Where are the children?
An experimental archaeology study concerning the role of practitioner bias in the recovery of juvenile skeletal remains

by

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B.A., University of Northern British Columbia, 2009

Thesis Submitted in Partial Fulfillment of the
Requirements for the Degree of
Master of Arts

in the
Department of Archaeology
Faculty of Environment

SIMON FRASER UNIVERSITY
Spring 2020

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Ethics Statement

The author, whose name appears on the title page of this work, has obtained, for the research described in this work, either:

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or

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Abstract

Juvenile skeletal remains are generally underrepresented in the archaeological record, despite the high infant and child mortality rates in prehistoric and pre-modern populations. The invisibility of juvenile skeletal remains has often been attributed to several factors, including environmental, cultural, and methodological filters. These include taphonomy, differential burial patterns, and the methods employed by archaeologists. However, practitioner bias, the prejudice of archaeologists in field projects, also plays an important role. To evaluate how practitioner bias affects the identification and recovery of juvenile skeletal remains, an experimental archaeology study was conducted. In total, three mock excavation units were constructed comprised of two control units and one experimental unit. All units contained replica material culture and one contained the macerated skeletal remains of one juvenile pig (*Sus scrofa*) as a proxy for *in situ* juvenile human skeletal remains. During this blind study, a total of 28 participants excavated the units. Participants were grouped into four groups based on experience in heritage resource management and background in human osteology. Participants were evaluated based on the recovery rate of replica material culture and skeletal elements through both intragroup and intergroup analysis. The initial hypothesis was that more experienced participants or participants with human osteology would recover a higher proportion of skeletal remains than those who are less experienced or do not have specialized training in osteology. The results of the study contradict this expectation/hypothesis, with less experienced participants generally recovering a higher proportion of skeletal remains than those with more experience. The results reflect the epistemology of present-day commercial archaeology – how the inculcation into professional archaeology can modify an individual's *a priori* beliefs and develops individual confirmation bias – and illustrates how current methods and attitudes are typically insufficient for the complete/successful/reliable excavation of juvenile skeletal remains.

Keywords: juvenile osteology; experimental archaeology; funerary archaeology; mortuary archaeology; heritage resource management

Dedication

This thesis is dedicated to the archaeologists in the past who showed me how much we need to improve and to the practitioners who have inspired me to make the discipline better.

The truth is always there for those with the eyes to see and the ears to hear.

Acknowledgements

This project could not be realized, nor possible, without the support from several groups and individuals.

My supervisor, **Dr. Hugo Cardoso**, has offered me countless opportunities over the years and I lack the vocabulary or literary prose to describe how thankful I am to him. Hugo has continued to push to make me a better scholar and push my thinking on how I approach my projects and studies and I am a better archaeologist for it. Thank you, Hugo.

Dr. Darcy Mathews was instrumental in the guidance of this project and providing valuable feedback and direction with my studies.

Thanks to **Dr. Francesco Berna**, who provided keen and thoughtful questions and feedback as internal examiner for my defence.

Gratitude to **Dr. Christina Giovas** who chaired the defence and provided insightful questions and commentary on the subject matter.

Without the assistance of **Peter Locher** and **Shannon Wood** it's likely I would still be looking for equipment and hanging tarps in the pit. Thank you both!

The members of the ***Juvenile Osteology*** **(JUNO)** lab group (2016-2020) provided integral feedback and assistance during the duration of this project.

The **British Columbia Association of Professional Archaeologists**, **Archaeology Society of British Columbia,** alongside other firms and individuals disseminated recruitment materials for this study. Of which, I thank you all.

To both **Nicole Oakes** and **Doug Brown**, as both colleagues and mentors you have been a strong backboard for my ideas and with quick wit and critical eyes, you have both helped shape the trajectory of this project in a way for the better. **Kristina VanderMeer** has been invaluable to helping me shape and articulate my project and ideas while also instilling the value of 'turning off' the brain for a pint after many long days excavating midden or construction monitoring.

Most of this project was devised and written while completing arduous field programs across the south coast – from daily and weekly ferries, to barge and logging camps while completing a multitude of projects, from multi-year excavations of village site settlements or surveys that spanned the Sunshine Coast. For that reason, I am indebted to my family and friends who helped me through this time. You made sure I was eating, sleeping, and keeping healthy enough to keep a spartan pace going… not to mention two close confidants that would ensure that I would retreat from my office for a pint every fortnight or so.

Special thanksgiving is owed to **Grace**, **Steve,** and **Adam O'Neill** for continued support through this adventure. Finally, to **Nikki Kroetsch** for her keen editorial eye, continued support, and constantly driving me to be the best while supporting me throughout the length of this project . Thank you.

Finally, to all of the participants. Without you this experiment would not have been possible and for that I'm thankful for each and every one of you.

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List of Acronyms

AIA	Archaeological Impact Assessment
AOA	Archaeological Overview Assessment
BC	British Columbia
BCAPA	British Columbia Association of Professional Archaeologists
BP	Before Present
HCA	*Heritage Conservation Act*
HRM	Heritage Resource Management
SFU	Simon Fraser University

Chapter 1.

Introduction

1.1. The research issue and objective

Human skeletal remains offer the most direct insight into the lifestyles and epidemiology of both modern and past populations (Manifold 2012:51). Further, juvenile skeletal remains provide evidence and the most direct window of understanding into the patterns of growth and development, childhood disease, and nutrition of prehistoric and historic humans (Baxter 2008; Crawford et al. 2018; Fahlander 2011; Hadley 2018; Lancy 2008; Mays et al. 2017; Montgomery 2008; Tibbetts 2017). Equally or more significant than the scientific value of juvenile skeletal remains is the role of ancestral remains to Indigenous groups. To Indigenous groups, ancestral remains can act as a nexus between the living and the deceased, the spiritual and the corporeal; therefore, the identification, recovery, and preservation of ancestral remains is paramount for archaeologists working within mortuary sites. Beyond the scientific and spiritual implications, if human remains are missed during archaeological impact assessments it can lead to major political and economic consequences (Mapes 2009). The study of children in the archaeological record has often been marginalized or excluded from the discipline until the 1990s (Lally and Moore 2011; Mays et al 2017; Ruttle 2010); however, archaeologists have begun an upswing in recognizing the importance of children, through both material culture and skeletal remains, in the archaeological record.

The burial context from which juvenile skeletal remains are excavated can also provide a suite of information about the culture and social practices in the past. The burial of the dead is embedded with meaning and significance (Murphy and Le Roy 2017). The treatment of the dead, funerary rituals, and mortuary landscape are all instilled with the agency of the living (Duday et al. 2009; Murphy and le Roy 2017). The agency of the living is visible in the archaeological record through headstones, coffin plates, funerary adornments, grave goods, and the remains of the dead. Funerary rites and gestures, such as fumigations to clear a sacred space, a wash to clean the bodies of the dead, or botanical arrangements on the graves, are an integral part of the death ritual and can manifest themselves in the archaeological record (Baxter 2008:161; Brookshaw 2018).

Burials, mortuary sites, and exploring the funerary landscape help archaeologists understand the social and cultural patterning and tensions of the past. Certainly, if children were treated differently in life then it is likely to be visible in how they are treated in death (Binford 1971). These differences can be manifest in a variety of gestures or differentiations, from the way the bodies of the dead are handled to the locations they are buried, interred, or placed, and the way they are remembered and mourned (Duday et al. 1990; Maines et al. 2017).

While grave markers may help archaeologists understand the spatial patterning of mortuary sites, the skeletal remains of juvenile humans are imperative to understanding the past life course of children living in past societies (Mays et al 2017; Hockey and Draper 2005). Skeletal remains offer archaeologist's data about past health and disease (FitzGerald et al. 2006; Milner et al. 2009; Waldron 2009), the interaction between the natural and social environment, mortality, and aspects of skeletal biology (Mays et al. 2017; Molleson 1989; Katzenberg et al. 1996; Woods 2007). The remains of individuals who died prior to, or soon after birth, represent a record of a very precise time in reproductive females (Katzenberg et al. 1996; Tibbetts 2017). Infant remains inform us of the prenatal health of both mother and child and for those children who survived past birth, provides a lens into postnatal health (FitszGerald et al. 2006; Mays et al. 2017; Tibbetts 2017).

Paleodemographic studies have demonstrated that mortality rates in infants and children were higher in prehistoric and historic periods than contemporaneous times (Angel 1969; Lewis 2009; Séguy et al. 2008; Weiss 1973; Woods 2007). In fact, Weiss notes "the greatest variance in human mortality occurs among juveniles, and particularly among infants in their first year of life" (1973:26). For example, population studies have shown that infant and child mortality was as high as 35 percent in China during the Qing dynasty, 30 percent in late Tokugawa Japan, and between 12 to 45 percent for early modern Europe (Woods 1993, 2007). Further, given that many paleodemographic studies did not account for infanticide in their studies, the mortality rate for sub-adults may be higher (Weiss 1973). Consequently, it is to be expected that juvenile skeletal remains would be reflected in large numbers in the prehistoric and historic record; however, that is not usually the case. Juvenile skeletal remains are identified and recovered at a disproportionately low rate compared to adult skeletal remains in archaeology sites both nationally and globally.

Why are so few juvenile skeletal remains recovered from archaeological sites?

The skeletons of fetuses, infants, children, and adolescents are imperative to the study of population reconstruction, stress and adaptation, disease and health, and group social dynamics (Halcrow et al. 2017; Hoppa 1992; Katzenberg et al. 1996; Lewis and Flavel 2006). Given the importance of identifying and recovering human remains, the question must be asked: why are so few juvenile skeletal remains recovered from archaeological sites?

Authors have previously suggested that the lack of juvenile remains is due to differential preservation (Pokines and Baker 2013a; Newcomb et al. 2017; Pokines and Junod 2013; Gordon and Buikstra 1981; Bello and Andrews 2006; Manifold 2013), differential burial practices (Maines et al. 2017; Milner et al. 2007), or differential excavation methods (Gordon and Buikstra 1981; Graesch 2009; James 1997; Katzenberg and Saunders 2008; Mays 1992; Mays et al. 2012; Pokines and de La Paz 2016; Pokines and Baker 2013b; Saunders 2008); however, I argue that bias of archaeologists is the rarely acknowledged fourth contributing factor (Figure 1). As Milner et al. identified, practitioners "…differ greatly in their interest in finding bones and in their experience in recognizing poorly preserved bones or infant skeletons" (Milner et al. 2007:574). How the dead are treated, both in burial and future engagement with the departed, account for the cultural filter. How societies treat their dead often mirrors how they treat their living; largely based on an individual's age, gender, and status. This treatment often manifests in the types and location of one's burial; therefore, if infants are buried in a different part of a cemetery, or outside formal cemetery grounds, then these cultural biases will affect what type of skeletal remains are encountered during an excavation. The environment surrounding the bones, the exposure to oxygen and groundwater, soil acidity, bioturbation, and anthropogenic alterations to land all account for how bones pass through the "environmental filter". Thus, the surrounding environment influences how much bone is preserved and enters the next stage. Lastly, the tools and strategies in the excavation of an archaeological site comprise the methodological filter. The strategy to use machine trenching versus hand excavation is one such example that and would likely greatly impact the identification and recovery of cultural material or skeletal remains. These cultural, environmental, and methodological biases act as "filters" (Hoppa 1996; Figures 1 and 2). Once deceased, how an individual passes through each filter determines how observable one is in the archaeological record (Figure 2). While cultural, environmental, and methodological filters affect what material is recovered from the original living population, practitioner bias affects the outcome, or perceptions, of the interaction of these factors. Generally speaking, these filters act in a hierarchical manner with each filter affecting the outcome of what would be processed through to the next.

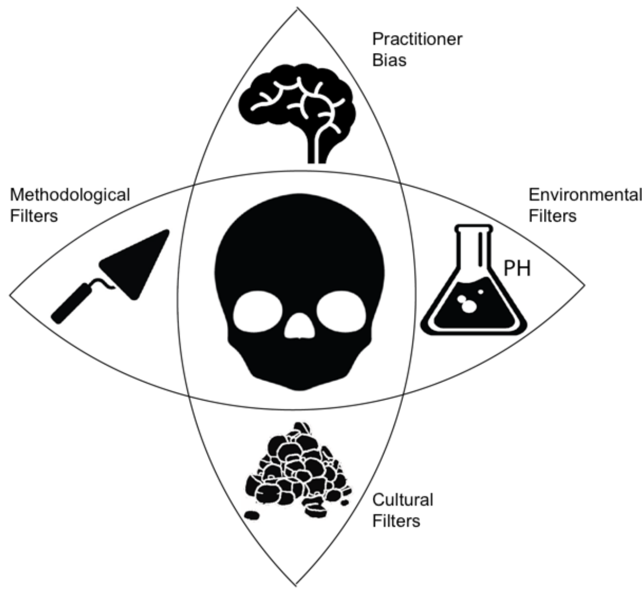


Figure 1. The four factors affecting representativeness of human juvenile skeletal remains

In much of the world, academic archaeology investigations only comprise a small amount of the data collection while Heritage Resource Management (HRM) projects comprise the rest. For example, in 2011 only three percent of all Heritage Conservation Act (HCA) permits issued in British Columbia were designated for research and field schools while the remaining 97 percent were issued for residential development, resource extraction, and governmental developments (la Salle and Hutchings 2012:11). For those employed as professional archaeologists, the approach to mortuary sites and the treatment of juvenile skeletal remains requires special consideration. Human remains are unique; due to their status as the remains of the once-living peoples, special considerations are required above and beyond that which pertain to other types of archaeological material (BABAO 2008).

1.1.1. Speaking of biases: cognitive and practitioner

The goal of this study is to evaluate if practitioner bias plays a role in the identification and recovery of juvenile skeletal remains. To this end, an experimental archaeology study was developed to evaluate the biases of participants with various educational backgrounds and levels of experience partook.

My hypothesis is that the bias of the practitioner plays a significant role in the recovery of human remains from HRM contexts. For the purpose of this paper, I define practitioner bias as the partiality individuals demonstrate when interpreting the archaeological landscape. Thus, the bias of a practitioner directly affects the methodological filter, in turn affecting the identification and recovery of archaeological resources. Although taphonomy and the types of burial play a role in the preservation of human remains, my hypothesis is that a practitioner's bias plays a central role in what material is identified, recorded, and recovered from the field in addition to what is recorded in the laboratory. For this thesis, I define practitioner bias based on previous studies of cognitive bias within forensic sciences. On cognitive bias, Nakhaeizadeh et al. (2014) notes "[t]he limitation within the human cognition system and its capacity to process information can cause selective attention toward information and may affect our judgements, perceptions, and final evaluations" (Nakhaeizadeh 2014:1177). The bias of a practitioner and the excavation bias of research methods can often result in a positive feedback loop or confirmation bias. Confirmation bias is when individuals seek out and interpret information in ways that are partial towards their existing beliefs (Ask and Granhag 2005). Thus, archaeologists may find themselves in a continuous loop where their biases are confirmed. Regardless of scientific validity, if an archaeologist believes that the soil's acidity dissolves the bones of children at a proportionally higher rate than adults, then their bias may blind them to the evidence in front of them.

1.2. Challenges with identification and recovery of juvenile remains in archaeology sites

There is substantial literature produced on the subject of human juvenile skeletal remains in archaeological contexts (e.g., Arden 2006; Baxter 2005, 2008:161; Chapman 2015; Kamp 2001; Derevenski 1997; Lillehammer 2018; Mays et al. 2017; Murphy and le Roy 2018; Scott 1999); however, a consensus has not been reached between practitioners as to why there is an underrepresentation of juvenile skeletal remains. Most scholarly work that tackles this subject refers to two primary reasons for the absence or lack of juvenile remains in burials; these are: taphonomic factors and differential funerary treatment or burial methods (Hanson and Buikstra 1987; von Endt and Ortner 1984; Zapata et al. 2006). Beginning with Thomas Jefferson's 1788 excavation of mounds in Virginia, he commented "…[t]he bones of infants being soft, they probably decay sooner, which might be the cause so few are found here" (Jefferson 1788:105). Jefferson's statement – effectively his own confirmation bias – while over two centuries old, echoes sentiments that still permeate project planning, budgeting, fieldwork, and analysis to this day. For that reason, taphonomy and differential burial methods or cultural practices surrounding death will be addressed.

The third reason for the lack of juvenile skeletal remains is the methods employed during field programs. The methodological framework utilized in archaeology programs – HRM or otherwise (e.g., survey, testing, and sampling strategies) – directly correlate to the recovery bias of archaeological material. The principal investigators or senior archaeologists impart their own bias into the research design of their projects. Thus, the next challenging component for fieldwork projects is establishing the acceptable threshold of recovery bias during the planning, management, and budgeting stages of a project. To reiterate, recovery bias is the prejudice of what is recovered during an archaeological investigation. Hence, an archaeological investigation using only ½ inch (12.7 mm) or ¼ inch (6.4 mm) screens may recover a disproportionate amount of medium to large lithics and skeletal elements while pieces of smaller debitage, stone and bone tools, beads, fauna, and human remains may pass through the screen (Coupland et al. 2010; Graesch 2009; Schaffer 1992). If contingencies are not in place to evaluate what is missed, then the recovery bias will lead to a skewed evaluation of the site.

Principal investigators and senior archaeologists are typically aware of what material culture can be missed and develop their research plan accordingly with their budget and timeline. For example, at the outset of a project involving systematic excavations, typically only a fraction of the units excavated (e.g., 10 or 20 percent) will be screened with a finer mesh (⅛ inch versus ¼ inch) in HRM programs. Indeed, the ¼ inch screen can capture material such as lithic tools, bone, debitage, and shells while also allowing microdebitage, beads, paleobotanical samples, and small bones to fall through. Nonetheless, beads are not human bones, so the archaeologists need to ensure that when they account for loss of material culture in their research design, they are also asking the challenging questions, like “where are the funerary components?”. In one study, Stewart and Wigen analyzed the faunal recovery from three sites in the Pacific Northwest where both ¼ inch and ⅛ inch (2.8 mm) screens were used (Stewart and Wigen 2003). The results revealed that in one site, accurate economic and subsistence reconstruction was completely contingent on processing matrix through a ⅛ inch screen (Stewart and Wigen 2003:27). In another study, the North Coast Prehistory Project (NCPP) excavated 10 sites in Prince Rupert Harbour from 1966 to 1973, excavating over 500 m^2 from six areas (Ames 2005; Coupland et al. 2010; MacDonald 1969; MacDonald and Cybulski 2001; MacDonald and Inglis 1981). In prehistory, the northwest coast’s economy was heavily reliant on salmon; as such, it is normal to observe a large degree of salmon remains in occupational or household sites (Ames 2003; Coupland et al. 2010; Stewart and Stewart 1996). However, using casual screening methods and in situ collection of artifacts and faunal remains, the NCPP determined that while larger fauna specimens were present, salmon was largely absent (Ames 2003, 2005; Coupland et al. 2010; MacDonald and Cybulski 2001; MacDonald and Inglis 1981). In Coupland et al.’s study (2010), the team rescreened the midden backfill from components of the NCPP study. The screening methods included dry-screening through 6 mm mesh, wet-screening with low pressure hose through 3 mm mesh, and then bulk sampled matrix for further analysis in the lab to process through 3 to 1 mm mesh (Coupland et al. 2010:191). Finer screening of the midden back fill showcased that the majority of fauna assemblage was comprised of fish, often with salmon accounting for over 90 percent of the faunal assemblage (Coupland et al. 2010). Certainly, it would be unusual for archaeologists to not use screens during impact assessments; however, during monitoring programs or post-impact assessments, visual inspection, rakes, and sample screening are often used to determine distribution or frequency of archaeological materials. These two studies showcase how methodological filters influence the recovery bias of osteological and other materials.

The lack of recovered juvenile remains recovered from HRM scenarios also may speak to a larger systemic issue endemic to HRM firms and their field programs. The systemic issues are multifaceted; however, I argue that the issues stem from several main deficiencies, including inadequate training for HRM practitioners and in-house expertise to be able to identify burials; lack of knowledge of regional burial practices and rituals that would be expressed in the archaeological record; and, the guiding legislation for compliance archaeology set forth by provincial, state, or federal legislation. This is compounded by the capitalist framework that most HRM programs are structured within. The interests of the heritage managers (e.g., archaeologists, First Nations, and special interest stakeholders) are often at odds with the interests of the proponent who has chosen to develop the land. While it can differ between project types (e.g., forestry versus residential or infrastructure projects), generally proponents are on tight schedules, budgets, and timelines to complete their environmental assessments and begin construction.

1.3. Research Questions and Goals

There is one central research subject with three interrelated research questions addressed in this research, outlined below in Table 1. The sources of data used and the methods employed to answer these questions are briefly discussed below.

Table 1. Thesis research questions, data sources, and methods.

	Research Question	Source of Data	Methods
1	To what extent does experience and training affect the recovery of juvenile remains in the archaeological record?	SFU experimental archaeology study	Experimental archaeology study using a piglet as a proxy for juvenile human remains. Contrasting the recovery rate of material from the control units and the experimental units within and between groups.
1.a	Do individuals with more experience recover more skeletal remains than those with less experience?	SFU experimental archaeology study	Inventory of skeletal remains identified and contrasted between groups.
1.b	Do individuals with a background in human osteology recover more skeletal remains than those who do not have a similar background?	SFU experimental archaeology study	Inventory of skeletal remains identified and contrasted between groups.

This research project is the first systematic assessment of practitioner bias in the recovery of juvenile skeletal remains. As such, there is ambiguity in the roles that differential preservation or burial methods affect the recovery of juvenile skeletal remains in archaeological sites. Continued ignorance towards the recognition that individual biases of archaeologists may be significantly impacting the recovery of skeletal elements is doing a disservice to the archaeological record and the descendants of the dead.

There are some hypotheses to the performance of archaeologists in field programs that will be investigated in this study (Table 1). The expectation is that archaeologists with more experience will recover more archaeological material, material culture or bone, than those with less experience. This hypothesis follows the premise that the longer you have been completing certain tasks (e.g., excavation, screening, reporting, analysis, etc.) the more proficient you are at it. Hence, the assumption is that archaeologists with several decades of experience should demonstrate to be better at the identification and recovery of archaeological material than those who have less experience.

The second hypothesis is that an individual with specialized training will recover a greater frequency of material than an individual without training. For example, an individual with training in lithics is likely to identify and recover more lithics than an individual without said training. For the purpose of this study, individuals who identified as having formal human osteology training were grouped separately from those who did not. Therefore, the expectation is that individuals with a formal background in human osteology will outperform, through the identification and recovery of skeletal elements, individuals who lack training in human osteology.

The third hypothesis is that the recovery rate of replica material culture and skeletal elements will be approximately the same. If this hypothesis proves true, then participants who recover 90 percent of the replica material culture from a unit should recover approximately 90 percent of the skeletal elements. Further, the theory applies to the groups of participants as well. If participants exhibit a heterogenous recovery bias (e.g., recover 100 percent of lithics but only 60 percent of glass artifacts or 90 percent of material culture items but only 50 percent of skeletal elements) then the expectation is incorrect and there is a recovery bias towards particular materials (e.g., stone, glass, ceramic, or bone).

While the purpose, results, and implications of this study are relevant for commercial archaeology and academic or research investigations, it should be noted that the study is focussed largely on HRM archaeology. In British Columbia, and much of the world, commercial archaeology is situated as one component in the environmental assessment model. Archaeologists are typically engaged prior to development of land to assess the potential for archaeological resources. In British Columbia, when approached with a project, archaeologists will conduct an archaeology overview assessment (AOA) and if the project meets the standards that requires further information then it is scheduled for an archaeology impact assessment (AIA). Thus, potential modeling of a proposed project location may deem that the area has ‘high’ or ‘low’ archaeological potential; however, theories cannot be ground-truthed without an AIA. Commercial archaeology in British Columbia often has very limited budgets with slim profit margins for heritage consulting firms. As such, companies and the staff therein are often challenged by limited mentorship and training opportunities and limited funding, while imposing huge time stresses onto staff to get projects complete within scope and schedule. Unfortunately, even those practitioners who may leave academia as trained experts (e.g., osteologists or zooarchaeologists) may only get to use that skill set infrequently, and in some cases, virtually not at all. This study has been developed with my own bias of working in HRM full-time for over a decade, living and working in the subarctic, boreal forest, interior plateau, and for the past five years, in Coast Salish territory within the south and Sunshine Coasts of British Columbia.

Chapter 2.

