommended to use magnetic susceptibility/conductivity to locate small, ephemeral features, rather it is better suited to identify large areas of use or disturbance that can be then more closely surveyed with other instruments (Dalan 2006). Terraplus has remedied the issues identified during this project and will hopefully be releasing a new version of the KT-20 in the summer of 2019 (C. Meunier personal communication, October 2018).

The Terraplus KT-20[15] (Figure 3.10) is operated very similar to a metal detector, in that it is moved from side to side to take readings. These readings include both susceptibility and conductivity measures, 20 of each per second, that are then averaged

[15] The KT-20 S/C meter was in the beta stages of testing during this project. Use of the instrument was mainly to field-test its capability as a geophysical survey tool and see if it had potential in archaeological applications.

every four readings to produce five total data points. An internal GPS records the location of each reading, accurate to ±2 m (Terraplus 2016). To maintain data consistency a transect width of 1 m was used when surveying with the KT-20, as the instrument's side to side movement would increase its lateral coverage. Boundary ropes were used to mark off survey grids, but only two flags were used to mark transects: as each transect was completed the flag was moved to the next end point on that line (effectively skipping every other meter mark on the rope, as the adjacent mark to the transect just completed would be the return transect, and vis-versa) thus a marker designating the path of travel was always present. This method proved economical as it required no additional helpers or ropes, so it was adopted during the subsequent GPR survey.

Figure 3.10: KT-20 3F S/C meter operated by field assistant Dillon Montague.

A total of 15,750 m^2 or 17.5 30x30 m grids were surveyed using the KT-20 in this fashion. The speed of data acquisition is comparable to that of the Sensys cart as both required about 15 minutes to complete a grid. The KT-20 required a regular recalibration that consisted of an "air measurement" where before, and following scans, the instrument would be held aloft and "zeroed" to counteract any drift related to environmental (diurnal) changes. Scans were taken initially in 90 second timeframes (requiring an air calibration before/after each scan) but due to issues with data loss a scan time of 60 seconds was deemed optimal.

This instrument was plagued by problems and required replacement mid-way through the field season. Conductivity data was often not collected due to a software error that recorded it as a "0" value during data processing. Both susceptibility and conductivity data were often not recorded at all due to further software issues, though these have apparently since been remedied by Terraplus (C. Meunier personal communication, October 2018). Susceptibility data was analyzed because it was available in a large enough sample size to make it process-able.

Ground penetrating radar survey

A Sensors and Software Noggin SmartCart system (Figure 3.11) was used for the GPR survey portion of this project. 11,500 m^2 or only 13 30x30 m grids were surveyed, this being the last instrument used and therefore susceptible to the end-of-project time crunch. The survey setup for running the GPR is identical to that of the KT-20 where a flag is placed at the end of each transect and navigated towards in lieu of individual ropes. A zig-zag pattern was therefore utilized and transects were spaced at 0.5 m apart (as recommended by Conyers (2004)) though this meant that 60 total transects per grid were required. The time required to complete just one grid was approximately 90 minutes, due to the slower nature of pushing the cart across uneven and shrubby terrain. While a SmartTow configuration was available, it this was not used as another person is required to ensure the antenna being towed is in the correct position behind the operator; this is easier to accomplish with the cart system (antenna in front) as a field assistant was not always available. Unfortunately, the previous brush clearing done to facilitate easier movement of the magnetometer cart and KT-20 proved not fine enough for the GPR i.e. the level of clearance on the first two instruments was much greater and did not require cutting brush flush to the ground surface.

Figure 3.11: Sensors and Software GPR Noggins SmartCart system in the field.

A 500 MHz antenna was used, as this was the highest frequency antenna Archaeology Department had available. A 1000 MHz antenna would have been preferable as it has a much finer resolution (though this would have doubled the number of transects needed), but the overall inconvenience of use was what limited the functionality of the instrument. Tudor (2013) noted similar problems of brush, roots, and other surface obstructions limiting the GPR in practical application. The primary concern during the 2018 survey was the inability to accurately calibrate the odometer in the field, which caused a substantial amount of null data. Additionally, the stubs of previously cut trees and bushes would constantly become tangled in the odometer often without the knowledge of the operator. Pushing the cart in the lulls between dunes was also much more time consuming than going over the ridges as water would occasionally pool there. It was for these reasons the GPR was used in a limited fashion compared to the other two instruments.

It is worth discussing why an alternative GPR survey strategy, one that utilizes perpendicular transects to create higher density subsurface images, was not employed. This method assumes transects are completed in both a north/south and east/west direction where, effectively, two separate surveys are performed in the same grid. By doubling the volume of data collected the possibility of identifying more ephemeral features increases. Consequently, the time required to survey each grid also doubles, in this case each 30x30 m grid would take approximately three hours to survey at 0.5 m transect spacing. To cover the 25 grids surveyed with the magnetometer this would have taken 75 hours, or over 9 regular working days—an unrealistic expectation. As one of the research questions this project set out to answer regarded the efficiency of equipment a decision was made to adhere to the coarser recommendations by Conyers (2004) to use a zig-zag survey at 0.5 m transect spacing. Additionally, when the GPR failed to identify a visible surface feature in grid #10 (where a transect directly passed over the feature) the utility of GPR on the landform was further questioned.

Data processing

Data was processed for each instrument nightly after the workday, providing an up to date look at the functionality of each piece of equipment and possible areas of interest. This also ensured that any issues encountered while collecting data in the field could be remedied the following day. The software required to analyze each instrument's data is different, but each unique dataset is presented as individual layers in QGIS allowing a direct comparison between equipment in terms of the geophysical anomalies each method identified.

Magnetometer data

Downloading data from the MXPDA cart requires proprietary MAGNETO software provided via dongle by Sensys. This program allows individual grids to be visualized, but it is rather limited in terms of other processing abilities. For this reason, individual grids were then saved as Surfer. grd (grid) files and imported into Surfer 15, a more robust spatial data processing software package. From here, distinct processes were applied to the data called "filters." Spatial filters are mathematical processes applied across a series of values. In this case, each magnetometer grid is an image constructed using ~36,000 data points arranged in rows and columns as tabular .txt (text) files, each with a numerical (+/-) value in nT. The image we see is the result of an interpolation, or an average of those numbers together to visualize the contrast between values as black to white pixels in greyscale. This allows us to literally see the contrast between archaeological features and their surrounding matrix.

Three forms of filtering were then used: (1) a low-pass filter was applied to effectively "smooth" the data and remove lower nT value "noise" from the imagery (2) a FreiChen column detection filter was applied to "de-stripe" the data—as magnetic data is prone to "herringbone" heading errors that show transect paths, and (3) the data was "clipped," where the maximum and minimum values were limited to a standard range of ±10 nT (Kvamme 2006). Once these processes were completed the finalized grids could be imported into QGIS as hillshades and georeferenced according to their relationship to the pre-established digital grid of the site. In this way, each of the 25 magnetometer grids were stitched together to form a contiguous mosaic image of the surveyed area.

EMI data

KT-20 data was downloaded from the instrument into Terraplus's proprietary GeoView 2.1 data management software. From here, the data was exported into Surfer 15 where it was visualized using contour lines in addition to greyscale contrast. The use of contour lines appeared most effective in the identification of possible archaeological features, as when the data is imported into QGIS it loses that functionality and the finer resolution that Surfer provides. Low-pass filters were applied to the EMI data, but this had little effect on the overall interpretation, and further filtering was not undertaken. As mentioned, the data were problematic in the sense that it was not always recorded properly, which created large gaps in the surveyed grids. Where the magnetometry data was recorded in perfect rows and columns, the KT-20 data was taken via lateral swings of the instrument walking without rope transects. The combination of less systematic data collection and gross system malfunctions limited the utility of the intact data and tended to not provide quality interpolations. For this reason, KT-20 data was not relied upon for determinations regarding future ground-truthing, as it additionally did not corroborate the more reliable magnetometer data (Figure 3.12).

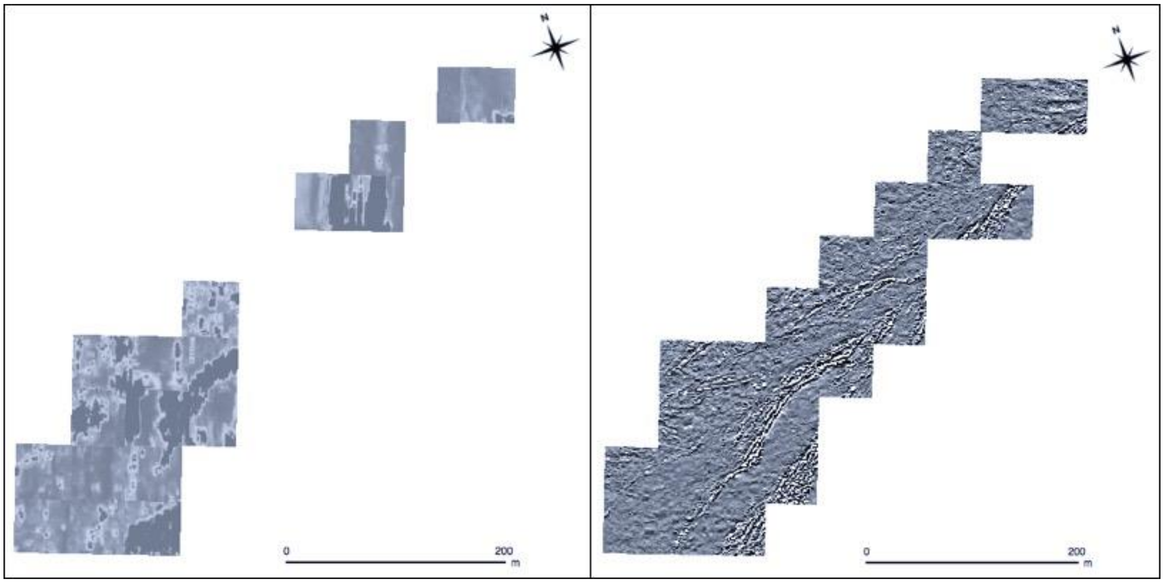

Figure 3.12: Magnetometry (right) and Magnetic Susceptibility (left) data.

GPR data

The proprietary software available from Sensors and Software is EKKO Project, a visualization tool that allows three-dimensional construction of GPR data. This software was used to scan through GPR profiles (vertical thin sections) representing each transect. There is an additional ability to see radar reflections in a plan view heat map (horizontal thin sections) in incremental 5 cm sections, but Memorial University's Archaeology Department does not have a travelling license for this aspect of the software and its use is limited to in-house processing. This hindered field data analysis, and restricted GPR results to profiles exclusively. Once the software was available, plan view images of each surveyed grid were taken at 15 cm below surface (the known cultural horizon), and these were georeferenced in QGIS in the same manner as the other data (Figure 3.13).

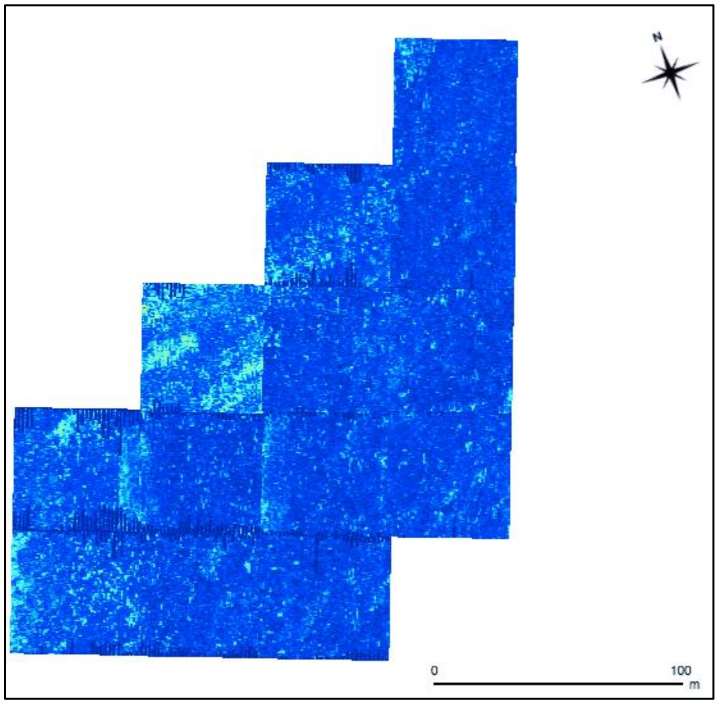

Figure 3.13: GPR plan view at 15 cm below surface. Dark blue lines indicate odometer failure.

No additional processing of GPR data was undertaken, as the default settings in EKKO Project automatically apply a gain correction, dewow, and velocity calculation. This was deemed acceptable due to the sandy nature of the site being a perfect candidate for GPR survey in the first place (Conyers 2006, Milsom 2013). Additionally, the relative absence of subsurface inclusions like boulders or mixed stratigraphy limited the level of "noise" present in the data. Despite this, the GPR was similarly ineffective in locating ephemeral targets. Troy De Souza, a representative for Sensors and Software was contacted regarding this issue, and he explained that the first 20 cm or so in the data collected using a 500 MHz antenna is effectively masked in the "surface" layer of information (T. De

Souza personal communication, October 2018). This was solved by further filtering the data, but no features were visible. Further, the GPR clearly failed to identify a possible hearth feature that was erupting from the surface. This issue combined with its painfully slow data collection speed and calibration issues contributed to its limited use.

The experience of the author in using, and processing, geophysical data is also an important variable that must be considered in this thesis. Having participated in over a dozen geophysical projects throughout the US, the author maintains a baseline of expertise related to the operation of instruments and in overall survey design. However, this was the first occasion where survey design, operation, and data processing were the author's sole responsibility. While the utmost confidence is maintained in the quality of data acquisition there remains the possibility that a more experience operator/processor of geophysical data may uncover or identify additional features. For this reason, all raw geophysical datasets will be available upon request from the author and the PAO for further review.

Surface survey and unit establishment

During the grid construction, brush clearing, and eventual geophysical surveys lithic material was noted and marked across the landform. Venovcevs assisted with the GPS marking of these lithic elements using the same RTK that set up the overall grid. Individual lithic elements were given their own coordinates unless several occupied the same small area, in which case they were grouped together, and these were uploaded into QGIS as discrete points along with the processed geophysical data to help inform excavation location. A total of 80 elements were recovered, though four diagnostic artifacts were collected between 2013 and 2015 (Neilsen 2013, 2015).

The marking and collection of lithics came post-geophysical survey and pre-excavation, during the establishment of several 1x1 m units. A total of eight units were georeferenced using the RTK, along with six areas of interest that could be investigated if time permitted. These units were initially marked with metal spikes at their corners but were replaced with wooden ones so each unit could be metal detected to determine if the magnetic anomalies present were thermoremnant (likely precontact) or due to ferrous objects (likely modern). A metal detector was therefore a very useful tool to establish the credibility of each unit.

Summary

This chapter addressed archaeo-geophysics broadly, as well as survey (both geophysical and surface collection) design and data processing. Geophysical instruments have been used to locate archaeological features by providing a visual contrast between properties of materials. This is accomplished by establishing a survey methodology that is suited for locating the desired targets, in this case 0.50 m transects across numerous 30x30 m grids. The data from these surveys is then amalgamated in different geospatial processing software (here Surfer and QGIS) and manipulated with specific algorithms called 'filters' to create interpretable visual imagery. Once the data was processed, it could be analyzed between datasets and the utility of each instrument compared. A surface survey for lithic materials was also undertaken, after the archaeo-geophysical survey and during the marking of 1x1 unit corners. The next chapter will discuss the results of each of these investigations: the archaeo-geophysical surveys, the surface collection, and the subsequent excavation of identified features.

Chapter 4 – Pedestrian survey, archaeo-geophysical survey and excavation results

Introduction

This chapter will build upon Chapter 3 by providing the results of the pre-excavation surface survey, geophysical survey, the excavations themselves. The surface survey was comprised of both marking artifact locations with GPS, and then collecting the them for later analysis. Archaeo-geophysical survey consisted of using the magnetometer cart, the KT-20 S/C meter, and GPR. Excavations were conducted based upon collected magnetometry data as the GPR (poor antenna and transect choice) and EMI (beta-version instrument) did not yield interpretable results.

These locations chosen for investigation were done so independent of the results of the surface survey and the location of previously known archaeological sites on the Ushpitun landform. This is an important point to remember when considering that one of the research questions for this project asks "what is the efficacy of archaeo-geophysics in this environment?" therefore, archaeo-geophysics was used here in a controlled manner for "pure" prospection, as the selected locations for test units were not influenced by existing knowledge of lithic densities or the locations of known sites. The archaeo-geophysical surveying was performed between July 16th and August 9th, marking and collection occurred on August 9th, and excavations took place between the 10th and 12th of August 2018.

Archaeo-geophysical survey results

Magnetometry cart survey

During the planning stage of this project, magnetometry was determined to likely be the most effective methodology, as combustion features could be readily located due to their thermoremnant magnetism. The total area surveyed using magnetometry defined the geophysical survey extent for the following two instruments.

Results from the magnetometer survey revealed a total of 14 anomalies thought to be of potential cultural origin. These anomalies were broken into two categories: (1) test unit anomalies (TUA), and (2) areas of interest (AOI). TUAs were excavated as 1x1 m units that were expanded as necessary to determine the extent of any features present. AOIs would be marked as a single point and investigated as time allowed—these being of a lower perceived "quality" in terms of possible cultural affiliation, or in the immediate vicinity of anomalies already being excavated. Both TUAs and AOIs were given a number to indicate the order in which they were investigated—these would later be given coordinates based on the established arbitrary grid (Table 4.1). Figure 4.1 shows the locations for all TUAs and AOIs on the Ushpitun landform, with corresponding imagery in Figures 4.2 and 4.3.

Table 4.1: TUA and AOI location information.

TUA #	Coordinates (yxz*)	Grid #	AOI #	Coordinates (yx)	Grid #
1	593N 635E, 13.40m	12	1	553N 576E	6
2	574N 562E, 12.93m	10	2	675N 722E	24
3	670N 720E, 13.70m	24	3	677N 717E	24
4	749N 767E, 13.57m	29	4	719N 786E	28
5	715N 789E, 13.11m	28	5	759N 769E	29
6	758N 761E, 13.02m	29	6	766N 826E	32
7	776N 749E, 12.81m	31			
8	729N 736E, 13.40m	27			

* Z values are given as meters above sea level (masl).

