

**AN ARCHAEOLOGY OF FOOD AND SETTLEMENT
ON THE NORTHWEST COAST**

by

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Abstract

This dissertation examines multiple scales of Indigenous history on the Northwest Coast from the disciplinary perspective of archaeology. I focus on cultural lifeways archaeologically represented in two key domains of human existence: food and settlement. The dissertation consists of six individual case studies that demonstrate the utility of applying multiple spatial and temporal scales to refine archaeological understanding of cultural and historical variability on the Northwest Coast over the Mid-to-Late Holocene (ca. 5,000-200 BP). The first of three regionally scaled analyses presents a coast-wide examination of fisheries data indicating that Pacific herring (*Clupea pallasii*) exhibit a pervasive and previously under-recognized importance in Northwest Coast Indigenous subsistence practices. Next, I use zooarchaeological data from the southern British Columbia coast to identify a pattern of regional coherence in Coast Salish and Nuuchahnulth hunting traditions reflecting the scale of intergenerational cultural practice. The third study recalibrates the settlement history of a small and historically significant locality in Coast Tsimshian territory (Prince Rupert Harbour) to clarify the temporal resolution of existing radiocarbon datasets and test inferences about social and political change. Following this regional exploration of scale, I document site-specific temporal variability in archaeological fisheries data from a Nuuchahnulth ‘big-house’ reflecting climatic and socio-economic change. I examine Indigenous oral histories and archaeological datasets to evaluate these parallel records of settlement in the neighbouring territory of an autonomous Nuuchahnulth polity before and during the occupation of a large defensive fortress. Finally, I demonstrate how everyday foodways are archaeologically expressed and reflect ecological differences and active management strategies within several spatially associated sites over millennial

timescales. These linked case studies offer new clarity into long-standing debates concerning archaeologically relevant scales of cultural-historical variability on the NWC. They collectively demonstrate an enduring regional and temporal coherence for key aspects of indigenous resource use and settlement and a historical dynamism at finer scales. I argue this has cultural, historical, and archaeological significance as well as relevance for contemporary understandings of the Northwest Coast environment. I conclude that a focus on the pervasive aspects of *the everyday over millennia* offers insight into individual actions across broader patterns of history.

Preface

Chapter 2 is a multi-authored manuscript that was submitted for publication on September 16, 2013 and accepted for publication on December 12, 2013. I am the principal author and analyst on this manuscript, which has been co-written primarily with Dana Lepofsky. Other authors include Madonna L. Moss, Virginia L. Butler, Trevor J. Orchard, Gary Coupland, Fredrick Foster, Megan Caldwell, and Ken Lertzman. Aubrey Cannon has generously provided unpublished data and commented on multiple versions of this manuscript. Andrew Martindale provided column and auger sample fauna for osteological identification by the author.

Chapter 3 has been previously published as: McKechnie, Iain and Rebecca J. Wigen (2011) *In Human Impacts on Seals, Sea Lions, and Sea Otters: Integrating Archaeology and Ecology in the Northeast Pacific*, edited by Todd J. Braje and Torben C. Rick, pp. 129–166. University of California Press, Berkeley. © 2011 by the Regents of the University of California. I designed the study, compiled data, completed quantitative and cartographic analyses, wrote much of the chapter and worked with co-author Rebecca Wigen on developing concepts, revisions and edits.

Chapter 4 is a manuscript co-authored with Morley Eldridge. I conducted background research and designed and conducted calibration analyses, and co-wrote the paper and conducted the bulk of the revisions on multiple drafts over a period of four years. An initial version of this chapter was originally presented in 2008 at the Society for American Archaeology meetings in Vancouver and subsequent drafts have been heavily revised in correspondence with Andrew Martindale and Susan Marsden.

Chapter 5 has been previously published as: McKechnie, Iain (2012) Zooarchaeological Analysis of the Indigenous Fishery at the Huu7ii Big House and Back Terrace, Huu-ay-aht Territory, Southwestern Vancouver Island. *In Huu7ii: Household Archaeology at a Nuu-chah-nulth Village Site in Barkley Sound*, by Alan D. McMillan and Denis E. St. Claire, pp. 154–186. © 2012 Archaeology Press, Simon Fraser University, Burnaby, BC. This manuscript was conducted in the service of the Huu7ii Archaeological Project with the support of the Huu-ay-aht First Nation and the 2006 University of Victoria archaeological field school. I took part in the primary fieldwork, field based sampling, coordinated sorting of samples and conducted osteological identification and am the sole author of this manuscript, which was written in 2011 and completed in the Spring of 2012.

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List of Abbreviations

NWC – Northwest Coast

NISP – Number of Identified Specimens

MNI – Minimum Number of Individuals

DFO – Department of Fisheries and Oceans Canada

TEK – Traditional Ecological Knowledge

LEK – Local Ecological Knowledge

Glossary of Technical Terms

Number of Identified Specimens – Used to describe the total number of skeletal specimens which have been confidently identified to at least family, genus or species level (i.e., not including ‘unidentified’ specimens). This is not the same as miscellaneous unidentified bone specimens which are sometimes referred to as simply Number of Specimens (NSP).

Specimen – skeletal fragment. The term ‘specimen’ is used rather than ‘bone’ because skeletal elements are often broken into multiple pieces and can therefore be counted more than once in a zooarchaeological assemblage.

Taxa - a term used to describe different animals (or plants) that are not necessarily all of the same taxonomic category. For instance ‘Northern anchovy’ is a species while ‘rockfish’ (Sebastes spp.) is a genus designation (following Linnaean taxonomy).

Relative abundance (relative frequency, %NISP or % weight) – simply the percentage of a particular item (e.g., herring, clam weight) relative to all other specimens within the same category (e.g., identified fish remains, identified shell fragments).

Rank order abundance (%NISP) – the relative rank order of a particular item (e.g., herring) in comparison to all other specimens within the same category (e.g., identified fish remains, identified shell fragments).

Ubiquity – Frequency of occurrence or the percentage of contexts in which a certain item is present versus absent. For example, herring would be ‘ubiquitous’ if it was present in every level of every excavation unit at the site.

Column sample – Small (typically 10x10 cm) vertical ‘column’ of archaeological sediment excavated from the sidewalls of an excavation area.

Archaeological ‘site’ – An archaeological term describing a place with material and human altered sediments indicative of past human use and settlement. In this dissertation, I use the terms site, shell midden, and settlement interchangeably.

Shell midden – A widely used archaeological term to describe places in coastal, near-coastal, and aquatic areas containing anthropogenic (human created) sediments. On the Northwest Coast, shell middens are typically composed of varying quantities of shell, bone, fire altered rocks (e.g., boiling stones), artifacts, charcoal, greasy silt, decomposed plant and other organic remains, architectural features, and a host of other cultural materials, including isolated and multiple human interments. Shell midden sediments can range widely in volume from small instantaneously deposited lenses to massive deposits enveloping entire landforms and spanning broad periods of time (ca. 100-10,000 years).

Midden – a term that “has its roots in the Scandinavian languages, meaning material that accumulates about a dwelling place” (Stein 1996:638).

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Dedication

This dissertation is dedicated to Flora Frances McKechnie and Nicole Fenwick Smith.

Chapter 1. Archaeological Scales of Analysis on the Northwest Coast

“Archaeological synthesizing on the Northwest Coast and elsewhere is always a process in which we move back and forth between scales of analysis. The ecological foundation for patterns found through analysis of a single site or sites occupied by a local group is often lost when ‘scaling up.’”

Madonna Moss (2012:16).

Introduction

This dissertation examines multiple scales of Indigenous Northwest Coast history from the disciplinary perspective of archaeology. I investigate social life materially represented in subsistence and settlement data to examine temporal and geographic scales of historical variability over the mid-to-late-Holocene (ca. 5,000-200 BP).

Scholars have long argued that the Northwest Coast is not a homogenous place but exhibits cultural and historical variation that is, in part, influenced by environmental and ecological differences (Boas 1887; Suttles 1987). These factors have long been central to archaeological investigations of human history on the coast but the temporal and spatial scale of this variation remains unknown, yet must have major consequences for archaeological interpretation (Ames 1991; Cannon 2001; Moss 2012). Confronting this interpretive challenge requires moving beyond the archaeological tendency to generalize from a single case or a small set of cases to examine many examples at a variety of scales and evaluate how robustly aspects of human and environmental history are archaeologically supported and conversely, which aspects of archaeological interpretation are in need of revision. As stated by Madonna Moss in this chapter’s epigram, a central interpretive challenge is the issue of scale. As a conceptual heuristic, scale is both a virtue and a constraint in the archaeological

interpretation of Indigenous histories on the Northwest Coast. Scale is virtuous because archaeological data are effective at illuminating the enduring presence of Indigenous People occupying vast landscapes over hundreds of generations throughout the coast. However, a spatially and temporally coarse scale also severely constrains the analytical and interpretive resolution of the conventional archaeological record (Bailey 2007) and correspondingly, can contribute to a lack of richness and dynamism in Indigenous history when this is often a result of inadequate archaeological methods and a lack of preservation. Applying a large-scale archaeological perspective also has the particularly negative consequence of homogenizing a host of potentially significant aspects of cultural, historical, and environmental variation. This analytically erases the possibility of identifying archaeological patterning and social practices as expressed at smaller scales.

This dissertation confronts the issue of scale across six chapters within the unifying theme of – *the everyday over millennia*. This theme focuses on two fundamental domains of human existence that have a pervasive archaeological expression: **food and settlement**. My methodology focuses on *the everyday over millennia* through six case studies that variously draw on zooarchaeological, settlement, and radiocarbon data from multiple localities and time periods on the Northwest Coast. These linked case studies query the strength of archaeological patterning at multiple spatial and temporal scales and demonstrate the interpretive utility of contextualizing archaeological history alongside the intergenerational history represented in Indigenous oral historical narratives and place names.

Theoretical Framework

The theoretical framework I employ to examine *the everyday over millennia* is inspired by the historical approach of Braudel (1970; 1980, 1981), particularly the *Annaliste*

concept of the *longue durée*, which is the broad centennial and millennial scale of history beyond ‘*the history of events.*’ This broad scale and inclusive conception of historical analysis is applicable to the narration of archaeological history in part because:

- 1) Archaeological data are exceptional for their encompassing representation of time as well as a range of temporal scales. This ‘depth’ ensures that a broad assemblage of items and human circumstances are encountered in archaeological sequences.
- 2) Archaeological data often represent the material legacy of a multitude of people and this collective representation (at a community scale over long periods of time) constitutes a rich representation of human history.
- 3) Archaeologists intuitively recognize that many aspects of the archaeological record produce strong patterning at millennial scales but often lack a nontrivial explanation to account for such patterning.
- 4) Adopting a broad spatial and temporal scale facilitates the exploration and recognition of smaller-scale variability and encourages the comparison of phenomena across multiple scales to account for conjunctures and/or disjunctures in historical phenomena.

Archaeologists in western North America periodically invoke Braudel and the *Annaliste* concept of the *longue durée* (Ames 1991; Cannon 1996; Hull 2005) but also recognize that emphasizing patterning at a millennial-scale can be simultaneously amorphous, homogenizing, and under-specific (Silliman 2012). Archaeologists have also commonly evoked a similarly amorphous term of ‘long-term history’ (Lightfoot 1993; Mitchell and Scheiber 2010), which can also underspecify why or how certain aspects of the archaeological record persist over millennial-scale time frames. Such concepts remain useful descriptive heuristics under which archaeological data exhibit patterning but often lack detailed exploration and explanation. On the Northwest Coast, those who focus on millennial-scale history do not feel compelled to adopt Braudel’s historical scales, but rather emphasize the Indigenous robusticity and stability of cultural institutions (Cannon 2002,

2011a; Martindale and Letham 2011). This approach considers the agency of Indigenous peoples and their ritual cosmology as an explanatory factor in the persistence of certain archaeological patterns rather than the more common characterization of Northwest Coast societies as shaped and “subject to biological and environmental constraint[s]” (Cannon 2011a:57).