Background

2.1. Importance of children in the archaeological record

Childhood is a universal and natural experience experienced by all of those who live to adulthood (Baxter 2008). Albeit that the lived experience of childhood is experienced differently from one culture to the next, it is one of the true universals of life. Regardless of this universality, children have largely remained invisible in prehistorical research and reconstruction, museum exhibits, and the archaeological record (Baxter 2008:161; Brookshaw 2018; Chamberlain 1997). Some authors have suggested that archaeologists have discounted children as non-viable subjects of study given that they were perceived to not make significant contributions to past social groups (Baxter 2008:161; Crawford et al. 2018:8). Despite their apparent absence in the archaeological record, however, children are significant economic and social actors, developing independent status, social and political persona, and significantly impacting society at a young age (Baxter 2008; Crawford et al. 2018; Fahlander 2011; Hadley 2018; Lancy 2008; Montgomery 2008). Röder exposes how children in pastoral and agrarian societies would take on age appropriate tasks, such as domestic or subsistence activities, as early as age five (Röder 2018:135). Certainly, families, communities, and societies dedicate a significant amount of resources and restructure to accommodate the care and training of children (Arden 2006; Baxter 2005; Baxter 2008:161; Kamp 2001; Sofaer Derevenski 1997, 2000). Thus, we can recognize that the existence of children shaped the landscape: through the collection of subsistence, domicile organization, curation, collection (and loss) of artifacts, participation in ritual and ceremonies, harvesting the landscape, and burying the dead (Crawford 2009; Crawford et al. 2018; Hadley 2018; Montgomery 2008). This challenges us to consider why children – both their physical remains and their contributions to the formation of the archaeological record – are largely absent in archaeological studies.

Authors have previously queried why children are missing from archaeological interpretations. Coşkunsu (2015:4) puts forth the following:

1. The supposed intangible nature of childhood in the archaeological record and the a priori assumption that children lack easily recognizable archaeological correlates

2. Conceptualizations that see children as socioeconomically unimportant

3. Acceptance of a universal/stereotypical view of childhood

4. Gender biases

5. Cultural biases

6. The lack of substantial interdisciplinary collaborations on the subject

While Coşkunsu's (2015:4) six axioms may not specifically address skeletal remains, they do address the importance of recognizing the inherent structural and individualized biases in archaeology and nods towards the necessity of interdisciplinary collaboration rather than a siloed approach.

The preservation, identification, and recovery of material culture representative of children or skeletal material is subject to numerous extrinsic and intrinsic forces (Mays 2018; Gordon and Buikstra 1981; Pokines and Baker 2013a, 2013b; Haglund and Sorg 2002, 1997). Further, Crawford et al. note that cultural priorities and shifts affect how the archaeological record is approached and can lead to the suppression of evidence and failure to observe juvenile remains when they are present (2018:27). Due to taphonomic processes, items that could reflect childhood, such as clothing, tools, or game pieces, may not survive unless they are created out of non-organic materials such as stone or metal. It is for this reason that the burial plots and skeletal remains of children are vital to those studying prehistoric pathways; they provide a tangible lens into the values and structure of how societies treated their children in death (Baxter 2008; Binford 1971; Mays et al. 2017; Murphy and le Roy 2018; Kamp 2001).

The burial of an ancestor or community member is a deeply profound act imbued with meaning that permeates through the cultural strata of a group (Manifold 2013; Rahtz et al. 2000; Scull 1997). As Murphy and Le Roy note "death is not only a biological reality but a complex cultural event" (2017:1). It is through death and funerary rituals that we see customs, taboos, and rituals imprinted into the landscape. These imprints, or lack thereof, constitute the memorialization of the death of the young; for some cultures choose to remember and some choose to forget (Crawford et al. 2018:27). However, over time when these cultural imprints on the landscape fade and become forgotten, archaeologists find themselves further challenged. Without tangible proof of childhood, archaeologists have to pierce the tensions and arguments in methodological and theoretical frameworks in pursuit of the only evidence that undoubtedly proves the presence of children: the skeleton.

2.2. Cradle to grave: representativeness of juvenile skeletal remains in the archaeological record

While the discipline of archaeology studies the prehistoric pathways and life patterns of humans on the landscape, it is odd that children are largely absent from the narrative. Children comprised substantial demographic portions of all social groups, thus any interpretation of the past without children should be considered incomplete (Arden 2006; Baxter 2005; 2008; Chamberlain 2000; Crawford et al. 2018). There is no doubt that children existed in antiquity and are represented in the archaeological record, irrespective of whether archaeologists are competent or careful enough to recognize them (Chamberlain 1997).

The study of children in archaeological contexts provides necessary insight into the social organization and identities within a society (Boric and Stefanovic 2004; Hadley 2018; Gilmore and Halcrow 2014; Halcrow et al. 2017). Hadley (2018) purposes how the study of children in ancient Viking settlements can reveal evidence to how families organized, adapted, and renegotiated concepts of childhood in relation to migration and resettlement patterns throughout Scandinavia (2018:423). Environmental stressors, growth, disease, diet, and mortality leave markers on the skeletal remains of those who pass (Mays 2018). The study of bone growth and associated skeletal lesions, such as Harris lines, can assist in determining period of arrested bone growth, often a result of suffering through adverse conditions in a growth period (Mays 1995, 2018). The growth of an individual can be measured through the long bones and cortical thickness (Saunders 2007; Scheuer and Black 2004), the dimensions of the ilium (Mays 2018; Pinhasi et al. 2005), and the dimensions of the iliac alongside long bone length (Hoppa 1992; Merchant and Ubelaker 1977). Through stable isotope analysis, the time of weaning can be examined in skeletal populations (Jay 2009; Mays 2018:81). Cultural milestones, such as weaning or puberty, can also dictate the cultural age of an individual in conjunction with their biological age (Mays 2000, 2018).

The probability of recovering the remains of all individuals of a population during an archaeological investigation is greatly reduced or nullified due to a set of complex factors that can distort the representation in skeletal samples (Cardoso 2006:238-239). An examination of the factors that lead to preservation and subsequent recovery of juvenile skeletal remains is warranted. These factors, both intrinsic and extrinsic, are best expressed through the sampling hierarchy in skeletal biology created by Hoppa (1996; Figure 2). Through this sampling hierarchy, one can observe the various filters or samples created by biological, cultural, environmental, and methodological filters. Stage I represents the living population; thus, you can only expect those who were living to be expressed in the archaeological record. Stage II represents how a group's cultural beliefs, rituals, and gestures impact the treatment of the dead. Stage III represents the environmental filters that the dead are subjected, including taphonomic processes. Stage IV represents how archaeologists encounter the dead, through sampling strategies, field methods and tools, and analysis. Finally, Stage V is the observable skeletal sample that has been recovered by the archaeologists. Each of these filters has the capacity to greatly change how much skeletal material moves from Stage I to V. These stages discussed through the lenses of childhood, agency, personhood; cultural beliefs and burial practices; environmental influences on skeletal material; and the theories, tools, and techniques used by archaeologists are explored below.

I. **LIVING POPULATION**

↕ Biological Filter

II. **MORTALITY SAMPLE**

↕ Cultural Filter

III. **CEMETARY SAMPLE**

↕ Environmental Filter

IV. **EXCAVATION SAMPLE**

↕ Methodological Filter

V. **OBSERVABLE SKELETAL SAMPLE**

Figure 2. Sampling hierarchy in skeletal biology (Hoppa 1996:52).

Everyone eventually dies; it is one of the true axioms of natural world. Thus, the living population encompasses the population currently alive. The biological filter acts as a screen, processing the living from those who are deceased. This can be problematic as those who die and proceed to comprise the ‘cemetery sample’ are generally not the healthy, normal individuals but rather the weaker individuals (Cardoso 2006: 239). Therefore, the mortality sample is distorted and does not represent all living individuals randomly in any range (Milner et al. 2000), as normally, the differential mortality of a population constitutes a selection mechanism (e.g., disease or age) to enter the mortality sample (Cardoso 2006:240). While the biological filter (Figure 2) is imperative to understanding *who* moves through the filters, it has little interest to this study.

2.3. Mortality sample and cultural filters

2.3.1. Infancy, childhood, and adolescence: what is a child?

Socio-biological immaturity, or childhood, is an experience that every single adult share (Cave and Oxenham 2017:179). It is generally understood that the term child and the concept of childhood are socially constructed concepts (Baxter 2005; Crawford et al. 2018; Fahlander 2011; Scott 1999; Sofaer Derevenski 2000). This stage of life is conceptualized and experienced differently by different cultures, localities, and geographies (Cave and Oxenham 2017:179-180). In a broad sense, childhood can be defined as the period of social and physical development from birth to maturity, accounting for social independence, sexual maturity, and biological development (Chamberlain 2000:207).

Demographic conventions to define the benchmark of childhood vary, with some authors choosing 15 years old (Chamberlain 2000:207) and others up to the age of 18 years old (Angel 1969; Milner et al. 2007). Individuals who reach this benchmark have the ability to move from a dependent relationship to their parents or older kin to the potential for reproductive and economic self-sufficiency. However, Angel (1969) does note the limitations of restricting the age of adolescence, “[using the age of] 15 has the great advantage of including with adults those sub-adult females who died in childbirth and so gives a more truthful picture of adult health and efficiency than age 20 or even age 18 at the start of adulthood” (1969:430). For this reason, when looking at the funerary treatment of children, it can prove meaningless to prescribe modern concepts on past societies and to focus on the relationships between the child and family, the community, and society (Scott 1999). Further, when using paleodemographic data to understand past populations, one must be careful to discern what groupings of individuals make up juvenile and adult cohorts.

I define a child as an individual who has yet to pass the threshold into adulthood based on both biological and social age. While the terms juvenile or sub-adult may be used to describe individuals who have not passed onto adulthood, the purpose of this study is concentrated on the recovery of *fetal* and *infant* remains. Therefore, while juvenile remains have intrinsic cultural and scientific value, this paper is concentrated the specific stages from fetal to newborn through infancy.

2.3.2. Of personhood and agency: the corporeal and social body

The role of agency and personhood within the realms of archaeology have come to occupy a central position within archaeology theory (Voutsaki 2010:65). When children were buried by adults, we can draw inferences from the life of the child but also the imbued agency of the adults impressed into the dead (Cave and Oxenham 2017:180). Indeed, it is the adults and the fabric of the society which would dictate how the deceased children were perceived. The milieu of cultural milestones and passages that children incur on their route to adulthood may be invisible in the archaeological record; however, tangible clues such as a delineation in burials or funerary gestures based on cultural factors assist archaeologists in interpretation of the past. For example, many societies do not consider a newborn infant to be a fully-fledged member of society (Mays 2018:81–82). To understand the visibility or spatial patterning of the dead in the graveyard, we must first understand the relationships between the living.

With respect to the utility of labour, we can observe how an individual passes into adolescence as they become more productive or participate in society, thus becoming a member of "visible society" (Binford 1971). The fluidity of how one moves from invisible to visible and back again is a direct reflection of the agency or personhood that is appointed upon an individual. Upon death, the agency of an individual, and the milestones of personhood can be often seen in the archaeological record in the forms of funerary gestures.

Societies imprint their values, ontologies, and epistemologies into the corporeal body of the child. Indeed, there is a delineation between the corporeal (physical) body of a person and their social persona, thus archaeologists must approach the funerary landscape with knowledge of both to succeed (Crawford et al. 2018:4). Further, there are a number of methodological issues that are exacerbated when the skeletal remains are highly degraded or incomplete (Manchester 1989:11; Scheuer and Black 2004:12; Cunningham et al. 2016). If an individual does not reach sexual maturity, then determination of sex is often quite challenging (Manchester 1989:11; Scheuer and Black 2000:12).

It is important to differentiate between the three 'types' of age (Halcrow and Tayles 2008; Scheuer and Black 2004:8), these are:

1. Chronological age: indicates the age of an individual based on the number of days since birth.

2. Biological age (sometimes referred to as phenotypic, physiological, or functional age): represents the age an individual appears based on factors such as exercise and diet. Archaeologists use biological age to estimate age based on biological changes in the body, such as skeletal and dental age.

3. Social age: reflects the culturally constructed norms of appropriate status and behaviour of individuals within an age category.

Determining the "age" of a child is challenging. Certainly, estimations of chronological age from osteological and dental evidence may differ from phenotypic age and from social age (Fahlander 2011:17; Scott 1999). To further complicate, in bioarchaeological and archaeological research, the basis for which age is determined is not often cited (Crawford 1991; Crawford et al. 2018; Halcrow and Tayles 2008:192). Certainly, the citation of methods or criteria is crucial for future archaeologists to understand how the age of an individual was established.

Comparing several manuals used by osteologists and skeletal biologists, it is clear that a consensus is lacking historically when attributing ages to non-adult skeletons (Fahlander 2011; Gustaffson and Lundin 2004; Martin and Saller 1959; Scheuer and Black 2004). It is crucial for archaeologists to understand the terms in which we speak of children if we are to introduce notions that they are present or absent. It is certainly possible that one of the reasons that juveniles are underrepresented in the archaeological record is that their skeletal remains or funerary plot is being recorded as that of an adult. This could be a result of the discrepancy between biological age, social age, and chronological age. For example, upon initiation into society some individuals may be considered “adults”, even though they may have a chronological age of 13 or 14. Consequently, it is expected that the individual will be treated in death how they were in life. This can result in the grave of someone who is chronologically younger being buried as someone who is socially older. Thus, if the grave of this individual is encountered in the future then it is the challenge, and onus, of the archaeologist to describe the findings using a holistic view of biological and social ages. Further, given that there is no set codex or universal standard of practice for how we describe “non-adults”, I believe that juveniles are underrepresented due to categorization deviances while describing the biological age. Surely if the methods used to basis the age of osteoarchaeological remains is not cited (Crawford 1991; Crawford et al. 2018; Halcrow and Tayles 2008:192) then it could provide unnecessary flexibility into interpretations over age categories such as fetus, infant, child, adolescent, juvenile, subadult, and adult (see Fahlander 2011; Gustaffson and Lundin 2004; Lewis 2011). To best understand representation of age in the archaeological and historic record, the importance of rites of passage into society should not be understated. These passages can express the transition from childhood to adulthood, marriage, procreation, or an individual transitioning from an “other” to a member of society. Arnold van Gennep termed these rites as “rites of separation”, “transition rites”, and “rites of incorporation” (van Gennep 1960:11). These states of being, of inclusion or exclusion, are of special importance to mortuary archaeologists for those who are treated differently in life are treated differently in death (Binford 1971).

2.4. Mortuary variability and differential funerary treatment

Funerary treatment of the dead is not a fixed phenomenon. Burial types, grave goods, and funerary rituals will vary and mutate over different time periods, between different socio-economic classes, and reflect the current cosmology and ontological perspectives of the living. Lewis Binford (1971) notes four main categories for differential mortuary treatment, including: age, sex, the relative rank or distinctiveness within the broader social group, and “the affiliation of the deceased with respect to membership segments of the broader social unit, or in the case of inter-societal symbolism, the form appropriate to the society itself” (1971:17).

As individuals move from infancy to adulthood, they become more productive or participatory members of society; conversely, as one moves from adulthood into elderhood they become less productive members of society. The phenomenon of individuals transitioning in and out of “visible society” is likened to the visibility of an individual to their level of participation within a group (Binford 1971:7). Further, Binford notes there are minimally two components of a social situation to be evaluated when endeavouring to understand the types of social phenomena symbolized in a burial situation (Binford 1971:21). This includes both the “social persona” of the deceased and the composition and size of community that recognizes the social persona of the deceased (Binford 1971:21-22). Generally, there are three primary variables in which mortuary variability of treatment of the deceased will occur, these include: 1. The treatment of the body, 2. Preparation of the facility where the body is placed, and 3. The furnishing of the grave (Binford 1971:21).

2.4.1. Atypical death, rituals, and deviant burials

Throughout space and time there are marked deviations from the common funerary protocols and methods of internment. From an etic perspective, infants and children are the group most likely to be subject to non-normative burial treatment (Aspock 2008:20); however, one must be cautious when approaching the past and ascribing normalcy to cultural practices. What can constitute non-normative treatment is the differentiations that have been observed in the treatment of the body or location of the graves for deaths that occurred in abnormal circumstances, for example deaths at sea, in warfare, by lightning, or in situations where remains were not able to be returned to the community due to travel (Binford 1971; O’Neill 2016, 2017).

For a society to have the perception of ‘deviant rituals and burials’ it first requires a collected representation of ‘normal’ funerary rites and burials (Nizzo 2015). Viewed through the lens of *anthropologie de terrain* (Duday et al. 1990), cultures have codified funerary gestures – where the burials are part of the preserved material structure that reflect part of the gestures in the funerary process (Duday et al. 1990). Rather than simply static indicators of social status, funerary remains offer archaeologists’ traces of a larger system of entrenched beliefs and ritual practices (Crawford 2004; Hausmair 2017; Knüsel et al. 1996; Mitchell 1996; Nizzo 2015; Stodder and Rieth 2011). Death is a boundary and its delineation manifests in the archaeological record via cultural and ideological separations between the ‘norm’ and ‘infringement’, between human and nonhuman, and between ‘burial’ and ‘non-burial’ (Nizzo 2015:5). On deviant funerary gestures, Nizzo

(2015) writes "…based on funerary gestures codified and shared, the denial of burial is set up as a discriminating choice, closely linked to the social features, identity features, or even biological features of deceased, in accordance with its age, sex, religion, ethnic origin, health, ethical or mental condition and, in general, to all those attributes that [made the individual] "different" (Nizzo 2015:5).

The anomaly in the treatment of the dead, or deviances, can be viewed through three categories: atypical death, atypical deceased, and atypical ritual (Nizzo 2015:5-6). The term *atypical death* encapsulates those who suffered accidental external factors such as homicides, accidents, diseases, epidemics, wars, etc. In these cases, funerary rituals may be displaced and give route to abnormal behaviour surrounding the ritual and behaviour surrounding the disposal of the dead (Nizzo 2015:5). The term *atypical deceased* reflects in the innate characteristics that makes the individual different in the eyes of the community (Nizzo 2015:5). Lastly, *atypical ritual* can be defined as rituals "connected to beliefs and superstitions that often could act outside of the formalism of the funeral ceremony, resulting in interventions after the deposition aimed at suppressing the nefarious influence of the dead" (Nizzo 2015:6). Of the three deviances, archaeologists are likely to encounter burials of juveniles who experienced atypical deaths and who were atypical deceased due to the high mortality rates and cultural exclusions of infants and juveniles until formally recognized by society.

Without adequate historical or ethnographical records to correlate, burials of deviant nature provide challenging interpretations of the archaeological record. Non-standard burials are especially challenging phenomenon for professional archaeologists. In British Columbia, professional archaeologists conduct Archaeology Overview Assessments (AOAs) and Archaeology Impact Assessments (AIAs) to evaluate archaeological resources in the landscape. In British Columbia, AOAs and AIAs typically score the landscape for "potential" of archaeological resources often in binary (high and low), trinary (high, medium, and low), or quintenary modes (very high, high, medium, medium-low, and low). For this reason, the level of assessment (e.g., pedestrian survey, subsurface testing, or systematic excavation) is based on the perceived level of potential and the subsequent successful identification of archaeological resources. If individuals, such as children, are subject to non-normative funerary treatment and buried outside the customary areas then they could be overlooked during studies due to how HRM field programs triage the landscape for archaeological potential, often without ground truthing the results (pers. obs). For example, in the boreal forest of British Columbia due to prevalence of muskeg, swamps, and bogs most micro and macro-topographical landforms would be categorized as high potential and require subsurface investigation (e.g., shovel testing). So imagine – a team of archaeologists are conducting a survey for a petrochemical development through a landscape of swamp and muskeg. If one encounters a well-drained landform that rises above the muskeg, the team will conduct a series of surface and subsurface tests to assess for archaeological materials. If they encounter a subsurface lithic scatter in one test, it is common to extend tests outwards in cardinal and intercardinal directions at systematic spacing to evaluate the extent of archaeological resources. If these tests are not positive for resources, then the site could be considered defined and no further work would be required unless direct impacts to the boundaries of the site are anticipated by development. This is problematic – in this imaginary situation, the landform would be considered 'high potential' for archaeological resources and the muskeg or surrounding area with poor drainage would be likely classified as 'low potential'– because 'low potential' does not mean *no* potential. In antiquity, if a child suffers an atypical death and the rituals or customs dictate that they be buried immediately on the landscape, then perhaps their final resting space may be within the muskeg or on the borders of landforms? Or what if the landform and surrounding low-lying swamps were prehistoric burial grounds but the funerary rituals didn't include grave goods such as stone tools, beads, or other offerings?

Archaeologists can be skilled surveyors, cartographers, and excavators; they see, recognize, and visualize patterns of the prehistoric landscape and the peoples on it. Typically, patterns reflect normal, customary behaviour; thus, knowing that cultures deviate from norms, especially in their burial customs, is crucial knowledge for HRM practitioners.

2.5. Differential funerary ritual and burial practices

Throughout both space and time, the archaeological and ethnographic record showcase that sometimes children were treated differently in death and burial than adults. This includes the preparation of the body, the selection and preparation of the burial location, the ritual adornments of the body and burial site, and the subsequent internment of the body (Binford 1971; Crawford 2004; Scott 1991; Stodder and Rieth 2011).

2.5.1. Differential funerary ritual and burial practices: Coast Salish contexts

The Coast Salish have a rich history of ritualized funerary treatments that span millennia. The Coast Salish are groups of linguistically and culturally similar peoples on the west coast of British Columbia, Canada and Washington and Oregon, in the United States. Human burials, especially those of juveniles, are intrinsically part of overlapping spheres of socio-politics, economics, ritualization, and belief. Accordingly, this section will further explore the types of prehistoric burial methods used and the differential treatment of individuals based on personhood. The dichotomy between social age and biological age and the acquisition of personhood introduces complications when analyzing archaeological sites that contain human burials (Halcrow and Tayles 2008:203). Coast Salish peoples employed various burial or interment methods over several millennia, including canoe burials, shell midden inhumation, funerary petroforms, cremation, mounds, mortuary pole, cave, 'sky burials', and in special cases, grave boxes or small mortuary houses (Brown 1996; Curtin 1998; Lepofsky et al. 2000; Mathews 2006, 2008, 2014; Mitchell 1996). In contrast to cemeteries where burials are delineated by tombs and gravestones, the prehistoric burials on the northwest coast have challenged archaeologists in identifying both the location and extent of burial sites. In certain cases, mortuary features like burial cairns are defined by the topography of the landscape, following natural edges and bedrock exposures (Mathews 2006, 2014), whereas other cases deviate from the funerary norm, such as the mass grave of adults and infants, of which some were cremated, found at Kulleet Bay (Parsley 2018).

Wright (2000) notes that the "demographics of the prehistoric burial population demonstrate a very low percent of infants in comparison to the expected infant mortality rate in society with no access to modem medical assistance. This is likely caused by differential burial practices, and preservation factors" (2000:60). During their research, Mitchell noted the challenges of population reconstruction as females and infants were subject to differential burial practices than men (Mitchell 1996:62). Selective funerary treatment, such as burying infants in baskets or blankets has been observed, whereas subadults and adults may be treated differently (Mitchell 1996:39). Further, in a study at False Narrows on Gabriola Island, British Columbia, Curtin found that infant remains recovered were disproportionately treated with fire than those of adults (Curtin 1998). The study found that 13.4 percent of adults and 50.6 percent of children were unburned compared to 82.3 percent of infant remains (Curtin 1998:141). While the treatment of burning the bodies of the dead is largely attributed to the affliction of treponemal disease at False Narrows (Curtin 1998), the preservation of human remains changes when subject to heat and fire. Heat alteration to bone, or lack thereof, could account for why the archaeological record in some localities, during some time periods, are biased towards particular age groups, given that the calcification of bone assists with long term preservation (Mayne Correia 1997; Owens 2010).

2.5.2. Differential funerary ritual and burial practices: examples in European contexts

From a theological perspective, in Christian societies within medieval Europe, one of the primary landmarks for a child's social persona was their baptism (Hausmair 2017:210). Baptism is a rite of passage for followers of Christianity, meant to clear the soul of Original Sin (Hausmair 2017:210-211). The cleansing of the Original Sin in a transformative act, a rite of passage, and a prescription of personhood. Thus, to be buried within the grounds of the church one must have gone through the baptismal transformation. In some cases, Churches would permit those whose baptism was questionable to be buried in church grounds; however, the burials would take place in an "unblessed" section of the cemetery (Kerin 1941:160). Thus, in medieval Christian cemeteries across Europe archaeologists are prone to encounter infant or juvenile burials in clusters within or outside of the formal cemetery (Hausmair 2017). Some studies have found that the depth of the grave can reflect the transition to adulthood with children being buried shallower than adults in the same mortuary space (Cave and Oxenham 2017:184).