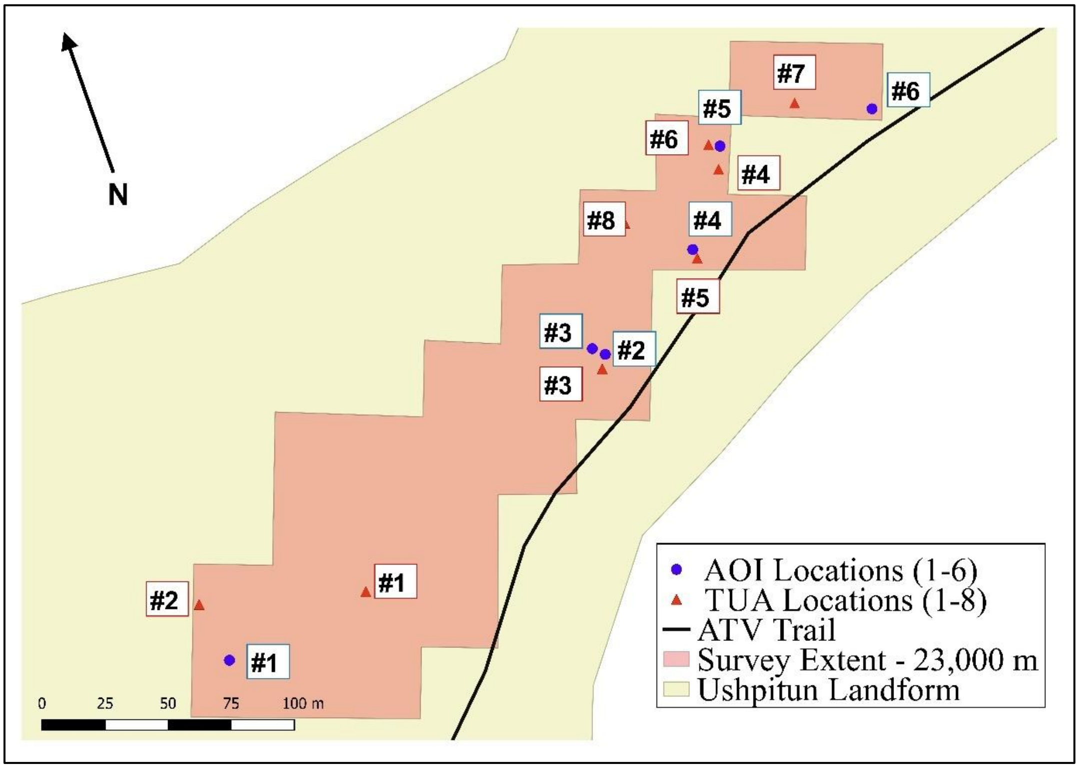

Figure 4.1: TUA and AOI locations on the Ushpitun landform.

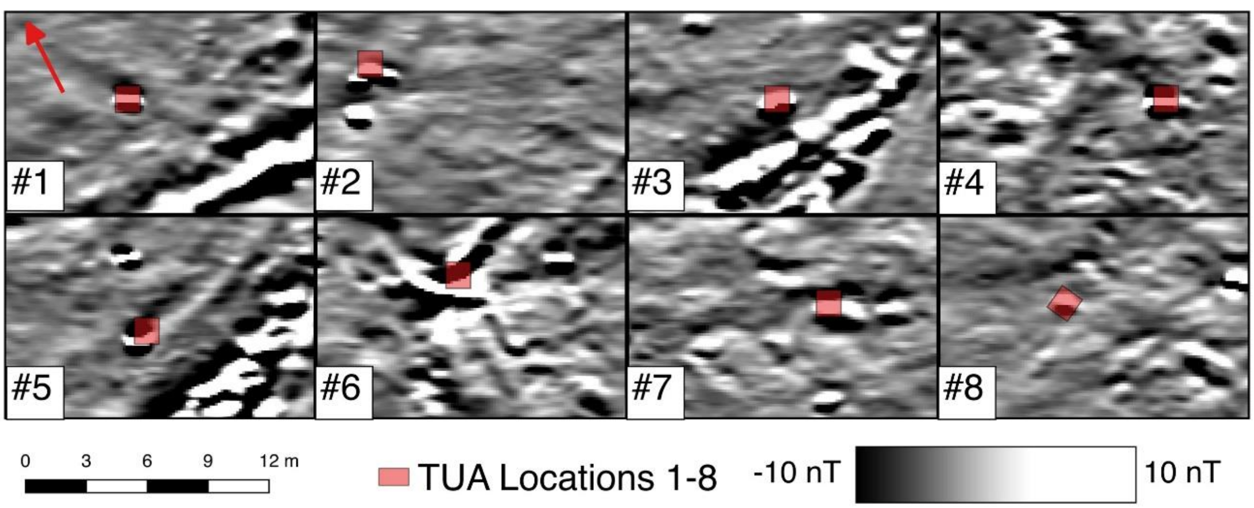

Figure 4.2: TUA magnetometry data showing location of excavated units (TUA # 1-8). TUA #8 was marked without using the arbitrary grid and was therefore oriented roughly due north.

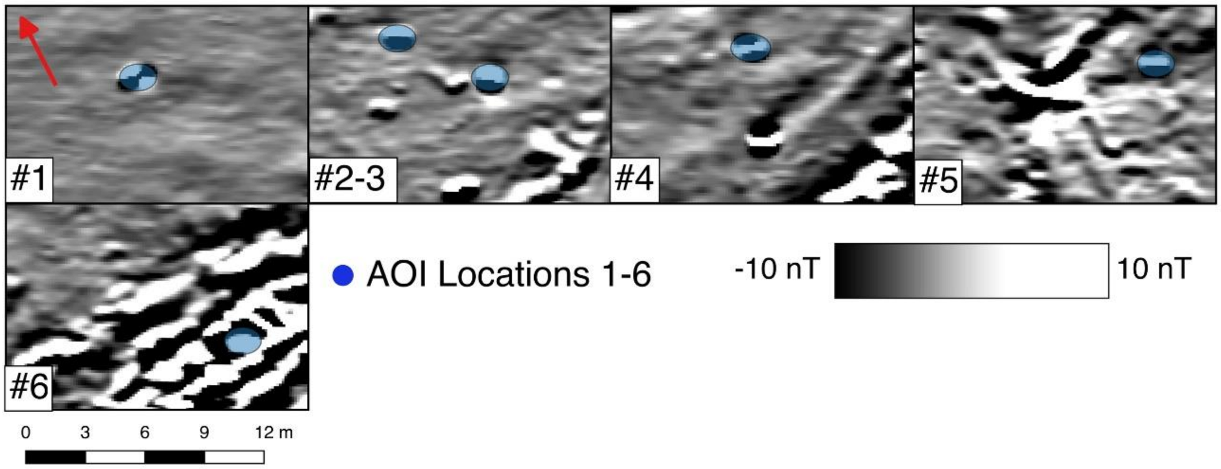

Figure 4.3: AOI magnetometry data showing locations of un-excavated anomalies. AOI # 1-6.

Geophysical anomalies appear as contrasts to the areas around them. In the case of Ushpitun, ephemeral combustion features were the targets of interest, so isolated, round-shaped features were selected for study. These can be seen in Figures 4.2 and 4.3 above as the sharply contrasting black and white circular, dipolar anomalies, with a visible magnetic positive and negative element represented in black and white (Jones and Munson 2005). The neutral grey color in the figures represents the magnetic background, while other sharp black and white contrasts are considered "noise" or magnetic interference that can come from a variety of sources. In this case, after discussing the matter with geophysics expert Paul Cheetham of Bournemouth University, he asserts that the substantial amount of background noise is likely due to ferrous minerals in the soil (Fassbinder et al. 1990; P. Cheetham personal communication, October 2018; St. Croix 2002). This interference can be seen in every image but is most prominent in panel #6 of Figure 4.3, where the entire image is interrupted by noise (one can carefully make out what appears to be a rectilinear feature surrounding the blue circle, though this was not investigated due to time constraints). The level of magnetic susceptibility naturally present in some areas of Ushpitun could be tested in a laboratory and would offer a greater understanding of the overall magnetization of the landscape.

EMI survey

The KT-20 3F S/C meter was used to survey 17,500 m^2 of the landform, within a select portion of the 22,500 m^2 area that was covered by the magnetometer cart. As mentioned previously, the KT-20 had numerous hardware and software issues and necessitated replacement midway through the project (Wolfrum 2018, unpublished technical report). The foremost issue was that the equipment would selectively fail to store both susceptibility and conductivity data as well as GPS points, rendering entire transects meaningless. Additionally, conductivity data was not accessible due to a software bug during data download, so only the susceptibility data is presented here. Given the somewhat arbitrary data density available the susceptibility results are suspect but were processed anyway to provide a comparative dataset. Figures 4.4 and 4.5 show the same anomaly locations (those covered in both surveys) as pictured in Figures 4.2 and 4.3, but with magnetic susceptibility imagery.

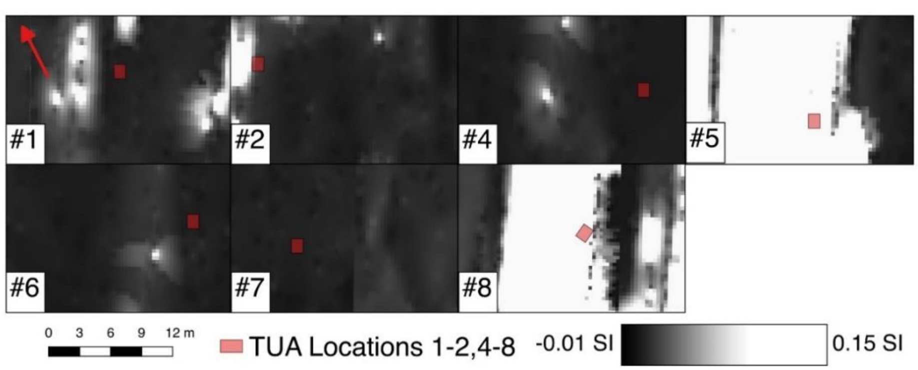

Figure 4.4: Magnetic susceptibility results for TUAs.

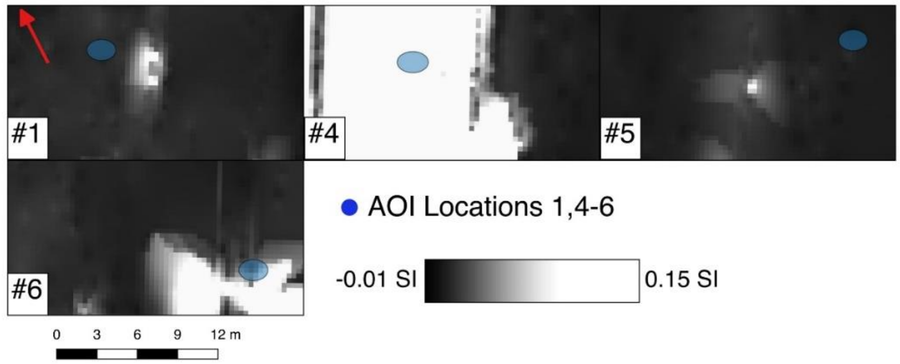

Figure 4.5: Results for AOIs.

As one can see, compared to the relatively distinctive magnetometry data, the EMI survey yielded poor results with no anomalies located in the same location as those discovered using the magnetometer cart. Further, the locations of areas of magnetic susceptibility are several meters from those seen in the magnetometry survey, indicating that the instrument's utility in locating discrete features is lacking the accuracy necessary for later ground-truthing. While it is possible that the EMI survey revealed features the magnetometer did not, the extensive nature of the KT-20s technical issues made this unlikely.

GPR survey

The final archaeo-geophysical survey to be completed was ground penetrating radar. This survey covered 11,500 m^2, again within the initial 22,500 m^2 area surveyed using the magnetometer cart. A limited schedule towards the end of the project resulted in less coverage for the GPR survey, though this was somewhat by design as the GPR was deemed the least likely of the instruments to locate combustion features. While the sandy soil of Ushpitun is a perfect setting for radar use the nearness of features to the ground surface made its utility questionable. This became clear in the data as neither plan, nor profile imagery could definitively identify features otherwise visible in the magnetic data. As the magnetometer and GPR measure entirely different properties this is not necessarily unbelievable, but the presence of burnt stones meant that the radar should reflect off the rocks themselves or any significant soil disturbance associated with burning. This proved not to be the case, as can be seen in the data below. Figure 4.6 shows the location of TUA #1 in Grid #6, and Figure 4.7 shows TUA #2 in Grid #10. Neither of these locations appear as highly reflective in the GPR plan imagery.

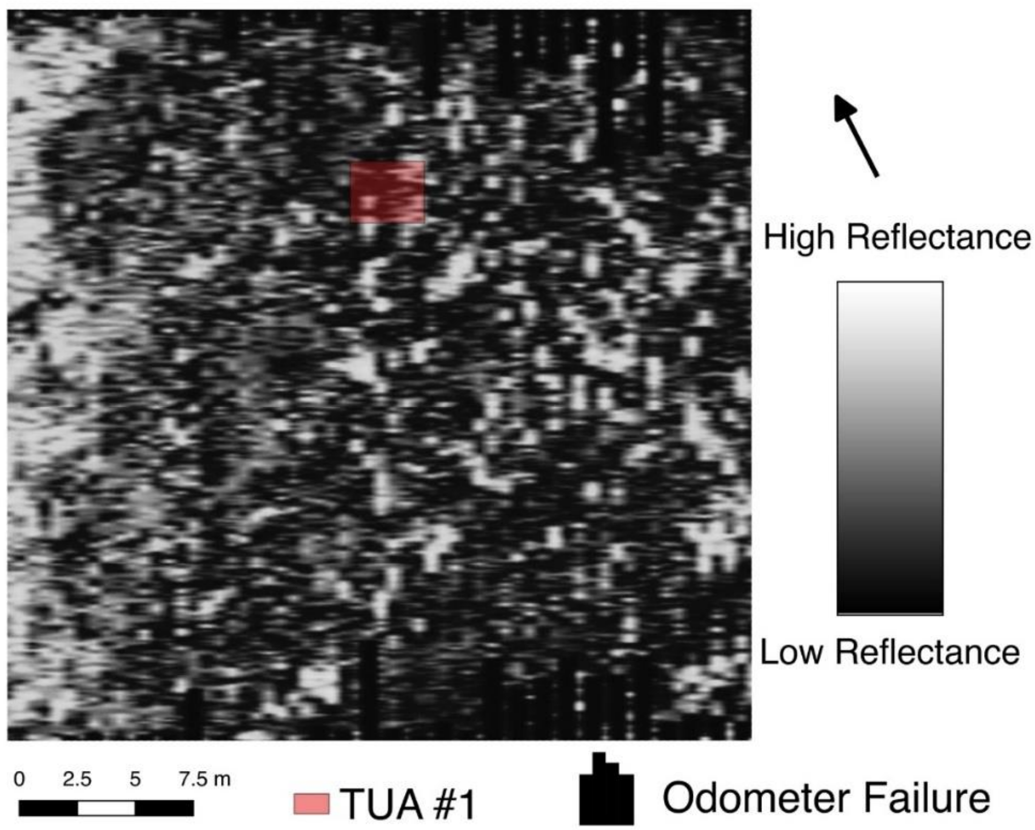

Figure 4.6: GPR plan view over TUA #1 at 10-15 cm below surface.

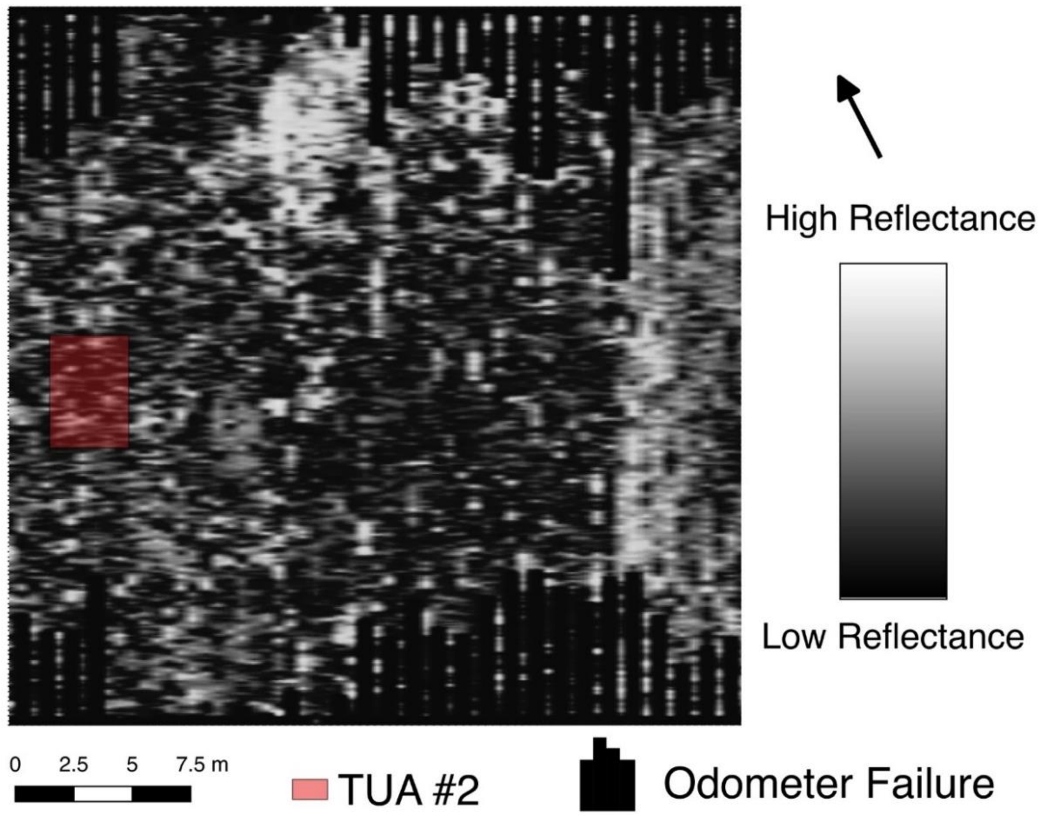

Figure 4.7: GPR plan view over TUA #2 at 10-15 cm below surface.

Several transects cross over the feature in TUA #2, yet in the GPR profiles (see one example in Figure 4.8) the usual hyperbolic wave reflections seen in GPR data that would indicate a subsurface feature, are absent (Conyers 2006). This indicates that the features (bracketed in red in Figure 4.8) are too shallow and/or too small to register in the GPR data. A background subtraction process was applied to this data, which removed a solid, dark band present for the first several centimeters near the surface of the data, but the combustion feature is still not apparent. As the combustion features are erupting from the surface in this instance, they would fall within a range undetectable by the radar apart from the physical contact of the rocks with the antenna. The GPR, using a 500 MHz antenna was thus determined to be ineffective for locating these kinds of features on this landscape, as predicted.

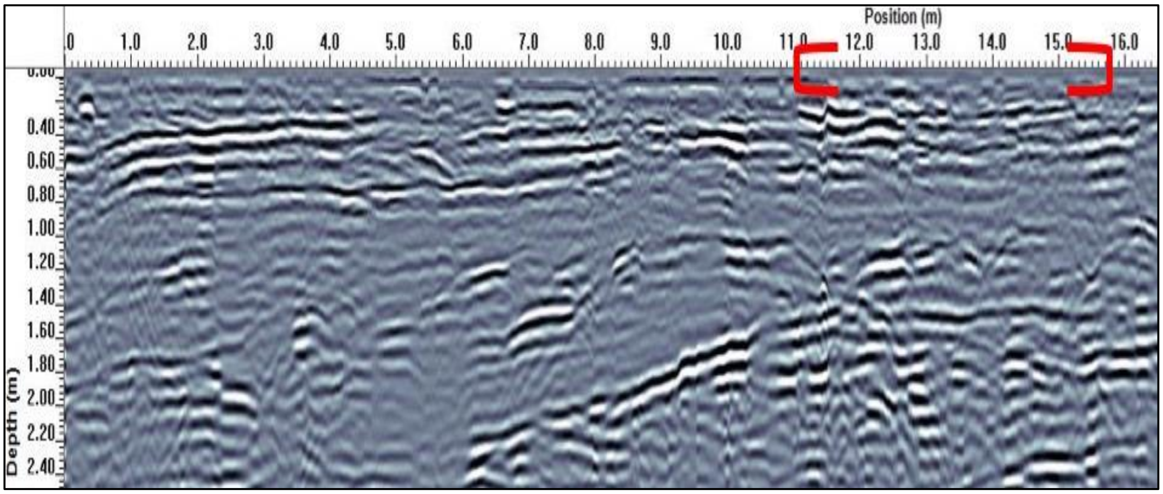

Figure 4.8: GPR profile of TUA #2. Red brackets mark the extent of the feature.