This dissertation engages with millennial-scale and centennial-scale patterning and variability in Northwest Coast archaeology. I draw on Braudel’s (1970; 1981) concepts of the *longue durée* and *conjunctures* (medium-term change over human lifetimes) but do so in combination with Bourdieu’s concept of *practice* (1977). I combine these concepts to investigate how the *habitus* (i.e. culturally situated orientations or *dispositions*) of the ‘everyday’ is expressed as a persistent practice unfolding over human generations and over millennia of human history. As stated by Ortner (2005:33), *habitus* emerges from *practice* and represents “a system of dispositions that incline actors to act, think, and feel in ways consistent with the limits of the structure.” This structure, rooted in history, is inherently cultural and:

“Culture is a product of acting social beings trying to make sense of the world in which they find themselves, and if *we* are to make sense of a culture, we must situate ourselves in the position from which it was constructed”

(Ortner 1984:130, emphasis in the original).

Similarly, in this dissertation I attempt to identify the practice-based outcome of everyday life as represented in the fine-scale archaeological record of food and settlement. Like Ortner’s subjectivity-oriented view of culture, I seek to adopt the perspective “from which it was constructed” by applying it to interpreting the structured depositional practices of the

archaeological record of food and settlement (cf. Garrow 2012; Thomas 2012). I argue that regular and individually practiced elements of everyday life over millennia can be recognized in archaeological deposits when examined at a fine depositional scale and collectively across millennia and broad geographic regions.

Aspects of the *longue durée* are archaeologically and anthropologically significant as they are reflective of actions expressed on the highly regular timescale of the ‘everyday’ which nevertheless durably persist over the ‘long-term.’ Everyday life is an important but understudied domain of history which “consists of the little things one hardly notices in time and space” such as “the ways people eat, dress, or lodge” (Braudel 1981:29). Such durable practices are often under-recognized or remain un-questioned (Giddens 1984:41) but importantly transcend the “event-centered” focus of conventional historical discourse (Fogelson 1989). This under-recognition extends to archaeological interpretation wherein everyday quotidian practices are often considered historically inconsequential relative to ritual and symbolic practices. In the words of Garrow (2012:85, emphasis added), such “*material signatures of ‘everyday’ practice have been under-theorized and all too often ignored*” and yet it is “*vital to consider the ‘everyday’ as well as the ‘ritual’ processes which lie behind the patterns we uncover in the ground.*” Thus, certain pervasive forms of archaeological data are under-considered given their interpretive relevance to understanding the ‘everyday’ and such a lack of focus inhibits exploration of patterning in such data at a finer scale as well as the integration of such data across larger scales of history.

Bourdieu’s (1977) concept of *practice*, as an iterative unfolding of culturally constructed subjectivities and dispositions (Ortner 2005), provides a direct causal linkage between the everyday and the *longue durée*. That is, regularized everyday practices exhibit

remarkable persistence across the vast timescales of the *longue durée*, even amidst change in their form and expression, because macro-scale patterns are the collective product of everyday actions and not *vice versa*. This is particularly applicable to those intergenerational secular rituals of food and settlement that curate and recreate ‘traditional’ practices, the material signatures of which are richly represented in archaeology. Thus, an archaeological analysis of the *longue durée* has the potential to highlight the power of individuals as causal agents in the construction of history. At the same time, given the volatility of individual agency, evidence of millennia-long stability in everyday practices speaks to the power of cultural traditions and the conventions that foster such continuity.

Food and Place as Multi-scalar

This dissertation examines two forms of archaeological data that are fundamentally regular aspects of everyday life, that stretch across human generations and are pervasive aspects of the archaeological record on the Northwest Coast: 1) *food* and 2) the *places people live*. The animals people eat and the places their remains are deposited offer particular insight into the quotidian daily practices of ancient communities as we can be confident that animal and/or animal products are eaten on a daily basis and that consumption most often occurs in settlements where people spend a great deal of time (homes). Evidence of food consumption and deposition at specific places has enduring interpretive value in archaeology precisely because such data are the result of everyday practice (Atalay and Hastorf 2006; Gifford-Gonzalez 2008). Moreover, because consumption likely occurs on such a fine temporal scale, archaeological evidence of food can be examined at a large variety of scales: from a handful of sediment deposited in a day or a week to an entire midden deposited over centuries or millennia. While there is an unknown degree of temporal averaging and taphonomic bias

built into such a multi-scalar comparison (Bailey 2007; Kowalewski, et al. 1998; Lyman 2003a), observations of the repetitive occurrence and stable proportionality for certain foods in archaeological deposits (aka. *structured deposition*) represents a strong archaeological pattern and creates a basis for inferring the consistent importance of certain foods and thus a continuity in practice over generations.

Food Deposition as Social Practice

This dissertation focuses on the identification of such collective depositional patterns and argues that a focus on food at particular places provides insight into how “one is disposed to do and to be in certain ways because of one’s experiences in social settings” (Pauketat 2001:4). I argue that such a simple insight – the repetitive continuity of a cultural practice – is often lost amid the more common tendency to emphasize dynamic historical change, the symbolic dimensions of practices, and especially to avoid the equally hazardous narrative trope of an unchanging Indigenous history.

A contrary perspective on food is that it can be an abstraction that may have little or no consequence or relationship to major historical and social transformations. In other words, a tsunami of social change may have just occurred but breakfast may remain the same for the next hundred years. However, it is also the case that breakfast wouldn’t be possible without that skilled but often mundane activity of collecting and preparing food on which those ‘higher-level’ historical dynamics unfold. While this is not to suggest, for instance, that a history of medieval Europe can be deduced from an analysis of farming practices alone, but rather, that such a history cannot be holistically achieved without attentiveness to everyday activities on a broad spatial and temporal scale (Braudel 1981). It is additionally noteworthy

that large-scale social transformations often begin from everyday circumstances that become magnified through “the amplification of minor differences” consequentially turning “small issues into big events,” and thus “how microhistories become macrohistories and vice versa” (Sahlins 2013:161). Such disruptions can alter the ways people and communities relate to one another and this correspondingly has the potential to be reflected in the proportion and intensity of food being collected, processed, consumed and deposited into the archaeological record.

Food pervades most social relations due to its regularity of consumption and its often fundamental centrality in social and ceremonial gatherings (Dietler and Hayden 2001). Food has human and historical agency as it both represents a culturally unique transformation of various animals and plants into a category of ‘food’ and in so doing, both reflects and facilitates the perpetuation of a “specifically cultural and historical consciousness” (Ortner 2005:34). As in Bourdieu’s *habitus*, such a consciousness does not structurally determine a given future, but it likely informs, influences, and guides practices into the future. Put more simply, such a regular aspect of everyday life also defines what is considered ‘acceptable’ in a given setting, or conversely, what is *not* considered acceptable¹. Such a formulation is equally applicable to how a person ‘goes about living’ in a place and what and how one prepares and consumes food and disposes of waste.

Animals consumed as human food are often themselves considered to have levels of agency in that they require skill and attentiveness to catch or harvest, prepare and/or care for

¹ For instance, in Nuu-chah-nulth territory on western Vancouver Island, an ethnographic account states that a “common punishment for eating alone was to have one’s mouth ‘stretched’ by two husky individuals, one of whom hooked a finger in either corner of the mouth and gave a yank. Food boxes and dishes of the offender would be smashed up, contents and all” (Drucker 1951:388)

(e.g., Ingold 1980; Russell 2012). On the Northwest Coast, animals are often associated with a human-like animism which emerges from specific social and cosmological histories with people (e.g., Drucker 1951:151; Hill 2012; Losey 2010). Animal products and products made from animals also obtain a spiritual significance and serve a host of other practical and secondary uses (e.g., Hodgetts and Rahemtulla 2001). The disproportionate abundance of certain foods combined with exceptional preservation conditions further structures archaeological perspectives on food and food waste. The presence of these foods represents actions of processing and provisioning and involves connections between people and landscapes and of people to each other. It is through such quotidian, under-recognized routines, that communities are commonly defined and persist through time.

Place and the *Practice* of Settlement

An even more elemental aspect to the human history of everyday life concerns *place*. As stated by Casey (1993:21) “there is no (grasping of) time without place” and thus, place is a primary category and a fundamentally ‘prior’ condition. Places emerge over the long-term through routinized practices in a “landscape of habit” that is both consciously and non-discursively built upon the “well-trodden (or well-paddled) paths” laid out by one’s predecessors (Mackie 2001:25). Places are central to the expansive history of the *longue durée* as articulated by Braudel and the *Annaliste* school of historians. *Places* are not simply a backdrop to the arc of human history but act as “a major continuous constraint on human activity” (Thornton 2008:20).

Archaeological sites, such as shell midden settlements on the Northwest Coast, are particularly significant as human places, as they are constructed localities where groups of

people have “invest[ed] themselves into their landscape” (Momaday 1974:80) and literally have mixed “their labour with the earth” (Williams 2005:76). Such physically altered places acquire a broader social and historical significance that can come to signify “points in the geography of a community where time and space intersect and fuse” (Bakhtin 1981:84).

Similarly, the surrounding landscape in which archaeological sites develop and in which human histories unfold, both shape people’s history and are correspondingly shaped by people over time (Ingold 1993). In this fashion, human places and landscapes can be said to be ongoing co-productions, reflecting the regular actions of people and natural processes alongside more periodic but larger-scale transformations. Under these conditions, an attempt “to separate natural history from social history becomes extremely problematic” as “the idea of nature contains, though often unnoticed, an extraordinary amount of human history” (Williams 2005:67-76).

For the purposes of this dissertation, shell midden deposits are considered human *places* or *settlements*. I consider shell middens to be physically created *places* where people spent a great deal of time, and whose everyday practices have cumulatively produced a physical assemblage of material spanning generations of persistent human activity (Blukis Onat 1985; Cannon 2003). I recognize that shell middens are only one of a large variety of other ‘types’ of sites on the Northwest Coast and comprise a relatively narrow aspect in what was undoubtedly a much more widely used coastal and inland landscape (e.g., Oliver 2007). Moreover, materials preserved in these deposits do not encompass the full spectrum of human activities that took place there (e.g., Croes 2003) and neither do the materials represented reflect purely incidental utilitarian deposition or an exclusively ritualized deposition (cf. Klokler 2008; Luby and Gruber 1999; Luby, et al. 2006; McNiven 2013;

Villagran, et al. 2011). However, shell middens deposits do contain an immense amount of material evidence of past human activity (Moss 2011a) and persist as settled places because these built environments act to structure future deposition (Mackie 2001:62). Moreover, because shell middens are observed to be localities where people spend a great deal of time, it can be reliably assumed that many of the materials deposited in shell midden sites are related to the everyday human activity that occurred there. As physical deposits, shell middens are places where “time takes on flesh and becomes visible for human contemplation” and thus may serve as “monuments to the community itself” (Bakhtin 1981:84).