Across the world, there are multiple accounts of infants and juveniles being buried beneath the floor or incorporated into structural elements of the private domicile while adults were buried in a cemetery or public location (Binford 1971; Borić and Stefanović 2004; Stefanović and Borić 1997) For instance, in Roman Britain (Scott 1991, 1993) a large number of animal and infant burials are "found under malting floors and in association with other agricultural features but separate from the burials of adults and older children, suggesting a different social or symbolic status for babies" (Kamp 2001:6). In the Mesolithic and early Neolithic site of Lepenski Vir, subadults have been found in graves cut into the limestone plastered floors or into the perimeter of dwellings (Borić and Stefanović 2004; Stefanović and Borić 1997). These infants, neonates, and fetuses were typically placed in systemic patterns within the larger household complex of Lepenski Vir with their graves being sealed with stone slabs or the floor being re-plastered (Borić and Stefanović 2004). Certainly, in antiquity some families would experience the death of multiple children, many of which may not have had access to the economic means for proper burials. Again, those who have not formally entered society, acquired personhood or agency through the eyes of the church or otherwise, were often considered non-persons, and thus these types of burials took place.

2.6. Cemetery sample and biological filters

2.6.1. Taphonomic processes and differential preservation

Taphonomy can be defined as the chemical, biological, and physical transformation processes that affect organic remains after death until fossilization (Haglund and Sorg 1997; Knüsel and Robb 2016; Manifold 2012; 2013). Taphonomic factors can be divided into two types: intrinsic (characteristics of bone tissue) and extrinsic (environmental influences), both of which exert influence on the long-term survival of non-adult bone (Manifold 2012:51). For the purpose of this study, I am interested in the processes that disturb and damage the bones prior to, during, and after the burials take place. Once a bone has been deposited it undergoes chemical, biological, and physical processes (Baxter 2004; Evans 2007; Gordon and Buikstra 1981b; Haglund and Sorg 2002; Pokines and Baker 2013a; Pokines et al. 2013). Manifold (2012) lists the intrinsic preservation factors as the age of the deceased individual, bone type and size, pathology, the porosity of the skeletal elements, and bone density (2012:52-55). Furthermore, Manifold lists the extrinsic preservation factors as groundwater, soil type and pH, temperature, flora and fauna, plant roots, grave depths, and anthropogenic impacts (Manifold 2012:55-61, 2013:24), each of which will be explored below.

Bone is a complex material composed of both organic and inorganic components, and water (Kendall et al. 2018). Bone is fortified and hardened through biomineralization, a process where poorly soluble inorganic minerals are produced by a living organism (Kendall et al. 2018). There are two types of bones in the human skeleton, cortical (or compact) bone, such as the shafts of the femur or tibia, and cancellous (or spongy) bone, which occupies *inter alia* the ends of the long bones and vertebral bodies (Waldron 2009; White et al. 2011). Each type of bone, cancellous and cortical, has a different resilience to intrinsic and extrinsic elements. Depending on burial methods, skeletal elements with a higher proportion of cancellous bone, such as the sternum, vertebrae, ribs, and epiphyses are more vulnerable to destruction and loss (Manifold 2013). Simon Mays notes how vertebrae can be disproportionally affected by burial methods, with cervical vertebrae being the most resistant and lumbar vertebrae being the least, to taphonomic influences (Mays 1992). Thus, it is the porous nature of each type of bone (e.g., spongy versus compact) that can impact its relative survival, with more porous tissues decaying more rapidly than less porous tissue (Manifold 2013).

Groundwater and bone porosity

Hydrological processes play an integral role in the preservation of osteological material (Robb 2016). Further, water environments can modify bones through abrasion, encrustation, bioerosion, and mineral dissolution (Haglund and Sorg 2002; Sorg et al. 1996). Mineral dissolution, the corrosion or pitting of skeletal surfaces, and bioerosion, the alteration of bone by fungi and bacterial agents or aquatic microorganisms, significantly impact the preservation of skeletal material (Haglund and Sorg 2002; Kendall et al. 2018). Upon decomposition of soft tissue, ground water, associated ions, and bacteria can penetrate via the lacuna-canalicular network (Kendall et al. 2018). The amount of internal and external surface area, or porosity, available to groundwater is important (Manifold 2012, 2013; von Endt and Ortner 1984). Porosity of skeletal tissue influences the nature and speed of post-mortem modifications to teeth and bone (Kendall et al. 2018). The interconnectedness and diameter of the various pores determines the ease with which microorganisms, dissolved ions, and water enter and exit the tissue (Kendall et al. 2018; Hedges et al. 1995). Juvenile human skeletal remains are shown to be more susceptible to diagenetic contamination due to the surrounding soil (Von Endt and Ortner 1984; Zapata et al. 2006; Hanson and Buikstra 1984). Further, an individual who has experienced pathological disease or bone damage in life will likely experience expedited decomposition of the bone (Manifold 2013). If bones are damaged as a result of injury, infectious disease, blood poisoning, or pathological conditions then it is easier for micro-organisms to enter (Manifold 2013).

Temperature

Solar radiation, temperature, sunlight, chemical processes, and precipitation all play roles in the subaerial osseous weathering and degradation of skeletal material

(Pokines and Junod 2013). The temperature that the body of the dead is subjected to can affect the preservation of the remains (von Endt and Ortner 1984). Temperature affects human remains in two stages: first, the interval between death and burial and secondly, the interval from burial of remains onwards. Studies have shown that higher temperatures accelerate the decomposition of human remains while cooler temperatures slow, but do not halt, the decomposition process (Pokines and Baker 2013a; O'Brien and Kuehner 2007). If subject to fluctuations in temperature (e.g., daily cycles of direct sunlight or episodes of freezing and thawing), bones will experience contraction, expansion, and likely failure and destruction (Pokines and Junod 2013).

Given that many cultures practice surface or sky burials, some exposition is warranted to understand the survival of skeletal elements on top of the ground. Subaerial weathering causes flaking, moisture loss, delamination, cracking, and bleaching of osteological material. The effects of subaerial weathering decomposing the bones can lead to further taphonomic processes. While not broadly studied, differing environments, and microhabitats within that environment, play large roles in what skeletal material survives in the archaeological record (Pokines and Junod 2013). For example, patches of muskeg or peat may yield very different preservation than pine groves or spruce meadows in the boreal forest. Recent studies have shown that the maturity of bone plays a role in the compositional and physical changes from bone weathering (Fisk 2018). In experimental studies, Fisk found that in the first-year post-mortem both mature and immature bone are affected and mediated within buried and subaerial environments (2018). Fisk's studies found that juvenile skeletal remains exhibit greater compositional changes while mature bones undergo greater physical reactions to the environment (Fisk 2018).

Soil acidity and microbiology

In both academic and professional circles, the acidity of the soil is a commonly cited factor to the recovery of skeletal remains, even though the literature contradicts itself at times (Manifold 2013:26). This notion is not incorrect as scholars have cited soil acidity as being "perhaps the most pervasive long-term destructive force acting up bones…" (Pokines and Baker 2013:76; Casallas and Moore 2012; Crow 2008). Some scholars note that a highly acidic depositional environment can lead to complete dissolution (Watson 1967). More recent work suggests that higher pH (more alkaline) environments tend to have better bone preservation in sites, partially due to the lack of microbial attack (Manifold 2013). Others note that if the depositional environment has a pH that is slightly basic or near-neutral, then bone preservation is normally excellent (Pokines and Baker 2013). The decomposition of soft tissues initiates changes in the surrounding soil, affecting chemistry (pH) and temperature (Carter et al. 2008; Coe 1978; Haglund and Sorg 2002). Further studies have shown how the burial and decomposition of a body can affect the surrounding soil's pH level. One experimental study determined that the decomposition of a body can shift soils from a basal pH of 5.0 to a pH of 8.0 to 8.1, thus rendering the soils surrounding the body more alkaline (Carter et al. 2008).

These studies illustrate how heterogenous the landscape can be in differential preservation of organic remains with respect to pH levels; however, the amount of exposure to air and microbial organisms also influences the survivability of juvenile skeletal remains. Peat environments exhibit excellent preservation of soft tissue and skeletal material due to the acidic nature of the material, the anaerobic environment, and the lack of microbial attack (Manifold 2013:26). In some regions, fragile organic archaeological materials such as basketry, bone and wooden tools, and human remains are recovered in higher proportions in ancient shell middens (Stein 1992). As shellfish decompose, they increase the calcium-carbonate content in surrounding soils, producing a more alkaline matrix which reduces the normal rate of decomposition of organic materials. As such, archaeology sites containing shell midden may provide the only windows for archaeologists to engage with artifacts and skeletal remains that would otherwise experience dissolution in non-shell midden matrix.

Bioturbation, root, and animal activity

Bioturbation is the disturbance of sedimentary deposits by living organisms. Common examples include the disturbance of the soil by rodent burrows or tree roots. Roots can creep and grow into bones causing fragmentation through external pressure (Manifold 2013:27). This phenomenon, termed "root etching", results in the erosion of cortical surface of bone and leads to complete dissolution of the mineral portions of bone via the excretion of humic acids (Lyman 1996; Manifold 2013). In forensic and archaeological contexts, roots can penetrate and alter the bone in a manner that presents itself like defects or ante-mortem injuries (Manifold 2013:27).

Anthropogenic alterations to the landscape

Anthropogenic alterations to the landscape, such as aeration and cultivation, and introducing new soils to an area can substantially impact the survivability of skeletal remains. Further, anthropogenic funerary treatment of a corpse affects the preservation of human remains (Booth 2016). Acts of human intervention such as burying corpses quickly after death, coffin burials, wrappings or clothing, surface burials, excarnation, and other cultural practices can affect the bacterial bone bioerosion (Booth 2016; Knüsel and Robb 2016; Knüsel et al. 2016; Stodder and Rieth 2011). Cultural practices of inhuming juveniles in shallow graves is well documented (Manifold 2013; Rahtz et al. 2000; Scull 1997). Thus, it is likely that individuals who are buried at a shallower depth may be susceptible to higher degrees of destruction and bone loss. For example, in present day pastoral and agrarian communities, it would be expected to see greater destruction and loss of infants remains inhumed within ‘plow zone’ of fields versus those buried beneath or outside the ‘plow zone’.

2.7. Excavation sample and methodological filters

2.7.1. Differential recovery and excavation bias

This section examines concepts of representativeness for skeletal biology and the inherent biases in archaeology. Once the deceased has passed through the biological and environmental filters, what remains of the body composes the excavation sample. Thus, it is the methods applied at this stage that dictates how the deceased and their burials are identified, quantified, and subsequently analyzed.

It is the author’s opinion that a practitioner’s lack of ability to identify, and thus appropriately interact and explore, the mortuary landscape of a region leads to archaeological biases being created (e.g., adults overrepresented in the skeletal samples versus juveniles). Robert Hoppa (1996) proposed a hierarchy of four filters that act on skeletal samples (biological, cultural, environmental, and methodological) (see Figure 2). These filters act as a foundation to understand how past populations are represented in the archaeological record and how the inherent filters can create biases that reflect a certain sex, age, or burial type over another. For the purpose of this thesis, I am focusing primarily on the methodological filters and how they affect the represented skeletal sample.

The research design of field programs in HRM and academic investigations will always have inherent methodological filters or biases; however, it is crucial to account and mitigate for these biases at the outset of a study. Material culture assemblages, whether they be pottery, lithic, bone, or a combination therein, are subject to diverse taphonomic processes. As aforementioned, recovery bias, in bioarchaeology or forensic anthropology terms, can be defined as the partiality on the type of skeletal elements recovered or represented in the archaeological record. Based on excavation or analytical methods, recovery bias can exhibit partiality towards sex and age, the size of skeletal elements, the minimum number of individuals (MNI) within a site, and the types of funerary components within a site.

Funerary processes, such as the primary or secondary burials, multiple internments, or cremations can have substantial repercussions on the successful recovery of skeletal elements (Robb 2016). As one author notes "…human skeletal assemblages form by a combination of three processes: deposition, removal, and *in situ* destruction" (Robb 2016). To this end, it is crucial that archaeologists develop methods suitable at the outset of the project suitable for the types of funerary components they may encounter. For instance, often secondary burials or internments result in the loss of small bones, such as those in the hands and feet or vertebrae (Robb 2016). If detailed field methods were not enacted (e.g., finer screen mesh, wet screening, or changing to finer hand tools versus shovels), and a disproportionate loss of smaller bones occurred, then it is possible the site interpretation would be skewed. The same situation could apply to the skeletal remains of juvenile humans or small fauna.

2.7.2. Excavation Methods

While taphonomic effects on skeletal remains and the differential treatment of burials is largely discussed in literature, the recovery or excavation bias of practitioners is rarely discussed or explored. I argue that the subjectivity of the practitioner plays a large role in what is identified, ignored, and recovered from archaeological sites, especially those in HRM settings. The categorization of what creates an individual's bias is outside the scope of this paper; however, I argue that it is largely informed by education, intracompany training and policies, and the overarching attitudes of the practitioners in the region and field that the individual works. Simon Mays asserts that practitioners tend to be less careful with incomplete or fragmentary skeletons (Mays 1992:55), therefore careful thought must be given at the outset of a project to the methods and tools used to mitigate the loss of archaeological material. When recovering and analyzing the skeletal remains from a mortuary site, there must be significant consideration given to the patterning of incomplete skeletons (Pokines and Baker 2013:447). Certainly, it is possible that skeletal elements that are smaller or more susceptible to damage and decay may not be represented fully in secondary graves (Robb 2016); however, the astuteness of excavators should be scrutinized in burials that are disturbed or incomplete.

The recovery of skeletal remains in taxing conditions, such as high heat, has been documented in the search for missing persons abroad (Moore et al. 2002; Webster 1998; Pokines and Baker 2013b:459). While no formal study was conducted, anecdotally, Pokines and Baker identify that common sense must prevail and mitigative measures such as temporary shade shelters to prevent heat injury of staff (2013:459). Further, staff in field programs involving excavation and recovery of archaeological materials in conditions containing low or freezing temperatures, inclement climate, low light, and matrices of heavily saturated material require special attention to reduce loss of archaeological material due to methods, fatigue, or numbness due to the environment. Measures should be taken to ensure that sediment acquired on footwear (e.g., matrix adhered in the tracks or sides of an individual's boots) is collected at the end of the day and screened to ensure there is not loss of archaeological remains or skeletal remains. Archaeology, both survey and excavation programs alongside laboratory analysis, involves a large number of repetitive tasks. The physical fatigue of conducting repetitive tasks and the inevitable 'mind wandering' associated with mental fatigue should both be contemplated in mitigative measures in field and lab programs.

The tools that are chosen for excavation of sites should be reconsidered where osteological material may be present. Often the tools of choice are the metal trowel and shovel for excavation; however, studies show the negative impact of metal tool marks on bone (Pokines and Baker 2013b:461). Typically, these marks can be differentiated between premortem, perimortem, and postmortem; however, skeletal trauma can lead to defects, destruction, and loss of skeletal elements that could skew the representation of osteological material in the site (Pokines and Baker 2013b; Robb 2016).

Given that a majority of archaeological sites are encountered during the inventory stages of AIA programs (e.g., subsurface investigation or colloquially 'shovel testing' programs), it is prudent to discuss the methodology employed to identify archaeology sites. In British Columbia, HRM programs that are conducted under an *HCA* permit need to have the methods approved by the regulator, either the BC Archaeology Branch or Oil and Gas Commission depending on the type of project (BC Archaeology Branch 2020). Once approved, the archaeologists are bound to the permit methodology with little room for deviance unless a permit amendment is issued. While methods like survey transect spacing may vary based on perceived archaeological potential, the use of screens and shovels does not.

Table 2. Screen mesh size and fetal skeletal element loss ratio based on the study by Pokines and De La Paz (2016:185-188)

Size of mesh in screen	Percentage of skeletal elements lost	Type of skeletal elements lost
6.4 mm	63.2%	Clavicles, ribs, vertebral elements, and some humerus, ulna, radius, tibia diaphysis
3.2 mm	16.2%	High loss of pedal and manual elements, phalanges, some ribs, some teeth, some long bone diaphysis
2.0 mm	7.5%	Auditory ossicles, some sacral elements, ribs, metacarpals and metatarsals, phalanges
1.0 mm	0.2%	Distal phalanges

Standard research and HRM archaeology programs in Canada, and much of the world, employ the use of 6.4 mm (¼ inch) mesh in their screens for general shovel testing and excavation (for example, see Keyser et al. 1988; Schaffer 1992; Sulton and Arkush 2002:237). If a culturally rich feature is encountered (e.g., hearth), then methodology often switches to 3.2 mm (⅛ inch) mesh to capture smaller artifacts and faunal remains (Sutton and Arkush 2002:237). Finer screen sizes are not usually used unless they are required for specialized analysis (e.g., paleobotanical). A study conducted by Pokines and De La Paz (2016) outlined the effectiveness of mesh sizes for the recovery of juvenile skeletal remains, contrasting mesh sizes between 1.0 to 6.4 mm (approximately 1/32 to ¼ inch). The study found that the use of 1/4 inch mesh does allow for the recovery of some skeletal elements, significant loss will still occur even under ideal preservation circumstances (Table 2). The results of Pokines and De La Paz's study (2016) illustrate the requirement for rigorous evaluation of screening methods if there is a possibility of juvenile skeletal remains.

It is important for archaeologists to have some plasticity in methods when the environmental conditions are not facilitating successful recovery of human remains and material culture. For example, in one contemporary forensic archaeology case where the conditions of the gravesite quickly became inundated with water and matrix, compromising the grave, the remains, and associated grave, goods were collected and transported offsite to be processed (Bunch 2010). While the context and resources available may be unique to a forensic archaeology case like this, methods could be adapted for mortuary archaeology contexts too. Often, I have observed archaeologists employ methods in the field that are completely ineffective at identifying archaeological resources; however, they meet the regulators requirement for an archaeological assessment.

2.8. Practitioner bias

Psychological bias is innate in human nature, thus, disciplines and practitioners within need to examine their own biases and establish controls and mechanisms to reduce the biasability of individuals within their field. Practitioner, or psychological, bias is not endemic to archaeology but permeates all disciplines. The bias of an individual is perhaps best understood through the philosophy of phenomenology. Phenomenology studies how individuals experience the essence of phenomenon, both describing how and what is experienced by an individual (Neubauer et al. 2019). Thus, how an individual experiences the world is shaped by their direct experiences, grounded in their epistemological and ontological beliefs, or “life world” as philosopher Edmund Husserl coined the term (Laverty 2003; van Manen 1990). Important to subjects within the humanities, like anthropology and archaeology, is an aspect of phenomenology: the concept of intersubjectivity. While covering a wide range of meanings and phenomenon, intersubjectivity can be defined as the commonalities or shared subjectivities between multiple individuals (Duranti 2010). The lens which archaeologists view the past is rooted in the subjectivity of the viewer which has historically led “othered” viewpoints (e.g., gendered, Indigenous, young, queer) to be marginalized in the interpretation of archaeological evidence (Baxter 2005, 2008; Chamberlain 1997). Given that all individuals were actors in the archaeological record, irrespective of gender, age, belief, or status, it is important to recognize these biases, our individual’s *life worlds* that we decode the past through, and address them when interpreting the archaeological landscape.

The biasability of an individual can have both positive and negative outcomes. Certainly, an individual who has been subject to many lived experiences with a particular subject matter (e.g., forensic anthropology investigations) may have particularly helpful insights that a less skilled colleague may not have; however, the more biased an individual is, the greater the likelihood that they may have blind spots in their approach. Nakhaeizadeh et al. note that in forensic sciences, despite the best efforts and procedures, that psychological bias interpenetrates the discipline and can distort the outcomes of evidence interpretation (Nakhaeizadeh 2014). An individual's bias can vary substantially contingent on what contextual information that individual is subjected to (Ask and Granhag 2005).

Archaeologists conducting fieldwork are subject to numerous personal, environmental, and structural conditions that influence their biases. Simon Mays noted that practitioners tend to be less careful in the recovery of skeletons that are poorly preserved in contrast to those in good state of preservation (Mays 1992:55). Furthermore, Pokines and Baker note that "[f]ield archaeologists excavating a mostly undisturbed depositional context frequently blame missing elements on the actions of small species such as rodents rather than the recovery method or lack of recognition of remains as human instead of non-human mammal" (2013:457). Others have noted the effects of stress and fatigue in recovering human remains in the field (Pokines and Baker 2013:458; Fairgrieve 2008; Sledzik et al. 2009). Working with human remains, whether in archaeological contexts or in contemporary mass graves, is stressful. It should be recognized that working with human remains, especially those of infants and juveniles, can have varying effects on the emotional and psychological health of excavators. Not everyone who enters the field of archaeology has had the opportunity to be taught with real teaching specimens but rather plastic skeletal replicas.

From personal experience, there is a proportion of individuals who enter the field of professional archaeology that do not have a background in human osteology. This occurrence is likely due to two factors: first, human osteology not being a requirement for a degree in archaeology, and second, human osteology not being offered regularly for students to take vocationally (per. obs). This phenomenon is not endemic to British Columbia, nor Canada, but heavily plays into the bias of what is identified and recovered from field programs. I argue that the lack of experienced osteologists on staff, or individuals with a background in osteology, add significant risk to HRM investigations; both a risk to the company itself and the archaeological record. The need for practitioners to be able to train under seasoned osteologists is just as crucial as osteologists to have their work check. Often, I have seen staff 'osteologists' have their analysis go unchecked, making inaccurate assessments, and thus, training the next wave of junior archaeologists in their attitudes and methods.

2.8.1. All that I know is that I know nothing: or the paradox of confirmation bias

It is vital for the practitioner not to impart their own cosmologies, epistemologies, or ontologies when approaching a mortuary, or any other, archaeological site. If an archaeologist believes that there are no juvenile remains in the site and no juvenile remains are identified or recovered, then it leads to a *confirmation bias*. In short, if the results of a study reflect what an individual already perceives to be true then they will believe that their assumptions were correct. These behavioural reinforcements do a disservice to the archaeological record.

Confirmation bias is further exacerbated by the regulatory systems that HRM practitioners work within. For instance, in British Columbia the individuals who lead investigations (e.g., Permit Holders and Field Directors) are required to meet a certain amount of regional experience and education (BC Archeology Branch 2020). This works to validate that individuals have experience with common site types like lithics, culturally modified trees, or shell midden; however, what of the other nuances like funerary petroforms, ancient trails, and osteological material? Thus, individuals become accustomed to looking for the site types they are familiar with and perhaps missing those which leave markers on the landscape or within the matrix that they have never encountered before. Therefore, one has to ask, if an individual has been an archaeologist in a region for five, ten, or fifteen years and has never identified an ancient trail during a survey, is it because there is no trace of it on the landscape or is it because they do not know what to look for?

Experience builds knowledge and with experience comes confidence, or rather, it should. Aptly coined the Socratic paradox, the statement "all that I know is that I know nothing" was confessed by the Greek philosopher Socrates during his *Apology* (Pojman 1999:37). The denouncing skepticism of Socrates illustrates the need for the belief of knowledge to be questioned. Certainly, there are a great many HRM practitioners who exude confidence and keep their *a priori* views unchecked. The "Dunning-Kruger effect" is a psychology term to describe individuals who are overly favourable of their abilities in intellectual and social domains (Kruger and Dunning 1999). If experienced individuals are unable, or unwilling, to confront their own lack of skill but rather mask it as bravado then I believe that it would explain how some experienced individuals are not skilled in the spheres of identification and collection of juvenile remains.

2.9. Heritage resource management and mortuary archaeology

To best understand the methodological filters that professional archaeology imposes and the practitioner bias that professional archaeologists may develop, an exploration of HRM in the context of funerary landscape is merited. Throughout much of the world, private archaeology companies make up the contemporary workforce of archaeologists practicing HRM. In the United States up to 85 percent of archaeologists who are employed work in the private sector or the government regulators overseeing the private industry (Neumann et al. 2010:1). In Canada, Europe, and for much of the world the ratio is much the same with only a small percentage of archaeologists being employed in research or academic positions (CITATION?).

It is through these decades of advocacy that archaeologists have built and cultivated a culture of conservation ethic and interdisciplinarity which greatly informs HRM in the present day (Welch et al. 2007; Lyonett and Wylie 2005; Wylie 2005). Welch et al. note that HRM's "conservation ethic identifies preservation and stewardship of the archaeological record as our profession's first priority, discouraging extractive use of the record of the past except in cases of imminent destruction, substantial societal benefit, or some combination thereof" (2007).

In HRM, the primary scope of work for most professional archaeologists completing AIAs or AOAs is to identify any heritage resources that could be impacted by potential developments and provide management recommendations based on the findings. Given that much (or all) of HRM is funded by the proponent, often site avoidance or project redesign are the choice mitigative options for keeping cost and schedule in check.

We have seen a paradigm shift over the past 20 years in Canada over HRM and the treatment of ancestral remains. In British Columbia, in the past (e.g., 1980-1990s) projects encountering large burials would not require project cancellation but rather some mitigative work; however, in current times, encountering unanticipated ancestral remains could give cause for avoidance and project redesign (Mason 2018). This could be seen as a paradigm shift as settler societies move closer towards reconciliation.