Known combustion feature (FhCb-07) survey

After each instrument survey was completed, a final survey of a previously known combustion feature was undertaken. This took place at FhCb-07, a site on the northeastern edge of the landform (Figure 4.9).[16] Identical to the overall survey, the magnetometer, EMI meter and GPR were used, in that order. A rough 15x15 m grid was established using tapes, as this area was not a part of the original grid system. The combustion feature is readily visible in the eastern edge of the magnetometry data (Figure 4.10) as a familiar dipolar anomaly, displaying both the highly positive (white) and highly negative (black) poles. The neutral greyscale background makes this feature quite recognizable, in contrast to the EMI data (Figure 4.11).

[16] Note the erroneous placement of FhCb-07 in the GIS data compared to the survey area (yellow square) that is almost 40 m away to the east. The accuracy of handheld GPS units will be discussed in Chapter 5.

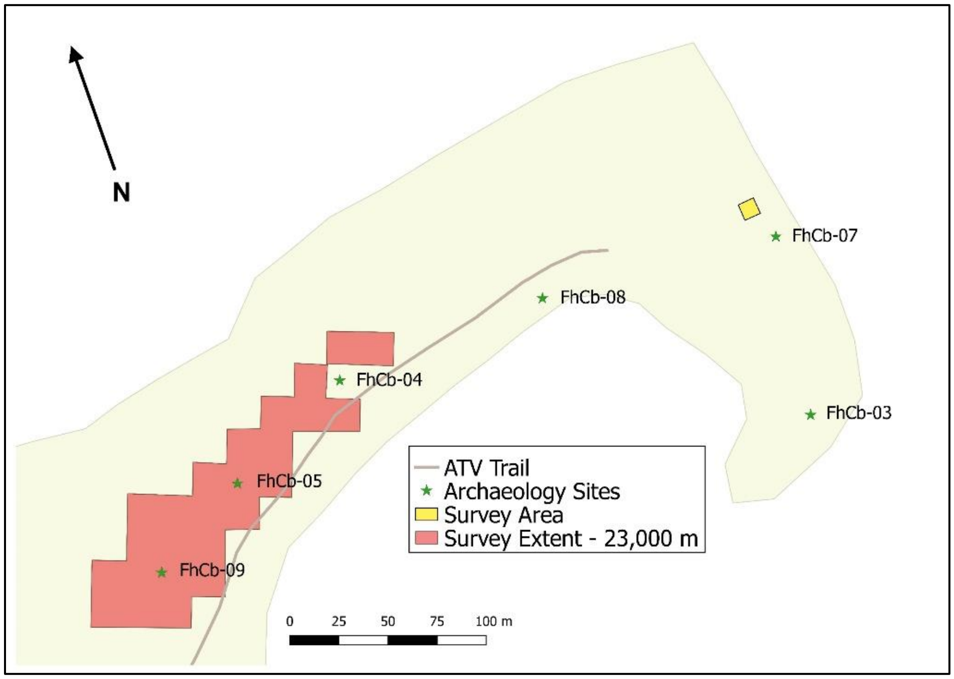

Figure 4.9: Location of FhCb-07 survey area relative to the original survey area.

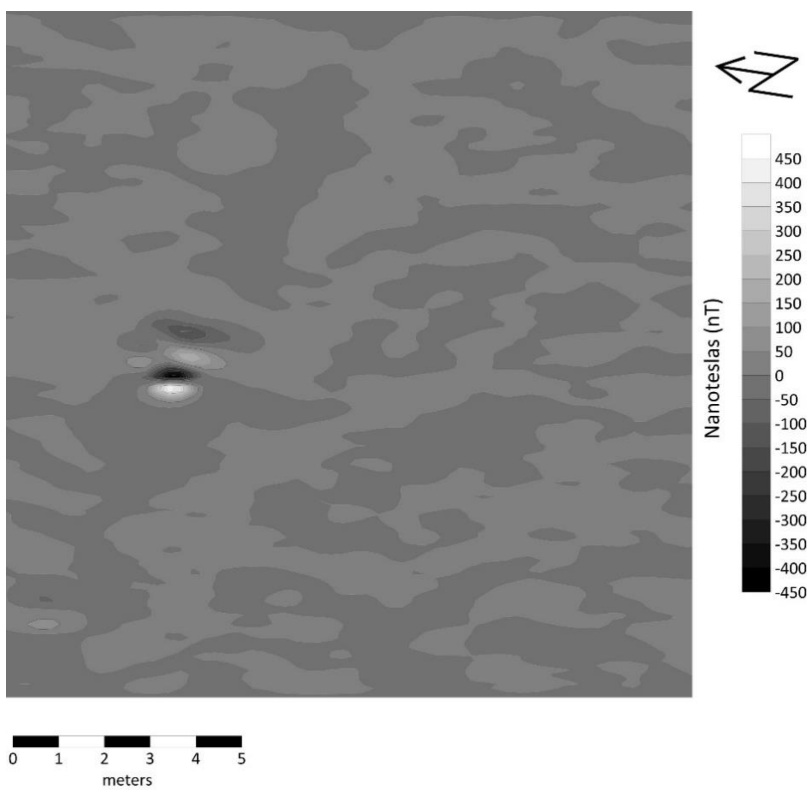

Figure 4.10: Magnetometry data from a known combustion feature at FhCb-07.

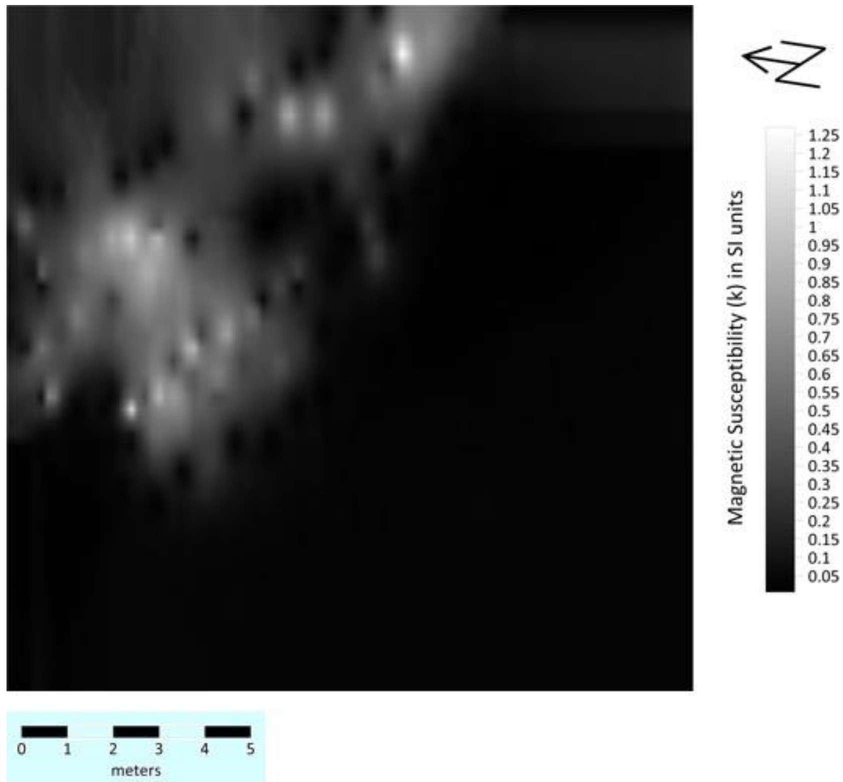

Figure 4.11: Magnetic susceptibility data from a known combustion feature at FhCb-07.

The results of the EMI survey over the same area were less impressive than the magnetometer survey. A distinctive area of magnetically susceptible ground activity is visible from the bottom left, to middle right-hand portion of the image, though no discrete features are visible. One can, however, see that the magnetometer anomaly and the darker (more highly susceptible) areas are in approximately the same locations, so EMI does warrant further investigation in terms of its ability to define, at the very least, possible locations of cultural activity. It is reasonable to assume that the data from this location were of higher quality (a greater number of evenly collected data points, fewer non-recorded points, etc.) and showcases the upper end of EMI functionality in this environment. But, as the data from the main survey failed to accurately delineate between feature and not, the methodology unfortunately remains uncertain at best.

The GPR survey of the known combustion feature was the least informative of the three surveys and fell victim to the same issues identified in the main survey. Like TUA #2, the proximity of the features to the ground surface made the interpretation of data impossible. The only indication of present archaeological materials was the noise of the antenna scraping over exposed cobbles. Figure 4.12 below reveals the plan view of the known combustion survey, while Figure 4.13 shows the profile view of two transects that cross the feature.

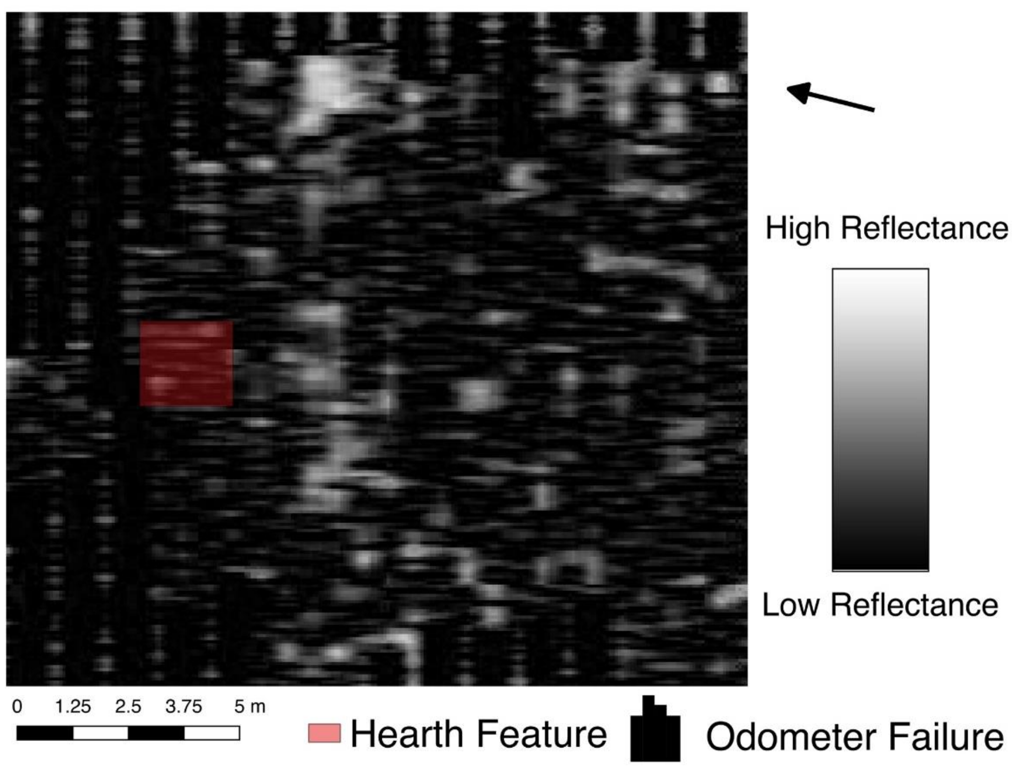

Figure 4.12: Plan view of GPR survey of known combustion feature at 10-15 cm below surface.

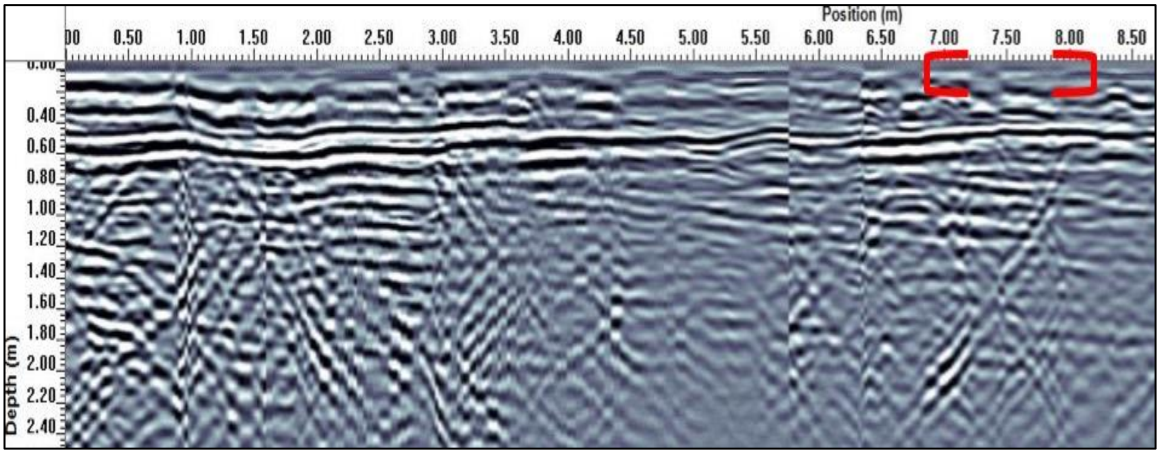

Figure 4.13: Transect profile of the known combustion feature. Feature location marked in red brackets.

One can see that in both the plan and profile views the combustion feature is all but invisible in the GPR data. This confirms the results from the main survey in a meaningful way that lends credence to not using the instrument on a larger area, as this would likely not have revealed anything at the soil depth of interest.

Surface Survey

Collection

Neilsen and Venovcevs arrived on site in the afternoon of August 9th, 2018 with an RTK GPS to record positions for artifacts and sites on the landform, and to set up the corners for 1x1 m excavation units to be excavated the following day. As archaeo-geophysical survey is a de-facto form of pedestrian survey, some surface artifacts were located and marked during the operation of equipment. These marked artifacts, in combination with extant marked artifacts from previous walkthroughs provided the basis for which locations were more intensively scanned for lithic materials. The corner locations for eight 1x1 m TUAs and six AOI point features were marked first, and the lithic survey followed.

Most lithic elements recorded were found in the northern grids of the survey in the general vicinity of FhCb-04 and between FhCb-04 and FhCb-05 (Figure 4.14). A rough best-fit line can be drawn between the plotted artifact locations and known sites that trends positively in a northeast/southwesterly direction following the former beachfront. As can be seen in Figure 4.14, some artifacts were found outside the original survey area and close to the ATV trail, validating the concern regarding the trail and its possible negative effects on cultural resources, though to date no artifacts have been found in the trail itself (S. Neilsen personal communication, July 2018). Ultimately, individual lithic elements were recorded, unless several occupied the same space in which case, they were collected individually but given the same GPS point. Erupting cobbles thought to be of cultural origin were also marked, though these were not collected.

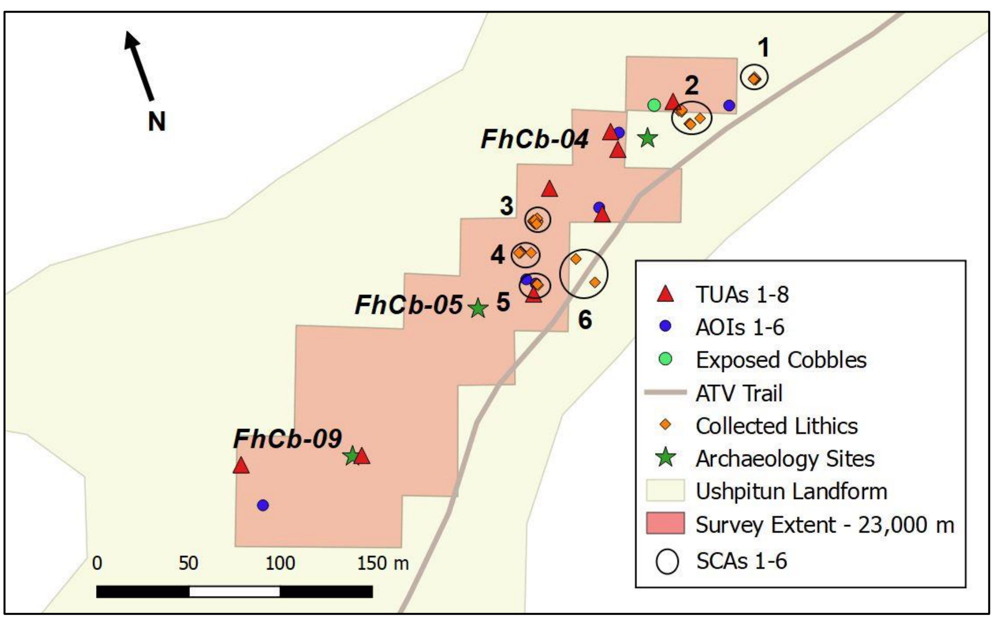

Figure 4.14: Locations of SCAs on the landform.

Areas where artifacts were collected were referred to as "SCAs" or surface collection areas, and individual elements were given a number within these groupings. In total, there were six SCAs, each with between two and twenty points apiece, though it is essential to remember that multiple artifacts were tied to a single point if in proximity to one another (Table 4.2). These areas were previously identified as possessing artifacts, and more intensively scanned during the recording and collection of extant lithic materials. Once no further artifacts were visible within a few meters of the initial cluster, the process moved to another known site within the original survey zone.

A total of 80 individual lithic elements were recovered from surface survey on August 9th, while four other artifacts that had been collected from the site in 2013 and 2015 were included in the assemblage. Table 4.3 displays the types of lithic materials collected

Table 4.2: Artifact density by surface collection area.

SCA #	SCA 1	SCA 2	SCA 3	SCA 4	SCA 5	SCA 6
Artifacts Collected	18	13	36	8	2	3
Points Recorded	10	7	20	7	2	3

and their frequency relative to the entire assemblage. It should be noted that the four elements included in this list (recovered in 2013 and 2015, are: two bifaces, one biface fragment, and the split cobble (Neilsen 2015, 2016b). The guidelines for this lithic analysis will be discussed in the next chapter, but followed the conventions established by Neilsen in 2004 after Andrefsky (1998) and Kooyman (2000) (Neilsen 2006). Each lithic artifact was designated with the Borden number followed by a number representing the order it was collected, e.g. FhCb-12:1 would be the first lithic recorded during the 2018 survey (referred to in the document simply as “#1”).

Table 4.3: Type and frequency of collected lithic materials.

Specimen	Number	Percentage
Biface	2	2.44%
Biface Fragments	3	3.66%
Utilized Flakes	0	0.00
Flakes	25	34.49
Flake Shatter	30	34.15%
Shatter	0	0.00
Microdebitage*	23	28.05%
Split cobble/nodule	1	1.22%
Total:	**84**	**100%**

*Defined as less than 1cm in size (after Neilsen 2006).