Dissertation Structure

This dissertation is divided into two parts consisting of six individual chapter contributions as well as an introduction and conclusion. The first half of the dissertation examines Indigenous subsistence and settlement histories as archaeologically expressed on large, medium, and small geographic scales on the Northwest Coast (Chapters 2, 3, and 4). The second half of the dissertation consists of three chapters that focus on archaeological data specific to Barkley Sound on the southwest coast of Vancouver Island (Chapters 5, 6, and 7). These multiple temporal and spatial scales and mixture of regional and local case studies (Figure 1.1 and Figure 1.2) focus on foodways and settlement practices and indicate that Indigenous history on the Northwest Coast exhibits remarkable continuity at the scale of the everyday.

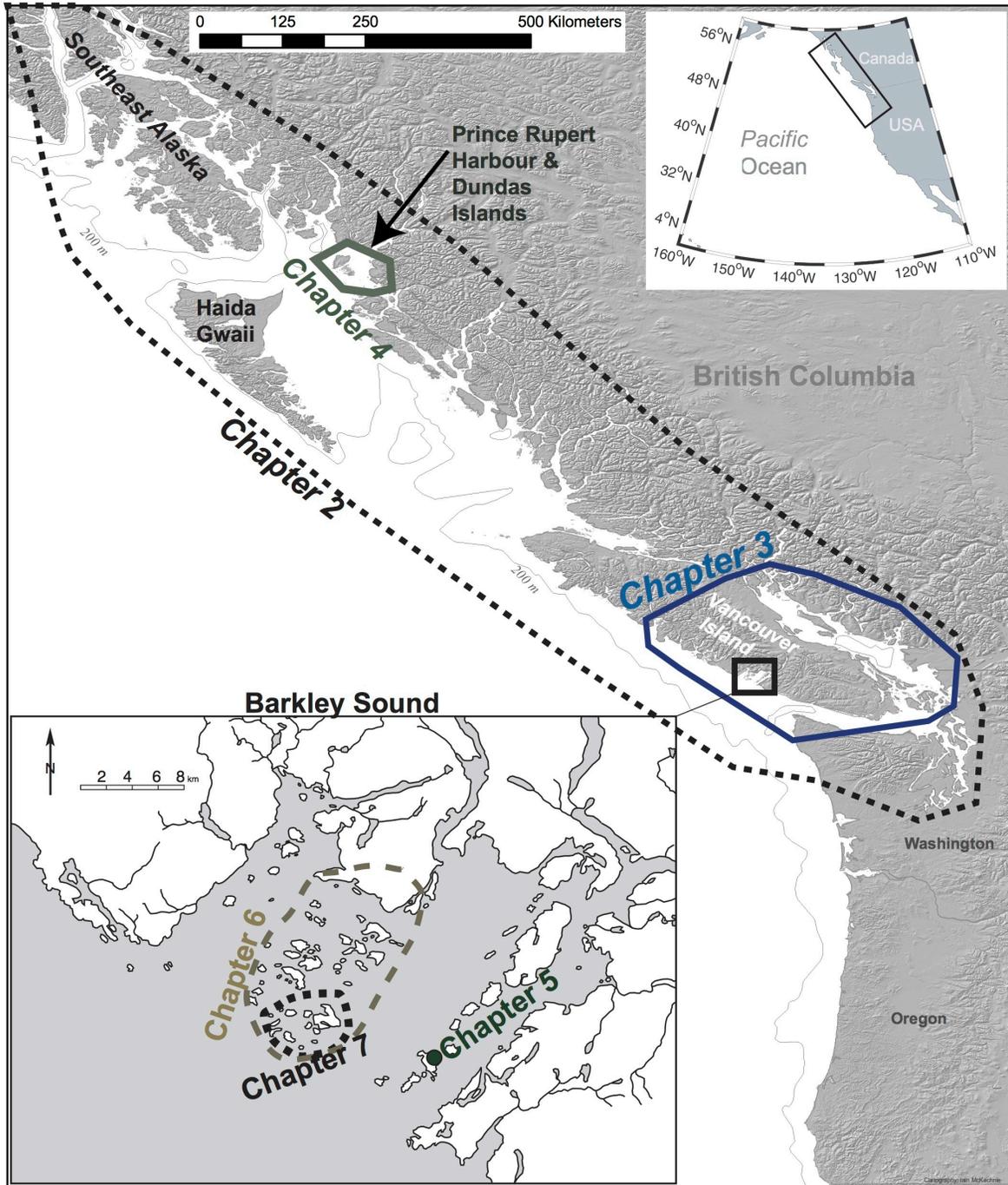


Figure 1.1 Map of the Northwest Coast showing geographic scales of analysis that are the focus for chapters in this dissertation.

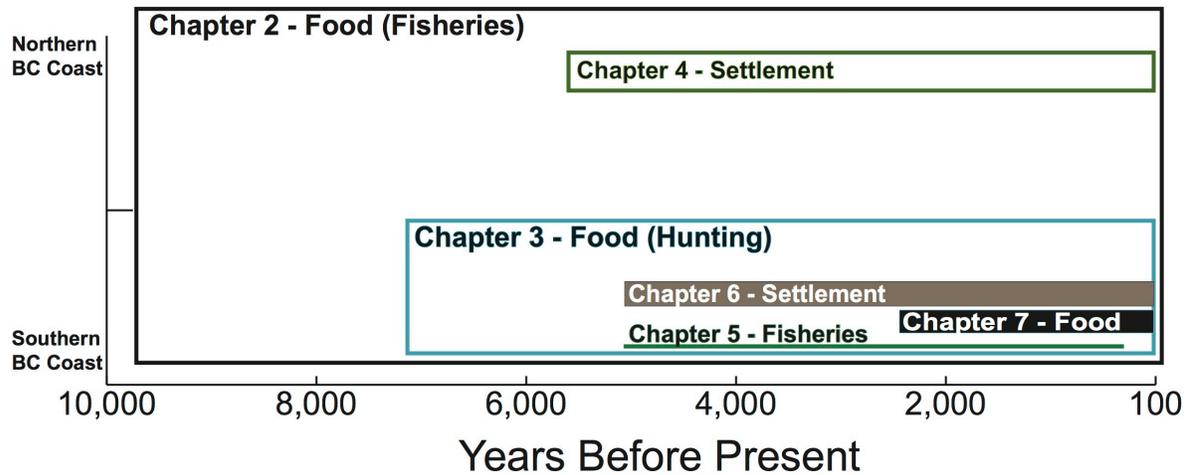


Figure 1.2 Temporal scales of analysis that are the focus for chapters in this dissertation. Vertical scale approximates north-south gradient.

Regional Scales of Human and Ecological Histories

Chapter 2 adopts a historical ecological approach (e.g., Jackson, et al. 2001) to investigate the archaeology of Indigenous herring fisheries and ecological baselines within much of the Northwest Coast as a singular region over the Holocene. I, along with several co-authors, demonstrate that Pacific herring (*Clupea pallasii*), have an under-recognized importance in the history of Indigenous fisheries on the Northwest Coast. We compile and integrate a wealth of formerly scattered black and grey-literature data on fine screen fish remains (171 sites) and identify a pervasive coast-wide pattern with a high archaeological importance of herring relative to all other fish species. We observe herring to have a more significant role in Indigenous subsistence economies than has been previously appreciated and further demonstrate that herring exhibit strong spatial variability in abundance across this large region. We explore variability at the finest archaeologically reported scale within 50 individual sites across the coast and argue this indicates herring use and herring habitat was

broadly consistent over time and within regions and micro-regions. We further hypothesize that pre-industrial herring population variability differs from modern variability that characterizes industrial fisheries and advocate that research at an archaeologically finer temporal scale is needed to qualify the strength of these observations.

Chapter 3 narrows in geographic scope and shifts from Indigenous fisheries to Indigenous hunting traditions on the southern British Columbia coast, from the Strait of Georgia in the Salish Sea around to western Vancouver Island (Figure 1.1). Along with co-author Rebecca Wigen, I examine the spatial and temporal coherence of mammalian hunting practices as represented in a compilation of existing zooarchaeological data within the linguistically distinct Nuu-chah-nulth and Coast Salish culture areas. These regions have long been recognized as distinct by Indigenous Peoples and anthropological researchers (e.g., Boas 1887), but this study compiles a wealth of existing zooarchaeological data to further demonstrate how this distinctiveness is archaeologically represented in hunting practice. Thus, within each of these two regions, we observe an unexpected degree of geographical and temporal coherence in the proportionality of zooarchaeological data. These results yield further insight into the ecological contribution that human hunting had on the marine and terrestrial environments over the Holocene and offer an improved basis for interpreting how these ‘traditions’ and/or ‘cultural adaptations’ contributed to and/or complemented other domains of human subsistence and ritual practice (e.g., burning, plant harvesting, spiritual training and preparation). Although these hunting practices have an obvious environmental distribution (outer coast versus an inland sea), this by no means explains the cultural persistence of these practices which are direct products of repetitive, culturally embedded,

intentional social action (e.g., Ingold 2000) operating over an intergenerational time scales and at the scale of the everyday or at least every year.

Chapter 4 refines the temporal and spatial scale of analysis to examine settlement history in the heavily investigated area of Prince Rupert Harbour. I explore the issue of radiocarbon calibration and the chronological resolution of archaeological phenomena in marine settings with co-author Morley Eldridge. We employ available marine reservoir data from the Dundas Islands and Prince Rupert Harbour to re-evaluate the archaeological settlement dynamics of two long-standing radiocarbon chronologies that have played a significant interpretive role in Northwest Coast archaeology, particularly concerning the antiquity of Indigenous oral history and regional conflict (Cybulski 1999; Martindale and Marsden 2003). This re-analysis narrows and affirms the previous identification of this medium-scale temporal patterning in Coast Tsimshian settlement dynamics and burial practices. Our re-analysis advocates for continued improvements in the use of calibration techniques for marine and marine influenced dates in order to clarify and strengthen previously published chronologies by re-engaging with the cumulative legacy of existing data. We conclude by emphasizing the value of acknowledging ambiguities and contingencies in archaeological claims to knowledge (Gero 2007; Martindale n.d.), which can limit archaeologists' ability to resolve the temporal scale in key periods in human history.

Case Studies of Indigenous History in Barkley Sound

The second half of the dissertation examines the archaeological history of subsistence and settlement in two different First Nation territories in Barkley Sound on Southwest

Vancouver Island and demonstrate how these reflect both an enduring cultural continuity at a broad scale and provide vital insight into intermediate timescales including periods of dramatic historical change in settlement and more subtle change in foodways.

Chapter 5 examines fine-scale coherence and variability in archaeological fisheries data from a single Nuu-chah-nulth ‘big’ house. I explore the depositional patterning in these everyday foods at multiple depositional and spatial scales within this very large house (35 x 17 m, or 115 x 50 ft) in the centre of a village in the named origin place of the Huu-ay-aht First Nation (McMillan and St. Claire 2012). Two additional column sample time series dating to the mid-Holocene (ca. 5000 to 3000 years BP) and associated with a period of higher sea levels, further contextualize these later household associated data. This chapter also evaluates the interpretive utility of converting the number of fish bones (NISP) into numbers of fish (MNI) and extrapolates these in terms of fish per cubic metre. I also examine temporal trends in the use of key species (hake, salmon, rockfish) that indicate coherent shifts in the marine climate during a period of when there is a regional increase in dated defensive sites on western Vancouver Island (ca. 800-500 years BP). This study demonstrates the relevance of exploring subsistence and climatic variability in a single large house over a 1000 year period.