The identification of heritage sites and mitigation strategies in the face of development can lead to what Thomas King coined“Archeo-Bias” (King 2002:148). “Archeo-bias” is “the practice of narrowly focusing on archaeological sites and concerns, to the exclusion of other cultural resources and resource issues” (King 2002:148). If archaeology is concerned with stewardship and conservation of heritage, then those who practice professional archaeology need to be concerned with how they engage with the funerary landscape. Professional archaeology is often grounded in cultural materialism and has historically managed only tangible cultural heritage. However, funerary sites are more than just skeletal remains, gravestones, and markers; they encompass the trees where the boxes of bodies were hung, the beaches and mountains where the dead were laid atop bare, and meadows where spirits are still said to reside (Schulke 2017a, 2017b). Graveyards are not limited to the tombstones above the dead but to the limits that surround the funerary grounds and archaeology, specifically HRM, needs to take a syncretic approach to managing these complex localities.

2.9.1. Legislation and standards of practice for HRM professionals engaging with mortuary archaeology and human remains

From an academic perspective, the literature on how to approach human remains in an archaeological context are plentiful; however, much of the world lacks standardized procedures for professional archaeologists to follow. National or state adopted legislation (e.g., see HCA 1996; ICOMOS 1990; NAGPRA) may afford protections to archaeological sites, materials, and human remains; still, it is the policy and law dictated by the regulatory agencies that archaeologists must follow to conduct their business in the private sphere.

The guidelines ensure that professionals are required to complete a baseline of requirements of investigation to meet minimum requirements; however, it is within the minutia of rules and policies that affords the level of effort to also fall short. After all, professional archaeology is a business and proponents generally seek the lowest budgets and shortest timelines. Something that is rarely afforded by encountering burials.

To best understand how archaeologists are required to approach and examine human burials and mortuary sites, an examination of standards of practice or best practices from various professional organizations, academic institutions, descendent communities, and regulatory agencies across the world is warranted. It is not expected that HRM practitioners are members of professional or research associations and fewer still are specialized osteology groups; however, there is an expectation that those who practice archaeology professionally are subject to a system of practices that has been codified in some manner. It should be understood that in most cases professional archaeologists are not required to be part of a professional organization to practice; professionals must be recognized by the local or state regulatory body as a qualified professional to carry out work. Unlike other frameworks of professional reliance (e.g., registered professional biologists or foresters or professionals with licensing boards like doctors or dentists), archaeologists are not required to be a member of a professional association or hold any licenses to practice. Providing that archaeologists complete the minimum requirements set forth by the regulatory agency there is little to no oversight or audit of field projects or the performance of field archaeologists.

Further from national and state policy or regulatory frameworks set forth, archaeologists working in some parts of the globe are required, or encouraged, to engage with the descendent communities on how to manage the archaeological record. Descendent communities may have specific protocols, methods, rituals, and taboos to follow when working around or within burial sites. Cultural protocols specific to Indigenous groups are often established in project planning phases with archaeologists and proponents; however, historically, many projects resulted in ad hoc consultation after ancestral remains were unexpected encountered, further exacerbating issues.

To better understand how juvenile burials and skeletal remains are approached in the archaeological record, I have taken an examination of materials put forth from professional and academic institutions and regulatory bodies governing archaeological work from around the world.

2.9.2. North America: Canada, United States, and Mexico

North America has several large academic and professional bodies that many HRM practitioners belong to, including: the Society for American Archaeology (SAA), the Archaeological Institute for America (AIA), the American Anthropology Association (AAA), the Registrar for Professional Archaeologists (RPA), the Canadian Archaeology Association (CAA), and the Mexican Institute of Anthropology and History (Instituto Nacional de Antropología e Historia or INAH). These organizations have adapted thematically similar principles within their Codes of Conduct and Standards of Practice (see AIA 2019; AAA 1998; AAPA 2003; CAA 2019; INAH 2018; RPA 2019a, 2019b; SAA 1996). Relating to professional practice, members of an organization are expected to (but not objectively evaluated or enforced):

- Assess the adequacy of their training and expertise for the demands of the project and mitigate inadequacies by acquiring additional expertise
- Act honestly and in good faith, representing their expertise, qualifications, and objectives to prospective employers
- Ensure that they have the proper facilities, support, and resources required to conduct a program of research in a manner consistent with the standards and principles of professional practice
- Keep up to date with developments and research within their discipline

Consequently, members of these organizations have an operational framework and ethical guidelines to follow; however, there are no clear standards of practice set forth on how to handle burials or mortuary sites. The SAA's Principle No. 8 (SAA 1996) is most applicable on how to approach investigations containing mortuary components.

> Given the destructive nature of most archaeological investigations, archaeologists must ensure that they have adequate training, experience, facilities, and other support necessary to conduct any program of research they initiate in a manner consistent with the foregoing principles and contemporary standards of professional practice.
> (Principle No. 8: SAA 1996)

Accordingly, without detailed manuals or codices on how to operate, a methodological vacuum develops as practitioners will develop their own standards.

2.9.3. United Kingdom

Like North America, the United Kingdom (UK) boasts a diverse selection of organizations for professional and academic archaeologists to apply to. These include: the Chartered Institute for Archaeologists (CIfA), Historic Scotland, and Historic England. Additionally, there are a number of specialized societies dedicated to burials and mortuary archaeology in the UK, including the Advisory Panel on the Archaeology of Burials in England (APABE) and the British Association of Biological Anthropology and Osteoarchaeology (BABAO).

Through combined efforts, BABOA and CIfA created a best practice guideline that provides standards for the recording of human remains (Mitchell and Brickley 2017). Historic Scotland provides general guidelines for approaching archaeological sites containing human remains managed by Historic Scotland. Historic Scotland does not detail exact methodologies for recovery and analysis; however, the policies lay out a framework on how individuals should approach burial grounds and human remains with respect, dignity, and guidance to not impose modern attitudes to non-contemporary remains (Historic Scotland 2006). Additionally, chance find procedures are set in place in the event that unanticipated human remains are encountered during non-archaeological work. Akin to North American archaeological organizations, these groups have similar Codes of Conduct and expectations of members. However, some groups have excelled at developing a detailed standard of practice to excavate, analyze, and curate human remains. The Advisory Panel on the Archaeology of Burials in England (APABE) was developed in conjunction with the Church of England, Historic England, and the Ministry of Justice. The aim of APABE is:

> "…to support professionals and others in interpreting the guidance documents issued in 2005 by the Department for Culture, Media and Sport (DCMS) and by Historic England and the Church of England, by the provision of casework advice on any aspect of archaeological burials, and to produce new guidance where necessary" (APABE 2019).

Incorporating the values of the diverse stakeholders, APABE has successfully produced handbooks and best practices that offer a consistent approach to ethical, legal, scientific, archaeological and other issues surrounding the treatment of archaeological burials in England. APABE has provided framework and best practices for the treatment of human remains in museum settings, the excavation of burial vaults, and large cemeteries (see APABE 2010, 2013, 2015, 2017, 2019). These approaches are robust and deserve merit as they provide guidance to HRM practitioners on how to approach a mortuary site from a culturally sensitive perspective while providing approaches that are entrenched in the values of budgets and timelines, crucial for commercial archaeology approaches (APABE 2016).

An examination of professional archaeological associations around the world demonstrates that the core qualifications for membership eligibility is solely within the level of education achieved in a post-secondary institution and professional experience. While organizations have provisions to discontinue membership when dues lapse or applications are late; few organizations have clear mechanisms for membership removal. Thus, members can be conducting archaeological investigations to a sub-par level without any major recourse. Throughout most societies, the only apparatus to remove someone is through a grievance procedure. In cases such as this, there are possibilities a defendant could prove that they were compliant with all federal or state laws regarding cultural heritage or human remains and be cleared of wrongdoing while still conducting egregious errors against the archaeological record.

Chapter 3.

Experimental archaeology study: materials and methods

3.1. Methodological framework

Participants excavated experimental units containing both replica material culture and skeletal remains of a newborn pig. There were two different types of units excavated in this study:

1. Control units: containing only replica material culture
2. Experimental units: containing replica material culture and skeletal elements from one newborn piglet

The recovery of the skeletal elements was used to evaluate the practitioner bias of participants.

3.1.1. Field site location and environment

The study took place at the flintknapping facilities of SFU's Department of Archaeology at the SFU campus in Burnaby, British Columbia, Canada. The excavation location is covered, thus free from rain, sleet, and snow, and generally covered from the burden of wind and elements. During the experiments, the weather was generally rainy or snowy (averaged precipitation of 180 mm per month) with averaging temperatures of +10º to -12º Celsius from the months of October 2019 to January 2020 (Climate-Data 2020). The experiments commenced between approximately 10:00 AM to 12:00 PM to facilitate the maximum amount of daylight and enough time for participants to excavate. Accordingly, each participant was generally subject to similar types of elements, temperatures, lighting, and time constraints as the next. These environmental conditions, while cold and inclement, reflect the best working conditions for participants. Often professional archaeologists are subjected to tight schedules and arduous conditions, including challenging supervisors, project directors, and clients, in addition to the fact that often there is machinery or other crews working in proximity and whose success and timelines are contingent on the speed and success of archaeologists. Studies have shown the efficacy of archaeologists in their recovery of skeletal remains and material culture drops under adverse conditions (Wiederick 2018).

3.1.2. Selection of pigs as human analogues

Due to the similar compositional structure of the bones, similar body mass, fat-muscle ratio, being largely hairless, and similar physiology to humans, pigs are often used as analogues for humans during experiments involving entomology, decomposition, taphonomy, thanatochemistry, skeletonization, skeletal fracture, and trauma studies (Anderson and Hobischak 2004; Banaschak et al. 2005; Cardoso and Coelho 2013; Dekeirsschieter et al. 2009; Carvalho et al. 2000; Gill 2005; Grassberger and Frank 2004; Haefner et al. 2004; Iannacone 2003; Jaggers and Rogers 2009; Payne 1965; Payne and King 1972; Payne et al. 1968; Karr and Outram 2015; Knüsel and Robb 2016; Richards and Goff 1997; Schotsman et al. 2012; Wieberg and Wescott 2008). One pig (*Sus scrofa domesticus*) was selected as an analogue for juvenile human, specifically fetal or newborn, skeletal remains. The pig used in this study was a newborn piglet, euthanized shortly after birth, that weighed 616 grams, gutted, prior to maceration.

Given the morphological and biological similarities, pig bone is accepted in most studies (Matuszewski et al. 2019; Turner and Wiltshire 1999); however, using faunal remains as a proxy for human remains does come with limitations and issues. Microscopically, pig bones are different (e.g., the arrangement of their osteons is not identical to humans); (Hillier and Bell 2007), but they also look different to a trained eye. For this reason, a novice practitioner is likely able to discern that the mandible or cranium of a juvenile pig is likely not human. However, less discernible human skeletal elements may not trigger that thought process and mistakenly be inventoried as faunal remains.

3.2. Determination of participants for the study

To best understand how to construct groupings of participants, an analysis of the composition of practicing archaeologists was required. Due to the low threshold of requirements to participate in the HRM field, individuals who participate are comprised of diverse backgrounds of education and skills. Given the diversity of educational backgrounds and specialized skill sets that HRM practitioners have, it was essential that this diversity was represented in the study.

3.2.1. Establishing a representation of Heritage Resource Management practitioners

Individuals working in HRM are not monolithic: they are comprised of a large cross section of education, skills, and backgrounds. The prerequisites to practice archaeology are often contingent on regional contexts, whether it be the locality (state or federal laws) or the type of land the project is located on, for example federal, state, or others like Parks Canada or First Nations reserves (Parks Canada 2005). Thus, while an individual may be accredited to run their own projects with a bachelor's degree in British Columbia, they would be ineligible to practice in neighbouring states and provinces (see Yukon or Alberta, Canada or Washington and Oregon, USA) without regional experience and a graduate degree (Historic Resources Management Branch of Alberta 2002; BC Archaeology Branch 1999; Oregon State Historic Preservation Office 2015; Yukon Archaeology Program 2018; Washington State Department of Archaeology and Historic Preservation 1998). Further, HRM projects in some settler states are conducted in collaboration with local Indigenous groups who can comprise a large portion of the field staff. In British Columbia for example, often large HRM projects may be comprised of 80 percent First Nations for field crews. Accordingly, a model was devised to capture the experience levels of practitioners to fill the study.

As a proxy to understand the spread of experience levels in HRM, the membership list for the BCAPA, of which most professional archaeologists within British Columbia are members, and survey conducted by SFU to the global HRM community were analyzed (Wiederick 2018).

Table 3. BCAPA Membership Requirements

Membership Category	Number of members (2019)	Minimum days of experience required in HRM	Minimum education requirement	Percentage of professional body
Student	43	0	Current student valid for 2 years after graduation	17%
Affiliate	5	240	Bachelor's degree	2%
Intern	7	240	Bachelor's degree	3%
Associate	67	360	Bachelor's degree	27%
Professional	128	720	Bachelor's degree	51%

The BCAPA has five membership categories: Students, Affiliates, Associates, Interns, and Professional. The membership requirements (Table 3) show that there is proportional mix of junior (students and intern), intermediate (associate), and senior (professional) heritage resource managers (BCAPA 2020b).

Thus, it is observable that there are three groupings of practitioners:

1. Individuals who are in school or recently graduated and are getting experience (zero to two years)

2. Individuals who have been practicing for a moderate amount of time (two to five years)

3. Individuals who have been practicing for a long time (five to 10 years or more)

Based on the results of SFU's HRM survey (Wiederick 2018), for experimental purposes, the practicing body of archaeologists is divided into three groups: 1 to 5 years, 5 to 10 years, and 10 to 15 or more years. It should be recognized that the survey was voluntary and may not serve as an exact proxy for the professional body.

Table 4. Participant groupings, rationale, and number of participants within the experimental archaeology study.

Group I: Individuals with more than 5 years of experience and background in human osteology	Total of eight (n=8) participants: five (n=5) experimental units and three (n=3) control units
Group II: Individuals with less than 5 years of	Total of eight (n=8) participants: five (n=5) experimental units and three (n=3) control units

experience and background in human osteology	
Group IV: Individuals with less than 5 years of experience and no background in human osteology	Total of six (n=6) participants: three (n=3) experimental units and three (n=3) control units
Group III: Individuals with more than 5 years of experience and no background in human osteology	Total of six (n=6) participants: three (n=3) experimental units and three (n=3) control units
Total	**28** participants across four groups.

Inspection of both the SFU HRM survey and the BCAPA membership (Table 6) demonstrates that professional archaeologists can be divided into two cohorts. This bifurcation is based on the experience levels demonstrated by those who participated in the survey, the requirements of BCAPA members (Table 3), and the divide in membership levels within the BCAPA (51 percent are professional members with 49 percent making up the other four tiers of membership; see Tables 4 and 5; BCAPA 2020a). Thus, the two cohorts can be defined:

1. This cohort is comprised of those still in academia, the recently graduated, and those who have been working in the field for several years. This cohort contains participants who have practiced professionally from zero to five years (0 to 60 months total).
2. This cohort includes individuals who have practiced for more than five years (60 months or more in total) and continue to practice in HRM.

Table 5. BCAPA members in experience groupings

Membership Category	Percentage of professional body	Groups based on professional experience
Students	49%	Zero to five years of professional experience on average.
Affiliates		
Intern		
Associate		
Professional	51%	Five years or more on average

Several methods were employed to recruit and evaluate prospective participants for the experimental archaeology study:

1. A *Call for Volunteers* poster (Appendix B) was created and distributed through various channels to students and professional bodies of archaeologists. This included both SFU's Department of Archaeology

and British Columbia Association of Professional Archaeologists' (BCAPA) mailing lists and social media channels. Alongside the poster, a *Participation Form* (Appendix B) was distributed for interested parties to fill out and return.

2. The author leveraged his personal network of local archaeologists to participate and disseminate recruitment materials to other local firms and academic institutions outside of SFU and the BCAPA.

The *Participation Form* was used to establish the educational background, expertise, and the amount of experience in HRM that an individual has. Prospective participants could identify how many months or years that they have worked in HRM either continuously or discontinuously, as commercial archaeology can be largely seasonal. The prospective participant then identified their educational background and any field schools they participated in. Lastly, the participant was able to self-identify any expertise or background they have and to which extent. Categories such as *Lithics, Zooarchaeology, Ceramics, Human Osteology,* and *Wet Sites* comprised the list that students could choose from. This study is only interested in the human osteology component, but it was important that the nature of the study was kept blind. Thus, none of the promotional or recruitment materials were created to represent that this was an osteology-based study but rather an *Experimental Archaeology Study*.

The level of education achieved by a participant was logged into an education matrix (Table 6). By assigning numerical values to level of education, patterning within the results can be analyzed based on individual or group educational levels.

Table 6. Education matrix for participants of experimental archaeology study

Number	Current level of education
1	Bachelor's student
2	Bachelor's degree holder
3	Master's student/candidate
4	Master's degree holder
5	PhD student/candidate
6	PhD holder

The purpose of these groupings is to address the underpinning theme to practitioner bias: to what extent does education and training affect the recovery of juvenile skeletal remains? It is commonly accepted that an individual with more experience is likely to perform better at a task than someone with less experience (Quińones et al. 1995). Further, someone with training in a particular subject matter would be expected to be better at a task than someone with no training. Accordingly, I hypothesized that archaeologists with less experience would recover less cultural material than those more experienced and those with specialised training (e.g., osteology) would identify and recover a higher percentage of skeletal material than those without specialized training (Figure 3).

Figure 3. Expected trajectory for experience in HRM and identification and recovery of juvenile skeletal remains

3.3. Excavation methodology: preparation and execution

Prior to the commencement of the study, both the excavation units and one (n=1) fetal pig (henceforth, the specimen) required preparation.

The excavation units were prepared inside 60 x 40 x 32 cm (53 L) Rubbermaid® containers with matrix and cultural material. Detailed preparation included:

- Standardized tool kits were created for participants. Each tool kit included:
    - Brushes (one small and one large)
    - Dustpans (one small and one large)
    - Trowel
    - Fine wooden tools for excavation (two tools per participant)
    - Measuring tape

  - Plastic bags (ranging from small to large)

- Procuring sterile soil to comprise the majority of the matrix
- Deaccessioned soil and shell samples from archaeological investigations around the world were mixed into each unit
- Procurement of a sample of crushed gravels from a construction site (approximately 0.5 L worth)
- Preparation of replica cultural material for inclusion
- Deposition of all matrix and replica material culture into each excavation unit.

To facilitate the excavation of osteological remains, a fetal pig was procured. While the specimen was received gutted, it required preparation to remove the remaining soft tissue for the study. Detailed preparation included:

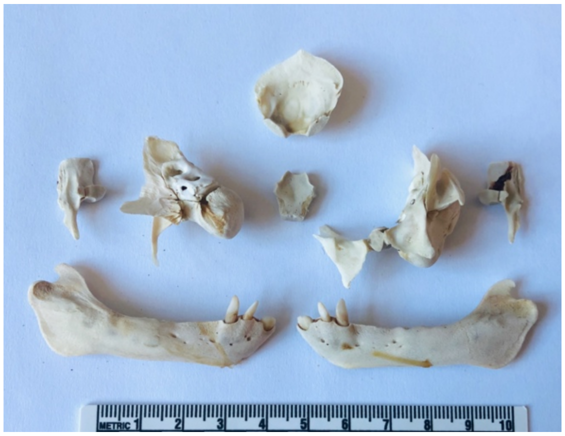
- Maceration of the specimen
- Completion of a detailed inventory and photographic log of all skeletal elements procured from the specimen
- Determination of which skeletal elements were to be used with the study

The purpose of this design was the ease of replicability and ensuring that participants would encounter the same materials as those before and after them.

3.4. Specimen preparation

The specimen was macerated in the summer of 2019 over a period of two days. The specimen was de-fleshed using a crockpot on simmer and mechanical tools. The maceration resulted in the complete removal of soft tissue, tendons, and ligaments with only the skeletal tissue and some cartilage remaining. While macerating the specimen, the soft tissue was passed through 1.56 mm (1/16 inch) and 0.79 mm (1/32 inch) screens to ensure that smaller osteological elements would not be lost. Once macerated, all skeletal elements were then catalogued and photographed to create a complete inventory (Appendix A). A total of 228 skeletal elements were recovered from the specimen, of which, a total of 221 skeletal elements were used in the final study (see Appendix A). Some elements (e.g., frontals, orbits, nasals, and sphenoid) were excluded from the study given their fragility and the destructive nature of excavation techniques (Figure 4b). Rather than include the entire axial skeleton, only the most robust and resilient elements, such as the petrous portion, occipital, pars basilaris, and pars lateralis, were included (Figure 4a). Skeletal elements were discretely marked with a highlighter pen to better identify and recover the remains using a UV light during the post-processing stage (Figure 4c and 4d).

(a) Selected elements from the skull to be used in the study



(b) Elements selected from the skull chosen not to be used in the study

(c) Selection of skeletal elements post-excavation

(d) Selection of skeletal elements post-excavation with UV light to illustrate markings

Figure 4. Sample of skeletal elements used in study

3.5. Preparation of replica material culture

At the outset, each excavation unit had a set amount of replica cultural material designated and planted in the unit. The material culture included lithic material, flint knapped glass, and ceramic (glazed and unglazed). The total amount of cultural material was limited to 50 total pieces in each unit (Table 7).

Table 7. Total count of replica material culture and skeletal elements based on size in excavation units

Small material (approx. 1 mm to 30 mm)	Quantity	Large material (approx. 30+ mm)	Quantity
Juvenile pig elements	158	Juvenile pig elements	62
Lithics	10	Lithics	20
Glass	10	Glass	0
Ceramic	5	Ceramic	5
Total:	**183**	**Total:**	**87**

The lithic material that was planted was comprised of debitage, cores, and flake tools comprised primarily of obsidian with some chert and basalt. The lithics used in this study were homogenous size, with the large lithics being approximately 5 cm in size while the small lithics and glass material were approximately 1 to 3 cm in size. The ceramic material was composed of a variety of fragments of pottery, comprised of both glazed and unglazed fragments. All material culture was marked using a yellow highlighter pen in discrete fashion to better identify and recover the remains using a UV light (Figure 5).

(a) Sample of glass artifacts without UV light

(b) Sample of glass artifacts with UV light showing UV ink on replica glass artifacts

Figure 5. Photos displaying the effects of marking replica glass artifacts with UV ink

Unlike materials like bone or wood that are subject to deterioration, decay, and decomposition, structures or tools composed of stone are considerably more resilient to taphonomic processes. For this reason, across the world the most frequent evidence of past human activity is observed through lithic-based sites (Kooyman 2005; Parkinson and Cherry 2010). The larger lithics were comprised of expedient tools, cores, and block shatter. The smaller debitage was comprised of complete, incomplete, and flake fragments (Andrefski 2005).

In protohistoric periods, glass was often flint knapped by Indigenous communities as a more convenient and accessible option than other stone types (Lucas 2001). As such, flint knapped glass was added to the study; however, it is rarely seen in commercial archaeology settings. Broken ceramics were also added as they provided a material lens into historic and prehistoric contexts by including glazed and unglazed options. Ceramic material is the outlier for professional archaeologists on the west coast, given the absence of ceramic or pottery material culture in prehistoric eras in British Columbia. Further, British Columbia *HCA*'s lack of protection of historic sites leads to initial assumptions that most professionals not trained in historic archaeology would likely discard or disregard any historic materials encountered.

The purpose of the cultural material was twofold. First, the addition of material culture assisted in adding "noise" to the experiment to ensure that participants were not solely focused on any present skeletal material. Second, the material culture acts as a proxy to evaluate if there is a link between the recovery rate of material culture and the recovery rate of skeletal elements.

Akin to the gravels, pebbles, root, and vegetal inclusions, the addition of material culture balances the units to resemble a scenario likely encountered in commercial archaeology settings. It would be unusual for a test to include such a concentrated variety of material culture; however, the aim was deliberate. If participants are used to identifying smaller lithics or a certain material type (e.g., obsidian) then their inherent bias may cause them to miss larger pieces of different material types (e.g., chert, glass, or ceramics).

3.6. Preparation of excavation unit

Once the skeletal and cultural material was prepared, the excavation units were assembled. A total of one experimental unit and two control units were constructed for this study. Each unit was contained in a 53 L plastic container with approximately 30 L of matrix in each unit.

The matrix contained in each unit was procured locally from Burnaby Mountain and was free of material culture prior to deposition. SFU's Archaeology Department provided deaccessioned soil samples from archaeology sites around the world which were deposited into each unit. Adding a layer of complexity, these soil samples provided traces of clay, silt, sand, shell, and stone inclusions not normally found in the soil around Burnaby Mountain. Additionally, a large amount of complete and fragmentary shells procured both locally on the northwest coast of British Columbia and around the world were added. Based on sampling, it is estimated that the matrix included approximately 10 to 15 percent inclusions, composed of rounded and sub-rounded gravels with trace gravels and cobbles. Due to the historic and contemporary development of SFU on Burnaby Mountain, the matrix also included historic pieces of debris like nails, screws, metal fragments, and at least one small ammunition shell casing.