TUA unit corner setup and AOI marking

Occurring simultaneously with the recording and collection of lithic materials was the establishment of TUA unit corners and point locations for AOIs. Prior to the lithic survey, the results of the archaeo-geophysical surveys were analyzed and certain anomalies in that data were targeted for excavation. To achieve this, a 1x1 m grid was digitally overlaid upon a georeferenced map of all three geophysical surveys and unit corners were marked with point locations (like the establishment of the original 30x30 m survey grids). In the same fashion, these corner points were sent to Venovcevs and imported into the RTK as navigable waypoints. Once on the landform, these waypoints were located and marked with stakes. AOIs were also marked with stakes. The author and Neilsen hammered stakes while Venovcevs used the RTK to designate unit corners and mark any nearby lithic materials.

A total of eight TUAs and six AOIs were marked during the survey. The naming convention for these units is based on the order they were marked, beginning at TUA #1, and continuing to TUA #8. The southwestern corner of each unit was determined to be the datum, and this location was assigned coordinates based on the preexisting arbitrary grid (origin of 500N 500E in the southwestern-most corner of the survey area). These coordinates are listed in Table 4.1.

TUA excavation results

The results of the unit excavations will be detailed below in the order of TUA number. Broadly speaking, the excavations were uneventful and revealed, for the most part, not much more than what was visible on the surface: eroding cobbles. Interestingly, none of the three potential features located had any artifacts within them, though as one can see on Figure 4.14 there were numerous lithics in the general proximity of TUAs #7 and #8. TUA #2 had no surface lithics nearby it, but nevertheless proved the most exciting as it was expanded from its original 1x1 m unit to include four additional 1x1s. An excavation summary is provided below for the TUAs in Table 4.4.

Table 4.4: TUA excavation summary.

TUA #	Coordinates (yxz*)	Grid #	Excavated?	Features Present?
1	593N 635E, 13.40m	12	No	N/A – surface iron
2*	574N 562E, 12.93m	10	Yes	Yes – combustion
3	670N 720E, 13.70m	24	Yes	No – buried iron
4	749N 767E, 13.57m	29	No	N/A – surface iron
5	715N 789E, 13.11m	28	No	N/A – surface iron
6	758N 761E, 13.02m	29	Yes	No – lightning strike?
7	776N 749E, 12.81m	31	Yes	Yes – pit
8	729N 736E, 13.40m	27	Yes	Yes – combustion

* Z values are given as masl.

TUA #1 (Grid#12)

This unit was not excavated due to the presence of a degraded tin can on the ground surface. TUA#1 remains significant as it demonstrates the limitations of the geophysical equipment in terms of interfering signals from ferrous trash on site.

TUA #2 (Grid #10)

TUA #2 was placed over stone cobbles erupting from the substrate, that were identified in both the magnetometry and EMI (susceptibility) data. Figure 4.15 below displays each resulting image side by side to demonstrate how the anomalies are interpreted. A series of circular anomalies are present, which would further lend credence to the decision to expand the initial unit. To differentiate between units associated with the original TUA #2, decimal assignments will be made e.g. TUA #2 will become #2.1, the next #2.2, etc. This is demonstrated in Figure 4.16 below.

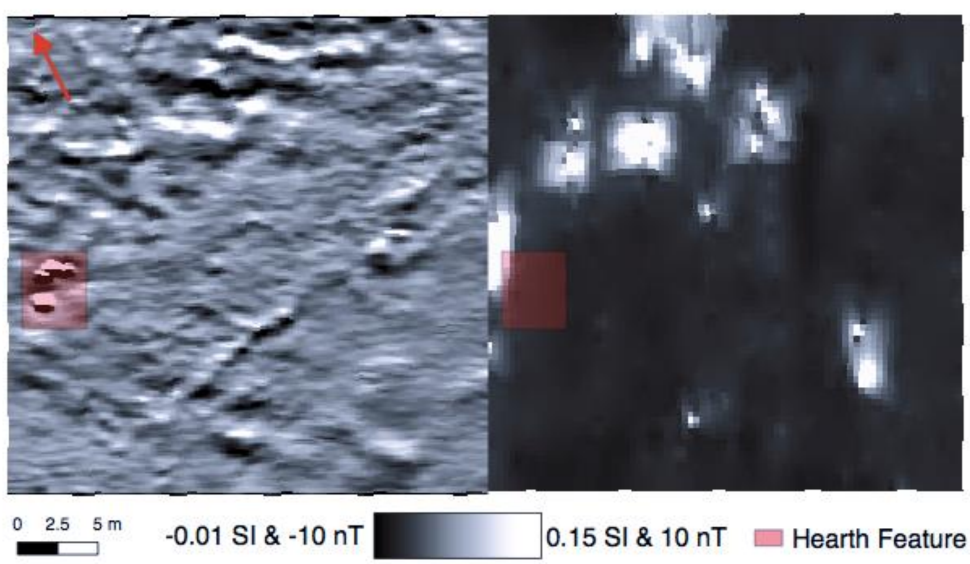

Figure 4.15: Magnetometry (left) and EMI (right) imagery of TUA #2.

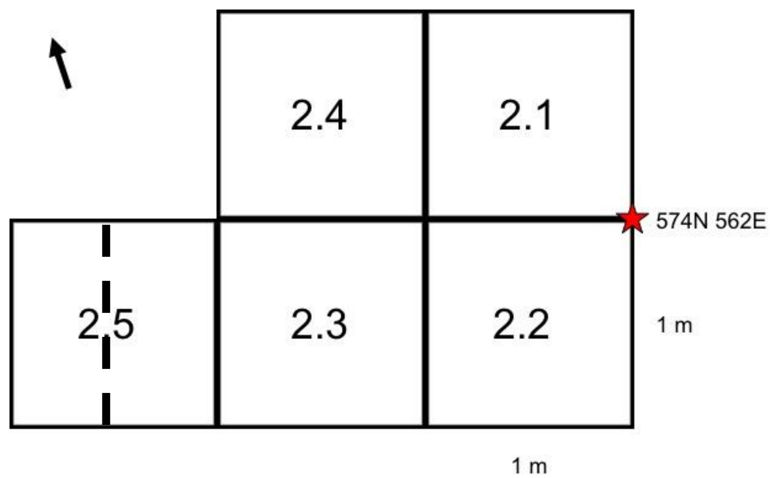

Figure 4.16: TUA #2 expansion (2.1 was the first unit excavated). Dash indicates half of unit excavated (eastern portion).

Upon initial assessment, there appeared to be at least two slate-like cobbles poking through the surface of the ground in the southwestern corner of the unit (Figure 4.17). One can note how with just moderate leaf-litter this feature is effectively hidden (with the amount of caribou moss and duff present before the brush fire this would only have further hindered visual identification of archaeological materials). Initially, the first 5-7 cm revealed additional cobbles (Figure 4.18), but no artifacts. A typically shallow A horizon and a single piece of red quartzite in the southeastern quadrant of the unit were also found. It was determined that the unit would be expanded one meter directly south to reveal the cobble feature. An additional element of red quartzite was recovered in TUA #2.2 (Figure 4.19), and more slate-like cobbles were revealed in the northwestern quadrant, continuing from the southwestern corner of the upper unit. A yellow/gold discoloration of the soil was also noted in the area of the cobbles, suggesting burning. A small amount of charcoal was found in association with the cobbles in TUA #2.2, but not enough to warrant collection.

Figure 4.17: TUA #2.1 cobbles highlighted in white.

Figure 4.18: TUA#2.1 excavated to sterile soil. Note red quartzite cobble on southern edge.

Figure 4.19: TUA #2.2 Excavated to sterile soil.

TUA #2.3 had further cobbles present in the northeastern corner of the unit, with additional red quartzite collected. A charcoal sample was taken from under the southern-most rock in #2.3, though there was some concern about contamination as a decaying root system was found under this rock as well. What is exciting about TUA #2.3 is the presence of not only charcoal, but what appears to be red ochre. Evidence of red ochre staining arose in the southwestern edge of the unit and can be seen in close-up (Figure 4.20). In addition to the red ochre present, Jenkinson also noticed possible evidence for a posthole approximately fifteen centimeters southwest of the cobbles the charcoal sample was taken from (visible in Figure 4.22 overview). He asserts that the posthole staining is a potential “apuanask,” an Innu term for a cooking/roasting spit that would have been sharpened at both ends to hold meat over a fire. The lack of actual wood material from the unit casts some doubt, but its proximity to the combustion stones suggests this may be the case.

Figure 4.20: TUA #2.3 red ochre highlighted in white.

TUA #2.4 (Figure 4.21) was unremarkable except for an additional three cobbles located in the southeastern corner of the unit that were in association with those found in adjacent unit #2.1. The final expansion was TUA #2.5 (Figure 4.22), which was located direct west from #2.3 and aimed to further investigate the red ochre staining. This unit was 1 x 0.5 m in size. No other cultural materials were recovered apart from a single element of quartzite from along the far eastern edge of the unit.

TUA #3 (Grid #24)

This unit was excavated just past the A horizon when a metal survey or "pin" flag was found pushed vertically into the center of the test unit. It was subsequently discovered that during the 2013 excavation season survey flags were pushed into the ground to make them inconspicuous to people either walking or using motor vehicles on the site. These -

Figure 4.21: TUA# 2.4 excavated to sterile soil.

Figure 4.22: Overview of the TUA #2 excavations. Note the dotted line marking the TUA #2.3/2.5 boundary and the possible posthole indicated in the white circle in TUA #2.3. TUAs #2.1, 2.2, 2.4 are backfilled.

flags marked the locations for surface lithic materials (S. Neilsen personal communication, August 2018). The iron composition of the flags caused anomalies in the magnetometry data, of which TUA #3 was but one (see Tables 4.4 and 4.5 for other examples).

The discovery of a vertically buried metal survey flag in TUA #3 led to the replacement of the initial metal pins used as corner markers with wooden stakes. This allowed the TUAs and AOIs to be metal detected prior to excavation to determine if they contained any buried ferrous metal that would remove them from interest as Amerindian features. Though it would have saved time later to metal detect prior to the geophysical surveys involving magnetics, this was purposefully not done to further evaluate the efficacy of geophysical instruments on the landform. By leaving extant ferrous metal on the site it allowed a comparison to be drawn between what cultural and non-cultural features represent in geophysical data. In hindsight, this decision possibly masked some ephemeral cultural features that were overshadowed in magnitude by metal trash. A more careful consideration of the impact of metal detection must be applied in future contexts.

TUA #4 (Grid #29)

After deciding to replace all corner nails with stakes and metal detect future TUAs and AOIs, TUA #4 was discovered to have a 30 cm long piece of rusty wire on the surface near the unit. No excavation took place at this location.

TUA #5 (Grid #28)

Like TUA #4, TUA #5 was re-staked and metal detected and was discovered to also be the product of past investigations as a metal datum stake was recovered from the ground surface. No excavation took place at this location.

TUA #6 (Grid #29)

TUA #6 was fully excavated as the magnetic anomaly visible in the magnetometry data was something of an aberration in the data. As can be seen in Figure 4.23, the amorphous, somewhat star-shaped anomaly stood out significantly compared to other circular dipolar anomalies.

Excavations revealed a total absence of cultural material, and a typical soil profile was present. Later conversations with Cheetham would confirm that the anomaly does in fact resemble a lightning strike found in magnetometry data (P. Cheetham personal communication, October 2018). Other examples of lightning in archaeo-geophysical survey data have been noted in numerous publications (e.g. Bevan 1995; Burks et al. 2015; Jones and Maki 2005; Maki 2005; Maki et al. 2015).

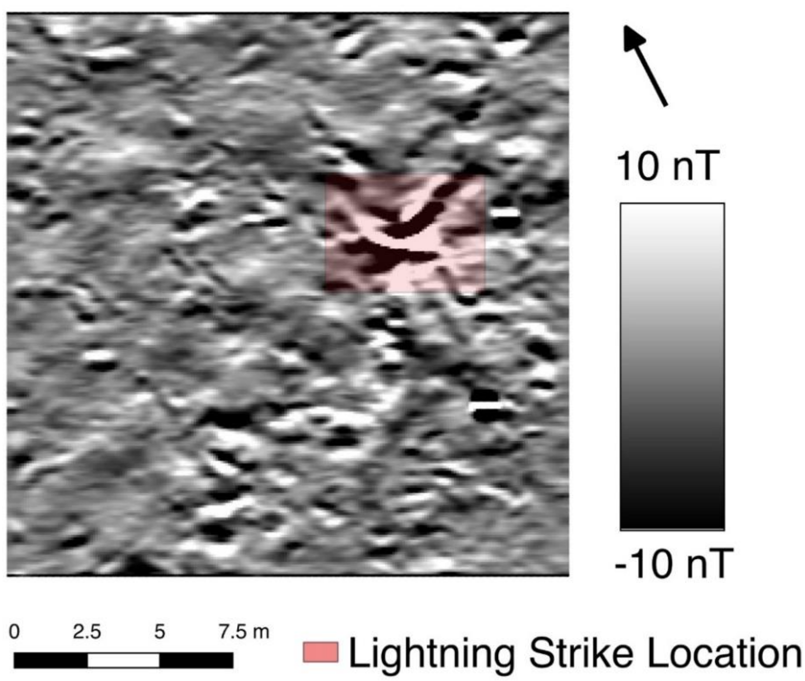

Figure 4.23: Likely lightning strike anomaly in magnetometer data.

TUA #7 (Grid #31)

TUA #7 appeared as a larger dipolar anomaly surrounded by smaller dipolar features. On the surface, the unit was positioned adjacent to a small mound of soil, which was unusual. Some other mounds were present, next to slight dips in the ground surface, in the immediate vicinity and their origin is presently unknown. Excavation revealed what is believed to be a pit feature, as an area of darker soil, ash, and charcoal located in the northwestern corner of the unit, as seen in Figure 4.24 below. Root material and flecks of charcoal were pervasive throughout TUA #7, and this casts some doubt on the quality of the purportedly burned feature. The sandy soil surrounding it appeared to be windblown and therefore intact, so a sample was taken for radiocarbon testing. No artifacts were found inside the unit though there are scatters within one meter of the excavation area. The proximity of an exposed cobble to this location (~4 m east-southeast) did lend some credence to the theory that this was associated with archaeological remains, in addition to the nearby lithic artifacts (Figure 4.14 above).

Figure 4.24: TUA #7 with possible pit feature marked in white. Note the charcoal lens continues along the eastern rim of the unit.

TUA #8 (Grid 27)

Test unit anomaly #8 was the final unit to be excavated for the project. This feature was located during the KT-20 magnetic susceptibility survey by field assistant Dillon Montague who was operating the instrument. As time was a factor, this TUA was not originally marked on the gridded unit system and was established in the field oriented towards magnetic north instead of grid north like the other TUAs. Here, cobbles are visible on the surface, which is how the location was identified in the field. Upon excavating, a very thin A-horizon gave way to orange/brown soil with further cobbles revealed (Figure 4.25). A thin layer of silty soil was associated with the stones, with a higher organic content surrounding the stones. There is a possibility this is associated with a cultural component, though, like the other TUAs, no lithic artifacts were found in direct association with this combustion feature though 25 m to the southwest is SCA #3, with the highest (n=20) count of recovered lithic artifacts in 2018 (see Figure 4.2 above). Lastly, a sample of charcoal was taken from the center of the feature for radiocarbon testing.

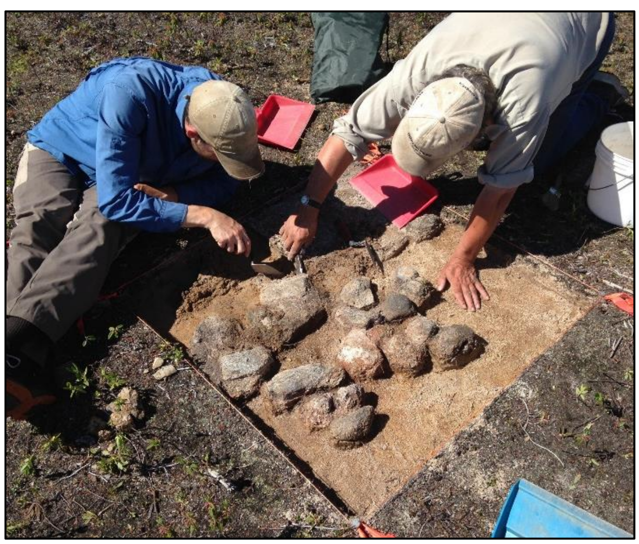

Figure 4.25: TUA #8 during excavation by the author and Jenkinson.

AOI investigation results

The results of the AOI survey were disappointing but contribute towards a better understanding of how archaeo-geophysics is susceptible to cultural interference. In this case, the interference was comprised of metal trash from both past archaeological investigations and contemporary use of the landscape. Ferrous metal objects like the same pin flag identified in TUA #4, as well as a recent tin can have appeared as anomalies in the data, indistinguishable from cultural features of interest (see Figures 4.2 and 4.3 in the beginning of the chapter to compare anomalies).

Table 4.5: AOI investigation information.

AOI #	Coordinates (yx)	Grid #	Excavated?	Explanation
1	553N 576E	6	No	Surface iron
2	675N 722E	24	No	Buried iron*
3	677N 717E	24	No	Buried iron*
4	719N 786E	28	No	Buried iron*
5	759N 769E	29	No	Surface iron
6	766N 826E	32	No	Time constraint

*Identified using metal detection.

Of the six AOIs identified for potential investigation none were selected for excavation, the rationale given in Table 4.5 above. Two were in proximity to TUA #4 and were metal detected and found to be additional survey flags. Others were determined to be a product of surface metal as well, like old datum stakes, cans, or bits of wire. The last AOI, located in grid #32 was not excavated due to time constraints. A more beneficial methodology would include metal detecting prior to archaeo-geophysical survey, but a practical one would simply metal detect before the establishment of unit corners, thus winnowing down the number of potential features before digging (Tudor 2013).

Summary

This chapter provides the results of four surveys (three geophysical, one surface collection) and both the TUA and AOI subsurface investigations. Geophysically, the magnetometer provided the only data that could be considered useful in locating precontact combustion features as the EMI meter had technical issues and the GPR equipped with a 500 MHz antenna was unable to locate features so near the surface. A small-scale survey of a known combustion feature confirmed these results as a control variable, and more promise was seen on the EMI data in this context. The surface collection survey resulted in the marking and retrieval of 80 individual lithic elements towards the northern end of the survey zone. These artifacts were close to TUA #7 and nearby TUA #8. Excavations revealed two potential combustion features and one possible pit feature in the data, all of which contained enough charcoal for radiocarbon samples to be taken.[17] No artifacts were found in these features. None of the AOIs were investigated, primarily due to false magnetic readings from old survey flags or metal trash both above and below the ground surface. This is a factor that must be considered in *all* archaeological investigations, as flags, stakes, or other metal associated with survey and excavations has the potential to impact future geophysical surveys.

[17] All FCR and heated cobbles were left, displaced in approximately their original locations.