Zooming out to a multi-site scale but remaining in Barkley Sound, Chapter 6 examines the settlement history in an archipelago identified in numerous Indigenous oral historical accounts as the territory of an autonomous Nuu-chah-nulth polity (the *Maktl7ii7ath* local group) in a portion of the Broken Group Islands (Sapir and Swadesh 1955; St. Claire 1991). This group of islands has a series of archaeologically anchored Indigenous place names and an oral historical record describing it as the defended year-round territory of the

Makl7ii7ath prior to the contact era (St. Claire 1991). I examine the archaeological evidence of settlement in this portion of the archipelago and evaluate how this corresponds to oral historically documented social history. I employ multiple measures (e.g., midden surface areas, radiocarbon dates) to archaeologically characterize this human settlement history. Collectively, these observations demonstrate these islands were enduringly occupied over multiple generations, consistent with the Nuu-chah-nulth concept of ‘home’ or ‘chiefly territory’ (*hahuulhi*). This dynamic settlement chronology, reveals considerable shifts exemplified in the archaeologically ‘sudden’ occupation of the elevated fortress of Huts’atswilh. This micro-regional settlement history is an archaeological example of the intermediate scale of intergenerational history akin to Braudel’s *conjunctures* and that transcends ‘event-centred’ history (cf. Braudel 1970; Fogelson 1989).

Chapter 7 builds from the previous chapter but focuses on the fundamentally regular activity of collecting and consuming food as a frame for contextualizing *the everyday over millennia*. Centering on zooarchaeological data from numerous auger samples collected from two settlements on Dicebox Island as well as associated villages on adjacent islands, this chapter details how archaeological evidence of ubiquitous foods are represented at multiple temporal and spatial scales over the last 2,500 years. This includes data from the territory as a whole between sites, and within individual levels at a single site. I demonstrate that certain foods constitute a consistent majority of the repetitively deposited items. I then evaluate if the relative proportion and/or density (bones per litre) of these foods persist over time, and explore the ecological factors by which they may differ spatially and/or temporally. I relate these to community processes identified in the settlement organization explored in the previous chapter.

Conclusion

These linked multi-scalar studies examine the most regularly practiced aspects of daily life at a variety of scales on the Northwest Coast. I identify the outcome of traditional foodways as represented in the archaeological record both over long temporal scales but also at small depositional scales (e.g., handfuls of dirt). The results provide evidence of both historical continuity and considerable stability of practice. I interpret this as evidence of both a thoughtful cultural adaptation to the circumstance of people's lives in these environments and as evidence of an extraordinary effort at maintaining historical continuity via a construct of tradition. Thus, the stability of the *longue durée* is achieved not as a fixed cultural entity but is iteratively reproduced within a cultured continuity of everyday practice. This approach seeks to confront the analytical tendency to consider certain aspects of the archaeological record to be static, essentialized and normative. Rather, I seek to demonstrate how archaeological attentiveness to identifying regular and structured depositional practices in a community setting and its variation holds potential for enriching archaeological understandings of the everyday practices of Indigenous peoples. Finally, I examine how both the Indigenous oral historical record and archaeological chronology of settlement enrich archaeological interpretations of continuity and change in settlement practices on the Northwest Coast.

Chapter 2. Archaeological Data Provide Alternative Hypotheses on Pacific Herring (*Clupea pallasii*) Distribution, Abundance, and Variability on the Northwest Coast²

Introduction

Low trophic-level fish (“forage fish”) are experiencing global declines with increasing recognition of widespread and cumulative ecological, cultural and economic impacts (Pikitch, et al. 2012; Pinsky, et al. 2011; Smith, ADM, et al. 2011). Both Indigenous and non-Indigenous peoples on the Northwest Coast of North America recognize Pacific herring (*Clupea pallasii*) as a foundation species in coastal food webs (Menge, et al. 2013) that serve an essential role in maintaining social–ecological systems (e.g., Garibaldi and Turner 2004; Platten and Henfrey 2009). Herring and its roe are critical prey for a host of fish (e.g., hake, Pacific cod, dogfish, salmon), bird and marine mammal predators (Robinson and Ware 1999; Therriault, et al. 2009; Ware and Schweigert 2002). Herring is also central to the social, cultural, and economic relations of coastal indigenous communities, many of which seek to continue their traditional fisheries for herring and herring roe on kelp or other substrates (Harris 2000; Thornton, et al. 2010a; Thornton, et al. 2010b). Since 1882 and continuing into recent decades, industrial fishing of herring has helped support many communities across the Northwest Coast (Funk 2010; Tester 1935).

Populations of this once highly abundant forage fish have been dramatically reduced across much of its North Pacific range relative to levels seen in the mid 20th century (Funk

² This multi-authored chapter was submitted for consideration for publication on September 16, 2013 and accepted for publication on December 12, 2013 (see preface for more information). Due to length, the tables associated this chapter are presented in the appendix to this dissertation.

2010; Schweigert and Linekin 1990; Schweigert, et al. 2010). Fisheries scientists have proposed various factors accounting for these declines and sustained low abundances even after reductions of fishing pressure. These include climate-induced ecological changes in distribution of predators and prey (Ware and Schweigert 2002), disease (Marty, et al. 2010), over-fishing (Pauly, et al. 2001), and the rebound of marine mammal populations that prey on herring (Schweigert, et al. 2010). Assessing these potential drivers and moving forward with conservation requires baseline information on herring abundance and distribution prior to its depletion. Yet current knowledge of Pacific herring distribution and abundance is based on biomass estimates that date back only to the mid 20th century – well after the onset of industrial fishing.

Most modern ecological data lack sufficient time depth for establishing baselines for marine ecosystem management and/or recovery (McClenachan, et al. 2012); this has the potential to dramatically underestimate the degree of population loss (the ‘shifting baseline’ problem [Pauly 1995]) and inhibit recovery efforts. As a result, traditional and local ecological knowledge (TEK/LEK) as well as paleoecological and archaeological data are increasingly important for informing these baselines (Rick and Lockwood 2013). Such data provide both the long-term perspective needed to assess pre-industrial ecological states, and ecologically and culturally salient baselines for conservation (Jackson, et al. 2011; Turner, et al. 2008; Wolverson and Lyman 2012).

Here, we compile the archaeological record of fisheries in the Northeast Pacific from Alaska, British Columbia, and Washington (Figure 2.2) to assess the spatial and temporal distribution of pre-industrial herring abundance. The abundance and spatial distribution of archaeological fish bones reveals the widespread importance of herring to indigenous peoples

throughout the region, and indicates the abundance of herring in coastal ecosystems over the past several thousand years. Herring were highly abundant along southwest Vancouver Island and in the Salish Sea. The archaeological record indicates that places with abundant herring were consistently harvested over time, and suggests that the areas where herring massed or spawned were more extensive and less variable in the past than today. Although archaeological data are expressed over different spatial and temporal scales than modern fisheries population estimates, archaeological data highlight both a disjunction between pre-industrial and contemporary herring abundances and distribution, and the need to revise and expand the data on which current fisheries management and conservation are based.

History of Herring and Herring Roe Fishing

For many First Nations and Native American groups from Alaska to Washington, the nutritionally valuable and readily harvested herring and its roe were integral to daily lives and worldviews (e.g., Boas 1932; Bouchard and Kennedy 1989; Brown and Brown 2009). This is reflected in photographs, interviews, oral histories, and indigenous place names (e.g., *Teeshoshum*, “milky waters from herring spawn;” *K'i:na?a*, “herring guts on rocks” (Sapir and Swadesh 1955:35); *Yaaw Teiyi* “Herring Rock,” the sacred place where the first herring arrived; *Shaan Daa* “White Island,” also known as “Fish Egg Island”, named for the whiteness created by the spawning activity each spring; and “Silver Bay”, because in the winter, there were so many herring “if you looked at it in the moonlight you’d see the backs of the herring... and it would look silver” (Thornton, et al. 2010a:60, 334, 489). Many coastal groups maintained family-owned locations for harvesting herring and herring roe from anchored kelp fronds, eelgrass, or boughs of hemlock or cedar trees (Drucker 1951; Powell

2012). Herring was harvested at other times of the year than the spawning period when massing in local waters (Grant 1857:300; McKechnie 2005b:103; Moss, et al. 2011; Sapir and Swadesh 1939:223) but most ethnohistorical observations identify late winter and springtime spawning as a key period of harvest for both roe and fish. Processed herring and roe were consumed in large quantities and traded widely among coastal First Nations (Bouchard and Kennedy 1989:8; Jewitt 1807:6). Sustainable harvests were encouraged by building kelp gardens (Brown and Brown 2009:xviii), wherein some roe-covered fronds were not collected, by minimizing noise and movement during spawning events, and by elaborate systems of kin-based rights and responsibilities that regulated herring use and distribution (Bouchard and Kennedy 1989; Powell 2012; Sproat 1868:224; Thornton, et al. 2010a; Thornton, et al. 2010b).

Industrial commercial fishing of herring began in earnest on the Northwest Coast in the late 19th century primarily using beach and drag seines to catch fish and then render (“reduce”) oil and meal (Stick and Lindquist 2009; Taylor 1955; Tester 1935; Thornton, et al. 2010a). In British Columbia, officials prohibited the reduction of herring into oil and fertilizer in 1910 (Carrothers 1941:111) and noted that the larger bays were “being gradually deserted by the larger schools where they were formerly easily obtained” (Tester 1935:7). In 1927 (23 years prior to the current management baseline for estimating historical biomass), the fishery on eastern Vancouver Island, British Columbia, processed 31,103 metric tons of herring (Munro and Clemens 1931:5), which is roughly two times the annual harvest rate in 2012 and approximately 38% of the current biomass estimate for the entire Strait of Georgia (Department of Fisheries and Oceans Canada 2012b; 2013:43). In Alaska, the herring reduction industry began in 1882, with state-wide harvests reaching a peak of 75,000 metric

tons in 1929 (Funk 2010:257). By the 1930s, the effects on population numbers and/or behaviour caused fisheries scientists to express deep concern about the effects of over-fishing on herring (Carrothers 1941:111; Taylor 1955:110; Tester 1933:289), as the fishery shifted to deeper water harvest technology (Tester 1935:7) and underwent a considerable spatial expansion in search effort (Taylor 1955:110).

By the late 1960s, as a result of increased fleet efficiency, reduction fisheries, and poor recruitment, the herring populations of British Columbia and Washington collapsed (Outram and Humphreys 1974). This led Canada to permanently close its reduction fishery in 1968 (Pearse 1982:15), followed by the closure in Washington state in the early 1980s (Stick and Lindquist 2009). In the early 1970s, the herring industry in Japan collapsed (Morita 1985), which increased East Asian demand for herring eggs taken from North American waters. As a result, a Sac Roe Fishery (SRF) began throughout the Northeast Pacific, targeting female herring just prior to spawning. In the last decade, coast-wide declines in herring numbers (Cleary, et al. 2010; Stick and Lindquist 2009) have led to a greatly reduced SRF, now limited to a few regions such as the Strait of Georgia (Salish Sea) and Sitka and Togiak, Alaska (Funk 2010). In addition to these larger ventures, a relatively small food and bait fishery has persisted since the early 20th century. Since the 1970s licenses and legal judgments have been issued to First Nations in Canada (Newell 1999; Powell 2012), Native Americans in Washington (Boxberger 1999), and Alaskan Natives (Thornton, et al. 2010a) that support food, social, and ceremonial fisheries and in some cases commercial fishing.