Within each unit (controls and experimental), the material culture was distributed homogenously throughout the matrix. Thus, one would expect participants to see replica material culture (e.g., glass, lithics, or ceramics) from the top to the bottom of the unit. Within the experimental unit, the skeletal elements were deposited consistently from one experiment to another. The skeletal remains were deposited in the unit, on top of the soil in a semi-articulated, extended position (Leighton 2016) with the forelegs stretched forward and the hindlegs stretched backwards (Figure 6). The unit had very little matrix on one side (where the forelimbs, skull, and mandible were placed) and significantly more on the opposite side (where the hindlegs were placed) which created a sloped ground surface (approximately 30º to 40º). This position was chosen as it would promote the excavation of the hind legs and pelvis first followed by the ribcage, spinal column, and finally the forelegs, and skull and mandible if participants were working in a systematic excavation downwards. This burial type is not fashioned off of any particular human analogue; however, by placing the skeletal remains in this orientation it would ensure that participants excavating in a systematic fashion would find the hind legs first, followed by the spinal column and ribs, then finally the fore limbs, skull, and mandible. The purpose was to not reveal whether a participant was excavating faunal or human remains by presenting any easily identifiable bones (e.g., mandible) early on. The aim was to allow participants to gauge early on whether they needed to switch methods based on initial observations or continue on. For example, an individual may observe meta-tarsals or phalanges and switch to a smaller screen mesh, slowing the pace of excavation, or using finer hand tools.

(a) Example of how skeletal elements and replica cultural material were placed when buried (prior to further matrix and material culture being added on top).

(b) Example of excavation unit encountering skeletal remains with both skull fragments and ribs in view.

Figure 6. Examples of burial orientation and recovery of the skeletal specimen

3.7. Excavation process: participant orientation and observation

Prior to excavation of a unit, each participant was required to submit a signed consent form (Appendix B). Each participant was then briefed of the nature of study. Participants were told:

1. The excavation unit is located anywhere in space and time.
2. Participants are expected to excavate the unit as they would any other archaeological unit. It is expected that this is a reflection of their professional experience and education.
3. Participants have a standard tool kit and can use as many, or few, tools as required to process the unit.
4. As opposed to typical field programs, no notes or photographic record are required for the study. However, participants are encouraged to mentally note or write down any changes to their methods as they excavate to discuss in the post-excavation debriefing.
5. Participants are allowed to ask questions; however, answers must be vague in nature to not compromise the blindness of the study.
    a. Examples of questions that could not be answered during the study:
        i. How should I excavate?
        ii. Should I be bagging historical material?

iii. When should I switch screen sizes?

6. If the study is completed concurrently with other participants, then two rules were asked:

    a. If participants are talking amongst themselves, do not reveal what methods they are using or what they are encountering in their unit.

    b. Respect the visual partitions between excavation units and do not try and inspect what others are doing.

As participants excavated the units, some general notes would be written including: the start and end times of excavations, the weather and lighting, and any specific remarks that participants made during the study.

3.8. Post-excavation procedures

Once the units were excavated, the participant and I would have a debriefing session. During these sessions several quantifiable questions were asked, including:

1. What were the tools you used in the study?

2. Did you change the screen from ¼ inch? If so, why?

3. Discuss your methods for approaching the unit and reasoning for how you bagged the material.

Additionally, each of the participants were asked for their feedback on how they found the study and if they had any questions. Participants anecdotal feedback was summarized and written down.

Once the excavation/s were completed for the day, the bagged material was inventoried and processed. This included analyzing each of the bags that the participant used in the study, analyzing the various material culture recovered, my personal note taking and abnormalities or anomalous material recovered, and placing the data into spreadsheets (Appendix A). For experimental units, this stage also involved a skeletal inventory of the remains that the participant recovered. Once the inventory was completed, each unit was rescreened (control units using a ¼ inch mesh; experimental units using ⅛ inch). The material culture and skeletal elements that were recovered during the rescreening process were then logged. After the unit had been processed, the material culture, skeletal elements if required, and matrix were added back into the unit.

The skeletal material was inventoried based on individual skeletal elements. Elements were then grouped into several categories, including skull, spinal column, ribs, pelvis, long bones, wrist and hoofs, scapula, and other. There is some deviance to the categorization scheme, foremost is that the pelvis group only includes the ilium, ischium, and pubis and excludes the sacrum. Due to the underdeveloped vertebras, it was deemed too difficult to assess if the vertebral fragments were sacral, lumbar, or thoracic, and as such the fragments were lumped together for ease.

Upon conducting the initial experiment run, it also became apparent that some elements were too small or fragile to be recollected to reset the unit. Therefore, two totals are provided to assess the recovery rate of skeletal material (Tables 10, 12, 14, and 16; Appendix A). The first gives the total amount of possible bones recoverable per study. The total initially starts at 220 elements and then is reduced as elements become destroyed. Some elements, such as ossification nodes, vertebral bodies, phalanges, and coccygeal vertebra occur in a large number but were recovered so infrequently that it created a large disparity in the percentage of skeletal remains that participants were recovering. Thus, it was decided that two totals would be calculated, one that represented the recovery rate of all skeletal remains and one that did not include ossification nodes, phalanges, coccygeal vertebras, or vertebral bodies. Therefore, unless otherwise stated, the number of recovered skeletal elements is from the *adjusted* total.

Upon completion of the last excavation unit, a debriefing notice was distributed to all participants outlining the purpose of the study and the requirement for a blind study (Appendix B).

Chapter 4.

Results

The following chapter summarizes the results found in the experimental archaeology study described in Chapter 3. The results are presented by groups (Groups I to IV), and within those groups, the experimental and control groups are compared and contrasted. The average amount of recovered cultural material from the control units is summarized in Table 18; Figures 5, 7, and 9; and, Appendix A. The average recovered skeletal elements and cultural material from the experimental units are summarized in Table 18; Figures 6, 8, and 10; and, Appendix A.

Table 8. Summary of background experience, education, excavation time, and screen size used.

		Average experience in HRM (years)	Average level of education	Duration of excavation (hours)	Screen mesh utilized
Group I	Control	11.7	2.7 (BA/BSc)	1.25	100% used 6.35 mm
	Experimental	8.7	3.2 (MA/MSc Candidate)	2.25	40% used 6.35 mm; 60% used 3.14 mm and 6.35 mm
	Total (average)	9.8	3.0 (MA/Msc Candidate)	1.87	67% used 6.35 mm; 33% used 3.14 mm and 6.35 mm
Group II	Control	2	2.7 (BA/BSc)	1.50	67% used 6.35 mm; 33% used 3.14 mm and 6.35 mm
	Experimental	2.3	2.4 (BA/BSc)	2.45	80% used 6.35 mm; 20% used 3.14 mm and 6.35 mm
	Total (average)	2.2	2.5 (BA/BSc)	2.09	80% used 6.35 mm; 20% used 3.14 mm and 6.35 mm
Group III	Control	8.5	4.0 (MA/MSc)	1.75	100% used 6.35 mm
	Experimental	7.9	2.3 (MA/Msc Candidate)	1.67	67% used 6.35 mm; 33% used only 3.14 mm
	Total (average)	8.2	3.1 (MA/Msc Candidate)	1.71	83% used 6.35 mm; 17% used only 3.14 mm
Group IV	Control	2.0	1.7 (BA/BSc)	1.67	100% used 6.35 mm
	Experimental	0.7	1.3 (BA/BSc)	1.75	100% used 6.35 mm
	Total (average)	1.3	1.5 (BA/BSc Student)	1.71	100% used 6.35 mm

4.1. Experimental archaeology study: Group I

4.1.1. Group I: results on intragroup recovery of material culture

Group I is comprised of individuals with more than five years of HRM experience and a formal background in human osteology. Group I excavated a total of three (n=3) control units and five (n=5) experimental units (Appendix A).

Table 9. Group I: comparative recovery rates of material culture between the control and experimental units

		Material culture type					Skeletal elements
		Glass	Lithic (large)	Lithic (small)	Ceramic	Total	
Control unit	Maximum recovered	100%	100%	100%	100%	100%	-
	Minimum recovered	70%	95%	60%	50%	84%	-
	Average recovered	87%	98%	87%	83%	91%	-
	Standard deviation	12%	4%	19%	24%	7%	-
Experimental unit	Maximum recovered	100%	100%	100%	100%	98%	55%
	Minimum recovered	90%	90%	100%	70%	90%	33%
	Average recovered	93%	95%	98%	77%	91%	42%
	Standard deviation	5%	4%	0%	12%	3%	9%

Group I is characterized as having the most experienced participants with an average of 9.8 years of experience in HRM. Participants also achieved the shortest average excavation time at 1.25 hours per unit (Table 8). Participants in Group I averaged an education level of 3.0 (currently a master’s degree candidate or more) (Table 8).

Table 10. Group I: average recovery rate of skeletal elements by individual element, element grouping, and adjusted element grouping.

Skeletal grouping	Skeletal element	Percentage recovered	Percentage recovered based on groups	Percentage recovered based on adjusted groups
Skull	Cranium	57%	50%	50%
	Mandible	100%		
	Teeth	15%		
Spinal column	Vertebra bodies	1%	26%	
	Complete vertebral arches	86%		21%
	Incomplete vertebral arches	15%		
	Tail vertebra	0%		
Ribs	Ribs (right)	73%	73%	73%
	Ribs (left)	72%		
Pelvis	Illium	50%	27%	27%
	Ischium	20%		
	Pubis	10%		
Fore and hind limbs	Humerus	100%	93%	93%
	Ulna	90%		
	Radius	100%		
	Femur	83%		
	Tibia	100%		
	Fibula	70%		
Wrist & hoof	Metacarpals and metatarsals	7%	1%	7%
	Phalanges	0%		
Scapula	Scapula	100%	100%	100%
Other	Ossification nodes	0%	0%	
Total percent recovered		19%		42%

On average, participants in control units recovered 91 percent of the material culture. The maximum material culture recovered was 100 percent and the minimum recovered was 84 percent.

On average, participants in the experimental units recovered 91 percent of the material culture. The maximum material culture recovered was 98 percent and the minimum recovered was 90 percent. On average, participants recovered 19 percent of the total skeletal remains buried. However, removing the vertebral bodies, coccygeal vertebrae, phalanges, and ossification nodes from the tally resulted in participants recovering 42 percent of the skeletal remains. The maximum skeletal elements recovered was 55 percent and the minimum recovered was 33 percent (Table 9). On average, participants in experimental units recovered 50 percent of the skull, 21 percent of the spine, 73 percent of the ribs, 27 percent of the pelvis, 93 percent of the long bones, seven percent (n=7) of the metacarpals and metatarsals, and 100 percent of the scapulas (Table 10).

The participants recovered similar amounts of cultural material, with a standard deviation of zero percent in the total average recovery of material culture (Table 18). Between Group I's control and experimental groups, the largest standardized deviation in the recovery of material culture was with small lithics at six percent.

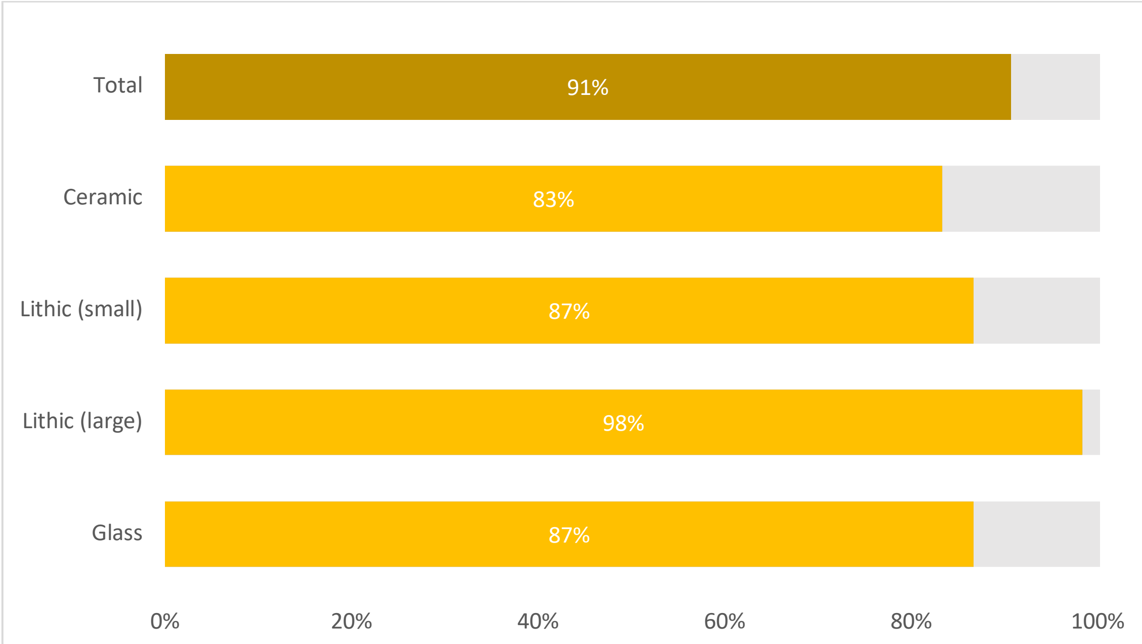


Figure 7. **Average recovery of material culture within Control Units in Group I.**

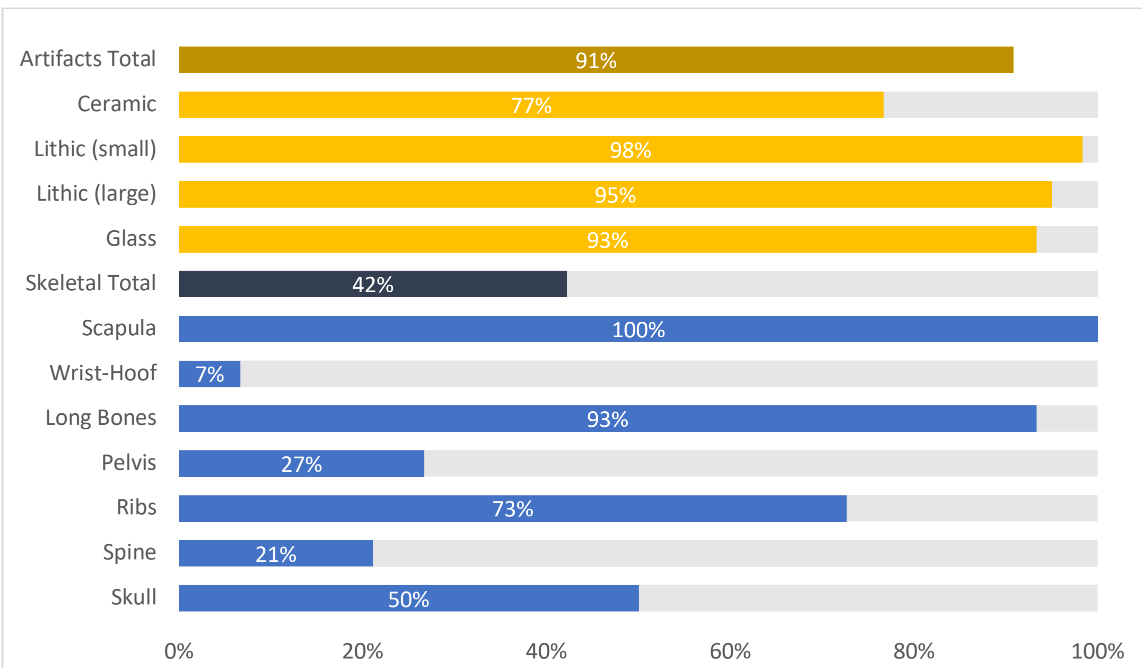


Figure 8. **Average recovery of skeletal elements and material culture within Experimental Units in Group I.**

4.2. Experimental archaeology study: Group II

Group II is comprised of individuals with less than five years of HRM experience and a formal background in human osteology. A total of three (n=3) control units and five (n=5) experimental units were excavated. The following are the results of Group II.

Table 11. Group II: comparative recovery rates of material culture between the control and experimental units

		Material culture type					Skeletal elements
		Glass	Lithic (large)	Lithic (small)	Ceramic	Total	
Control unit	Maximum recovered	100%	100%	100%	100%	98%	-
	Minimum recovered	90%	95%	60%	100%	90%	-
	Average recovered	**97%**	**98%**	**83%**	**100%**	**95%**	**-**
	Standard deviation	5%	2%	17%	0%	4%	-
Experimental unit	Maximum recovered	100%	100%	100%	100%	98%	83%
	Minimum recovered	70%	90%	90%	70%	90%	45%
	Average recovered	**92%**	**95%**	**95%**	**75%**	**89%**	**60%**
	Standard deviation	12%	3%	5%	11%	5%	14%

Group II is characterized as having the second-least experienced participants with an average of 2.2 years of experience in HRM. Participants also achieved the longest average excavation time at 2.09 hours per unit (Table 8). Participants in Group II averaged an education level of 2.5 (achieved a bachelor’s degree or more) (Table 8).

Table 12. Group II: average recovery rate of skeletal elements by individual element, element grouping, and adjusted element grouping.

Skeletal grouping	Skeletal element	Percentage recovered	Percentage recovered based on groups	Percentage recovered based on adjusted groups
Skull	Cranium	88%	63%	63%
	Mandible	100%		
	Teeth	4%		
Spinal column	Vertebra bodies	0%	35%	
	Complete vertebral arches	93%		38%
	Incomplete vertebral arches	34%		
	Tail vertebra	13%		
Ribs	Ribs (right)	86%	83%	81%
	Ribs (left)	81%		
Pelvis	Illium	92%	73%	73%
	Ischium	90%		
	Pubis	33%		
Fore and hind limbs	Humerus	100%	97%	97%
	Ulna	100%		
	Radius	100%		
	Femur	100%		
	Tibia	100%		
	Fibula	83%		
Wrist & hoof	Metacarpals and metatarsals	61%	9%	61%
	Phalanges	1%		
Scapula	Scapula	100%	100%	100%
Other	Ossification nodes	0%	0%	
Total percent recovered		23%		60%

On average, participants in control units recovered 91 percent of the material culture. The maximum material culture recovered was 100 percent and the minimum recovered was 84 percent (Table 11).

On average, participants in the experimental units recovered 89 percent of the material culture. The maximum material culture recovered was 98 percent and the minimum recovered was 90 percent. On average, participants recovered 23 percent of the total skeletal remains buried. However, removing the vertebral bodies, coccygeal vertebrae, phalanges, and ossification nodes from the tally resulted in participants recovering 49 percent of the skeletal remains. The maximum skeletal elements recovered was 83 percent and the minimum recovered was 45 percent. On average, participants in the experimental units recovered 89 percent of the material culture. The maximum material culture recovered was 98 percent and the minimum recovered was 84 percent (Table 12).

The participants recovered similar amounts of cultural material, with a standard deviation of three percent in the total average recovery of material culture (Table 18). Between Group II's control and experimental groups, the largest standardized deviation in the recovery of material culture was small lithics and ceramics at 15 percent each.

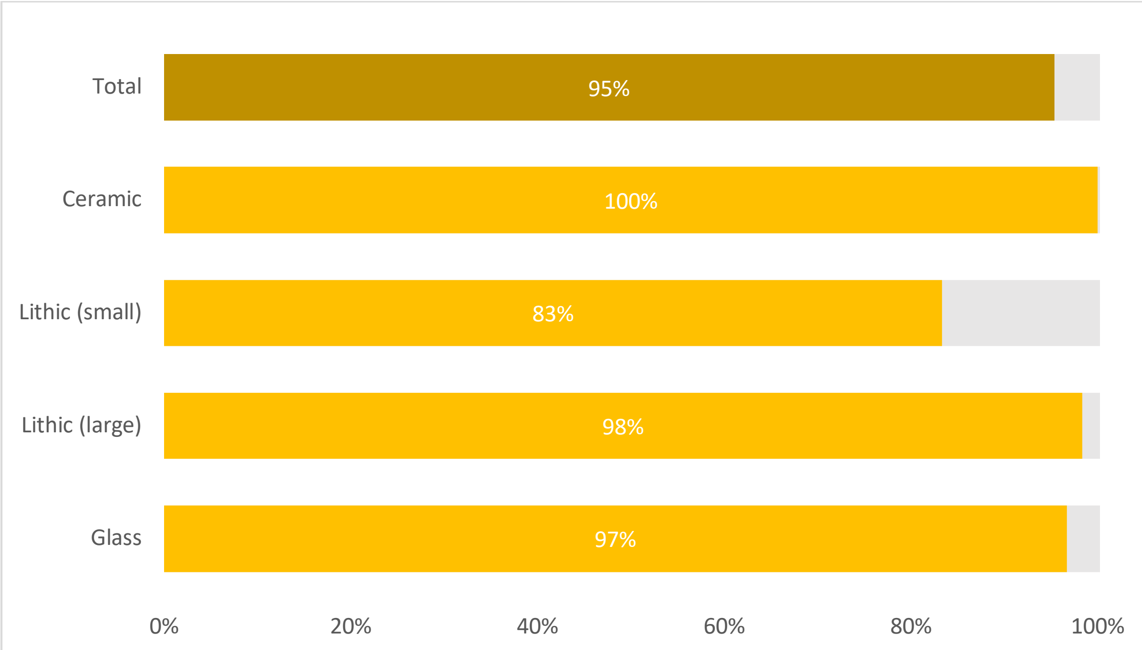


Figure 9. **Average recovery of material culture within control units in Group II.**

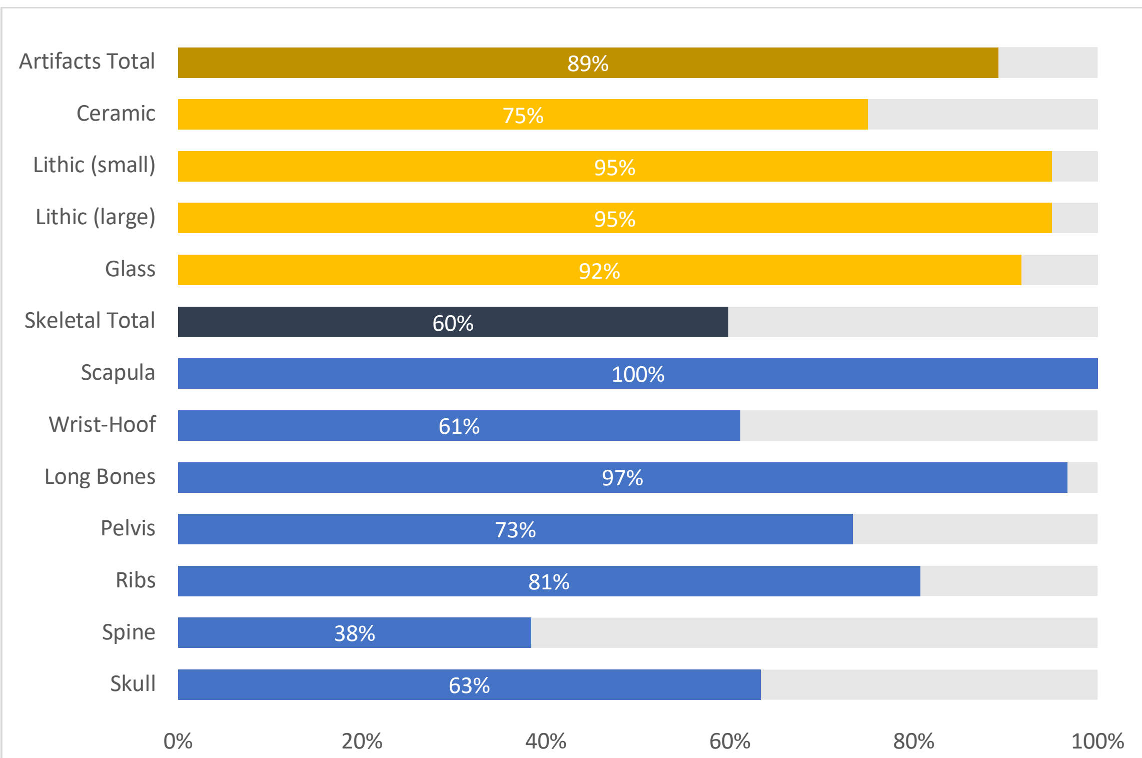


Figure 10. **Average recovery of material culture and skeletal material within experimental units in Group II.**

4.3. Experimental archaeology study: Group III

Group III is comprised of individuals with five years or more of HRM experience and have no formal background in human osteology. A total of three (n=3) control units and three (n=3) experimental units were excavated. The following are the results of Group III.

Table 13. Group III: comparative recovery rates of material culture between the control and experimental units.