Ch. 5 – Discussion: applying theory to results

Introduction

The archaeo-geophysical survey of the Ushpitun landform resulted in the excavation of several areas of interest and allowed for a limited pedestrian survey. In this chapter a landscape-based approach will be used to contextualize the analysis of surface-collected artifacts as well as ^{14}C radiocarbon (RC) dates recovered during excavations of identified combustion features. RC dates are then compared to the established relative sea level (RSL) curve and commentary is made regarding the utility of relative vs. absolute dating in Intermediate period contexts. A summary interpretation is offered that addresses the differential use of space on the landform based on artifacts and feature locations. Finally, the larger significance of the FhCb-12 designation will be discussed.

Landscape theory and archaeo-geophysics

The use of "landscape" in archaeology is quite liberal and encompasses many different aspects of the physical and nonphysical elements of a place. Addressed in Anscheutz and others' (2001:177-181) review of landscape archaeology these broad strokes are given context and put into three distinct categories: settlement ecology, ritual landscapes, and ethnic landscapes. Settlement ecology is perhaps the most utilized perspective in archaeology and simply means the interactions that people have with the space they occupy in terms of their use and subsequent transformation of that landscape, and the patterns that are archaeologically visible because of those interactions. Ritual landscapes are areas used by a group that are not used as living space and may comprise public areas and other social places whose organization is linked (usually through ethno-historic information) to some sort of cosmological influence. Lastly, ethnic landscapes are constructs that define either inclusiveness or exclusiveness to cultural or ethnic groups based on "customs and shared modes of thought and expression" using material culture or symbology (Anschuetz et al 2001:177).

These categories are by no means exclusive or universally agreed upon and constitute just one way in which archeologists can attempt to understand the use of landscapes in the past. For example, "constructed," "conceptualized," and "ideational" are other distinctions that have been made regarding types of cultural landscapes (Ashmore and Knapp 1999:10). Additionally, UNESCO has its own categories of landscape that includes "clearly defined," "organically evolved," and "associative cultural landscapes" (Rössler 2003:11). Further, the US National Park Service uses terms that have legal significance like "cultural landscape," "designed landscapes," "historic vernacular landscapes," and "rural historic landscapes," (King 2012: Ch. 6).

In summary, landscape theory offers archaeologists the opportunity to explore the past through the interactions and relationship that people had with their natural and constructed spaces. Importantly, one must remember that these distinctions are all different visions of the *same* landscapes and represent fluid, mutable parts of entangled relationships between people and their environments.

As archaeo-geophysical survey affords the archaeologist a rare opportunity to reveal subsurface activity across vast tracts of land, its relationship to landscape archaeology is quite direct: archaeo-geophysics "[detects what] traditional landscape approaches cannot: the buried architecture, dwellings, and other constructions that give structure and meaning to human occupations" (Kvamme 2003:454). Thus, archaeo-geophysics becomes a means to interpret "the built environment" as the physical remains of settlement and occupation reveal a spatial relationship between people and their environment. Helpfully, Thompson and others (2011:197-198) outline several methods for integrating archaeo-geophysics and landscape archaeology

Category 1: Identifying construction variation in terms of the built environment

Category 2: Identifying continuity/discontinuity in the use of space

Category 3: Identifying natural and cultural modifications

Category 4: Identifying regularities in the use of space and architecture at the regional level

These categories of inquiry are means by which archaeo-geophysicists can attempt to use equipment like GPR, magnetometry, and EMI to visually represent subsurface activity areas and interpret people's relationships to both each other and their environment. In this way, archaeo-geophysics makes is possible for archaeologists to tease out more subtle aspects of the past (e.g. like identity as seen in religious and socio-political organization in architectural remains, see Conyers 2009, or Thompson et al. 2009).

The merger of landscape and archaeo-geophysics is a logical one, as large-scale surveys have the potential to reveal numerous features and their spatial relationships. Unfortunately, this elucidation is biased towards concrete features like architecture or infrastructure that are well defined and easily discernable. This encapsulates one of the key limitations of geophysical applications in archaeology, namely that the utility is largely dependent upon a “built” environment to survey, i.e. one noticeably modified by humans. While Anscheutz and others (2001:161) argue that not all landscapes are synonymous with “built environments” it is difficult to otherwise visualize these geophysically. Thompson (2016) and Jones and Munson (2005) vocalizes the issue by arguing that preference is given to monumental or architecturally prevalent sites and little attention is paid to the ephemeral hunter-gatherer sites within archaeo-geophysical prospection. This opinion reflects the relative ease by which monumental architecture can be located using geophysical means, while conversely acknowledging the difficulty in locating small (less than 1 m diameter diameter) or otherwise discrete features. It is natural for the methodology to focus on the features that stand the best chance of being located, though it does create a bias in research. Archaeo-geophysics can thus be situated as primarily a method of “prospection” (meaning in this context purely for exploration), and thereby a tool to facilitate anthropological assessment of a site or region. There is no theory inherent in geophysics apart from physical theories such as gravity, or magnetism, for example, though in the case of archaeology it has a powerful ability to inform research when coupled with approaches such as landscape ecology.

Applying theory to Ushpitun

Integrating landscape theory and archaeo-geophysics on the Ushpitun landform encounters the very same issues discussed in the previous section regarding the lack of a distinctive built environment being problematic for interpretation. Using Thompson et al.’s (2011) methods for inquiry, one can realistically apply Category #2 to Ushpitun as “identifying continuity/discontinuity in the use of space” being the only category that does not favor the identification of architectural remains. This type of analysis is essentially a landscape ecology approach informed by archaeo-geophysical survey results. Neilsen (2006) and Josephs and Neilsen (2009) have addressed the use of space on Ushpitun, but the addition of new features located by archaeo-geophysical survey allows for a more informed analysis.

FhCb-12 designation: absolute vs. relative dating & lithic analysis

The creation of FhCb-12, the Borden number which encompasses the whole of the Ushpitun landform, is a product of an archaeological landscape approach. It was decided in consultation with Neilsen and the PAO that the extent and relatedness of archaeological remains at Ushpitun warranted their formal recognition as culturally connected entities. This is a landscape ecology perspective that addresses the use of space, as each site that has been subsequently discovered since 1998 adds to the archaeological understanding of how the Intermediate period manifested on Ushpitun. The analysis of absolute and relative dating, as well as lithic artifacts recovered, in this thesis will follow and further support this reassessment.

Fitzhugh (1972) utilized a combination of both RC dates and RSL dating to create his cultural timeline for Hamilton Inlet. The relative dating was synthesized in a later publication by Clark and Fitzhugh (1991) and used an RSL curve to approximate the age of archaeological sites from the known rate of isostatic rebound in Labrador. While the rate of emergence is practical for considering geological time, its application to archaeological sites is trickier. The undulations of a former beach terrace, like Ushpitun, offer a variable topography in terms of local elevation that can have drastic differences in age when charted on the RSL curve. When comparing the dates of RC samples and their RTK-measured elevations to those same dates on the RSL curve, the elevations are, in some cases, radically different.

Charcoal samples were collected from three features identified during the magnetometry survey and subsequently excavated: TUA #2, TUA #7, and TUA #8. These samples were processed in two stages, the first stage being the removal of all soil using sterile metal picks, while the second consisted of heating the three samples to 400 degrees Fahrenheit in an oven to desiccate them. Following this, they were packaged in aluminum foil and plastic bags and shipped to the A.E. Lalonde AMS Laboratory at the University of Ottawa, Ottawa, Canada where they underwent an acid-alkali-acid (AAA) wash prior to sampling (Crann et al. 2017).

The results of the AMS dating reveal that both TUAs #2 and #8 are contemporaneous with the established Intermediate period timeframe of c. 3500-1800 BP. TUA #7, the potential pit feature, is younger than anticipated, and is therefore not likely associated with the others. These dates have been plotted (cal BP) in Figure 5.1 and listed in Table 5.1. The AMS dates from 2018 have all been calibrated using OxCal Online: Calib 4.3.2, IntCal 13 atmospheric curve; FhCb-04 date was conventionally dated by Beta Analytic but has been subsequently calibrated to the same curve as the other samples (P. Ledger, personal communication, August 2019; Ramsey 2017, Reimer et al. 2013).

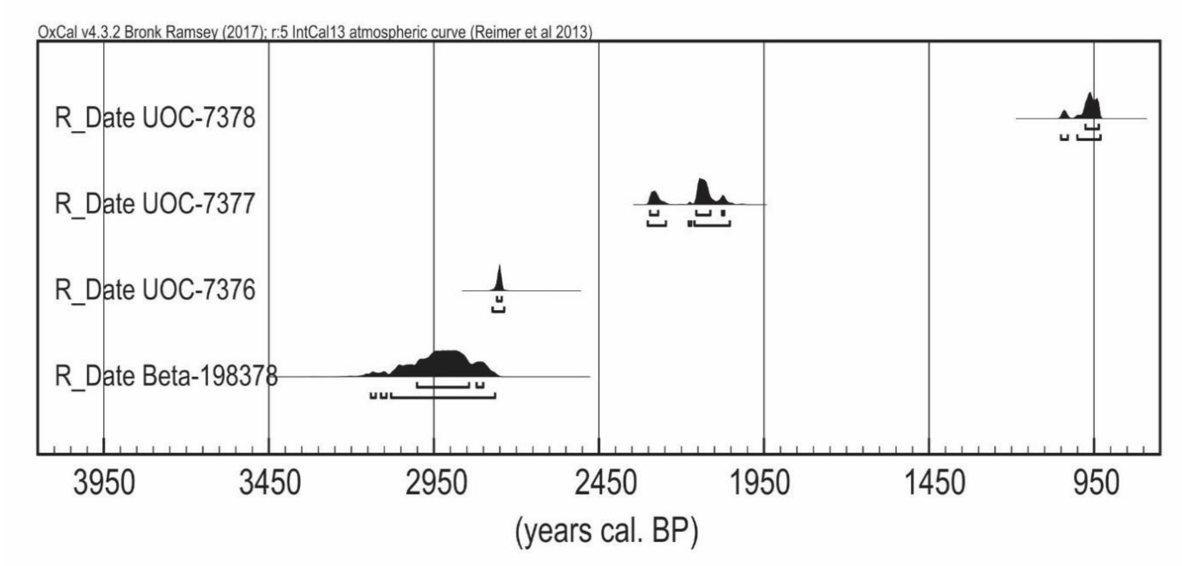

Figure 5.1: Radiocarbon (RC) dating from the Ushpitun landform.

Table 5.1: Calibrated RC Dates from Figure 5.1.

Sample Area	Sample #	^{14}Cal yr. BP	Error	cal. BP
TUA #2	UOC-7376	2622	±22	2772-2737 (95.4%)
TUA #7	UOC-7377	2147	±22	2302-2247 (23.8%) 2178-2170 (1.0%) 2160-2051 (70.6%)
TUA #8	UOC-7378	1064	±22	1050-1029 (11.1%) 1001-930 (84.3%)
FhCb-04	Beta-198378	2810	±70	3140-3126 (1.2%) 3110-3093 (1.4%) 3079-2764 (92.9%)

As one can see, there is a discrepancy between the elevation measured with the RTK and the elevation inferred from the RSL curve (Figure 5.2) using the RC dates in Table 5.1. For this comparison the RC dates were plotted on the 1991 RSL curve and their elevations were inferred based on their absolute age. Next, the measured elevations from those same features were plotted on the RSL curve and the relative ages of those sites was recorded. In this way, a comparison can be drawn between the accuracy of the RSL curve versus absolute dating methods.

The most drastic discrepancy is TUA #7, which has over seven meters difference between the RTK measured elevation and its inferred elevation from the RSL curve. For TUA #7, the 12.81 masl recorded by the RTK should be approximately the same age as TUA #2 (12.93 masl), but TUA #7 dates to over 1,000 years earlier. Conversely, when TUA #7's RC date (cal BP 1001-930) is plotted on the RSL curve it indicates an expected elevation of only 5 masl, which is obviously incorrect. It must be acknowledged that the charcoal collected during sampling from TUAs #2 and #8 were not associated with any kind of major burning activity (like TUA #7), therefore it is possible that these samples were wind and/or water deposited. Alternatively, the datable material in TUA #7 may have simply infilled an existing pit or depression on the landform.

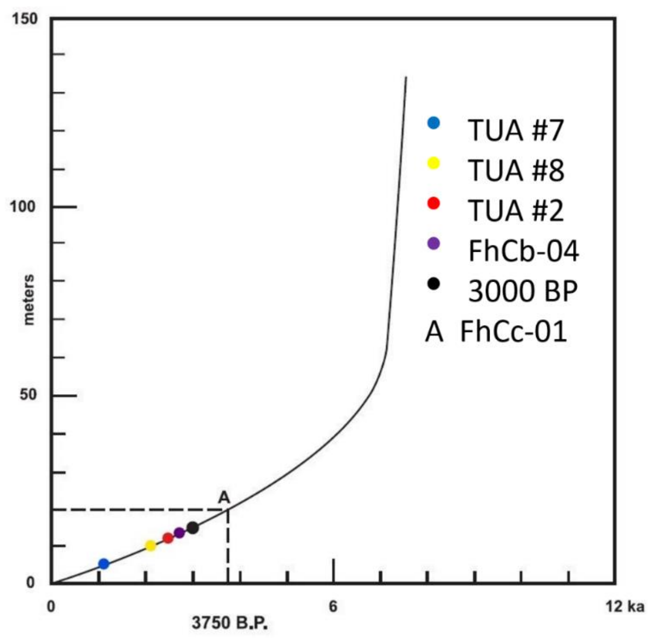

Figure 5.2: RSL curve from Clark and Fitzhugh (1992) adapted in Josephs and Neilsen (2009:107) displaying Ushpitun landform (FhCb-12) relative dates as well as Pmiusik[U] 1 (FhCc-01).

Table 5.2: A comparison of RC dates and GPS elevations to the RSL curve from Clark and Fitzhugh (1991).

Feature	GPS masl	cal BP	RSL masl (based on RC date)
TUA #2	12.93	2772-2737	~12.50
TUA #7	12.81	1001-930	~5.0
TUA #8	13.40*	2160-2051	~11.0
FhCb-04	17.00**	3140-2765	~15.0 – 12.50

* LIDAR-based measurement. ** Hand-held GPS measurement.

Other sources of error are evident as well; for example, TUA #8 had its elevation measured from LIDAR data (only accurate to 1 m horizontally), and FhCb-04 was recorded using a handheld GPS, which is much less accurate (±15 m) than the RTK (±0.1 m). These errors complicate the use of relative dating methods like RSL curves as the means by which elevations are taken can be highly variable, and elevations from an undulating landscape are prone to higher subjectivity than those in flatter areas. The ephemeral nature of features and arbitrary boundaries associated with lithic scatters raise issues with where an elevation should be taken, as choosing either the base or peak of a dune (Figure 5.3) could affect the relative age by several hundred years. Additionally, as is the case with FhCb-04, margins of error in RC dates (~400 years) are also problematic.

The distribution and elevations of SCAs (Figure 5.4, Figure 5.5, and Table 5.3) assists in clarifying the data presented by RC testing, though not without raising additional questions. We can attempt to correct the elevation of FhCb-04 to the average RTK-measured elevation for all collected lithics from SCA #2 (about 25 meters northeast, (Figure 5.4)) at 14.61 masl, a much more reasonable elevation than the 17.0 masl proposed by Neilsen (2006) and in accordance with the expected elevation for a site dating to c. 2800 BP according to the RSL curve. Unfortunately, when the elevation of 13.40 masl for TUA

#8 is adjusted to the average height of lithic materials at SCA #3 (about 18 m northeast, see Figures 5.4, 5.5) to 15.23 masl, this shifts the age of the site in the opposite of the expected direction several hundred years. The act of attempting to adjust the recorded elevations of sites to nearby artifacts is arbitrary and may lead to false conclusions as the local variability of elevations on the landform could certainly change over a short distance.

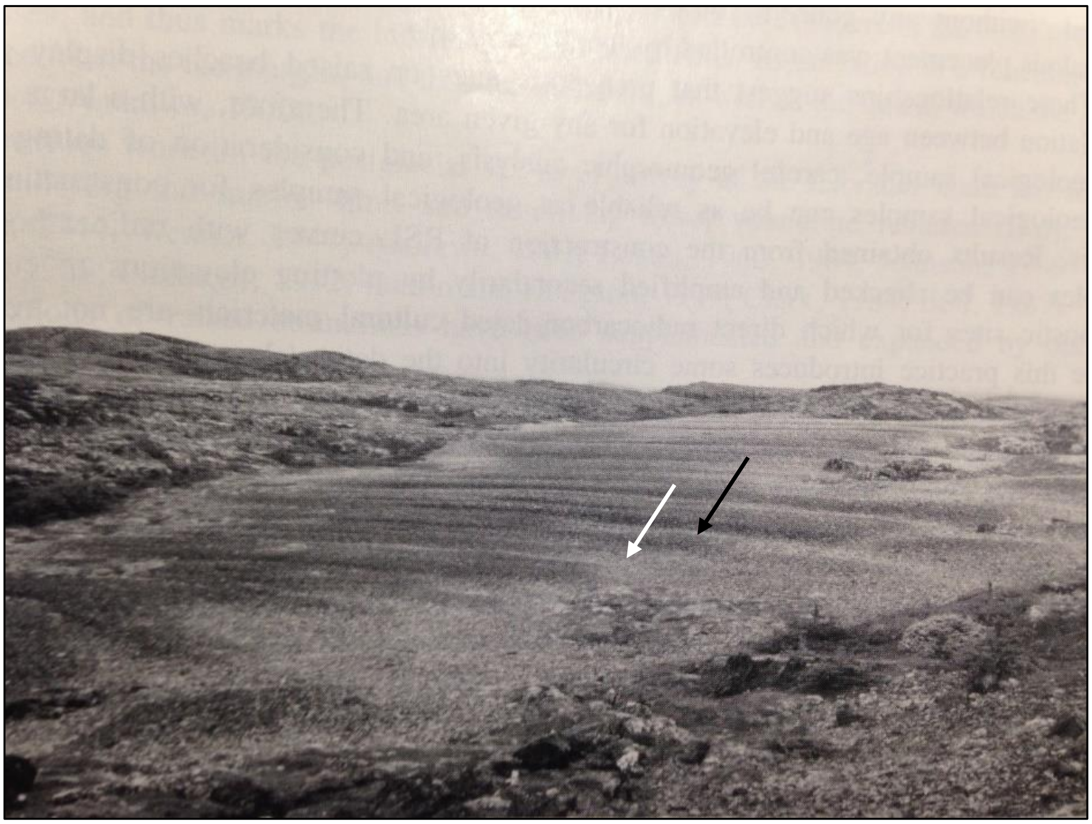

Figure 5.3: Raised marine beach near Aillek, Labrador Note local elevation variation between peaks (black) and base (white). From Clark and Fitzhugh (1991:199). See also Figure 3.7, this thesis.