Government fishery managers, scientists, and local and indigenous peoples lack consensus on the cumulative consequences of ongoing commercial fisheries on herring populations. Many First Nations, Native Americans, Alaska Natives and other local fishers,

based on personal observations and traditional knowledge, hypothesize that local herring stocks, on which they consistently relied for generations, have been dramatically reduced and made more difficult to access following 20th century industrial fishing (Haida Marine Traditional Knowledge Study Participants, et al. 2011; Hebert and Thornton 2010; Thornton, et al. 2010a; Thornton, et al. 2010b). In contrast, fisheries managers (Hay, et al. 2008; Schweigert, et al. 2010) identify commercial fishing as only one of several potential causes for the coast-wide decline in herring and/or persistent lack of recovery since implementing conservation measures (Hay, et al. 2009). In the Strait of Georgia (BC), managers hypothesize that populations have in fact not been depleted, but rather have shifted spatially due to climatic factors and predator abundance (Hay, et al. 2009; Ware and Schweigert 2002). The unresolved nature of these alternative hypotheses regarding the primary factors responsible for temporal and spatial shifts in herring populations represent a barrier to achieving consensus on the need and strategies for improving herring conservation and management. Zooarchaeological data offer a record of the pre-industrial abundances and distribution of herring, providing a longer-term perspective that can illuminate and contextualize these debates.

Herring and the Archaeological Record

On the Northwest Coast, stratified, shell-bearing archaeological sites (shell middens) provide long-term records of human-animal interactions. Although animal bones can enter archaeological sites through a range of cultural and non-cultural processes (Erlandson and Moss 2001), the majority of fish bones in coastal middens are associated with human processing or consumption of fish. Even though animal products were widely traded in the

past, the bulk of zooarchaeological remains in shell midden deposits tend to be composed primarily of resources harvested nearby (Cannon 2000a; Lepofsky, et al. 2007; Szpak, et al. 2013). Thus, in most cases, zooarchaeological remains, including marine fish bones, can be used as proxies for local distribution and abundance.

This synthesis of zooarchaeological fisheries records builds on the increasing number of recent analyses employing rigorous methods of fish bone recovery and quantification, particularly the use of column sampling and fine-screen mesh (≤ 3.2 mm) that is critical to ensuring adequate proportional representation of small-bodied fish such as herring (Casteel 1972). Our estimates of herring relative abundance and rank order are based on a standard zooarchaeological measure of “number of identified specimens” (NISP), which is not equivalent to biomass or meat weight. Rather, NISP is correlated with numbers of individual animals (Grayson 1984) and thus can be used as a culturally and taphonomically filtered proxy of past, local fish populations (Lyman 2008). Most archaeological deposits, including the zooarchaeological data presented here, have relatively low chronological resolution as calibrated radiocarbon age-range estimates often span more than a century; thus, specific deposits incorporate a degree of time averaging (Kowalewski, et al. 1998; Lyman 2003a).

Despite interpretive challenges, ancient fish bone records provide long-term and spatially explicit data on past use and abundance of herring and other fish. This is particularly so in the case of our dataset, which compiles rigorously screened data from numerous sites across the Pacific Northwest Coast that represent multiple temporal and regional scales. This is the largest available dataset of fine-screened archaeological fish assemblages from the Northwest Coast and offers new insight into the taxonomic composition of indigenous fisheries.

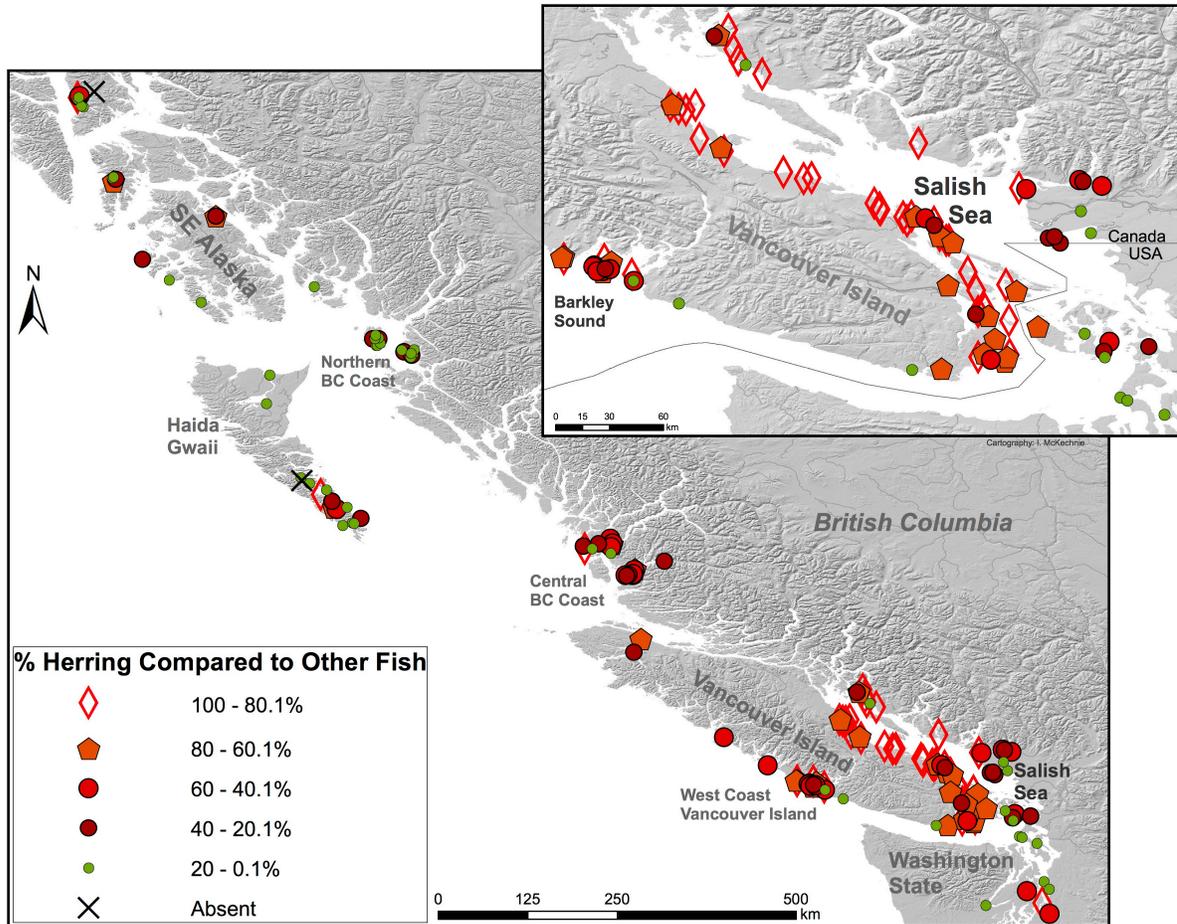


Figure 2.1. Percent abundance of herring bones in archaeological sites with >50 identified fish bones (N = 171 sites). Only two sites lack herring bones. Herring is abundant (>60% of total fish NISP) in sites throughout the Strait of Georgia in southern British Columbia. In 71% of sites, herring makes up at least 20% of the site's total assemblage of fish bones.

Material and Methods³

Data Sources

To examine the distribution and abundance of herring represented in archaeological sites of the Northwest Coast (SE AK, BC, WA), we compiled a database of all well-sampled sites with adequately recovered and identified fish bone assemblages located within 1 km of

³ Due to length, the tables for this chapter (Chapter 2) are presented in an appendix to this dissertation.

the current marine shoreline (Table 2.1). This entailed an extensive literature review of published and grey literature on zooarchaeological analyses completed over the past 40 years. Given the small size of herring bones (e.g., vertebral centra are 4 mm or less in diameter), we only included sites where the zooarchaeological remains were systematically recovered using a fine-screen mesh (equal to or less than 3.2 mm). All zooarchaeological remains were identified by established analysts or students working under the analysts' direct supervision using comparative collections (Table 2.1).

Only sites containing a minimum of 50 fish bone specimens identified to at least family level were included. Over 91% of the 171 sites have more than 100 fish bones. This is a reasonable threshold for assessing the relative abundance of the three-most ubiquitous and abundant taxa at a site (Butler and Campbell 2004:340). For the site-based analyses presented in Figure 2.1 and the regional analyses presented in Figures 2.3-2.6, we combined zooarchaeological data from sites with multiple excavated sub-assemblages to ensure adequate sample sizes (Tables 2.1 and 2.2).

We used the relative abundance of herring bones among all identified fish (number of identified specimens, NISP) as a proxy for the relative abundance of herring in archaeological sites. We did not convert herring bone NISPs to estimates of 'meat-weight' or biomass as suitable taphonomic, allometric, and stratigraphic data are lacking for the majority of sites. We judge our assessment of the abundance of identified herring bones as a proportion of all fish bones to be conservative given that herring have fewer vertebrae than some larger fish taxa that can fracture into numerous identifiable fragments (e.g., *Oncorhynchus* spp., *Squalus acanthias*). While quantitative data on herring bone density measurements have not been conducted, their bones are notably smaller and more delicate

relative to most other measured fish species (Smith, RE, et al. 2011a). Moreover, the cellular structure of herring bone likely makes them more susceptible to microbial degeneration relative to other fish (Szpak 2011:3367) indicating this species would likely be less well-preserved in the archaeological record.

Chronological Assessments

To assign age-ranges to archaeological assemblages, we used stratigraphic and chronological information provided in the original research reports and in subsequent published archaeological research (Table 2.1). The majority of sites contain at least one radiocarbon date (88%) while the remainder contain temporally diagnostic artifacts and are on landforms consistent with late Holocene sea levels (N = 21 sites). Radiocarbon age estimates were assigned age categories based on dates re-calibrated using the Intcal09 curve (Reimer, et al. 2009) and represent the 2-sigma calibrated range. Most radiocarbon samples were taken from the basal layers of individual site deposits.

Time Series Analysis

To examine within-site temporal patterns at the finest possible depositional scale, we identified a sub-set of 50 sites that report chronologically distinct vertical levels or stratigraphic layers (Figures 2.6 and 2.7, Table 2.2). We included only those sites that have been dated in their basal and terminal levels either by radiocarbon dating or the presence of historic artifacts of European manufacture. Assemblages had to have 50 or more identified fish bones per vertical level or stratigraphic layer and three or more levels in sequence. To ensure each datapoint had 50 or more specimens, some assemblages from contiguous strata or levels with less than 50 identifiable specimens were combined (Table 2.2).

Due to differences in how assemblages were collected *in situ*, and the level of detail in which they are reported, we present these data in four analytically separate categories in Figure 2.5. These are; 1) assemblages collected from multiple areas within a site according to temporally distinct strata (ca. 500-2000 years per stratigraphic layer, n=14 sites); 2) sites with a single column sample of contiguous levels (N = 19 sites); 3) sites with multiple column samples with multiple contiguous levels spanning broad temporal intervals (N = 8 sites), and 4) Sites with multiple column samples with multiple contiguous levels spanning broad temporal intervals in Barkley Sound (N = 9 sites).