		Material culture type					Skeletal Elements
		Glass	**Lithic (large)**	**Lithic (small)**	**Ceramic**	**Total**	
Control unit	Maximum recovered	100%	100%	100%	100%	100%	-
	Minimum recovered	90%	90%	100%	40%	86%	-
	Average recovered	**97%**	**97%**	**100%**	**80%**	**94%**	**-**
	Standard deviation	5%	5%	0%	28%	6%	-
Experimental unit	Maximum recovered	100%	100%	100%	100%	100%	63%
	Minimum recovered	90%	95%	80%	0%	74%	27%
	Average recovered	**95%**	**100%**	**90%**	**100%**	**96%**	**49%**
	Standard deviation	5%	2%	8%	47%	11%	16%

Group III is characterized as having the second-most experienced participants with an average of 8.2 years of experience in HRM. Participants also achieved a tie with Group IV for the shortest average excavation time at 1.71 hours per unit (Table 8). Participants in Group III averaged an education level of 3.1 (currently a master's candidate or more) (Table 8).

Table 14. Group III: average recovery rate of skeletal elements by individual element, element grouping, and adjusted element grouping.

Skeletal grouping	Skeletal element	Percentage recovered	Percentage recovered based on groups	Percentage recovered based on adjusted groups
Skull	Cranium	29%	39%	39%
	Mandible	100%		
	Teeth	0%		
Spinal column	Vertebra bodies	0%	0%	
	Complete vertebral arches	63%		25%
	Incomplete vertebral arches	13%		
	Tail vertebra	0%		
Ribs	Ribs (right)	67%	72%	72%
	Ribs (left)	77%		
Pelvis	Illium	50%	50%	50%
	Ischium	75%		
	Pubis	25%		
Fore and hind limbs	Humerus	100%	100%	100%
	Ulna	100%		
	Radius	100%		
	Femur	100%		
	Tibia	100%		
	Fibula	100%		
Wrist & hoof	Metacarpals and metatarsals	33%	1%	33%
	Phalanges	1%		
Scapula	Scapula	100%	100%	100%
Other	Ossification nodes	0%	0%	
Total percent recovered		19%		49%

On average, participants in control units recovered 94 percent of the material culture. The maximum material culture recovered was 100 percent and the minimum recovered was 86 percent. There is a drop in the recovery of ceramics in Group III. Based on conversations with participants, the recovery of ceramics can be accounted for by two means. First, participants were unable to identify and collect the samples of ceramics. Second, some participants in Group III identified that they had collected a representative sample of ceramics and left the rest in the backfill. This behaviour is likely a manifestation of the system that the practitioners work within. Ceramics, and historical material as a whole, are not regulated under provincial law in British Columbia (see *HCA 1996)*. As such, many individuals who encounter historic material in the field are quick to dismiss it as non-archaeological (pers. obs.).

On average, participants in the experimental units recovered 96 percent of the material culture. The maximum material culture recovered was 100 percent and the minimum recovered was 74 percent (Table 13).

On average, participants recovered 19 percent of the total skeletal remains buried. However, removing the vertebral bodies, coccygeal vertebrae, phalanges, and ossification nodes from the tally resulted in participants recovering 49 percent of the skeletal remains (Figure 12; Appendix A). The maximum skeletal elements recovered was 63 percent and the minimum recovered was 27 percent (Table 13).

The participants recovered similar amounts of cultural material, with a standard deviation of 11 percent in the total average recovery of material culture (Table 13). Between Group III's control and experimental groups, the largest standardized deviation in the recovery of material culture was with ceramics at 47 percent.

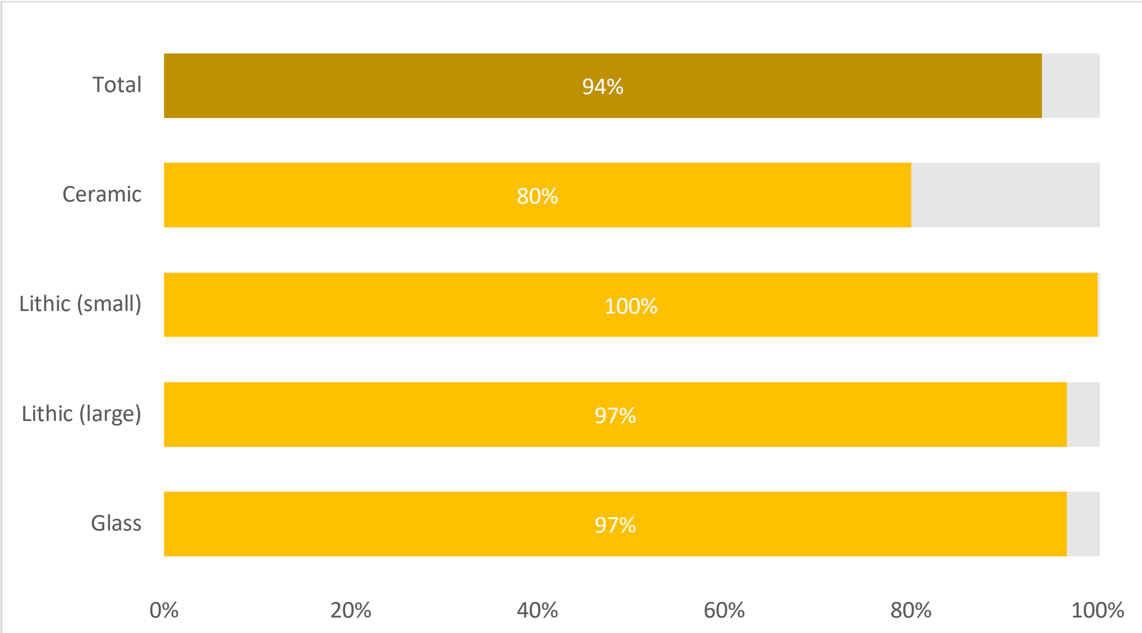


Figure 11. **Average recovery of material culture within control units in Group III.**

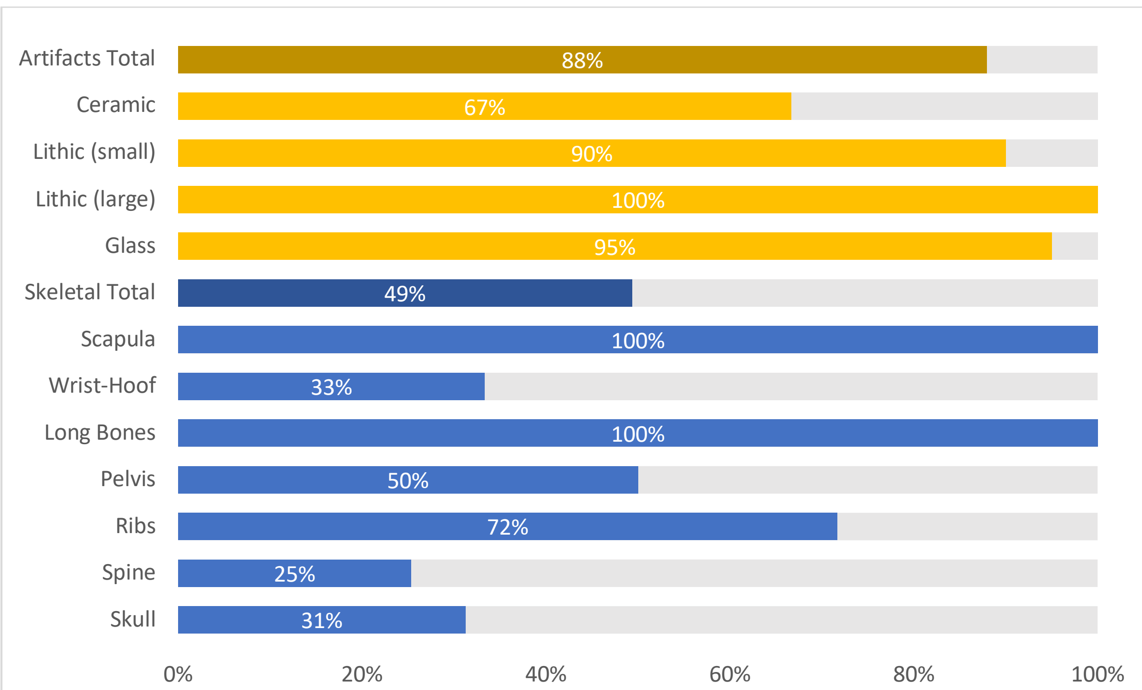


Figure 12. **Average recovery of material culture and skeletal elements within experimental units in Group III.**

4.4. Experimental Archaeology Study: Group IV

Group IV is comprised of individuals with less than five years of HRM experience and do not have a formal background in human osteology. A total of three (n=3) control units and three (n=3) experimental units were excavated. The following are the results of Group IV.

Table 15. Group IV: comparative recovery rates of material culture between the control and experimental units

		Material culture type					Skeletal Elements
		Glass	Lithic (large)	Lithic (small)	Ceramic	Total	
Control unit	Maximum recovered	100%	100%	100%	100%	100%	-
	Minimum recovered	90%	100%	100%	0%	80%	-
	Average recovered	**97%**	**100%**	**100%**	**47%**	**89%**	**-**
	Standard deviation	100%	95%	90%	100%	92%	-
Experimental unit	Maximum recovered	20%	80%	50%	90%	80%	70%
	Minimum recovered	95%	88%	70%	95%	87%	35%
	Average recovered	**1%**	**6%**	**15%**	**24%**	**1%**	**55%**
	Standard deviation	100%	100%	100%	100%	100%	15%

Group IV is characterized as having the least experienced participants with an average of 1.3 years of experience in HRM. Participants achieved a tie with Group III for the shortest average excavation time at 1.71 hours per unit (Table 8). Participants in Group III averaged an education level of 1.5 (achieved a bachelor's degree or higher) (Table 8).

Table 16. Group IV: average recovery rate of skeletal elements by individual element, element grouping, and adjusted element grouping.

Skeletal grouping	Skeletal element	Percentage recovered	Percentage recovered based on groups	Percentage recovered based on adjusted groups
Skull	Cranium	67%	58%	58%
	Mandible	100%		
	Teeth	13%		
Spinal column	Vertebra bodies	0%	24%	
	Complete vertebral arches	75%		22%
	Incomplete vertebral arches	20%		
	Tail vertebra	0%		
Ribs	Ribs (right)	77%	77%	77%
	Ribs (left)	77%		
Pelvis	Illium	100%	33%	33%
	Ischium	50%		
	Pubis	0%		
Fore and hind limbs	Humerus	100%	92%	92%
	Ulna	100%		
	Radius	100%		
	Femur	100%		
	Tibia	100%		
	Fibula	50%		
Wrist & hoof	Metacarpals and metatarsals	28%	3%	28%
	Phalanges	0%		
Scapula	Scapula	100%	100%	100%
Other	Ossification nodes	0%	0%	
Total percent recovered		21%		55%

On average, participants in control units recovered 89 percent of the material culture. The maximum material culture recovered was 100 percent and the minimum recovered was 80 percent.

On average, participants in the experimental units recovered 87 percent of the material culture. The maximum material culture recovered was 92 percent and the minimum recovered was 80 percent. On average, participants recovered 21 percent of the total skeletal remains buried. However, removing the vertebral bodies, coccygeal vertebrae, phalanges, and ossification nodes from the tally resulted in participants recovering 55 percent of the skeletal remains (Tables 15 and 16). The maximum material culture recovered was 92 percent and the minimum recovered was 80 percent. On average, participants in the experimental units recovered 87 percent of the material culture. The maximum material culture recovered was 92 percent and the minimum recovered was 80 percent.

The participants recovered similar amounts of cultural material, with a standard deviation of one percent in the total average recovery of material culture (Table 15). Between Group IV's control and experimental groups, the largest standardized deviation in the recovery of material culture was with ceramics at 24 percent (Table 15).

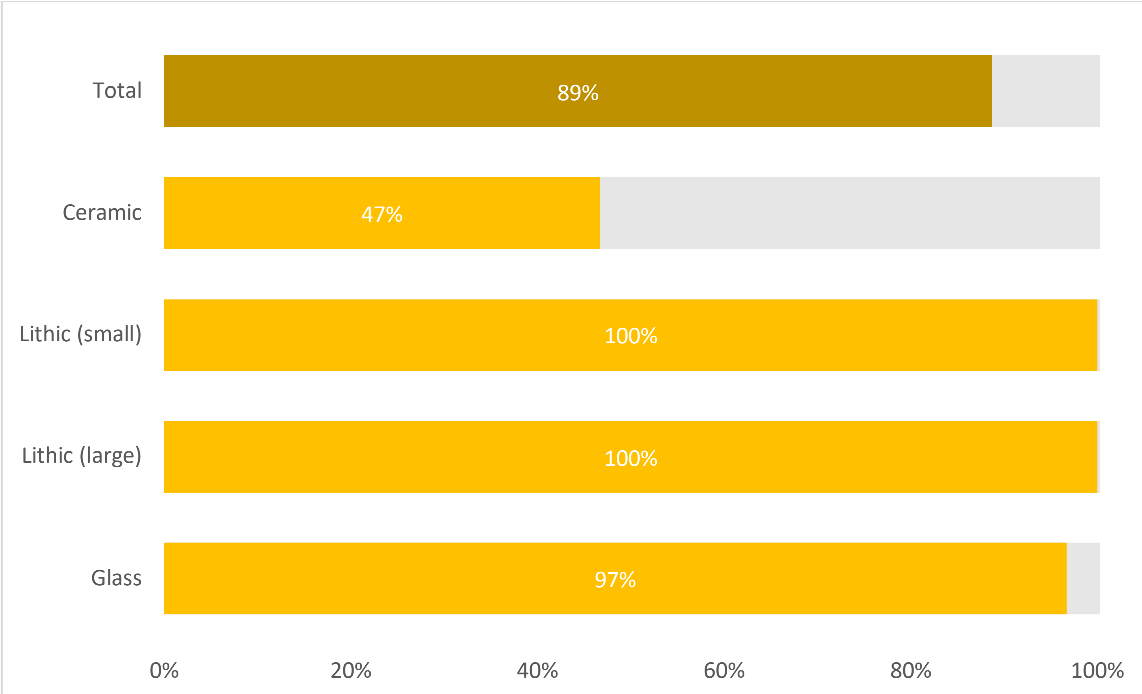


Figure 13. **Average recovery of material culture within control units in Group IV.**

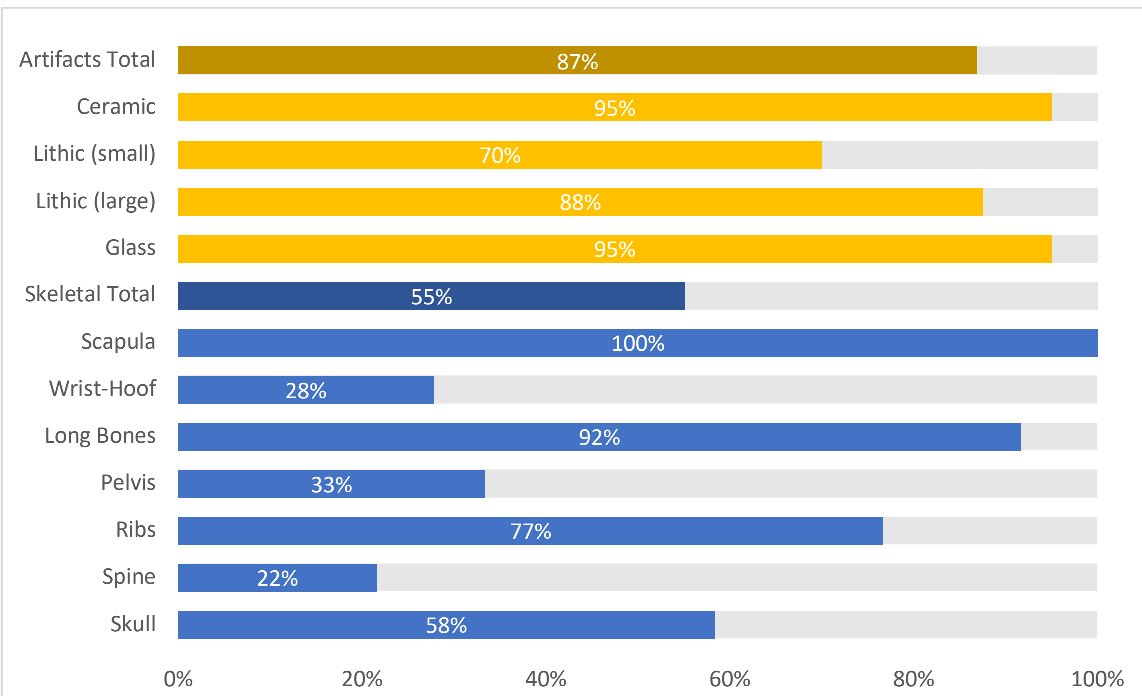


Figure 14. **Average recovery of material culture and skeletal elements within experimental units in Group IV.**

4.5. Principles, patterns, and key relationships of recovery rate

The results of this study found that there is a varying level of identification and recovery rates of juvenile skeletal material between groups. Given that both the experienced groups, Group I and III, recovered less skeletal material than the less experienced groups, Group II and IV, one could surmise that the amount of experience plays a role in the recovery of skeletal remains. This is the antithesis to the notion that more experienced individuals will outperform those that have less experience.

4.5.1. Observations through the recovery data

The principal finding of the study indicates that individuals with more experience in HRM or having a specialized background in human osteology did not afford a higher recovery rate of juvenile skeletal remains (Table 18; **Error! Reference source not found.**). Contrary to the primary hypothesis, the results indicate that individuals with less experience outperformed those with more experience on an intergroup basis.

Participants across all groups were successful in recovering 100 percent of some skeletal elements, including the humerus, radius, tibia, mandibles, and scapulas (Appendix A). While some of the long bones were still in a stage of ossification, generally the elements that were completely recovered were in a stage of development that would be distinguishable to an excavator. The morphology of the fully recovered elements prevents them from passing through any of the screen meshes provided. The shape of these elements is generally unlike any of the stone, root, and other inclusions present in the study; thus, it is expected that a participant would likely notice unusually shaped objects like a scapula or mandible in the matrix.

Contrasting the results between the control and experimental units, an inverse in recovery rates is observed (Figures 15 and 16). Whereas the experimental units illustrate that there is a marked decline in the recovery rate of skeletal material based on experience, the control units show the opposite. These observable increases and decreases of replica cultural material and skeletal material are most likely a result of the training, mentorship, and habits developed through years of work. The majority (80 percent) of the cultural material in this study was replicated lithics, representing the most common prehistoric archaeology site type (Keiser et al. 1998; Kooyman 2000; Parkinson and Cherry 2010); therefore, it is not unexpected to see trained professionals excel at site types they are familiar with. Further, the same logic can be applied to recovery of skeletal material. Thus, experienced practitioners may exhibit mastery over some site components (e.g., lithics, pottery, or shell midden) while lacking skills at other components, like juvenile skeletal remains.

4.6. Summary of the experimental archaeology study results

In summary, the recovery rates between, and within, groups display patterning that is inconsistent with the research question 1.A (Table 1). The recovery results in this study illustrate that the expectation that individuals with more experience should outperform those with less experience and that those with subject matter expertise should outperform those who lack expertise was not met (Table 18; Appendix A).

Table 17. Average use of individual tools in study.

Type of tool		Group I	Group II	Group III	Group IV	Experiment Average
Trowel		75%	100%	100%	100%	94%
Large dustpan		88%	100%	100%	100%	97%
Small dustpan		100%	75%	100%	50%	81%
Large brush		75%	50%	50%	50%	56%
Small brush		88%	50%	33%	33%	66%
Fine wooden tools		63%	75%	63%	50%	63%
Average use of all tools		82%	75%	74%	64%	74%
Average recovery of material culture from control and experimental units		91%	92%	95%	88%	92%
Average recovery of skeletal elements from control and experimental units		42%	60%	49%	56%	52%
Screen mesh utilized	¼ inch (6.35 mm)	67%	80%	83%	100%	82.5%
	⅛ inch (3.14 mm)	0%	0%	0%	0%	0%
	Both ¼ and ⅛ inch	33%	20%	17%	0%	17.5%

Table 18. Experimental archaeology study recovery rate summary

Group #	Type of Unit	Average recovery rate of material culture	Average recovery rate of skeletal elements (complete)	Average recovery rate of skeletal elements (adjusted)
I	Experimental	91%	42%	19%
	Control	91%	-	-
II	Experimental	95%	60%	23%
	Control	89%	-	-
III	Experimental	96%	49%	19%
	Control	94%	-	-
IV	Experimental	87%	56%	21%
	Control	89%	-	-
Mean standard deviation between experimental units		3.6%	7%	2%
Mean standard deviation between control units		2.0%		
Mean standard deviation between all types of units		3.0%		

To best understand the results, both the recovery rate of the full skeleton and adjusted skeleton should be observed (Table 18; Appendix A). As detailed in Chapter 3, the complete skeleton accounts for every skeletal element deposited into the unit (less the cranial elements removed). The adjusted skeleton has elements such as ossification nodes, vertebral bodies, and other elements removed from the calculation as they were frequently recovered in such small quantities or not at all recovered by participants (Table 18; Appendix A).

Using the complete skeleton model, the study found that the most successful group at recovering material culture was Group III, who also scored second-highest for recovery of skeletal remains. On average, Group II was the most successful in recovery of the skeletal elements, and also placed second-highest for recovery of material culture. Group IV, on average the least experienced and least educated of all groups outperformed Group I. Lastly, Group I, the most experienced, second-highest educated, osteology specialists recovered the least amount of skeletal remains. Within this model, the groups only have a standard deviation amongst each other of seven percent for recovery of skeletal remains.

Using the adjusted skeleton model, the study found that the most successful group at recovering skeletal remains was Group II with a 23 percent recovery. However, under this model Group IV scored second place with a recovery rate of 21 percent and both Group I and III tied for third with a recovery rate of 19 percent. Within this model, the groups have a standard deviation amongst each other of two percent for recovery of skeletal remains.

The results indicate that 17.5 percent of participants elected to switch or use a finer mesh screen during the experiments (Table 17). Contrasting the tools used by groups, the results confirm that participants with more experienced were more likely to switch their screens to a finer mesh (Table 17). Group IV, with the least experience, never changed their screens; however, the more experienced Groups I and III changed to finer screen mesh sizes more frequently (Table 8). Lastly, results showcase that typically control units were excavated faster than experimental units. Only in Group III were experimental units excavated marginally quicker (0.08 hr) quicker than control units.

A total of 12 participants excavated control units with material culture. Based on the results, all four groups' average recovery of material culture was between 87 to 96 percent with a standard deviation of three percent (Table 18).

A total of 16 participants excavated the skeletal remains. Based on the results, it is evident that some skeletal elements were easily identifiable while others were more challenging. For instance, every participant recovered 100 percent of the humerus, radius, tibia, mandibles, and scapulas. However, the recovery rate of elements such as the incomplete and complete vertebral arches or metatarsals and metacarpals significantly varied between groups (Figures 4, 6, 8, and 10; Table 18; Appendix A). The results illustrate how practitioner bias plays an absolute role in the identification and recovery of juvenile skeletal remains.