Table 5.3: RTK elevations of all SCAs

Feature	Average Elevation (masl)
SCA #1	15.10
SCA #2	14.50
SCA #3	15.20
SCA #4	15.20
SCA #5	14.70
SCA #6	15.30

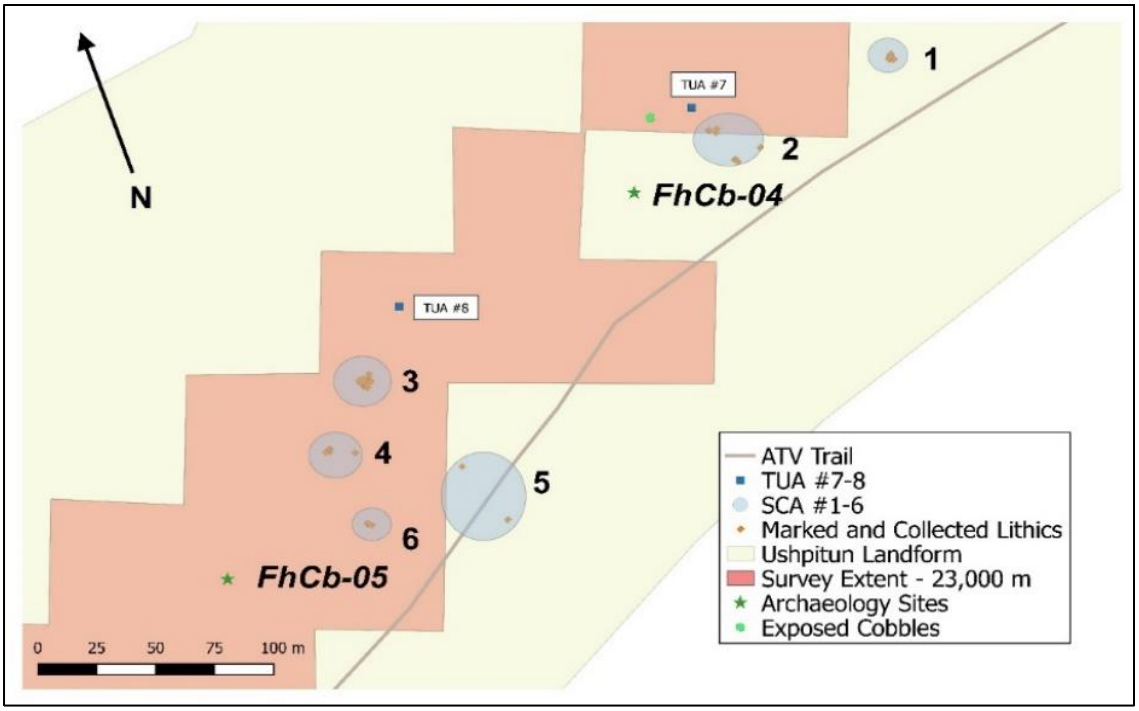

Figure 5.4: Locations of SCAs #1-6 and TUAs #7-8. (Dotted area below).

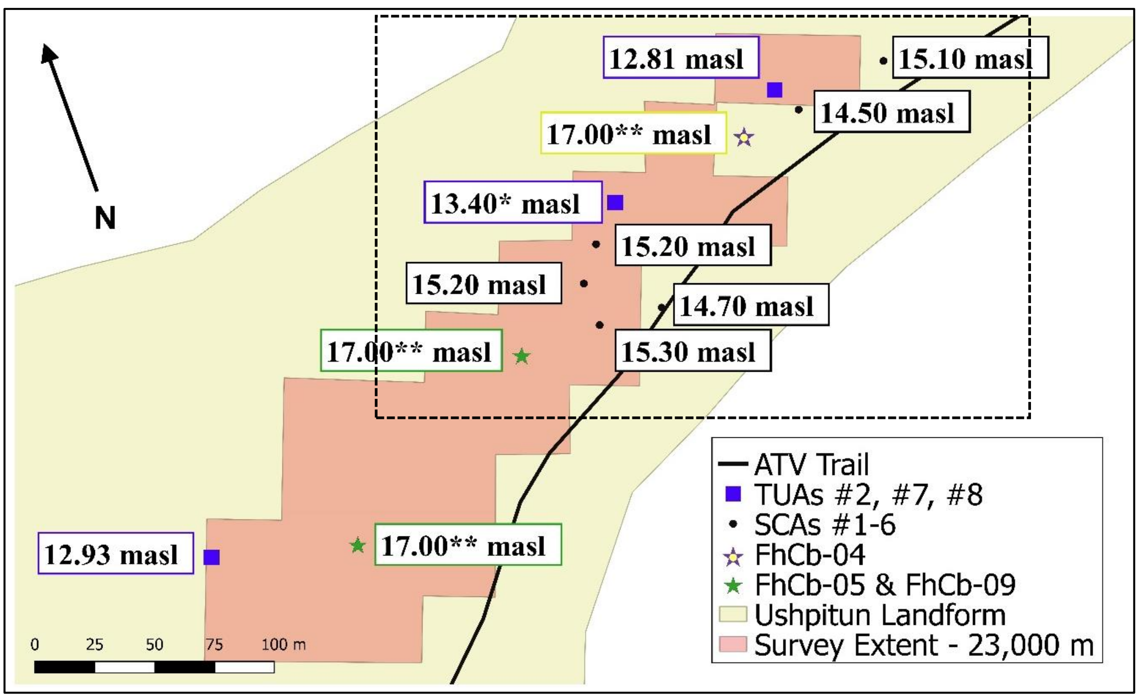

Figure 5.5: Elevations from the Ushpitun landform; * LIDAR-based measurement. ** Hand-held GPS measurement. Dotted rectangle indicates approximate extent of Figure 5.4 (above).

When one pairs the elevations taken with the features across the landform the discrepancy between measured values becomes more apparent and the utility of RSL curves in this environment is further called into question. First, the blanket 17.0 masl elevation given to FhCb-04, 05, and 09 is clearly incorrect as it is consistently 2 to 4 m higher than any other elevation measurement on the landform. While this can easily be attributed to handheld GPS inaccuracy it nevertheless creates a false interpretation of the area if dating is then left solely to the RSL curve as this would mean the entire landform (and FhCb-09, 05, and 04) all date to ~3250 BP.

The distribution of feature, site, and lithic scatter elevations across the landform demonstrates the need for a comprehensive approach when interpreting human interactions there. Landscape ecology offers a means to evaluate the range of elevation values and RC dates that goes beyond trying to piece together a series of individual sites and views the landform as a single archaeological element. Taking this into consideration, we can see that (of those measured with the RTK) there is a general trend for features to fall between 12.80 masl and 15.30 masl, a range of 2.50 masl. While the RSL curve would tell us that this is a significant difference in terms of site dating the local variation of a dune landscape and practical land-use must also be considered. For example, each TUA is at a lower elevation and further back from the paleoshoreline (right-hand side of the landform) than the majority of the SCAs, which would seem to indicate a preference for processing lithics closer to shore/further from cooking or habitation areas. It must not be discounted that Amerindian groups made a conscious choice to use the Ushpitun landform in a way that took advantage of natural topographic relief e.g. using defilade to shelter combustion features and the taller dune ridges to process stone materials which simultaneously offered a natural vantage point over the water to watch for fauna or other travelers.

It would be useful for future researchers to remeasure previous sites on Ushpitun with an RTK, or to incorporate a microtopographic survey into archaeological investigations to definitively record elevations across the landform. A well-defined topography would better display the interrelatedness of features, RC samples and lithic artifacts. The distribution and typology of the lithic materials themselves will be discussed in the next section.

Lithic analysis

Spatial distributions of lithic artifacts & material types

The distribution of lithic artifacts across the Ushpitun landform is heavily patterned and interpretable through landscape theory. Both presence, and absence, of lithics will be addressed; namely the absence of any tools or debitage inside or in proximity to the RC sampled TUAs #2, #7, and #8. This combined with the distinctive clustering of the SCAs would indicate a clear preference for differential use of space at Ushpitun.[18] The type of stone and morphology will be discussed here, as well as a brief comparison between the 2004 and 2018 collections.

The presence of a predominantly chert and quartzite lithic assemblage points towards IA occupation, specifically multicolored cherts (Fitzhugh 1972, Neilsen 2006).

[18] As the site has been surveyed numerous times prior to the 2018 project, one must remember that the density of lithic artifacts in Figure 5.4 is less than "original" in its representation (IEDW/JWEL 2001, Neilsen 2006, 2015, 2016b).

Although, as with the RSL data presented above, it is important to be cautious when basing cultural designations solely on the type and color of the lithic artifacts present on a site. The vast majority of lithics collected during Neilsen's 2004 excavations were chert (98.2%) compared to quartzite (1.8%) (Neilsen 2006). The overall breakdown of surface collected lithics on the Ushpitun landform from 2015-2018 are overwhelmingly chert as well, with n=65 elements equaling 77.4% of the assemblage. Quartzite made up 21.4% of the total (n=18 elements) (Chapter 4, Neilsen 2015, 2016b).

While the overall artifact numbers are not exceptional, the individual breakdown of each SCA is of interest (Table 5.4). SCAs #3-5 are the only lithic assemblages that contain quartzite, in contrast with SCAs #1, #2, and #6. The highly clustered nature of SCAs #1 and #3 are suggestive of discrete knapping events, with a likely relationship between SCAs #3-5 due to the presence of quartzite. The proximity of SCA #2 to FhCb-04 infers that these materials may simply be a diffusion of that site. Though SCA #6 is entirely chert (n=3) as well it is nearby SCAs #3-5 and not seen as anomalous.

Table 5.4: Distribution of chert vs. quartzite between SCAs.

SCA	(N)	N=chert	%	N=quartzite	%
#1	18	18	100	0	0
#2	13	13	100	0	0
#3	36	22	61.1	14	38.9
#4	8	7	87.5	1	12.5
#5	2	1	50.0	1	50.0
#6	3	3	100	0	0
Other*	4	2	50	2	50
Total	**84**	**65**	**77.4**	**18**	**21.4**

*Other represents diagnostic elements recovered from surface collection on the landform in previous year (2015-2016). Caution should be exercised in evaluating SCAs #5, #6, and the Other category as they have few samples to draw statistical interpretation from.

It is essential to reiterate that the designation of each SCA is based on observations made in the field during GPS marking and lithic collection. As lithic materials were discovered, they were documented, and this occurred in areas that the author, Neilsen, and Venovcevs could see as clustered together. Each SCA, then, is the result of on-the-fly documentation meant to ease the organization of collected materials. For example, this explains why SCA #5, contains only two elements 18 m apart from one another, and why SCA #4 includes one element over 6.5 m away from the main cluster (Figure 5.3 above).

Physical description of lithic artifacts

The only complete lithic elements recovered from the Ushpitun landform in the years since Neilsen's 2004 excavations were collected in 2015 and 2016 during pedestrian surveys (see Figures 5.6 and 5.7) (Neilsen 2015, 2016b). These include a quartzite biface (FhCb-12:80), and a chert scraper (FhCb-12:81). During the 2018 survey each lithic artifact was marked with the RTK and collected, though some in proximity were given a single GPS point. The designation of each artifact is per the PAO's guidelines: the Borden number, followed by a catalog number. In this case, the catalog number corresponds to the order in which that artifact was collected. For example, one possible broken biface base, FhCb-12:32, is referred to as #32. This element was located by Jenkinson during a walkthrough just prior to the start of the 2018 archaeo-geophysical survey and has been included in the 2018 count.

The total assemblage includes one complete biface made of grey quartzite (#80), one broken biface (tip missing) of red chert (#79), one biface of blue/grey chert (#81) thought to be a scraper or unfinished preform, and one grey quartzite biface rectangular in shape with a box base and missing the tip portion (#66) (Figure 5.6). Of interest is a large fractured cobble of grey quartzite (#82) that has pecking/flake removal on the distal portion of the dorsal surface, which represents the only nodule of raw material discovered on the landform (Figure 5.7). There are no obvious refits in terms of matching the flaked and pressure removed debitage to the diagnostic artifacts in the assemblage, though the distinctive knapping of grey quartzite in SCAs #3-5 and the presence of grey quartzite tools forces one to investigate the possibility. The grey quartzite used in #66 has visible red inclusions, while that of #80 does not. On macroscopic inspection alone it does not seem these elements are made of the same grey quartzite parent material.

Bifaces

The #80 and #79 bifaces listed above are definitive projectile, or spear points, while #32 appears to adhere to a similar design morphology as the other two though not much more can be said as only the base is present. These artifacts all possess a "box" or square base, and #79 and #80 possess side notches, while the red chert base (#32) appears to have broken at the point just below side-notching. While the chert bifaces (#79 and #32) appear thinned at the base, the quartzite (#80) is heavily ground. Additionally, #66 has a box base but is lacking the proximal portion and may be unfinished. Side-notched bifaces are indicative of the Intermediate period in Labrador (e.g. Fitzhugh 1972; Madden 1976; McCaffrey 2006; Nagle 1978; Neilsen 2006) and #79 and #80 look like points recovered by Fitzhugh (1972:270) in Northwest River at the Road Site 2 (FjCa-14). As the road site was heavily disturbed its context is highly suspect, though Neilsen (2006:29) notes that the assemblage resembles Charles complex artifacts (2700 BP), except for the two side-notched bifaces. A morphological relationship to Meadowood-style projectile points has therefore been suggested (Fitzhugh 1972:111; Neilsen 2006:30, 132).

Interestingly, #81 is the only example of a scraper-like tool recovered from recent pedestrian surveys, though this may represent an unfinished preform. The overall shape is roughly lanceolate and fits naturally in the hand. Fitzhugh (1972:76) noted side scrapers at the Piloski Garden Site (FjCa-09) and assigned them to the Charles complex. The material is a blue-grey chert with distinctive weathering on one surface and ferrous-iron staining. While bifacially worked on both lateral edges, it maintains an asymmetric appearance and it is unknown if this is simply an unfinished piece.[19] The tip of this tool is distinctively pointed and could be used as an awl/engraver, though one cannot be certain if this was a definite choice on the part of the knapper or, again, a result of incomplete work. Neilsen (2006) notes the presence of several end scrapers (n=11) and some flake-scrapers as well (n=4), but curiously no side-scrapers—where #81 would represent the first recovered. Similar staining is also noted on elements recovered from 2004 and speaks to the iron content of the sand that makes up the landform (St. Croix 2002; Neilsen 2006:70-71).[20]

In comparison to the lithic materials recovered during Neilsen's 2004 excavations the small number of bifaces and biface fragments recovered between 2015-2018 is not anomalous. Neilsen (2006) notes that bifaces and biface fragments made up the smallest relative categories of artifacts recovered from the site at 0.87% of the total assemblage.

[19] Other asymmetric bifaces were recovered by Neilsen (2006) at Ushpitun and by Fitzhugh (1972) in Northwest River; both associated with Intermediate Amerindian occupations.

[20] Neilsen (2006:69-72) notes staining on collected bifaces and utilized flakes. Specimens #59, #216, #237, #359, #365, #125 are documented to have iron staining on either (or both) the ventral and dorsal sides.

6.10% is therefore acceptable given that from 2015-2018 the recovered lithics make up a much smaller sample overall (n=84).

Figure 5.6: Diagnostic lithic artifacts from collected during pedestrian surveys at Ushpitun.

Figure 5.7: Split cobble FhCb-12:82. Note pecking on lower right-hand dorsal edge.

Debitage

Debitage recovered from the Ushpitun landform consists of flakes, shatter, flake shatter, and microdebitage. Most of these elements are made of multicolored cherts, though grey quartzite flakes are present in SCAs #3-5. Cherts range in color and include lavender, red, black, white, pink, and grey-blue elements consistent with the coloring of chert artifacts recovered in 2004 (Neilsen 2006). The coloration of some red cherts is potentially attributed to fire treatment (see FhCb-12:67-71). These lithics are from SCA #4, and the closest combustion feature is TUA #8, ~38 meters to the northeast, though this does not necessarily represent the location these artifacts were treated, if they were treated at all.

Of note is the complete absence of cortical flakes involved in the primary reduction process of lithic manufacture (Andrefsky 1998, Kooyman 2000). Combined with the high percentage of debitage (93.90%) to formal tools (bifaces and biface fragments; 6.10%) this supports Neilsen's (2006) theory that primary lithic reduction and tool manufacture occurred elsewhere, and these tools were sharpened and subsequently taken with their users when they left. The sole anomaly is the presence of the grey quartzite split cobble (#84) that appears tested, though not reduced as one would see with a core. This is unsurprising, as raw materials are entirely absent from the Ushpitun landform and local sources to the HVGB area are limited. Similarly, this would indicate that the fire cracked rocks (FCR) from the combustion features on the landform were also brought by in by groups using the area, and perhaps reused as well (Neilsen 2006; S. Neilsen personal communication, May 2019). Important to note is the presence of quartzite cobbles in the soil of both Northwest River and Sheshatshui, Labrador (roughly an hour's drive north of Ushpitun) and on the banks of the Churchill River in the interior, these areas also having been documented as IA habitation sites (Neilsen 2016; Stassinu Stantec 2014).

Comparing the 2004 and 2018 lithic collections

There are few direct comparisons that can be made as the number of formal (including incomplete) tools recovered in each collection is limited to five elements (2018) and 25 elements (2006). Additionally, the majority of these from Neilsen's (2006) excavations are some form of scraper, while only one scraper-like tool was found in 2018. The 2006 artifacts are almost exclusively for processing resources, as only two bifaces (one incomplete) were attributed to resource procurement (Neilsen 2006:68). Interestingly, only one quartzite tool was found, Specimen 600, which was the incomplete biface made of tan quartzite thought to be locally sourced (Neilsen 2006:74). The other biface, Specimen 827, is lanceolate in shape with "fish-tail" corner notches and is made of lavender chert (Figure 5.8). Neilsen (2006) notes that this is similar in form to other Charles/Saunders complex sites near Okak and Northwest River. The quartzite elements recovered in 2018 are distributed away from FhCb-04 and are likely unrelated to any of the quartzite artifacts from 2006 (Neilsen 2006:82). [21]

Comparisons are further stymied as no utilized flakes were found in the 2018 survey. However, debitage and microdebitage recovered during both projects is multicolored. The high proportion of microdebitage found in 2004 compared to 2018 is likely due to the excavation strategy being much more comprehensive than pedestrian

[21] It should be noted that the quartzite identified by Neilsen as "tan" has been described by the author as grey and upon examination appears to have similar reddish inclusions. Whether this means it is contemporaneous, however, remains to be seen.

survey and therefore more likely to find smaller artifacts. While the 2004 excavations revealed patterning associated with use-areas of FhCb-04, the more recent survey identified areas likely used for similar lithic reduction though on a much smaller scale (tens vs. hundreds of elements). The vast differences in sample size are troublesome when meaningful comparisons are made between assemblages, but it does become clear that both sets of materials reflect the same Intermediate period preference for multicolored cherts, and the absence of primary or cortical flakes in either assemblage supports a temporary occupation theory.

Figure 5.8: Biface specimens #600 (left) and #827 (right) from Neilsen's (2006) 2004 excavations.

Site interpretation analysis through landscape theory

The analysis of RC dates and the spatial examination of lithic artifacts mean the 2018 archaeo-geophysical survey can meaningfully contribute towards the existing body of literature surrounding the site (e.g. IEDW/JWEL 2001; Josephs and Neilsen 2009;

Neilsen 2006, 2015, 2016b; Neilsen and Wolfrum 2019). Through the lens of landscape theory, specifically landscape ecology, one can begin to better understand the occupation of the Ushpitun landform.