Comparison to Modern Spawning Records

To evaluate archaeological data in relation to historic and contemporary herring spawning records from British Columbia (Figure 2.7.), we calculated the distance between our archaeological study sites and historically documented herring spawning localities (Table 2.3). We restricted this analysis to sites within areas with modern herring spawning observations as these represent a long-term ecological record of cumulative spawning activity and are derived from annual surveys of spawning length, thickness, timing and other variables collected by the Department of Fisheries and Oceans Canada (DFO) (Department of Fisheries and Oceans Canada 2012a) since 1937 (McCarter, et al. 2005). Where available, we also documented the proximity to spawning areas identified in Traditional and Local Ecological Knowledge studies in BC (Haida Marine Traditional Knowledge Study Participants, et al. 2011; Helsing-Lewis, et al. 2011). These are based on interviews with knowledgeable indigenous and non-indigenous local residents with lifetimes of perspective on the fisheries in their traditional territories. Distance to closest documented spawn was

determined by placing geo-rectified maps of cumulative spawning localities into *Google Earth* and measuring the shortest route by water (± 500 m) to an archaeological site.

To assess the potential disjuncture between archaeological data and the cumulative record of historical spawning activity, we compared the six quantitative categories used by DFO (ranging from ‘vital’ to ‘minor’)(McCarter, et al. 2005)) to correspondingly ranked archaeological abundance categories (e.g., 100-80% NISP = vital, 1-20% = minor). If there was more than one record of cumulative spawning within a distance of 2 km, we chose the most abundant ranking for the comparison. If the ordinal grouping in the two records differed by more than one category, we considered the two records to represent a disjuncture in abundance (Table 2.3).

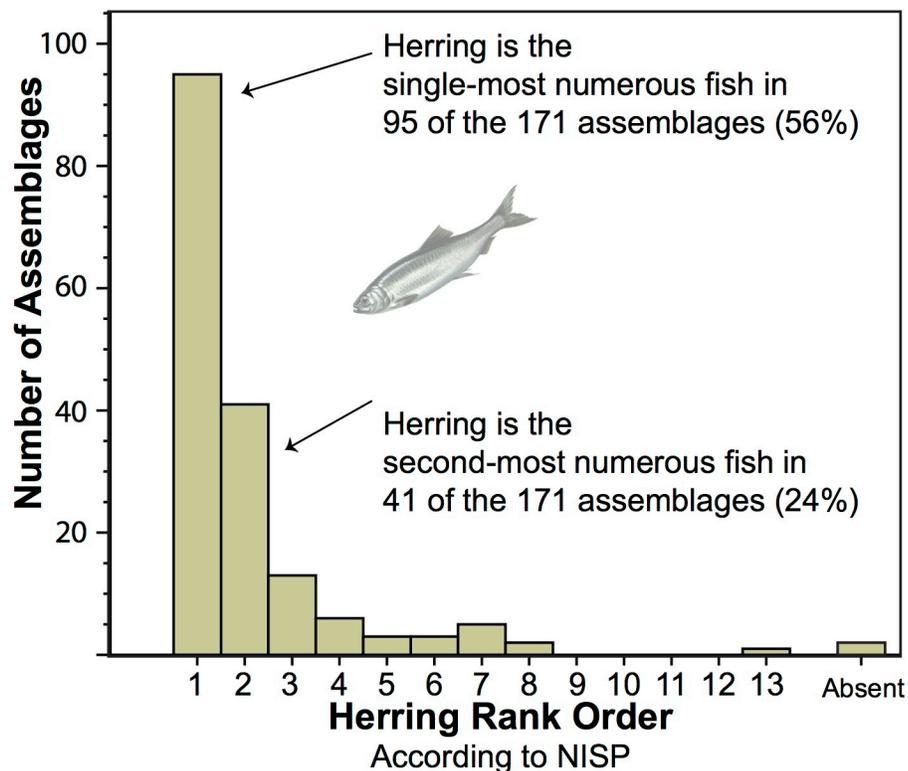


Figure 2.2. Rank order of herring bones in 171 adequately sampled archaeological sites. Herring is among the top three most abundant fish taxa in 88% of the sites and is absent in only two sites.

Results

In the study area, 171 coastal archaeological sites have been sufficiently sampled to evaluate the past distribution and archaeological abundance of herring (Figure 2.1, Table 2.1). These sites span the early Holocene (10,700 cal BP) to the contact-era (AD 1740-1860) with the bulk of sites dating to within the past 2,500 years (76%). The dataset contains 435,777 fish bones confidently identified to family, genus, and/or species. These specimens represent a wide range of taxa, with each site containing a minimum of 50 identified bone specimens. Coast-wide similarities in the taxonomic richness of assemblages and relative abundance of numerically dominant fish taxa indicate that the archaeofaunal sample sizes are adequate to assess the distribution and relative abundance of herring (Table 2.1).

Herring Ubiquity, Abundance, and Rank Order

Within this dataset, herring is the single-most ubiquitous fish taxon in archaeological sites throughout the Northwest Coast, occurring in 169 of the 171 assemblages (99%) representing various physiographic settings. It is also the single-most numerically abundant taxon in the dataset representing 49% of all identified fish bones, with a site average of 47% ($\pm 33\%$ NISP). Herring is similarly the 1st ranked taxon by NISP in over half (56%) of the 171 assemblages and is among the two most numerous taxa in 80% of assemblages (Figure 2.2). Herring comprises more than 20% of fish bones in 71% of the assemblages (NISP). The high ubiquity, rank order, and relative abundance of herring in most sites is remarkable given the many other taxa present in each site (mean N of fish taxa = 10.2, SD = 3.2) and that some ubiquitous genera, such as *Oncorhynchus* spp. (salmon and trout) and *Sebastes* spp. (rockfish) comprise many species (7 and 36 respectively). The occurrence and relative abundance of herring in the majority of sites surpasses any other fish taxa, and demonstrates

a pervasive and previously under-recognized role for this species in indigenous economies spanning the Holocene.

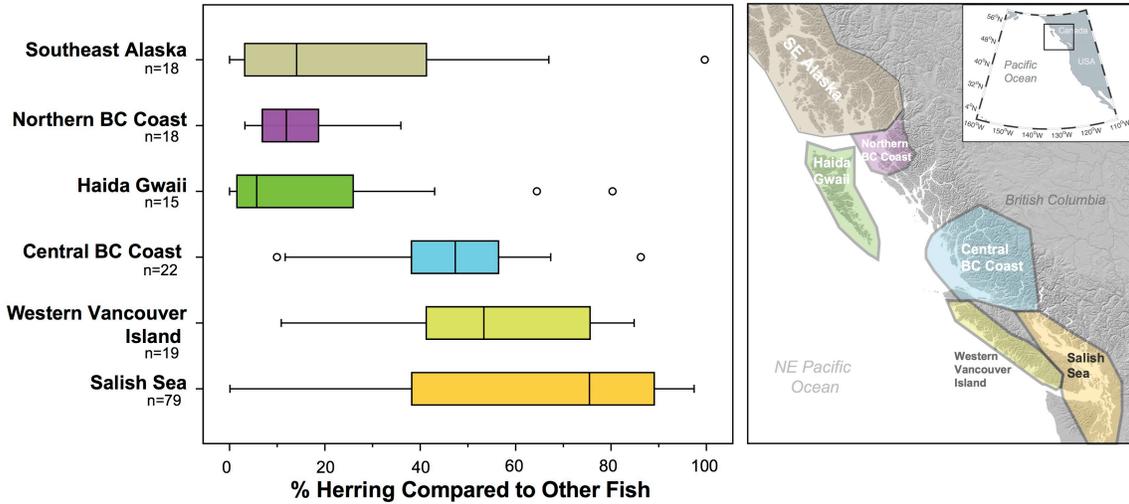


Figure 2.3. Boxplots showing percent abundance of herring bones in adequately sampled archaeological sites (N = 171) by major region (arranged north to south). Boxes encompass the middle 50% of cases, with the median represented as a vertical line. Whiskers encompass the 1.5 of the interquartile range, excluding outliers (represented as circles) and extreme outliers (represented as stars).

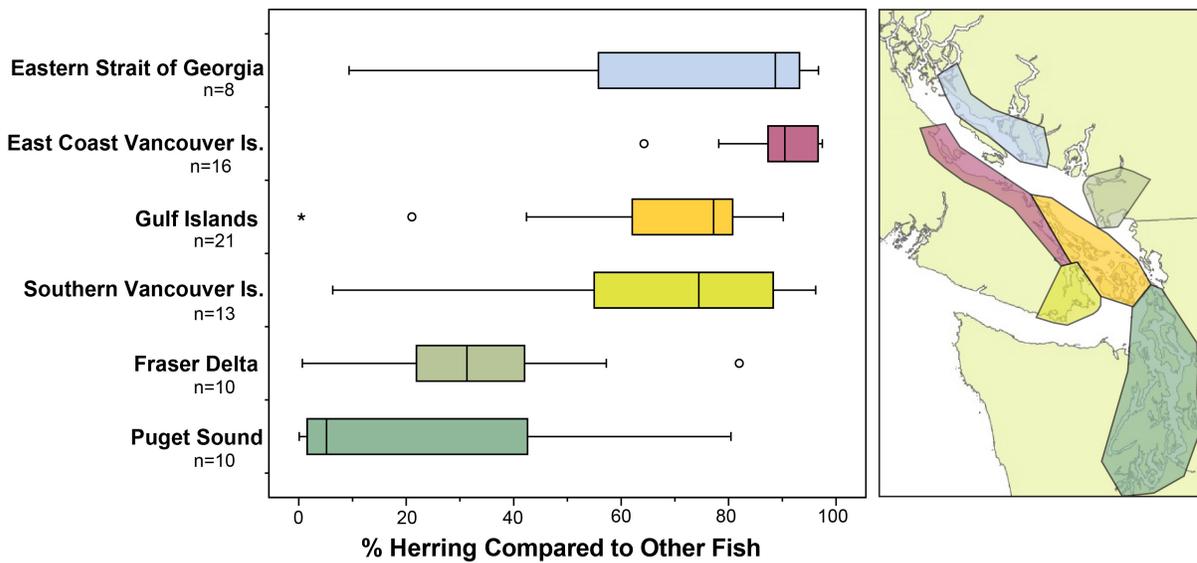


Figure 2.4. Boxplots showing percent abundance of herring bones in archaeological sites by sub-regions (arranged north to south) within the Salish Sea region (N = 78). Note the lower abundance of herring in the Fraser Delta and Puget Sound. Note: Gulf Islands includes the Canadian Gulf Islands and the US San Juan Islands.

Spatial Distribution of Herring

Geographically, nearly half the sites in the database (46%) are concentrated around the Salish Sea, reflecting more intensive archaeological investigation in this region. Only two assemblages, both in the northern portion of the study area, do not contain herring bones (Table 2.1). The occurrence of sites with significant proportions of herring throughout the study area (Figure 2.3) indicate that the spatial gaps in the distribution of analyzed sites reflect gaps in archaeological sampling, rather than gaps in the ancient distribution of herring. Thus, as a proxy for the number of fish harvested in coastal waters, these data reflect a widespread abundance of herring in marine ecosystems in the deep past.

Archaeological sites numerically dominated by herring occur throughout the study area. Sites in the Central Coast, West Coast Vancouver Island, and Salish Sea areas are consistently dominated by herring bones with median abundance values representing over 40% of the assemblage (Figure 2.3). Most sites where herring represents less than 20% of NISP (n=50) are in the northernmost portion of the study area (Haida Gwaii, northern BC Coast, and SE Alaska) or in the southernmost portion of the study area (Puget Sound and the lower mainland of British Columbia) (Figures 2.1, 2.3, and 2.4). Even in the northern portion of the study area, herring still ranks among the three most ubiquitous and abundant fish in 75% of sites (Table 2.1). The proportion of herring in Haida Gwaii exhibits high variability amongst nearby sites with salmon, rockfish, and dogfish (*Squalus acanthias*) representing the other dominant fish taxa. On the northern BC Coast, sites around Prince Rupert and on the Dundas Islands tend to be dominated by salmon and oil-rich smelts (Osmeridae). In southeast Alaska, salmon tends to dominate followed by herring, Pacific cod (*Gadus macrocephalus*), and sculpins (Cottidae).