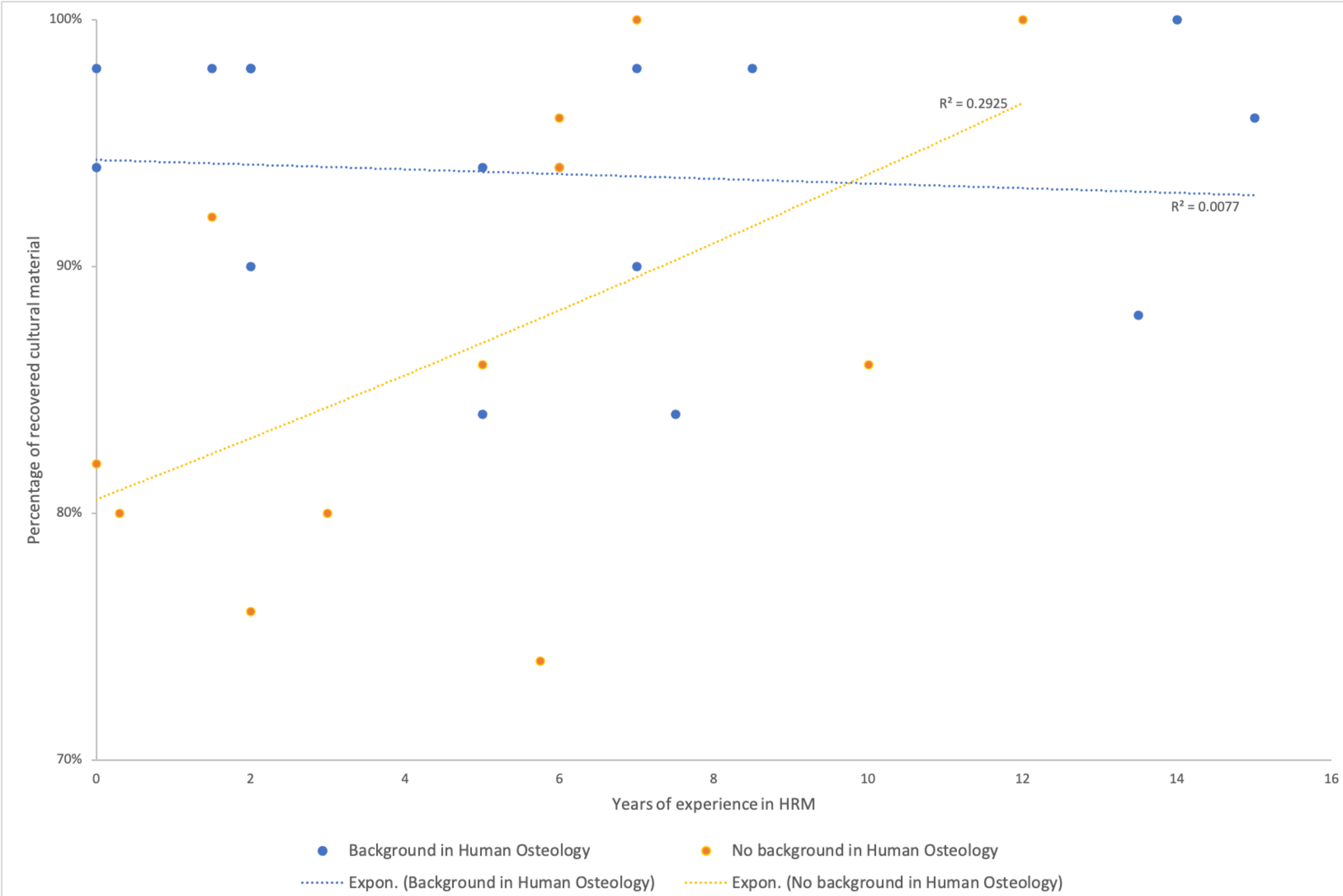


Figure 15. **Scatter plot chart detailing the recovery of replica material culture based on years of experience and background in osteology for both control and experimental units.**

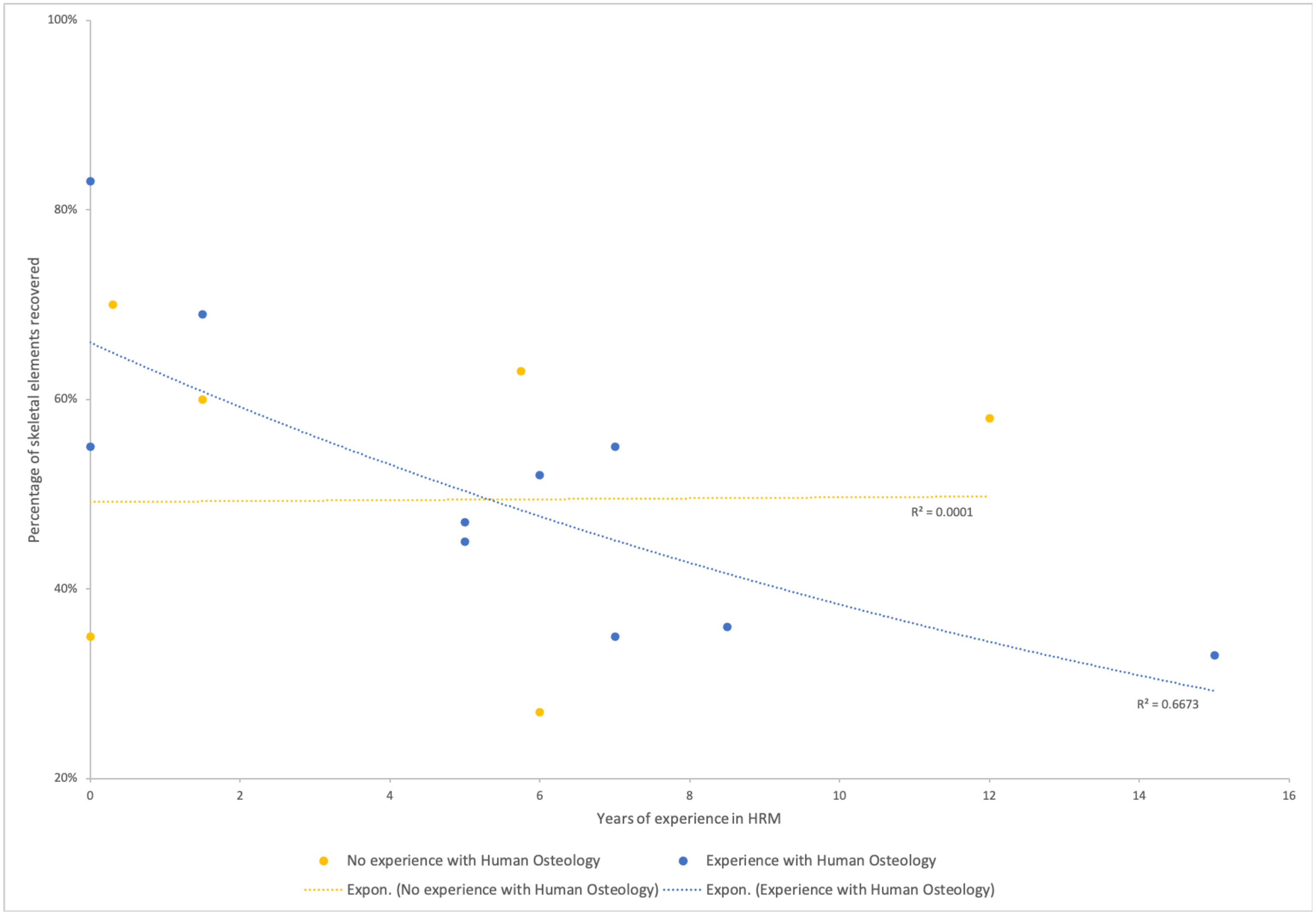


Figure 16. Scatter plot chart detailing the recovery of skeletal material based on years of experience and background in osteology for experimental units.

Chapter 5.

Discussion

This chapter begins by contextualizing the results of the study in relation to the primary research goals and questions outlined at the outset. The primary research question was to investigate if practitioner bias plays a role in the identification and recovery of juvenile skeletal remains. Further, does more experience in HRM equate a higher recovery of material culture and skeletal remains? Finally, are individuals with a background in human osteology more likely to identify and recover juvenile skeletal remains. The purpose of the exercise is to illuminate skill and/or education gaps of archaeologists and elevate the practice so that less skeletal remains are unidentified and missed.

5.1.1. Education achieved and experience in HRM

The purpose of this thesis was not to quantify the level of education and contrast against recovery rate; however, the analysis does provide insight into if those who have achieved higher education are more successful than others. However, little distinction could be made regarding the amount of education achieved and the level of identification and recovery of skeletal remains. Participant observation yielded insight that one or more participants appeared to not be excavating in any systematic manner nor exhibiting familiarity with using a trowel to excavate. It seems probable that a field school or field methods class would alleviate these concerns. Thus, it is possible that candidates showcasing a lacking in field knowledge had not partaken in a field school or methods class, or perhaps, need a refresher course.

5.2. Acknowledgement of problems and limitations of study

Foremost, it should be recognized that using non-human remains as a proxy for human remains has limitations and issues for what information or inferences can be extracted. Practitioners excavating an archaeology site are likely to adjust their decision-making process regarding how to approach and excavate bones whether they perceive them as human or non-human. This could be situationally contingent; however, in my experience, if ancestral remains are encountered during an impact assessment then considerably greater care and due diligence is applied than for faunal remains. Subsequently, the participants of the study have provided insight into how practitioners approach juvenile skeletal remains; however, the results need to be scrutinized for clarity when making statements about the identification, treatment, and excavation of human remains. Juvenile pig bones, as used in this study, provide a good analog for skeletal remains; however, many of the skeletal elements are discernably non-human upon inspection. Further, the skeletal elements and cultural material will vary in appearance from participant to participant due to taphonomic processes and the destructive nature of screening. Thus, the skeletal elements will appear differently from participant to participant, either due to weathering or destruction (Figure 16). It is possible that breakage in elements such as the ribs could make them more challenging, or easier, to identify; however, a temporal shift was not observed in the recovery rate of skeletal elements or groupings (Appendix A).

To try and make the experiments equitable, while resetting the units, if cultural materials such as glass or stone debitage was notably broken, another piece was procured, marked, and then buried to facilitate similar experiences between participants. The same was not true for bone, besides the initial specimen no “new” skeletal elements were introduced during the study. Typically, in between experiments the skeletal elements were left outside the unit prevent any accelerated taphonomic changes. However, the skeletal elements did change to a degree throughout the study. The purpose of using one specimen during the experiment was manifold. First, and most importantly, using one specimen provided assurances that each participant was subject to a similar size, shape, and number of bones during the study. Given that there is morphological diversity and intraspecies variation, it would be more challenging to provide inter and intragroup analysis for experimental plots if individuals were subject to different circumstances.

For instance, upon primary deposition the elements did incur soil staining which lasted throughout the study (Figure 16). Skeletal elements, for example the complete vertebral arches from the cervical vertebra, some ribs, and temporal bones, did change morphology as they incurred small fractures or separated at ossification centres through the recovery process (Figure 16).

(a) Humerus (posterior) prior to first burial

(b) Humerus (posterior) post-final excavation.

(c) Elements from the skull used during study, prior to first burial.

(d) Elements from the skull used during study, post-final excavation.

Figure 17. Photos of skeletal elements before and after burials

Finally, the results of this study are likely only applicable for inferences to fetal or infant skeletal remains. This is primarily due to the size and age of the skeletal remains used in the study. The skeletal elements used in this study are likely more difficult to identify and recover than those of a more developed specimen. For example, if an older juvenile specimen (e.g., several months old) was procured for the study then the percentage of elements that were further ossified or developed would be increased. I would speculate that if the vertebral arches were ossified to the vertebral bodies there would be a dramatic difference in the recovery rate. While the term juvenile does incorporate several life history stages, the results and implications of this study are primarily focused on fetal and infant humans (Halcrow et al. 2017).

Other than the results, one unexpected finding was the various methods and reasonings that participants used during the study. Foremost was the indifference of participants who observed skeletal material pass through the screen and did not seek to try and recover any missing pieces.

5.3. Inter and intragroup analysis of results

The results of this study demonstrate that some groups, and individuals therein, were more successful at the identification and recovery of the skeletal material than others. To best explain the patterning of results, several theories are proposed.

First, the proposal that some skeletal elements were easily identifiable while others were more challenging. For example, every participant recovered 100 percent of the humerus, radius, tibia, mandibles, and scapulas. However, the recovery rate of elements in the spine, such as the incomplete and complete vertebral arches or metatarsals and metacarpals, significantly varied between groups (Figures 4, 6, 8, and 10; Table 10; Appendix A). Based on the results, participants tended to recover a higher percentage of flat (e.g., scapula, ilium, ischium, ribs) and long bones (limb bones) while recovering inconsistent amounts of short (e.g., metacarpals, metatarsals, and pubis) or irregular bones (vertebral arches or arch fragments).

5.3.1. Deviant participants: the assumption that the groups represent the whole

To best understand the results of this study, it is prudent to observe any atypical results within a group. Accordingly, an analysis of every participant was conducted to evaluate if some individuals were skewing the results of a particular group by distorting the results to a higher or lower percentage (see Table 19). For the purpose of this study, deviant participants are comprised of those individuals who recovered 10 percent more or less than their peers in the same group.

In Group I, there was one deviant participant in the control group and two in the experimental (Table 19; Appendix A). Participant 7 in the control group recovered 100 percent of the cultural material while others recovered 84 and 88 percent each. Thus, Participant 7 skewed the results of the control group slightly higher. In the experimental units, Participants 6 and 7 recovered 52 and 55 percent of the skeletal elements while other participants only recovered 33, 36, and 35 percent in the group. With the exclusion of Participants 6 and 7, the mean recovery rate of skeletal elements moved from 42 to 34 percent for Group I.

In Group II, there were two deviant participants in the experimental group (Table 19; Appendix A). Participants 15 and 22 recovered 69 and 83 percent respectively while others in the experimental group only recovered 45, 47, and 55 percent of the skeletal elements. Therefore, Participants 15 and 22 skewed the results of the experimental group slightly higher. With the exclusion of Participants 15 and 22, the mean recovery rate of skeletal elements moved from 60 to 49 percent for Group II. Thus, the deviant participants within this group elevated the average recovery rate substantially. Had it not been for the more astute participants within Group II then the average recovery would be much closer to other groups.

In Group III, there were two deviant participants in the experimental group (Table 19; Appendix A). Participant 25 recovered 74 percent of the cultural material in the experimental unit while others in the group recovered 94 and 100 percent respectively. Participant 74 skewed the average recovery rate lower for the group and represents an anomaly in the entire study as the individual who recovered the least amount of cultural material in general. Participant 12 in the experimental group recovered 27 percent of the skeletal remains while others in the group recovered 63 and 58 percent respectively. Therefore, Participant 12 lowered the mean recovery rate for Group III significantly.

In Group IV, there was one deviant participant in the experimental group (Table 19; Appendix A). Participant 11 recovered 35 percent of the skeletal material while others in the group recovered 60 and 70 percent respectively. With the exclusion of Participant 11, the mean recovery rate of skeletal elements moves from 55 percent to 65 percent.

Table 19. Mean recovery rate of material culture and skeletal elements by each participant and group

Group #	Participant # (control)	Material culture from control unit	Participant # (experimental)	Material culture from experimental unit	Skeletal elements from experimental unit
I	24	84%	8	90%	35%
	23	88%	7	90%	55%*
	27	100%	6	94%	52%*
			4	96%	33%
			10	98%	36%
II	16	90%	9	84%	45%
	20	98%	2	94%	47%
	21	98%	13	94%	55%
			15	98%	69%*
			22	98%	83%*
III	1	86%	25	74%*	63%
	3	96%	12	94%	27%*
	5	100%	15	100%	58%
IV	28	80%	26	80%	70%
	17	86%	11	82%	35%*
	3	100%	18	92%	60%

* denote the participants/percentages that are identified as being *deviant*

Thus, it appears that some of the most problematic deviances between practitioners, and thus groups, is a result of the ability or inability to identify smaller or less-identifiable skeletal elements. Skeletal elements such as the vertebral arches, the metacarpals and metatarsals, the pubis, and the fibula appear to be the elements that are most frequently under-represented in the study (Appendix A). These results solidify that the recovery bias of participants in this study is towards larger, more recognizable skeletal elements rather than those that are smaller or unossified (e.g., the pelvis or vertebrae).

These deviants prove that while Group I recovered the least amount of skeletal material of the four groups, had the two deviant participants not partook then the mean recovery rate would be significantly lower. How successful each group performed may be a subjective perspective (e.g., is 60 percent recovery of a specimen successful or a failure?); however, it is evident that the more experienced groups underperformed in recovery of skeletal material when contrasted with the less experienced counterparts.

5.3.2. Assumptions regarding experience and participants in HRM

In this study, archaeologists of various skills and education levels were evaluated on how completely they recovered the skeletal elements of a fetal pig in an experimental archaeology study. Grouping archaeologists based on the level of experience in HRM and whether they had a background in human osteology is beneficial as it provides a representative cross-section of archaeologists in, or aspiring to enter, HRM. The discussion of the study is based on the key assumption that these four groups accurately represent said groups.

While it may be impossible to gauge how much the consent and participation forms altered any preconceived notions from participants, it should be explored. In the consent form (Appendix B), it was noted that the purpose is to:

> "further our understanding of the recovery of cultural material from archaeology sites. This study will help us make positive recommendations on how to improve the identification and recovery of cultural remains in heritage resource management (HRM) settings."

Depending on how astute the participant was in reading the form or how much value they put into the key words, one could argue that archaeologists thought they were only collecting cultural material (e.g., lithics or pottery). While it could be argued that participants recovered less skeletal material than material culture because of the wording in the consent form, I do reject that notion. My conclusion is based on the collection of other ecofacts. If participants believed they were not supposed to collect non-replica material culture then they would not have collected smaller samples such as charcoal, seeds, or shells. Given that participants were told to excavate the unit to the best of their ability and use whatever methods they saw fit, I believe that the results accurately reflect what they believed to be "cultural material", regardless of whether it is bone, stone, or ceramic in origin.

A key component not fully represented in this study is the recognition of stakeholders in HRM who partake in archaeological assessments and excavations but may not hold the title of *archaeologist*. The leverage of expertise and utilization of local labor is entrenched in early archaeological studies and field methods manuals from the early years of archaeology (Nicholas 2008, 2010). While the structure of early archaeological investigations is embedded in a colonial framework, the discipline of archaeology has seen an upswing in the post-colonial archaeological movement in recent years (Dupras et al. 2006; Hunter and Cox 2005). Some countries (e.g., Australia, Canada, the United States) have begun to adopt a post-colonial framework, wherein archaeologists frequently work with descendent Indigenous communities when partaking in HRM (Dupras et al. 2006; Hunter and Cox 2005). Based on my experience in Canada, commercial archaeology projects may be staffed by upwards of 50 to 80 percent of Indigenous archaeological field technicians, heritage monitors, and cultural specialists.

While the study was open to participation for any applicants who had a background in archaeology, it is recognized that it may not accurately reflect the abilities of stakeholders in HRM who do not hold a formal degree or archaeological title. Often Indigenous cultural heritage staff have much more experience and emic knowledge of the region's prehistory than archaeologists; however, in the eyes of the government, the title of *Archaeologist* is tied to education achieved. Consequently, based off of the BCAPA membership webpage, and considering that there are practicing professionals in British Columbia who are non-members, it is likely that 28 individuals represents approximately 10 percent or less of the body of practicing archaeologists in the province of British Columbia (BCAPA 2020). Another limitation of the study is the sample size used. Although, 28 participants are a limited sample size for the entire study, it provides a solid cross section of archaeologists of varying skills and backgrounds. Further, given the prerequisites for the study and timeline for completion of experiments, it would be quite challenging to increase the number of participants by much more.

5.4. Participant observation and post-excavation debriefing: some observations

It was anticipated that the bulk of the data used for results would be from the skeletal and material culture inventories; however, the debriefing with each individual proved valuable to their idiosyncrasies on how they excavated. After each excavation, each participant was queried on the tools utilized; the methods they used; how and why materials were bagged; and, general perceptions of the experiment.

5.4.1. Recovery bias based on methods

How skeletal remains are excavated will influence how they are recovered. If this axiom proves true, then the reasonings, theorems, and praxis each participant, or groups of, should be explored further for cause and correlation in the recovery of skeletal remains. A few key elements should be examined to best understand how individual methods were pursued, maintained, and possibly changed, during this study. These variables include the tools used by each individual, the screen mesh used, the time spent excavating, and if/when methods were changed.

The purpose of providing a standardized tool kit to participants was to ensure that participants had all the tools possible for excavating the remains but to also not give hints as to what was buried (e.g., participants may become suspicious that there is osteological material if the only tools provided are fine wooden tools and a trowel). In this study, some patterns are observable with what tools participants or groups chose. It was expected that participants would use a primary excavation tool and matrix collection tool (e.g., a trowel and dustpan). As the study did not incorporate buckets in the excavation, participants were required to get the soil from the excavation unit to the screen, although those were usually located within 1 meter of each other (Figure 18).

(a) Photo showing typical layout of the excavation.

(b) Plan view photo showing participant excavating faunal remains with fine wooden tools.

Figure 18. Photos of participants excavating the experimental units.

In total, approximately 94 percent of participants utilized trowels as their primary excavation method while the other six percent of participants elected to use brushes to sweep the soil into the dustpan (Table 17). Further, 97 percent of participants used the large dustpan, 81 percent used the small dustpan, 56 percent used the large brush, 66 percent used the small brush, and 63 percent used the small wooden tools (Table 17).

Examination of tools used and recovery rate by group identifies no significant difference (Table 17). It was anticipated that individuals who use finer tools may be able to recover more material in situ than larger tools (e.g., wooden bone tools versus a trowel) and thus mitigate any loss of bone during the screening process. However, the information gleaned from tool use in this study is limited as the focus of the study is not on recovery rates of material in situ versus in the screen.

In contrast to the types of tools used, screening matrix is one of the four major filters in the representation of skeletal remains in the archaeological record (Powers and Sibun 2014). Studies show that a finer mesh that is used in a screen will result in a higher recovery rate of skeletal elements and archaeological materials (Powers and Sibun 2014). If archaeological studies do not account for the loss of materials in the planning stages of programs, then the recovery bias of material culture and osteological elements will always favour larger and more diagnostic items. In one study, Pokines and De La Paz (2016) used fetal human remains (approximately 18 to 40 weeks old with the majority being closer to full-term) and attempted to pass the elements through various sizes of screen mesh to ascertain the efficacy of various mesh sizes (Table 2).

This study was designed with the results of Pokines and De La Paz (2016) in consideration; as such, all four screen sizes (6.4 to 1.0 mm) were made available to participants. Only six (n=6; 21 percent of total participants) of the 28 participants chose to switch the screen size from 6.4 mm to 3.2 mm; however, only five (n=5; 18 percent of total participants) of the six participants were excavating experimental units (Table 8). The results indicate that 21 percent of participants elected to switch or use a finer mesh screen during the experiments (Table 8). Further, results confirm that participants with more experience were more likely to switch their screens to a finer mesh. Group IV, with the least experience, never changed their screens; whereas, the more experienced Groups I and III changed to finer screen mesh sizes more frequently (Table 8). The recovery rate of skeletal elements in this study also mirrors much of the results from Pokines and De La Paz's study (2016). The high loss of phalanges, vertebral elements, and manual/pedal elements in screen sizes under 6.4 mm mirrors much of the results experienced during this study.

When designing the experimental units, the skeletal remains were orientated in a manner that would allow participants time and consideration of methodology adjustments. If participants were to excavate systematically, they would encounter the hind limbs first, then the pelvis and spinal column, followed by the forelimbs, skull fragments, and mandible. By depositing the skeletal remains in this manner it facilitated the participant having to excavate through the hindlimbs before reaching the spinal column. Thus, it was expected that if the participant did not recognize the metatarsals or some of the hind limbs, they would likely notice a large cluster of ribs and vertebral elements. Thus, it was expected that as participants noticed bones or a larger cluster of skeletal elements, they would evaluate the efficacy of their methodology and change tools or methods accordingly. This underpinning assumption was proven incorrect on several occasions. Participants explained in the post-excavation debrief how several factors, including disturbance of matrix, time, and previous working knowledge influenced their excavation.

5.4.2. The role of disturbed and intact matrix and practitioner bias

During the debrief, when questioned about methods or thought processes, several experienced participants commented on how the matrix appeared disturbed, and thus, their methods reflected that. Unfortunately, it is not possible to both create a mock excavation unit and for the soils to be intact. This study required the placement of the replica material culture and skeletal elements which required that the matrix be redeposited each time the unit was reset. For this reason, the matrix was consistently loose and dry. Further, the matrix also included historical and contemporary pieces of refuse such as bolts, nails, and other pieces of detritus that was located in the soil when the soil was procured. At the outset, I did not anticipate that the matrix appearing disturbed would be an issue given that each individual knew that I had built the unit, and recognizing that there is no way to build an “intact” unit inside a plastic tote. Regardless, the impression of the unit being disturbed influenced how individuals approached their methodology. For instance, some individuals noted that skeletal remains, such as ribs, were passing through the screen and were visible in the back-dirt pile. When asked why they did not change screen sizes or collect the skeletal elements, they commented that the disturbed context of the unit did not require a smaller mesh size or effort. With other participants, they noted that the material they collected was sufficient as it was a representative sample of the cultural or skeletal material, regardless that they observed elements that had passed through the screen. These observations correspond to Mays' findings that archaeologists tend to be less careful with fragmentary or incomplete skeletons (Mays 1992:55).

5.4.3. Pig versus human: the implications of using proxy skeletal material

The implications of the results of the study should be thoroughly challenged given that participants did not excavate human remains, replica or real, but rather analogues. While all participants noted that the mandibles were clearly non-human; only a few osteology-fluent participants were able to determine that some of the larger pieces were certainly faunal. To that end, most, if not all, participants excavated the experimental units with the notion that they were encountering non-human remains. However, in my professional experience, practitioners are likely to be considerably more careful if they are handling human remains than those of animals. However, the bones of the specimen were arranged in semi-articulated position to mimic the burial of a human infant or fetus.

5.4.4. The role time plays in practitioner bias

Concerned about participants rushing the excavation of their units, each individual was told at the outset of the experiment that they would have as much time as required. At the outset we predicted that the experiment would likely take 2 hours or more but wanted to create a time buffer and thus overestimated the completion time to four hours. Thus, participants were told that the excavation would likely take four hours or less, to alleviate participants rushing. The average completion time of experiments was 1.9 hours (Table 8). Typically, the individuals who exceeded two hours of excavation time only surpassed by 15 minutes or so; however, several participants' time ranged from 2.75, 3.75, and 5.25 hours (Appendix A). The longest time spent excavating a control unit was approximately 2.75 hours while the longest time spent excavating an experimental unit was 5.25 hours. This seems appropriate given the increase in complexity from control to experimental units. Interestingly, it appears that the time spent excavating is cross-sectional and not limited to one group; hence, it is observable that both experienced and non-experienced individuals process at a similar pace.