The evidence from the 2018 archaeo-geophysical survey supports what Neilsen (2006) and Josephs and Neilsen (2009) established in that the Ushpitun landform was likely a place of temporary encampment with limited tool manufacture and a focus on sharpening activity. From an artifact perspective, the dearth of formal tools/raw materials/cores/cortical flakes found in 2018 support the notion that primary reduction of lithic artifacts took place elsewhere, while the prevalence of microdebitage and flakes implies that these pre-made tools were sharpened for use on site (Neilsen 2006). The spatial distribution of recently recovered artifacts suggests that at least two discrete loci were likely used for knapping activities: SCA #1 and SCA #3 both exhibit dense clusters of lithics, while the presence of quartzite in SCAs #3-5 suggests that these areas may be related. The use of multicolored cherts and quartzite, in addition to the presence of side-notched projectile points is in keeping with other Intermediate period sites recorded in the province (Fitzhugh 1972; Madden 1976; Nagle 1978; Neilsen 2006, 2015; Stassinu Stantec 2014; 2015, 2016, 2017).

The discovery of combustion features at TUA #2 and #8 raise interesting questions regarding the interpretation of how space was used on Ushpitun as neither can be directly associated with any artifacts. Based both on RSL curve and RC dating, these combustion features appear to be separated in time by several hundred years and likely represent distinctive chronological events from each other and from FhCb-04. The spatial separation, possible presence of red ochre, and what appears to be the remains of a roasting spit indicate that TUA #2 may have additional elements undiscovered. TUA #8 is nestled between FhCb-04 and FhCb-05 and offers no further context to its purpose, though Neilsen (2006) notes that features of this nature could represent radiant heat zones for tents or other temporary structures. The lack of lithic artifacts may imply that knapping activities were kept outside the living spaces assuming the weather in late spring or early fall was amenable (Neilsen 2006).

The general distribution of sites across the landform exhibits a preference for the eastern waterfront edge of the terrace. This could indicate that arrival to the Ushpitun landform was via watercraft and these sites are in proximity to the water out of convenience, but the presence of game animals and possible travels of other Amerindian groups also likely warranted monitoring. TUA #2 is the most interior (furthest from the eastern waterfront) of any features so far discovered at Ushpitun and this could indicate that additional areas of use are located further west. It is also entirely possible more sites exist in locations along the northern curvature of the landform and into the “hook” moving towards FhCb-03 as this area was not surveyed.

The entire Ushpitun landform includes archaeological materials and a more comprehensive survey is warranted to investigate these areas further. The results of the 2018 archaeo-geophysical survey, in addition to the numerous projects undertaken on the landform in the past have contributed towards a better understanding of the Intermediate period in Labrador. For this reason, in 2018 the Ushpitun landform was designated, in its entirety, as FhCb-12. This new Borden number encompasses all previous Borden numbers on the landform (without replacing them in documents, metadata, etc.) and officially recognizes the holistic approach necessary when one attempts to understand this complex time in history. The spatial distribution of artifacts and features and their relationships warrant a broader approach to archaeological understanding, one that distinguishes the whole landform as an archaeological site. Therefore, all future sites discovered on the landform will also use FhCb-12. Additionally, this designation also allows the PAO and the town of HVGB to better formulate a strategy to combat the erosion of the landform and possible damage to archaeological resources by foot and ATV traffic.

The significance of FhCb-12

Landscape ecology paired with archaeo-geophysical survey can provide a means to visualize human/environment interactions. At Ushpitun, the remnants of human modification are ephemeral: small (less than 1 m diameter) cobble arrangements and diffuse debitage scatters offer the only interpretable features on the landform. However, the relationship between features, artifacts, and the space they occupy has become clearer as a result of the 2018 surveys. Where in 1998 two sites were located, 20 years later six Borden numbers are associated with the Ushpitun landform, as well as three combustion features and at least two lithic scatters that would have qualified for site designation had they been discovered in years prior. The volume of archaeological material and likelihood that still more remains at Ushpitun prompted a more comprehensive landscape-based perspective to coalesce at the end of the 2018 project into the designation of FhCb-12.

While the present boundary of FhCb-12 aims to include the entirety of the former river terrace it is imperative that one not conceptualize Ushpitun as exclusively falling within these confines. The actual significance of this landform to Amerindian peoples may never be known, but we can certainly assume there were no definitive boundary lines apart from perhaps natural obstacles. For this reason, landscape approaches to archaeological investigations in this area are imperative to allow broader regional comparisons between areas and sites. Comparisons to distant peoples like those of the Meadowood tradition or other Amerindian groups in Quebec helpfully reduce the reliance on stark, local artifact seriations and timelines. These rely far too heavily on stone tool typology and relative elevation for splitting groups, when there is arguably more linking them together on a regional scale than differences between them (McCaffrey 2006; Nagle 1978; Neilsen 2006; Tache 2008). The second chapter of this thesis discusses these perils and acknowledges the holes that exist in Intermediate period research in Labrador (Brake 2008; Neilsen 2006).

Legally recognizing the spatial relationships between artifacts and features across the landscape at Ushpitun also sets the precedent for future archaeological discoveries to be addressed similarly. While the concept of identifying patterns in artifact and feature density are inherent to any archaeological investigation the acknowledgement that an area some 200,000 m^2 in size could be considered one "site" opens the door for better protections for archaeological landscapes elsewhere.[22] Advocating for broader site designations also limits the amount of backtracking necessary after the inadvertent discovery of additional artifacts or features. This kind of judication has the potential to inform policy regarding how perceptions of cultural resources and their

[22] While the term "site" is used rather glibly (and simultaneously vaguely) in archaeology, it nevertheless represents the most common archaeological "unit"—hence its use here. While only a case of semantics, naming Ushpitun an "archaeological landform" would better contextualize the relatedness of the artifacts, features, and IA groups that occupied the space.

interconnectedness. In this way, FhCb-12 goes beyond a mere Borden number and situates itself as a progressive step towards better archaeological understanding and protections.

Summary

This chapter situates the logical merger of archaeo-geophysical survey and landscape theory to contextualize the spatial relationships between artifacts and features on the Ushpitun landform. Using RC dating, TUA #2 and #8 have been found to likely date to the Intermediate period, while TUA #7 does not. When these dates are plotted using Clark and Fitzhugh's (1991) RSL curve issues arise and point out the ambiguity in elevation measurements, but more importantly the limitations of using RSL curves in dating sites in dynamic topographic environments (and conversely the utility of RTK-based elevations). The lithic materials recovered from the landform during pedestrian survey support Neilsen's (2006) inference that Ushpitun was occupied in a limited, but not insignificant capacity. The brief comparison to materials collected in 2004 shows a continuity between collections. Finally, the significance of the FhCb-12 designation demonstrates how additional landscape-based archaeological investigations in Labrador could be beneficial for understanding the relationship between ephemeral features, diverse lithic artifacts, and the Amerindian people that made them. Archaeo-geophysical survey thus has great potential to locate additional combustion features and thereby offers a means to better understand people and place.

Chapter 6 – Conclusions

Introduction

This chapter addresses the four research questions posed at the beginning of the document as well as an executive summary of the thesis. Each question is fully explored with consideration paid to how easily they may be resolved, if at all, given the results of the project. Suggestions for future archaeo-geophysical investigations are also offered.

Research Questions and research suggestions

Four main research questions were posed at the beginning of this project in order to guide effective research and evaluate an archaeo-geophysical approach to locating Amerindian combustion features on the Ushpitun landform. These questions will be answered in the forthcoming text based on acute observations made during both the fieldwork and subsequent writing of this document.

1. *Can archaeo-geophysical survey be conducted on the Ushpitun Landform effectively?*

The results of the archaeo-geophysical survey proved decisively that this type of survey methodology can work in this environment. All three instruments were able to operate, though it must be stated that without the assistance of Neilsen cutting brush this would not have been possible. The main limitation of performing archaeo-geophysical survey on the landform is the foliage that interrupts walking transects and makes either carrying or pushing instruments difficult. As almost 20,000 m^2 was cleared this ceased to be an issue, but one cannot ignore the impact that this can have on a natural environment. Additionally, the high iron content of the sand did prove troublesome and required a larger clipping of nT ranges in the magnetometry data than would be preferred on a precontact site (±5 to 10 nT is ideal, but ±50 to 100 nT would have been required to completely erase background noise). As archaeo-geophysical survey usually necessitates the clearing of brush, and the systematic walking of an area anyway, it also acts as a de facto pedestrian survey and this can contribute towards locating surface features. For example, this is how TUA #8 was located as it did not immediately stand out in the data but was quite visible on the landform.

2. *Which instrument proved most effective in locating archaeological features?*

The Sensys MXPDA magnetometer cart was the only instrument that provided results that led to the identification of previously unknown features. GPR (with 500 MHz antenna) proved to be ineffective as the features in question were either too small or too ephemeral to appear in the data. Unfortunately, the beta-Terraplus KT-20 S/C meter exhibited numerous technical issues that prevented a satisfactory evaluation of its abilities in locating archaeological features. Therefore, a true comparison was unable to be made between instruments.

3. *Is this approach more efficient than previous pedestrian and shovel testing surveys?*

The use of the term 'efficiency' is problematic as it can be defined in many ways. As the magnetometer cart proved the most effective in locating archaeological features it will be used as the barometer for geophysical efficiency compared to pedestrian survey. From a simple cost perspective, the purchase of a magnetometer cart system like the MXPDA is about $50,000 CAD (similarly for the GPR).[23] The original survey conducted

[23] Conversely, the costs of determining that no archaeological resources are present, and then discovering additional features later must also be considered.

by Schwarz with three field assistants took three days and dug ~800 shovel tests, locating two sites (JWEL/IE 2001). Though the cost of their three-day investigation is not known, it is highly unlikely it came close to $50,000. If three field assistants were present to help move transect lines, or if the system was purchased with an integrated GPS, then an area of ~23,000 m^2 could be completed in a day's time with the cart system—assuming the area was cleared of brush. The MXPDA did discover two new sites, but in turn located several other locations of ferrous metal interference only known as such post-ground truthing. While other magnetometers are more portable (requiring less in terms of brush clearing) they would then need several persons moving ropes across a gridded site to work effectively while covering much less ground than the cart system.

A final consideration is the brush fire that cleared away much of the undergrowth at Ushpitun occurred after the initial 1998 survey and would have greatly improved visibility for the surveying crew and likely resulted in additional finds. Overall, there are simply too many variables to consider when making such a loaded claim as to which methodology is more "efficient" as time, money, and personnel must be evaluated; however, based purely on time and the number of features discovered the MXPDA was the most efficient geophysical approach.

4. *What more can be said about Intermediate period usage of the Ushpitun Landform based on this investigation?*

With the discovery of TUAs #2 and #8, respectively, we can support the claim that Amerindian use of the area was likely temporary. The most interesting aspects of the recently discovered features are their lack of artifacts (though FhCb-05 is also a cobble combustion feature with only a single flake recovered). In the case of TUA #2 especially the spatial distinctiveness combined with red ochre and potential roasting spit provide perhaps not a revolutionary viewpoint of the Intermediate period but do contribute towards nuancing the Ushpitun landform: this was an area used repeatedly throughout the period with distinctive areas for activities like lithic tool manufacture. The 2018 survey proved that additional research is advised and would only contribute to our understanding of how landscape and people interacted there.

This research does call into question the distinction of archaeological sites from this period in Labrador, and elsewhere. If features are artifact-less, then they become even more removed from association with past human culture and risk disregard during field assessments. In the case of TUA #2, is this simply a result of incomplete horizontal sampling, or is the apparent combustion feature and associated red ochre/roasting spit the extent of this feature? Additional excavations can eliminate the chance that the project in 2018 simply failed to broaden its scope, though there was no indication the feature extended beyond what was investigated. It is the opinion of the author that this is a prime case to highlight the dangers of "flake chasing,"[24] that is, the inability to account for ephemeral archaeology in the absence of lithic material or artifacts generally. Preservation bias is a known concept in archaeology, as the bone and wood tools used in the past almost never preserve in the harsh acidity of Labrador soil (Fitzhugh 1972). But one must consider that sites may exist *in absentia* of artifacts; that some heated stones may be the only

[24] Credit goes to Chelsee Arbour for introducing the author to this term and pointing out the significance of what is *not* there.

remnants of those that used the area in the past. Additionally, advances in our understanding of fire cracked rock (FCR) may also assist in future investigations and lead to better interpretations of ephemeral features, especially in Intermediate period contexts (Neubauer 2018).

While over 23,000 m^2 of Ushpitun has been archaeo-geophysically surveyed, this represents only ten percent of the landform's area, and excluded FhCb-03. If the opportunity arose it would be beneficial to survey north of the 2018 survey grid following the "hook" of the landform towards the peninsula, as this is a high-probability area for archaeological sites. Additionally, the area immediately surrounding TUA #2 warrants further investigation as this is the most isolated feature from the rest and a potential indication of additional cultural resources to the west and south of the survey grid. Further, utilizing microtopographic measurements with drone-based lidar or a total station could resolve issues with site elevation. Lastly, effective magnetic susceptibility survey would resolve any issues with the KT-20 S/C meter, while using a 1000 MHz GPR antenna could offer comparable datasets to the magnetometry.

Final conclusions

In July and August of 2018, a multi-instrument archaeo-geophysical survey was undertaken to find additional archaeological features on the Ushpitun landform. This survey set out to test the effectiveness and utility of applying geophysical survey techniques to locating ephemeral features in central Labrador. The magnetometer portion of this survey revealed numerous anomalies across the survey area. Unfortunately, the KT-20 S/C meter (EMI) encountered critical technical errors and failed to log meaningful data.

Similarly, the GPR was stymied by features being either too small or too shallow and it failed to locate any with the antenna provided.

A small pedestrian survey using an RTK GPS followed the archaeo-geophysical survey and recovered 80 lithic elements from the surface of the landform. This was accomplished while using the GPS to mark locations for 1x1 m unit corners. Very few artifacts are formal tools and the vast majority are being interpreted as “sharpening” debitage, supporting previous assertions that the area was used for short-term occupations likely related to resource procurement.

The results of the 1x1 m excavations revealed most anomalies discovered using the magnetometer were modern intrusions. The majority were related to Neilsen’s archaeological activities on the landform from 2004-2016 in the form of wire pin flags or unit nails, though some were wire of unknown origin and tin cans or shotgun shells. Using a metal detector to screen units prior to excavation seems most appropriate in the case of investigating magnetometer data, as noted by Tudor (2013).

The two most promising anomalies were TUAs #2 and #8, both of which appeared to be precontact combustion features i.e. small (less than 1 m in diameter) groupings of stones exposed to fire. While no artifacts were found in the immediate vicinity or inside these features, RC dating places both within the Intermediate period (3500-1800 BP). TUA #7 appeared to be a possible pit feature with obvious charring and ash within. RC dating proved this likely to be unrelated chronologically with IA occupation.

When comparing RC to relative sea level dating on Ushpitun it was found that some inaccuracy exists between methods. The likely culprits are a combination of forest fire interference and past site elevations being taken with either LIDAR data or handheld GPS units not known for vertical positional accuracy. For example, FhCb-07, the combustion feature located on the top of the landform was surveyed as a control, and the survey area was nearly 40 m west of the original handheld GPS point for the site.

Despite the effectiveness of magnetometry in locating ephemeral combustion features, the use of intensive pedestrian survey could likely have similar results. Density of surface cover is the most limiting factor to the success of a larger-scale pedestrian survey though most of the caribou moss has been burned away and has yet to substantially regrow. The cost of purchasing, let alone renting (with shipping and insurance costs) of archaeo-geophysical equipment, coupled with the training and software required to process data makes the methodology less accessible than traditional survey forms. However, the ability of magnetometry to cover large tracts of land in a single day, with 100% coverage is unparalleled, and if the terrain is amenable it should always be explored as a possibility, especially as support for shovel testing programs.

This thesis set out to test whether (1) archaeo-geophysical survey could be done effectively in central Labrador (2) what instrument is most effective in locating precontact features (3) if archaeo-geophysics is more efficient than previous survey methodologies and (4) if discoveries stemming from archaeo-geophysical survey can tell us an more information about the Intermediate period generally. It was discovered that archaeo-geophysics can be done with some landscape modification. Magnetometry was the most effective method of investigation attempted, but this was by default and not a real comparison between EMI and GPR. Efficiency was determined to be too subjective a term to accurately measure, as both pedestrian and archaeo-geophysical survey have distinctive pros and cons. The location of two combustion features without artifacts begs the question of what constitutes an archaeological site not only in Intermediate contexts, but in Amerindian archaeology broadly. Archaeo-geophysics thus has proved a useful tool in identifying areas of occupation otherwise discounted based on past interpretations.

Further archaeo-geophysical or pedestrian survey on the Ushpitun landform is likely to result in the location of additional features, as the instrument survey covered ~10% (~22,000 m^2) of the total area of FhCb-12 (~208,500 m^2 as demarcated by the PAO) (S. Hull personal communication, December 2018). There exists great potential for this otherwise underutilized technology in archaeological applications in Labrador archaeology, particularly in identifying small precontact combustion features.

Bibliography

Anschuetz, K., Richard H. Wilshusen, and Cherie L. Scheick
2001 An Archaeology of Landscapes: Perspectives and Directions. *Journal of Archaeological Research.* 9(2):157-211.

Andrefsky, W. Jr.
1998 Lithics: Macroscopic Approaches to Analysis. Cambridge University Press, Cambridge.

Armstrong, K.L. and T. Kalayci
2015 Images of the past: magnetic prospection in archaeology. In *Best practices of geoinformatic technologies for the mapping of archaeolandscapes*, edited by A. Sarris, pp.1-12. Archaeopress Publishing, Oxford.

Ashmore, W., and Arthur Bernard Knapp
1999 *Archaeologies of Landscape: Contemporary Perspectives*. Blackwell Publishers.

Aspinall A., Gaffney, C. and Schmidt, A.
2008 Magnetometry for Archaeologists. AltaMira Press, Lanham.

Bevan, B.
1995 Magnetic Surveys and Lightning. *Near Surface Views* (newsletter of the Near Surface Geophysics section of the Society of Exploration Geophysics). October 1995:7-8.

Brake, J.
2006 A Comparison of Maritime Archaic Indian and Intermediate Indian Sites Distribution in Labrador. *Nexus* 19:8-31.

Bonsall, J., Chris Gaffney, Ian Armit.
2014 Preparing for the Future: A reappraisal of archaeo-geophysical surveying on Irish National Road Schemes 2001-2010. Doctoral Dissertation. Department of Archaeological Sciences, Bradford University, UK.

Burks, J., Andreas Viberg and Bruce Bevan
2015 Lightning strikes in archaeological magnetometry data: A case study from the High Banks Work site, Ohio, USA. *Archaeologia Polona* 53:256-260.

Campana, S. and Salvatore Piro (editors.)
2009 *Seeing the Unseen: Geophysics and Landscape Archaeology*. Boca Raton: Leiden, the Netherlands: CRC; CRC/Balkema.

Clark, A. J.
1996 *Seeing Beneath the Soil: Prospecting Methods in Archaeology*, new edition. B. T. Batsford, London.

Clark, P.U. and W.W. Fitzhugh
1990 Late deglaciation of the central Labrador coast and its implications for the age of glacial Lakes Naskaupi and McLean and for prehistory. *Quaternary Research* 34:296-305.