The Salish Sea region exhibits exceptionally high archaeological abundance of herring, but with substantial variation among sub-regions (Figures 2.3 and 2.4). Sites along the northwestern and northeastern Strait of Georgia (eastern Vancouver Island, E. Strait of Georgia, respectively), the southwestern Strait of Georgia (southern Vancouver Island), and the Gulf Islands, have the highest mean relative abundances for herring (Figure 2.4). These high numbers contrast with sites in Puget Sound ($N = 10$, $\bar{x} = 20.6\%$) and along the Fraser Delta ($N = 10$, $\bar{x} = 33.7\%$), which tend to have abundance values less than 40%. This spatially variable distribution of herring across broad regions of the Northwest Coast and around the Salish Sea suggests that although herring was a ubiquitous component of coastal ecosystems, herring biomass (vis-à-vis other fish taxa) was relatively greater in some regions than others.

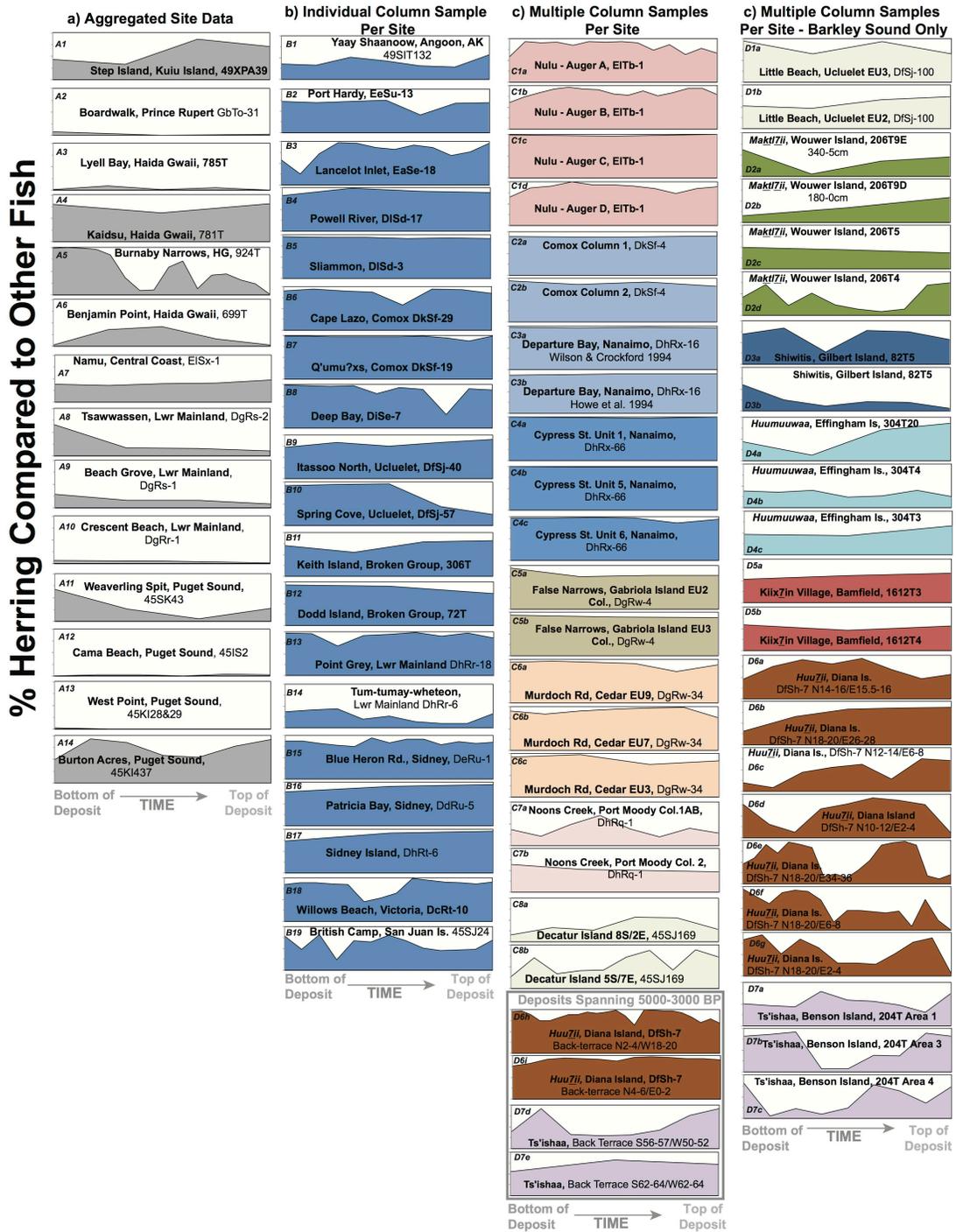


Figure 2.5. Percent abundance of herring bones over time in sites with dated samples (N = 50, Table 2.2). Sites are arranged into three groups a) Multiple samples within a site aggregated into broad temporal groupings (ca. 500-2000 years per stratigraphic layer, N = 14 sites), b) Sites with a single vertical ‘column’ of contiguously sampled levels (N = 19), and c) Sites with multiple column samples from multiple site areas including Barkley Sound (N = 17). Each site is associated with one or more radiocarbon dates and/or contain historic-era artifacts in the upper levels indicating they date ca. AD 1778-1850 (Table 2.1).

Temporal Patterns

The sites in the dataset span the past 10,700 calendar years. The majority of the sites (78%) have temporal components that fall within the past 2,500 years whereas much smaller numbers of sites have components that date prior to this period and only a handful that date before 5,000 years ago (Table 2.1). This temporal distribution broadly corresponds to the proportion of dated archaeological sites in the region (Ames and Maschner 1999:54), and is a product of site taphonomy, relative search effort, and geographically variable Holocene sea levels and shoreline locations (Mackie, et al. 2011).

Of the 171 sites, 50 (29%) meet our criteria for examining detailed intra-site temporal patterning (Figures 2.5 and 2.6, *see* Materials and Methods). Similar to the overall dataset, over half of these sites are from the Salish Sea region (N = 27, 54%) and the majority date to within the past 2,500 years. Collectively, the 50 sites are comprised of 571 vertically distinct levels, each with sample sizes of ≥ 50 NISP (Table 2.2).

Herring occurs in the overwhelming majority of the 571 individual levels (99.3%) and the mean relative abundance of herring exceeds 20% in the majority of the 50 sites (88%). Variance in the relative abundance of herring is less than $\pm 10\%$ within 96% of individual sites (Figure 2.6, Table 2.2), further supporting an interpretation of broad consistency over time. Variance is correlated with sample size, however (Spearman's $\rho = 0.303$, $p = 0.032$, $n = 50$), which reflects the influence of several thoroughly sampled sites from a single region with moderate variability (Barkley Sound, *see* Figure 2.5D). Herring ranks as the first or second-most numerous fish taxon in the majority (92.1%) of the 571 stratigraphic levels. Seven sites exhibit mean abundances lower than 20% and low rank orders (less than 3) for herring over time (Figure 2.6). Herring is only absent from four

individual levels in four sites which also have consistently low mean abundance values (<4% NISP; Figure 2.5).

The broad consistency in abundance through time is particularly striking considering these archaeological deposits likely represent a variety of cultural and ecological contexts, seasons of occupation, and depositional processes over multiple temporal scales (Cannon 2000a; Lyman 2003a). Of the two sites in our sample that exhibit highest intra-site variability (more than $\pm 10\%$ variance), one (Burnaby Narrows, Figure 2.5A5) spans a key period of subsistence change (Orchard 2011b) and sea-level change (Mackie, et al. 2011). In the other (Spring Cove, Figure 2.5B10), dramatic increases in anchovy in two of five occupational levels reduce the relative abundance of herring, which correspondingly increases variance (cf., Lyman 2003a). As with modern fisheries landing data, social, economic, and environmental circumstances as well as analytical resolution and ecological drivers, needs to be considered when interpreting fine-scale variability within a specific site.

Sites in close proximity and which are broadly contemporaneous display similar patterns of herring abundance over time (e.g., Tsawwassen, Beach Grove, and Crescent Beach around Boundary Bay [Figure 2.5A8-10]; Cape Lazo, *Q'umu?xs*, and DkSf-4 in Comox Harbour [Figure 2.5B6-7, 2.5C2a and 2.5C2b]; and the Nanaimo Harbour / Departure Bay area [Figure 2.5C4a-b]). This similarity suggests sub-regional-scale coherence in herring abundance over time and indicates that the formation processes associated with each site assemblage (either human harvest of herring or natural taphonomic processes within a site) do not obscure the overall ability of the zooarchaeological data to accurately estimate abundance of herring in these settings. Furthermore, the observations of similar herring abundance values from multiple columns from spatially separate but temporally overlapping

deposits within a single site (Figure 2.5C and Table 2.2) strengthens the inference that single column samples can document site-wide patterning for such abundant and ubiquitous taxa (McKechnie 2005b). These overall patterns thus support the value of zooarchaeological data as a proxy for past herring abundance.

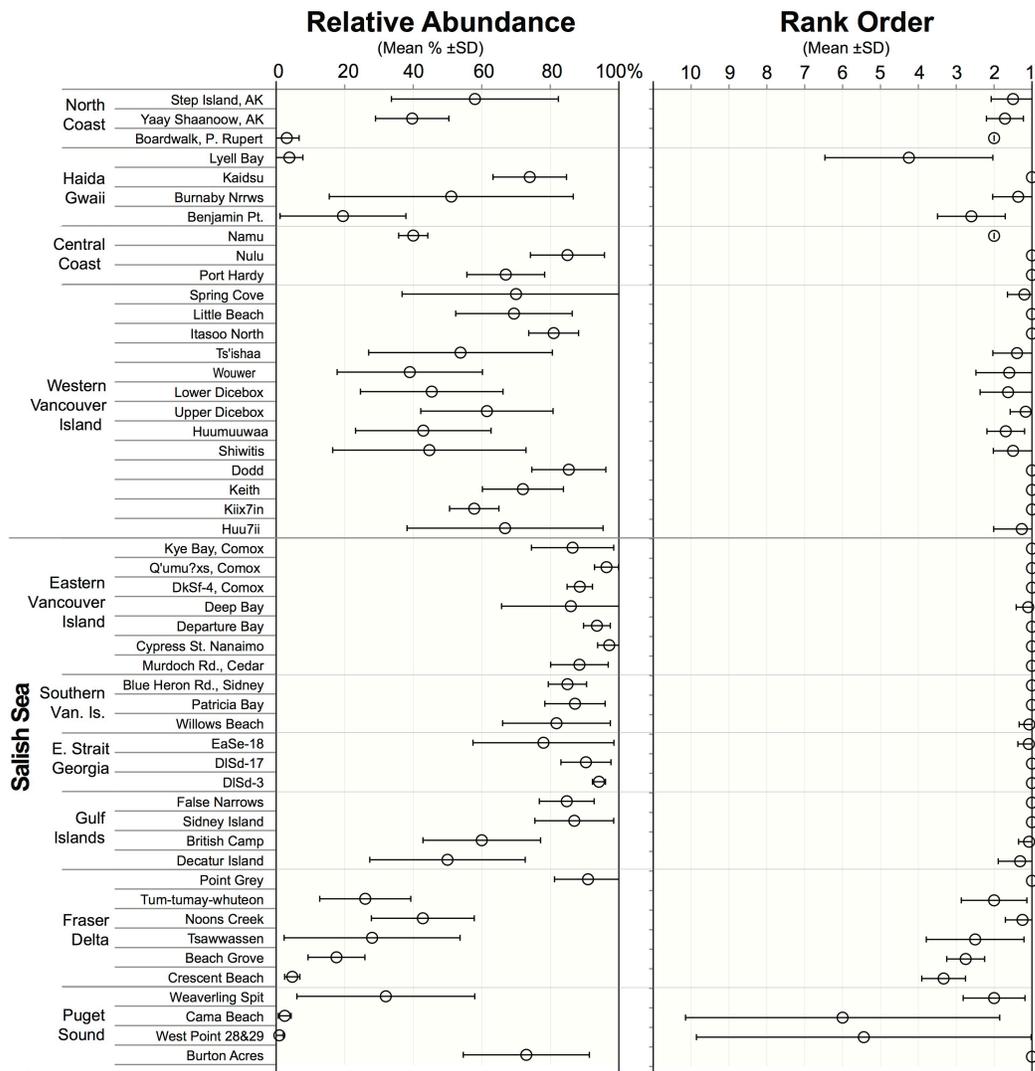


Figure 2.6. Mean abundance and rank order of archaeological herring bones from levels in adequately sampled and dated sites (N = 50; arranged north to south). Error bars represent ± 1 standard deviation (see Table 2.2 for supporting information).