The inter- and intragroup excavation time results could be observed as two different patterns. First, experienced individuals excavate faster due to practical work experience and comfortability with the subject matter. Alternatively, individuals with more experience reduce the speed of excavation to facilitate a more detailed excavation program. Based on observations, typically the experienced individuals who spent longer excavating were far more diligent in their bagging of fragments of shell and microdebitage, whereas other participants in those groups did not concentrate on the collection of shell fragments. Further, this can be observed as a professional versus academic trend. Those who have been inculcated into the world of professional archaeology know of the grinding deadlines and the need to keep projects on schedule, on budget, and completed to a satisfactory level. As such, it was expected, and observed, that professional archaeologists were generally faster at tasks than those who spent less or no time in HRM.

Further, it should be noted that the participants were subject to near ideal conditions for excavations. The flintknapping pit provided overhead cover from most elements and the sides, while partially open, did provide shelter from most wind, rain, and snow. Participants were also given the ability to complete the experiments at their own pace, an aspect that archaeological fieldwork rarely affords. Commercial archaeology programs, specifically those of monitoring or surveillance programs, are often done in conjunction with stakeholders aiming to develop the land. As such, the levels of stress and pressure that an archaeologist may face undertaking a normal AIA, months or years before development, may be markedly different than having to excavate skeletal material with construction crews and their excavation machinery on standby right behind them.

5.4.5. Of phenomenology and practitioner bias

The lived experience of each archaeologist plays an important role in every aspect of an archaeological investigation, from contract procurement, project planning and management, and execution of investigation, to analysis and deliverables.

Every practitioner has their own set of values of what is personally important in the archaeological record. Some may favour stone tool technologies, others perhaps wet sites or paleobotanical resources, and for others, it may be bones. These values are imbued through academia, personal practice, and the regulatory framework that the individual works within. Certainly, archaeologists may posture that the entire archaeological record is important, but often the legislation that HRM is grounded in denies that. These axiomatic differences define how we approach the archaeological record. It was clear from speaking to participants that some were comfortable with a loss of material due to screen size, while others carefully picked through the back dirt to recover errant ribs and vertebrae fragments.

It is likely that most participants held the a priori assumption that I would not bury human remains in this study. For this reason, caution must be used when determining how and why individuals approached the skeletal elements in this study. While the bones may appear similar to humans, the treatment of faunal remains and ancestral remains in archaeological settings if often dramatically different. During the study, when participants commented on the faunal remains, I would usually remark with “how do you know it’s not human?”. Typically, individuals remarked that the mandible was that of a small mammal as a rebuttal. One participant mentioned the shape of the ribs was inconsistent with human ribs and another participant mentioned that the scapulas appeared to not be human. However, when I would counter and ask, “what if there are human remains commingled with the faunal remains?” I was usually met with a look of dismay. Further, when individuals were certain that juvenile human skeletons could not look similar in size to the pig or how similar skeletal elements are, I would go through *The Juvenile* Skeleton (Scheuer and Black 2004) or *Developmental Juvenile Osteology* (Mayer-Oakes 1989) with them. Using a side-by-side comparison between the reference textbooks and the skeletal elements, participants were able to see the similarities, or lack thereof, between the samples. Most participants who queried about the comparative skeletal morphology between pigs and humans were shocked at how small juvenile skeletons could be and how fast some of ossification processes occur. It is likely that many individuals were unaccustomed to seeing or working with subadult faunal or juvenile remains given that most individuals believed the skeletal remains were likely that of a rodent due to size but rarely noted the underdevelopment of the bones. This is of importance important to note, given that many participants had confidence in approaching mortuary archaeology yet apparent lack of knowledge about the variability of skeletal remains.

5.5. Principle implications and recommendations for present and future practice

There are several principle implications as an output of this study. First, there is a false equivalency between the amount of experience in HRM and the recovery of juvenile osteology remains. Second, there is a false equivalency between the amount of education in specialized subjects and the recovery of juvenile osteology remains. These implications are derived from the results of the study and the decisions that participants made during their experiments. It was observed that individuals, often without working knowledge or a high degree of specialization in osteology, often did not change methods based on field observations. Many participants were comfortable having osteological material fall through the screen and did not return to re-screen the material or try and collect the material. When skeletal material was observed passing through the screen, many participants elected not to change their methods (e.g., change to a finer screen mesh).

Lastly, the use of non-human skeletal remains in this study has given insight into how participants may treat juvenile faunal remains in an archaeological context. While the purpose of the study was to address the lack of juvenile human skeletal remains, the results can be inferred to also reflect the lack of juvenile faunal remains as well. Based on these implications, several recommendations can be made to mitigate or remediate these issues.

Archaeologists have advocated for greater professionalization of the discipline for decades (Powers and Sibun 2014). Historically this has involved the creation and adoption of formal codes of ethics to ensure that high standards are met when standards begin to weaken (Powers and Sibun 2014). As archaeology has moved from a fledgling to a more full-formed discipline, the broadened responsibilities that heritage resource management now incapsulates need to be examined.

5.5.1. Recommendation for basic osteology training

Generally, skeletal material is easily identifiable when freshly macerated; however, the number of intrinsic and extrinsic factors that can influence how osteological material appears make the task more challenging (Baxter 2004; Hoppa 1996). For these reasons, it would be wise to recommend that all practitioners have basic osteology training at the outset of field programs. Understandably this could be logistically complicated given the course schedules in universities or the financial cumbrance of individual practitioners or sponsoring firms. However, in lieu of a university course, a module could be constructed and presented before a large field program or fieldwork season. It is likely not reasonable to expect every single individual on an HRM project to have advanced working knowledge of skeletal biology; however, an osteoarchaeology module would ensure that all participants had minimal working knowledge of osteology going into a field program. Based on this study, it is only once we recognize that there is skeletal material present that archaeologists adapt their methods. Without rudimentary understanding of osteology, I expect burials, such as that are non-intact, disarticulated, or commingled, or plots with very small skeletal elements, could be missed entirely. Certainly, it is a disservice to descendent Indigenous communities to have "qualified" archaeologists working amongst burial or mortuary sites without adequate training. Given the sensitive nature of Indigenous funerary sites, the requirement for osteology training for practitioners should be paramount.

Using the results of this study as an inference, participants may recover most, if not all, of the material culture within a locality but still miss a large portion of the fetal or infant ancestral remains. The tolerance threshold for 'missed' artifacts, faunal, or even human remains may differ between projects, localities, and the Indigenous communities whose traditional territory the project area takes place. However, if archaeologists are contracted to provide an impact assessment then the goal should be to ensure that all ancestral remains are identified and recovered, where warranted.

5.6. Recommendation for ongoing evaluation and professional development for osteology in HRM

The results of this study show the need for ongoing training in professional practice. This is not unusual for professional bodies. The guidelines, standards of practice, and code of ethics that archaeologists across the world practice under are not specific enough in their requirements for the identification and excavation of juvenile skeletal remains (e.g., see Archaeological Institute of America, Canadian Archaeology Association, or Society for American Archaeology's standards of practice). Some organizations, such as Historic England, Historic Scotland, and the Chartered Institute for Archaeologists (CiFA) have created specific manuals (e.g., CiFA's standards and guidance manuals for forensic archaeology, archaeological excavation, or archaeological field evaluation (CIfA 2014a, 2014b 2014c, 2014d); Historic England's manual on requirements for a osteology specialist (2018); or Historic Scotland's manual on the treatment of human remains (2006)) that provide clear guidelines and directions to pursue when undertaking archaeological investigations, regardless whether one is investigating known burials and cemeteries or if archaeological resources on the landscape is unknown. These manuals provide the foundation for the research methods and leave little room for interpretation on how to excavate. Having clear, robust standards of practice is imperative in ensuring that professionals across the spectrum are conducting work at a similarly acceptable level.

Based on the results of this study, it is clear that practitioners develop their own habits, good or bad, based on their experience and education or phenomenological understanding of the landscape. Given that the majority of participants recovered less than 60 percent of the skeletal elements, adjusted or total percentage, some recommendations should be pursued to alleviate the issue. When participants achieved their education (e.g., 10 to 20 years ago versus more recently) could influence a participant's skill level. The rubric required for a student to undertake and learn changes temporally and between institutions. Certainly, there are some post-secondary institutions where an archaeology degree is available; however, many practicing archaeologists are trained as anthropologists. For this reason, if an undergraduate degree's rubric does not require any specialized archaeology courses, if the courses are not offered during the student's study period, or if specialized faculty (e.g., lithic specialists, zooarchaeologists, or osteologists) are not currently teaching then the student could have a vastly difference experience than another student at the same institution but years apart. Additionally, a 'cohort effect' was observable through participants who studied at certain schools or worked for the same company/project together. This indoctrination of company methods assisted in explaining why several individuals employed the same methods, rationale, and similar excavation speeds for approaching many of the units while others with similar backgrounds and training employed vastly different rationale or methods.

For inspiration of elevating the quality of work of professionals in archaeology, we must look elsewhere to other professional bodies. The Project Management Institute (PMI) is an international body that governs the body of project management professionals and administers the formal title of Project Management Professional (PMP) to its members.

Similar to archaeology, there is no model of professional reliance set up for project managers. You can practice project management legally without a PMP title or membership to the PMI; however, having a title does provide recognition to employers, prospective clients, and peers. Aspirant members who wish to obtain their PMP are required to pass an exam, illustrate relevant work experience in various stages of project management over the past eight years, and then complete professional development units (PDUs) to retain their title (Project Management Institute 2019). If practicing professionals are not performing to an adequate level over time, then it should be argued that ongoing professional development alongside professional evaluation is a way to measure an individual's abilities. I argue that the requirement to complete PDUs to retain membership is something tangible that could be implemented within archaeology to better serve the subdisciplines.

The professional evaluation and development modules can be developed by borrowing training modules from forensic archaeology and anthropology coursework. The evaluations could involve looking at collections of catalogued human and non-human remains that have been subject to taphonomic processes (e.g., fragmentary, burned, mechanically altered) and have participants assess if the skeletal element is human or non-human. As this study illustrated that there can be a dramatic drop-off in recovery after the five-year mark of experience, it would be prudent to recommend training and recertification every two to three years.

5.6.1. The need for osteological oversight in HRM and academic field programs

First, having a trained osteologist on site for projects that involve any sizable amount of faunal remains would be wise. Several participants noted that during some of the larger scale excavation projects they would contract a local osteologist to evaluate the faunal remains collected. The osteologist would perform quality assessment of the osteological material recovered in the field and be able to assess if human remains, including juveniles, were being miscategorized as faunal. In these cases, the bones mistakenly catalogued in faunal or vise-versa and the situation was able to be corrected in the field. Other participants had mentioned how human remains were identified from faunal assemblages during the post-field analysis of faunal remains. Without knowing the exact research design and methodologies of each participants' examples, it would be unsuitable to further speculate; however, a few suggestions can be extracted from the examples. For example, a project that has known funerary components will likely be scoped and budgeted differently from those that may contain funerary components or those where funerary components are not likely to be found.

Considering the amount of participants' comments regarding the uncertainty on whether they were exhuming a human or non-human burial during this study, it would be wise for HRM field programs to ensure they have an osteologist assess their assemblages during the excavation to ensure that valuable management recommendations can be made. This includes having accredited human osteologists on staff during the excavation, providing oversight and quality assessment in the field and lab during the field program, and providing osteological oversight during the post-field analysis. Having a qualified osteologist available for all stages of a project provides extra assurances to the descendent communities, the client, and the archaeological record. As it stands now, the best-case scenario involves human remains from a non-intact burial being misclassified as faunal remains; however, what if the archaeologists misidentified all the skeletal remains as faunal? Providing there are no other tangible funerary features present (e.g., funerary goods, gravestones, or markers), this could result in completely missing the burial. Encountering non-anticipated funerary features or remains is not uncommon in archaeological projects, HRM or otherwise; however, unanticipated funerary components do have the capacity to derail the scope, budget, and schedule of a project if contingencies are not planned for.

Much like forensic cases dealing with human remains, the oversight of a forensic anthropologist or forensic archaeologist ensures a reduction in likelihood that skeletal remains may be left behind. Having family members, or a member of the public, revisit a crime scene only to encounter missed human remains could be harrowing and traumatic and it is for this reason that forensic specialists have developed standards of practice when approaching grave sites (see(Powers and Sibun 2014)). The same can be inferred for funerary components of archaeological sites; the same amount of respect and due diligence needs to be applied to the dead. It is a disservice to Indigenous communities to plan for mortuary components as an afterthought.

Many Indigenous communities maintain a spiritual connection to their ancestors via ancestral remains, funerary goods, and artifacts. For centuries, Indigenous artifacts, as well as human remains, from around the world were excavated, stolen, pillaged, and put on display without consent in institutions around the world. Now, in an era of reconciliation between state and Indigenous groups, archaeologists should look inwards at how their methods propel the ideals of the state, the oppression of Indigenous communities, and disproportionately favour settler cultural heritage over Indigenous. Accordingly, archaeologists must use introspection to evaluate the efficacy of their methods and approaches to research design.

Encountering human remains makes projects more difficult, costly, and can lead to extensive delays in timelines for clients; thus, it is for these reasons that I believe that practitioners may inadvertently impart their bias on the landscape. An individual's bias may not necessarily be malicious but could be as simple as finding some "faunal" remains in a survey program and not mentioning these remains to a supervisor. In this case, the junior staff may hold the belief that they are certainly non-human but lack the skills to discern, or alternatively, do not wish to ask questions or slow the progress of a field program. Certainly, if the skeletal remains are non-human then they would be bagged, catalogued, and reported on; however, if there is not an infield expert to verify, then who can verify that they may actually be in a mortuary site rather than a food processing site? Professional archaeology continually emphasizes the capitalization of labor, either via a quota of tests completed per day, per participant, or the hectares or kilometers of terrain surveyed per day. While this may be useful from a business perspective, it is doing a disservice to the field of heritage resource management. Junior archaeologists are inculcated by their mentors as to their efficacy in field or lab tasks. In some cases, individuals who do not meet daily or weekly quotas for subsurface testing programs were subject to their position being terminated, thus creating a competitive atmosphere within the company to ensure that productivity stayed high in lieu of job loss (personal observation). These scenarios illustrate how HRM practitioners are trained to keep projects moving forward as fast and efficiently as possible and to avoid delays or project setbacks.

The consistent commentary of participants towards a 'disturbed' matrix to rationalize their field methods is concerning. The sentiments are consistent with experiences I have witnessed in commercial archaeology. The fact is: disturbance does not change the fact that there is archaeology present – disturbance only alters it. Unfortunately, it is common for archaeologists to not value disturbed areas as much as intact sites. Participants would comment that they were excavating at that speed, using that mesh size, or not collecting some skeletal material given that the unit was disturbed. Of course, while they may lose some provenience, stone tools are still artifacts and bones are still ancestors. Therefore, it is imperative that archaeologists reject the axiom of “intact archaeology is more important” and embrace the notion that *all* ancestors are valued and deserve the same treatment. In a post-colonial landscape, it will be key for archaeologists to adjust their own thinking and attitudes towards the archaeological record, mortuary or otherwise. These changes can simply be confronting and changing internal dialogues about disturbed archaeology sites, the valuation of artifacts and site components, and balancing what is, and has been, the status quo in and if it fits into the notions of reconciliation.

From speaking to participants and personal in-field experiences, it is clear that archaeologists need a dialogue for addressing the intricacies of field programs, such as fragmentary osteological material, without repercussion. As such, recommendations need to come from a top-down approach, via government or regulatory agencies, to ensure that proponents and archaeologists are obliged to follow. If archaeologists continue to practice using current standards, then we shall no doubt see a continued absence of juvenile skeletal remains. This would prove to be a devastating loss for the archaeological record and a disservice for the Indigenous communities around the world.

Chapter 6.

Conclusion

Commercial archaeology is situated in a capitalist marketplace; as such, archaeologists are cogs in the wheels to earn their respective employers' money. The values and company culture will vary between large corporate conglomerates and small businesses or sole proprietors, but the fact remains that inculcation of work ethic, methods, and reasonings are instilled into every archaeologist by their academic institutions, the HRM firms they work with, and their mentors along the path. The results of this study illustrate that those who have been practicing in the field longer are often instilled with the good and bad habits transmitted via their mentors, company policy and permitting, and types of excavation experience. In this study, these habits often manifested as more experienced archaeologists recovering less skeletal material than those with less experience.

The ultimate aim of this study is to provide clarity and needed urgency for legislators overseeing heritage studies and the archaeologists therein to adopt new principles in their investigations. I hope that this study provides a framework for archaeological training, retraining, and redesigning policy, law, and practice surrounding ways to mitigate and minimize the loss of juvenile human skeletal remains during archaeology studies. If, as one participant noted, "We only find what we are looking for" then let us start improving how we look. If the purpose of professional archaeology, or HRM, is to indeed manage heritage, then one must be able to identify the heritage properly to manage it. If professionals are not willing to adapt, be better, and perform better in field programs then the working body as a whole is failing. Otherwise, the archaeological record and the descendant communities of the dead will suffer the consequences.

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Appendix A.

Supplementary Data File

Description:

The accompanying Excel spreadsheet shows the detailed results of the experimental archaeology study. The file contains the results of all four groupings of participants. Blue headers designate the *experimental units* while orange headers designate the *control units*. Each group is separated via the ‘page’ function of the document.

File name:

ONeillDerek_ExperimentalArchaeologystudy_Spreadsheet.xls

Appendix B.

Recruitment Documents

Experimental Archaeology Study Poster

SFU SIMON FRASER UNIVERSITY
ENGAGING THE WORLD

Department of Archaeology

EXPERIMENTAL ARCHAEOLOGY STUDY

WE NEED YOU TO VOLUNTEER!

SFU is conducting an experimental archaeology study and is issuing a call for volunteers for the winter of 2020.

We are looking for individuals to participate in an experimental archaeology excavation in the summer and fall of 2019. We require archaeologists from varying backgrounds, both students with no practical experience and professional archaeologists who have been practicing for years in the Heritage Resource Management industry, to participate in this study. Do you want to gain some experience excavating? Are you a seasoned pro' and want to show off your skills? Well, we need you!

Taking place this winter at the Burnaby SFU campus, the study will involve the excavation of an excavation unit by each participant. Each excavation is expected to last between approximately 1 to 4 hours.

We are looking for individuals with and without experience in the HRM industry (or consulting experience) in addition to those with identified specialized skillsets (e.g., zooarchaeology, ceramics, human osteology, lithics, etc...). So, grab your friends in university or coworkers at your firm and come on down!

Where: Simon Fraser University, Burnaby campus

When: throughout winter 2020 for ~1 to 4 hours

A fantastic opportunity to contribute to local efforts to better the discipline of archaeology!

IF INTERESTED:

Please complete the attached application form and return to Derek O'Neill

Any further questions can also be directed to Derek.

Experimental Archaeology Study Participation Form

SFU SIMON FRASER UNIVERSITY
ENGAGING THE WORLD
Department of Archaeology

The Department of Archaeology in Simon Fraser University is currently looking for volunteers to participate in an experimental archaeological project. The project will take place on campus at Simon Fraser University (Burnaby campus) in the Summer/Fall of 2019. We are currently looking to fill vacant spots. In order to best place you in the experiment, could you please provide some additional information?

Name: ____

Email or Phone Number to best contact you: __________________________________

Do you have any professional archaeological experience (i.e., Heritage Resource Management)?

☐ Yes, I'm currently employed as a professional archaeologist.

☐ Yes, I've been employed in the past as a professional archaeologist.

☐ No, I have no experience with professional archaeology.

If 'Yes', how many months have you been practicing (or practiced) in total & continually?
(e.g., I have been practicing for 60 months, with 6 months being the most continuous experience).

____

____

____

Are you trained or have experience in any archaeology specialization? If so, please identify:

LITHICS ☐ undergraduate level ☐ graduate level ☐ other____________________
CERAMICS ☐ undergraduate level ☐ graduate level ☐ other__________________
ZOOARCHAEOLOGY ☐ undergraduate level ☐ graduate level ☐ other___________
HUMAN OSTEOLOGY ☐ undergraduate level ☐ graduate level ☐ other__________
WET SITES ☐ undergraduate level ☐ graduate level ☐ other___________________

Other (please list); also, if you have taken a **field school/s** please also list:

____

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Thank you for your response! You will receive a response shortly. If you have any questions or concerns, please do not hesitate to contact droneill@sfu.ca for more information.

Experimental Archaeology Study Consent Form

SFU FACULTY OF ENVIRONMENT | DEPARTMENT OF ARCHAEOLOGY

"Consent Form"

Experimental Archaeology Study

Who is conducting the study?

The study is being conducted by **Derek O'Neill** (Principal Investigator - M.A. Candidate, Department of Archaeology, Simon Fraser University) and **Dr. Hugo Cardoso** (Faculty Supervisor - Department of Archaeology, Simon Fraser University).

Invitation and Study Purpose

You are being invited to participate in the Experimental Archaeology study because we need archaeologists with a range of experience and specializations/backgrounds. The purpose of this research is to further our understanding of the recovery of cultural material from archaeology sites. This study will help us make positive recommendations on how to improve the identification and recovery of cultural remains in heritage resource management (HRM) settings.

Your Participation is Voluntary

Your participation is voluntary. You have the right to refuse to participate in this study. If you decide to participate, you may still choose to withdraw from the study at any time without any negative consequences to the education, employment, or other services to which you are entitled or are presently receiving.

Study Procedures

If you say 'Yes', this is how we will complete the study:

- You must fill out and submit the application form honestly and to the best of your ability
- We will contact you once the date/s for the excavations has been set (projected winter of 2017)
- Each participant is expected to partake in the excavation of one unit in the Burnaby SFU campus
    - The estimated time for excavation of one unit is approximately 4 hours
    - Only session of excavating one unit is required per individual

Is there any way being in this study could be bad for you?

As the study involves an archaeological excavation outdoors, there are several minimal risks identified. These include:

- Inclement weather
- Wildlife encounters
- Slip, trips, and falls
- Ergonomic strains

As such, we will be asking participants to bring clothing appropriate for the weather (e.g., rain gear and cold weather clothing) and appropriate footwear (e.g., hiking boots). We will have safety glasses, face masks, and gloves if the participant requires them during the excavation. The excavation location is located on Burnaby Mountain and accessible by foot (approximately 10 min walk from campus).

Will being in this study benefit you in any way?

You may be benefited in this study by gaining experience in archaeology recovery methods, such excavation units, if you do not have previous excavation experience.

Will you be paid for your time in this research study?

We will not pay you, but instead are asking you to volunteer some of your time to the study.

How will your identity/privacy be protected?

All information collected in the electronic forms is anonymous and will, nonetheless, be kept confidential. Photographs will be taken at the excavation site to keep a log of excavations at the site, as such, it is expected that practitioners will be captured in photos. As such, if you wish to not be named in the future photo logs (in the associated graduate thesis) then that can be accommodated. The digital data collected from this study (e.g., excel spreadsheets of excavation data and photos) will be stored temporarily on the Principle Investigators computer with SFU Vault will be used to store all digital data produced in this study.

Assurances

You are under no obligation to participate in the study and are free to withdraw at any time without prejudice to pre-existing entitlements.

For the purpose of this study, information will be collected regarding an individual's skills, technical background, and the recovery of cultural remains from the experimental archaeology excavation. Individuals will be classified into groups and reported as such in the results of the study. Names or affiliations will not be published during the study without the written permission of the individual. Upon completion of the study (e.g., the last excavation units completed), dissemination of the results and purpose of the study will be emailed to all participants.

Who can you contact if you have questions about the study?

You can contact either Derek O'Neill or Dr. Hugo Cardoso.

If you have any concerns about your rights as a research participant and/or your experiences while participating in this study, you may contact Dr. Jeffrey Toward, Director, Office of Research Ethics

The data collected from this study will be used in a graduate thesis and for use in academic publications and presentations. The main study findings will be presented at academic conferences.

Taking part in this study is entirely up to you. You have the right to refuse to participate in this study. If you decide to take part, you may choose to pull out of the study at any time without giving a reason.

- Your signature below indicates that you have received a copy of this consent form for your own records.
- Your signature indicates that you consent to participate in this study.
- You do not waive any of your legal rights by participating in this study.

☐ By checking this box, you authorize photos containing your person to be included in the notes for this (e.g., excavation and general site photos)

☐ By checking this box, you authorize photos containing your person to be included in products that may be disseminated in the future (e.g., in the thesis manuscript, associated publications, and conference presentations)

____

Participant Signature Date (yyyy/mm/dd)