1992 Postglacial Relative Sea Level History of the Labrador Coast and Interpretation of the Archaeological Record. In *Paleoshorelines and Prehistory: An Investigation of Method*, edited by, L.L. Johnson, pp. (189-212). CRC Press, Boca Raton.

Conyers, L. B.
2004 *Ground Penetrating Radar for Archaeology.* AltaMira Press, Walnut Creek, California.

2006 Ground-Penetrating Radar. In *Remote Sensing in Archaeology: An Explicitly North American Perspective*, edited by Jay K. Johnson, pp. 131-159. Tuscaloosa, Alabama: University of Alabama Press.

2009 Ground-penetrating radar for landscape archaeology: methods and applications. In *Sensing the Unseen: Geophysics and Landscape Archaeology,* edited by Stefano Compana and Salvatore Piro, pp. 245-255. Taylor and Francis Group, London.

2018 *Ground-Penetrating Radar and Magnetometry for Buried Landscape Analysis*. Springer Briefs in Geography. Electronic.

Crann CA, Murseli S, St-Jean G, Zhao X, Clark ID, Kieser WE.
2017 First status report on radiocarbon sample preparation at the A.E. Lalonde AMS Laboratory (Ottawa, Canada). Radiocarbon 59(3): 695–704. http://doi.org/10.1017/RDC.2016.55.

Dalan, R. A.
2006 Magnetic Susceptibility. In *Remote Sensing in Archaeology: An Explicitly North American* Perspective, edited by Jay K. Johnson, pp. 161-203. Tuscaloosa, Alabama: University of Alabama Press.

Denton, D.
1989 La period prehistorique recente dans la region de Caniapiscau. Recherches amerindiennes au Quebec, 19(2-3): 59-75.

Eastaugh, E.

2002 The Dorset Palaeoeskimo Site at Point Riche, Newfoundland: An Intra-site Analysis. Department of Anthropology, University of Newfoundland, St. John's, Newfoundland, Canada.

Ernenwein, E. G. and Michael L. Hargrave

2009 *Archaeological Geophysics for DoD Field Use: A Guide for New and Novice Users.* Environmental Security Technology Certification Program (ESTCP). Submitted to DOD, ESTCP Project SI-0611.

Fanning, P., S.J. Holdaway, and R.S. Phillipps

2009 Heat retainer hearth identification as a component of archaeological survey in western NSW, Australia. In *New Directions in Archaeological Science,* edited by A Fairbairn and S O'Connor, pp.13-24. ANU Press, Australia.

Fassbinder, J., Helge Stanjekt, and Hojatollah Vali.

1990 Occurrence of Magnetic Bacteria in Soil. *Nature* 343(6254):161.

Filzwieser, R., L.H. Olesen, W. Neubauer, I. Trinks, E.S. Mauritsen, P. Schneidhofer, E. Nau, M. Gabler

2017 Large-scale geophysical archaeological prospection pilot study at Viking Age and medieval sites in west Jutland, Denmark. *Archaeological Prospection* 24(2): 373-393.

Fitzhugh, W.W.

1972 Environmental Archaeology and Cultural Systems in Hamilton Inlet, Labrador: A Survey of the Central Coast from 3000 B.C. to the Present. Smithsonian Contributions to Anthropology, No. 16. Smithsonian Institution Press, Washington.

1975 A Comparative Approach to Northern Maritime Adaptations. In *Prehistoric Adaptations to the Circumpolar Zone*, edited by W. Fitzhugh, pp. 339-386. The Hague, Chicago.

1978 Maritime Archaic Cultures of the Central and Northern Labrador Coast. *Arctic Anthropology* 15(2):61-95.

1987 Archaeological Ethnicity and the Study of the Prehistory of Labrador. In *Ethnicity and Culture,* edited by R. Auger, M. Glass, S. MacEachren and P. McCartney, pp. 141-153. Archaeological Association of the University of Calgary, Calgary.

2006 Settlement, Social and Ceremonial Change in the Labrador Maritime Archaic. In *Archaic of the Far Northeast*, edited by D. Sanger and M.A.P. Renouf. Maine: University of Maine Press.

Fitzhugh, W.W. and H.F. Lamb
1985 Vegetation History and Culture Change in Labrador Prehistory. *Arctic and Alpine Research* 17:357-370.

Gaffney, C., V. Gaffney, W. Neubauer, E. Baldwin, H. Chapman, P. Garwood, H. Moulden, T. Sparrow, R. Bates, K. Löcker, A. Hinterleitner, I. Trinks, E. Nau, T. Zitz, S. Floery, G. Verhoeven, M. Doneus
2012 Short Report: The Stonehenge Hidden Landscapes Project. *Archaeological Prospection* 19:147-155.

Gaulton, B. and D. Teasedale
2018 Archaeology at Ferryland 2018. *Provincial Archaeology Office 2018 Archaeology Review* 16: 109-115.

Gaulton, B. and R. Lacy
2017 Archaeology at Ferryland 2017. *Provincial Archaeology Office 2017 Archaeology Review* 15:114-117.

Grimes, V., Maria Lear, Jessica Munkittrick and Robin S. Lacy.
2017 Excavation and preliminary analysis of a historical burial ground at Foxtrap-2 (CjAf-10), Foxtrap, Newfoundland. *Provincial Archaeology Office 2017 Archaeology Review* 15:131-140.

IED Enterprises Inc. and Jacques Whitford Environment Limited.
1999 Labrador Hydro Project, 1998 Environmental Studies, Draft, Archaeological Investigations at the Wapeneau Mikue Site (FjCa-47), Near Northwest River, Labrador, LHP 98 17. Unpublished Report on file, Provincial Archaeology Office, Government of Newfoundland and Labrador, St. John's.

Jacques Whitford Environment Limited and Innu Environmental
2001 Labrador Hydro Project 2000 Studies, Churchill River Power Project, Historic Resources Overview Assessment Interpretive Summary, Recommendations and Appendices (1998-2000), Volume 1: Report, (draft report). Unpublished Report on file, Provincial Archaeology Office, Government of Newfoundland and Labrador, St. John's.

Jenkinson, A., and Stephen Loring
2011 Tshikapisk Foundation: Archaeological Research in 2011. *Provincial Archaeology Office 2013 Archaeology Review* 9:89-102.

Johnson, J. (editor.)
2006 *Remote Sensing in Archaeology: An Explicitly North American Perspective*. University of Alabama Press.

Jones, G. and David Maki
2005 Lightning-Induced Magnetic Anomalies on Archaeological Sites. *Archaeological Prospection* 12(3):191-197.

Jones, G. and Gene Munson
2005 Geophysical Survey as a Solution to the Ephemeral Campsite Problem: Case Studies from the Northern Plains. *Plains Anthropologist* 50(197):31-43.

Jordan, R.H. Jr.
1975 Pollen Diagrams from Hamilton Inlet, Central Labrador, and their Environmental Implications for the Northern Maritime Archaic. *Arctic Anthropology* 12(2):92-116.

Josephs, R.L and S.W. Neilsen
2009 Micromorphological Investigations at Two Intermediate Period Amerindian Sites in Labrador: Implications for Late Holocene Paleoshoreline Reconstruction in Western Hamilton Inlet. *Canadian Journal of Archaeology* 33:92-114.

Kelvin, L., and Maria Lear, Jacinda Sinclair and Lisa K. Rankin.
2017 Avertok Archaeology Project, 2017. *Provincial Archaeology Office 2017 Archaeology Review* 15:160-163.

King, T. F.
2013 *Cultural Resource Laws and Practice*. Fourth edition. AltaMira Press, Maryland.

Kooyman, B.P.
2000 Understanding Stone Tools and Archaeological Sites. University of Calgary Press, Calgary.

Kvamme, K. L.
2003 Geophysical Surveys as Landscape Archaeology. *American Antiquity* 68(3):435-457.

2006 Magnetometry: Nature's Gift to Archaeology. In *Remote Sensing in Archaeology: An Explicitly North American Perspective*, edited by Jay K. Johnson, pp.205-233. University of Alabama Press.

Kvamme, K. and S.A. Ahler
2007 Integrated Remote Sensing and Excavation at Double Ditch State Historic Site, North Dakota. *American Antiquity* 72(3):539-561.

Landry, D.B.
2018 Non-Invasive Investigation of Arctic Hunter-Gatherer Archaeological Landscapes Using Combined Remote Sensing and Near Surface Geophysics. Doctoral Dissertation, Department of Anthropology, University of Manitoba, Calgary, Manitoba, Canada.

Landry, D.B., Ferguson, I.J., Milne, S.B., Serzu, M., and Park, R.W.
2018 Integrated geophysical techniques for the archaeological investigation of LbDt-1, a Paleo-Inuit quarry site in the interior of southern Baffin Island, Nunavut, Canada. *Journal of Archaeological Method and Theory*, DOI: https://doi.org/10.1007/s10816-018-9370-6.

Landry, D. B., Ferguson, I. J., Milne, S. B., and Park, R. W.
2015 Combined geophysical approach in a complex Arctic archaeological environment: A case study from the LdFa-1 site, southern Baffin Island, Nunavut. *Archaeological Prospection*, *22*(3):157-170.

Linford, N.
2005 Archaeological applications of naturally occurring nanomagnets. *Journal of Physics: Conference Series* 17:127-144.

2006 The Application of Geophysical Methods to Archaeological Prospection. *Reports on Progress in Physics* 69:2205-2257.

Lombard, M.
2006 Direct evidence for the use of ochre in the hafting technology of Middle Stone Age tools from Sibudu Cave. *Southern African Humanities*: 18(1):57-67.

Loring, S.
1992 *Prince and Princesses of Ragged Fame: Innu Archaeology and Ethnohistory in Labrador.* Unpublished PhD dissertation, Department of Anthropology, University of Massachusetts, Massachusetts.

Madden, M.M.
1976 A Late Archaic Sequence in Southern Labrador. Master's Thesis. Department of Anthropology, Memorial University of Newfoundland, St. John's, Newfoundland, Canada.

Maki, D.

2005 Lightning strikes and prehistoric ovens: Determining the source of magnetic anomalies using techniques of environmental magnetism. *Geoarchaeology: An International Journal* 20(5):449–459.

Maki, D., Jeffrey A. Homburg, and Scott D. Brosowske

2006 Thermally Activated Mineralogical Transformations in Archaeological Hearths: Inversion from Maghemite Fe2O4 Phase to Haematite Fe2O4 Form. *Archaeological Prospection* 13:207-227.

Maki, D., Sigrid Arnott, and Mike Bergervoet

2015 Lightning Induced Remnant Magnetism at the Buffalo Slough Burial Mound Complex. *The Minnesota Archaeologist*. 74:30-47.

McCaffrey, M.

2006 Archaic Period occupation in subarctic Quebec: A review of the evidence. In *The Archaic of the Far Northeast* edited by D. Sanger and M.A.P. Renouf pp. 161-190. University of Maine Press, Orono, ME.

McGhee R. and J.A. Tuck

1975 An Archaic Sequence from the Strait of Belle Isle. National Museum of Man Mercury Series, Archaeological Survey of Canada, Paper No. 34, Ottawa.

Milsom, J.

2013 *Field Geophysics, 3rd edition.* The Geological Guide Series. Wiley & Sons Ltd., England.

Nagle, C.

1978 Indian Occupations of the Intermediate Period on the Central Labrador Coast: A Preliminary Synthesis. Arctic Anthropology 15(2):119-145.

Neilsen, S.W.

2006 Intermediate Indians: The View from Ushpitun 2 and Pmiusik 1. Master's Thesis, Department of Archaeology, Memorial University of Newfoundland, St. John's, Newfoundland, Canada.

2012 2012 Archaeology Mitigation at Sheshatshui. *Provincial Archaeology Office 2013 Archaeology Review* 10:101-115.

2013 2013 Archaeology Investigations, Upper Lake Melville, Labrador. *Provincial Archaeology Office 2013 Archaeology Review* 11:113-121.

2015 *Emergency Excavations in the Vicinity of FhCb-03 and FhCb-04, Happy Valley-Goose Bay, October 2013*. Submitted to Provincial Archaeology Office, Permit No. 13.52. Copies available from PAO, St. John's.

2016a Archaeology in Upper Lake Melville. *Provincial Archaeology Office 2016 Archaeology Review* 14:187-202.

2016b *Pedestrian Survey of landform associated with FfDn-04, FfDn-08, and FfDn-05: Filming for Wild Archaeology episode 12, season 1.* Submitted to Provincial Archaeology Office, Permit No. 15.35. Copies available from PAO, St. John's.

Neilsen, S. W. and Allan Wolfrum
2018 Archaeo-Geophysical Prospection in Upper Lake Melville, Labrador. Report submitted to PAO, St. John's.

Neubauer, F.
2018 Use-alteration analysis of fire cracked rocks. *American Antiquity* 83(4) pp.681-700.

Oswin, J.
2009 *A Field Guide to Geophysics in Archaeology*. Springer, in association with Praxis Books, Berlin.

Pintal, J-Y.
1998 *Aux Frontieres de la mer: La prehistoire de Blanc-Sablon.* Collection Patrimoines Dossiers. Les Publications du Quebec, Municipality de Blanc-Sablon.

Provincial Archaeology Office (PAO)
2004 Intermediate Amerindian Sites Database. CD of all Intermediate Amerindian Sites as of October 2004. Provincial Archaeology Office, Government of Newfoundland and Labrador, St. John's.

Ramsey, B.C.
2017 OxCal. Electronic application, https://c14.arch.ox.ac.uk/oxcal/OxCal.html, accessed August 25, 2019.

Reimer, P.J., Edouard Bard, Alex Bayliss, J. Warren Beck, Paul G. Blackwell, Christopher Bronk Ramsey, Caitlin E. Buck, Hai Cheng, R. Lawrence Edwards, Michael Friedrich, Pieter M. Grootes, Thomas P. Guilderson, Haflidi Haflidason, Irka Hajdas, Christine Hatté, Timothy J. Heaton, Dirk L. Hoffmann, Alan G. Hogg, Konrad A Hughen, K. Felix Kaiser, Bernd Kromer, Sturt W. Manning, Mu Niu, Ron W. Reimer, David A. Richards, E. Marian Scott, John R. Southon, Richard A. Staff, Christian S.M. Turney, and Johannes van der Plicht.

2013 IntCal13 and Marine13 radiocarbon age calibration curves 0–50,000 years cal BP. Radiocarbon 55: 1869–1887.

Ritchie, W. A., and American Museum of Natural History.

1969 *The archaeology of New York State*. Garden City, N.Y: Published for the American Museum of Natural History [by] the Natural History Press.

Rössler, M.

2003 Linking Nature and Culture: World Heritage Cultural Landscapes. In *World Heritage Papers* 7:10-15, UNESCO World Heritage Centre.

Schmidt, A.

2007 Archaeology, magnetic methods. In *Encyclopedia of Geomagnetism and Paleomagnetism*, edited by David Gubbins and Emilio Herrero-Bervera, pp. 23-31. Encyclopedia of Earth Sciences Series Heidelberg, New York: Springer.

Schmidt, A., P. Linford, N. Linford, A. David, C. Gaffney, A. Sarris, and J. Fassbinder

2015 *EAC Guidelines for the Use of Geophysics in Archaeology: Questions to Ask and Points to Consider*. European Archaeological Council (EAC). Submitted to EAC.

Schwarz, F.

2007 A beguiling simplicity: the Intermediate period in central Labrador Prehistory. Paper presented at the 40th annual Canadian Archaeology Association conference, St. John's, Newfoundland.

Schwarz, F. and Roy Skanes

2013 Lower Churchill Project Historic Resources Management Program, South-Central Labrador 2012-2013. *Provincial Archaeology Office 2013 Archaeology Review* 11:157-165.

Schwarz, F., Corey Hutchings, and Vincent Bourgeois

2017 Historic Resource Management Program, Lower Churchill Project, Central Labrador 2017. *Provincial Archaeology Office 2017 Archaeology Review* 15:222-231.

Stassinu Stantec Limited Partnership

2011 Historic and Heritage Resources Field Program. Report submitted to Nalcor Energy and Provincial Archaeology Office, St. John’s.

2013 Progress Report 2013 LCP Historic Resources Program Muskrat Falls, Labrador, Week Ending July 21, 2013. Report submitted to Nalcor Energy and Provincial Archaeology Office, St. John’s.

2014 2012 Historic Resources Assessment and Recovery Field Program. Report submitted to Nalcor Energy and Provincial Archaeology Office, St. John’s.

2015 2014 Historic Resources Assessment and Recovery Field Program. Report submitted to Nalcor Energy and Provincial Archaeology Office, St. John’s.

2016 2015 Historic Resources Assessment and Recovery Field Program. Report submitted to Nalcor Energy and Provincial Archaeology Office, St. John’s.

2017 2016 Historic Resources Assessment and Recovery Field Program. Report submitted to Nalcor Energy and Provincial Archaeology Office, St. John’s.

St. Croix, R.

2002 *Soils of the Happy Valley East Area, Labrador, Soil Surveys Report.* Soil and Land Management Division, Government of Newfoundland and Labrador, St. John’s.

Tache, K.

2008 Structure and Regional Diversity in the Meadowood Interaction Sphere. Department of Archaeology, Simon Fraser University, Burnaby, British Columbia, Canada.

Terraplus, Inc.

2016 *KT-20 Magnetic Susceptibility/Conductivity User’s Guide v1.3b.* Available digitally from Terraplus, Inc. Electronic.

Thompson, J.

2016 *Ephemeral Hunter Gatherer Sites: Geophysical Research*. Elsevier, Amsterdam.

Thompson, V.D., Philip Arnold, Thomas J. Pluckhahn, & Amber M. Vanderwarker

2011 Situating Remote Sensing in Anthropological Archaeology. *Archaeological Prospection* 18:195-213.

Thompson, V.D., Thomas J. Pluckhahn, & Amber M. Vanderwarker

2009 Geophysical Investigations at Teotepec, Mexioco (1000 B.C.—A.D. 1000). *Journal of Field Archaeology* vol. 34 4:439-455.

Tuck, J.A.
1975 The Northern Maritime Continuum: 8000 Years of Cultural Development in the Far Northeast. *Arctic Anthropology* 12(2):139-147.

Tudor, C.A.
2013 Geophysical Investigations at the Dorset Palaeoeskimo Site of Phillips Garden, Port Au Choix, Northwestern Newfoundland. Department of Archaeology, Memorial University of Newfoundland, St. John's, Newfoundland, Canada.

Wadley, L., Tamaryn Hodgskiss, and Michael Grant
2009 Implications for complex cognition from the hafting of tools with compound adhesives in the Middle Stone Age, South Africa. *PNAS:* 106(24): 9590-9594.

Wilton, D.
2015 Report on the MLA-SEM examination of two Precontact-Period pottery sherds and three mud samples from the Churchill Valley, Central Labrador. *Provincial Archaeology Office 2015 Archaeology Review* 13:229-240.

Wolfrum, A.A.
2018 Full Report on the Archaeological Application of the KT-20 3F Magnetic Susceptibility/Conductivity Meter in Newfoundland and Labrador, Canada. Memorial University of Newfoundland. Submitted to Terraplus, Inc. Copies available by request from author.

Wynn, J.C.
1986 A Review of Geophysical Methods Used in Archaeology. *Geoarchaeology* 1(3):245-257.