Collectively, these multiple analytical scales (Figures 2.5 and 2.6) and abundance measures indicate a pattern of relatively low temporal variability and broad consistency in

herring use as represented among and within archaeological sites distributed across a large coastal region. In areas where herring was archaeologically abundant, it appears to be consistently available and abundant throughout the mid-to-late Holocene. Given the limits of radiocarbon dating and calibration, we cannot determine the extent to which the temporal resolution of our data may inhibit our ability to detect finer-scale (e.g. annual, decadal, multi-decadal) variation in herring abundance through time. If high variation in the local availability of herring over time was characteristic for this region, however, we hypothesize this would be apparent in more of our site sequences. Overall, this large-scale archaeological dataset indicates that herring was a desired and reliable source of food in coastal waters in most locations across the Northwest Coast.

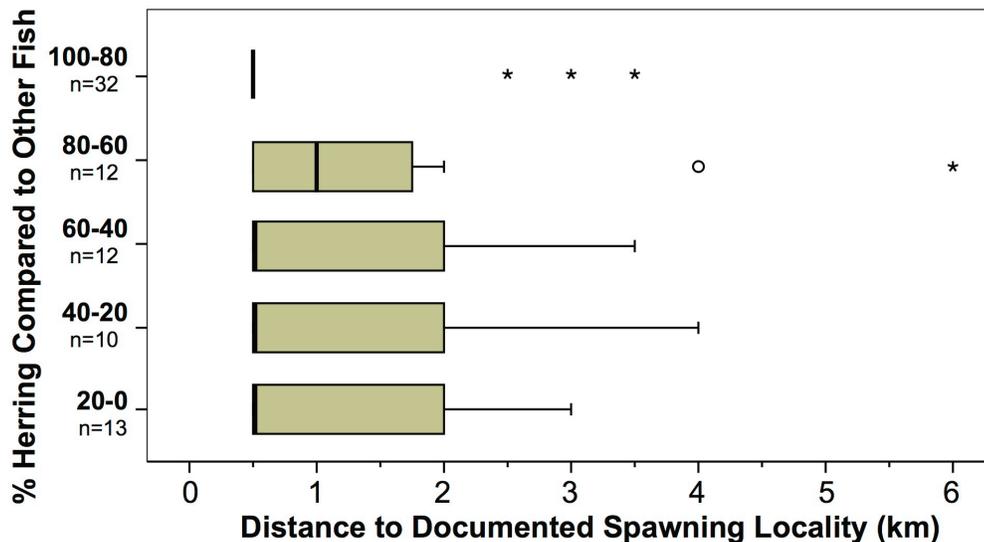


Figure 2.7. Boxplot showing variability in the archaeological abundance of herring bones in relation to proximity by water to historically surveyed spawning locations (± 500 m). Distance data calculated only for sites in BC within monitored areas ($N = 79$) and with components dating to within the last 2,500 years (Table 2.3). Archaeological data are grouped into relative abundance categories as per Figure 2.1.

Comparison to Modern Spawn Location Data

To evaluate the ecological longevity of herring spawning habitat and the extent that herring spawning areas have changed historically, we determined the proximity of

archaeological sites to herring spawning areas documented as a result of federal fisheries monitoring efforts that support stock assessment in British Columbia (Department of Fisheries and Oceans Canada 2012a). We limited our analysis to archaeological deposits dating within the last 2,500 years ('late period sites') and located within areas annually monitored for spawning activity since the mid 20th century (N = 79 sites). We observe that archaeological sites with greater than 80% herring are significantly closer (Mann-Whitney U = 525, Z=-2.936, p=0.003) to documented spawning locations than archaeological sites with less than 80% herring (Figure 2.7, Table 2.3). The significance of this difference is strengthened when we include data from nine sites with traditional and local ecological knowledge [TEK/LEK] (Haida Marine Traditional Knowledge Study Participants, et al. 2011; Hessian-Lewis, et al. 2011) on the BC Coast (Mann-Whitney U = 478, Z = -3.490, p=0.000). The strong correspondence between high archaeological abundance of herring bones and the multi-decade monitoring record of modern spawning sites is a compelling argument for the long-term site fidelity of herring spawning.

In British Columbia, over 30% (N = 35) of the 114 late period archaeological study sites are in areas that have not been monitored for herring spawn by Department of Fisheries and Oceans (DFO) (mean distance from closest monitored shoreline is 7.5 km, SD = 7.9 km). Of these, 14% (N = 5 sites) have herring abundance values over 80%. Based on the correspondence between sites with >80% herring bone abundance and documented spawning sites, we hypothesize that these five sites were also close (i.e., within ± 2 km) to former herring spawn locations. Thus, archaeological sites can be used to expand the ecological baseline for spawning populations and identify localities that may no longer support spawning or are missed by modern monitoring efforts.

We also note a general correspondence between six abundance categories used by federal fisheries monitoring in British Columbia (*see* Materials and Methods and Table 2.3) to characterize the cumulative location and intensity of herring spawning, and six ordinal categories of archaeological abundance of herring. That is, the majority of late period archaeological assemblages (48 of 79 sites; 60%) have similar categorical abundance values to the fisheries monitoring dataset (± 2 km). However, 25% of these archaeological sites (N = 20 sites) contain a categorically greater abundance of herring than fisheries monitoring records whereas, only 10% have substantially lower abundance values than cumulative spawning records (N = 8 sites).

Collectively, these comparisons both provide information on the longevity of spawning habitats as well as the potential depletion of spawning habitats in historic times. The predominant correspondence between ordinal categories in the ancient and modern data indicates correspondence between ancient productivity of herring and the productivity of contemporary spawning habitats in a given location. This in turn indicates consistency in the geography of spawning habitats from the distant to the more recent past. Furthermore, the quarter of archaeological sites that have higher abundances of herring than is predicted by the federal cumulative spawn records provides a basis for expanding our estimate of potentially productive spawning habitat beyond what is indicated by historic census records.

Discussion

This broad compilation of zooarchaeological data provides a previously unconsidered record of the past abundance and distribution of fisheries along the Northwest coast of North America. It establishes herring as among the most important marine fish on which coastal indigenous people relied in the past. These data expand greatly upon the extant

paleoecological fisheries record (O'Connell and Tunnicliffe 2001; Tunnicliffe, et al. 2001; Wright, et al. 2005) and indicate that herring was both widespread across the coast, and a mainstay of ecological and socio-economic systems over the Holocene. Herring occurred in abundance (>40% NISP) in numerous sites across all areas of the coast but exhibited superabundance (i.e., > 60% NISP) in a few regions such as the central and northern Strait of Georgia and west coast of Vancouver Island. Spatially clustered sites reflect similarly consistent abundance values and a few sites exhibit modest trends over time that may relate to physically driven habitat change, such as the geomorphological evolution of the Fraser Delta (e.g., Beach Grove and Tsawwassen). Only a small number of sites exhibit high variability whereas the more common pattern is of broadly sustained abundance over space and time (Figures 2.5 and 2.6).

Accounting for Differences Between Archaeological and Modern Herring Dynamics

Could the contrast between the consistency seen in the archaeological record and patterns in recent fisheries showing overall decline and increasing fluctuation in spawning distribution arise from insufficient temporal resolution in the archaeological data? Even though modern population fluctuations are observed at interannual to decadal timescales and the likely resolution of the archaeological record is at the centennial scale, it is unlikely that the temporal consistency in the archaeological record is an artifact of insufficient chronological resolution for several reasons. First, if extreme fluctuations in abundance and periodic absences were common in the past (for instance, such that sites with great abundance in some periods commonly declined to low levels) we would expect to see this reflected in our data, even if we couldn't resolve the actual temporal trajectory in an

individual population. Alternatively, our data may also represent subannual temporal variability, which is masked by the coarseness of existing calibrated radiocarbon records. Both scenarios indicate that in our sample of 571 levels, across 50 sites and representing ca. 7,000 years of harvesting data, we should observe some indication of absences and wide fluctuations in herring abundance if they were present. Yet these data show a remarkably consistent presence of herring with 99.3% of the 571 levels containing herring and a mean relative abundance exceeding 20% in 86% of the sites, with within site variance of less than $\pm 10\%$ in 48 of 50 sites (Figure 2.7, Table 2.3).

Second, because of the regularity with which ancient peoples ‘sampled’ their marine environments, the archeological record should be a sensitive indicator of marked declines in local abundance of herring as harvesters would conceivably switch to alternative prey when a target species declines to low levels. Such resource switching is observed in the regional zooarchaeological record, but is expressed over centennial scales and among a limited range of animal species other than herring (e.g., Butler and Campbell 2004; Orchard 2011b). In contrast, even substantial variability around a high mean abundance might not be reflected in our data if herring populations never declined to a threshold where people could meet their needs for consumption, storage, and trade. Likewise, another factor potentially contributing to consistency in the archaeological abundance of herring may be multi-season herring harvests, where fish, fish oil, and roe were processed for longer-term storage and extended consumption within a year (e.g., McKechnie 2005b:103; Moss, et al. 2011:283). This scenario may further dampen fluctuations in abundance over decadal or centennial time scales but also depends on consistent interannual availability of herring.

We envision three alternative hypotheses to account for the difference we observe between archaeological and modern data in the apparent variability and abundance of herring populations (Figure 2.8). The first hypothesis asserts that the modern pattern of interannual dynamics is an accurate reflection of the past and that the archaeological record overestimates abundance and underestimates variability in ancient herring populations (Figure 2.8, Hypothesis 1). For the reasons advanced above, we argue that this hypothesis can be rejected.

Our data seem most consistent with hypotheses that ancient herring populations had a higher mean abundance than in the last century (Hypotheses 2 and 3, Figure 2.8). Variability could have been damped relative to the industrially exploited populations of the 20th century (Hypothesis 2, Figure 2.8), or it could have been similar to those harvested populations (Hypothesis 3, Figure 2.8). In either case, abundance in the more distant past was sufficiently high to meet the needs of harvesters, leading to consistency in the archaeological record.

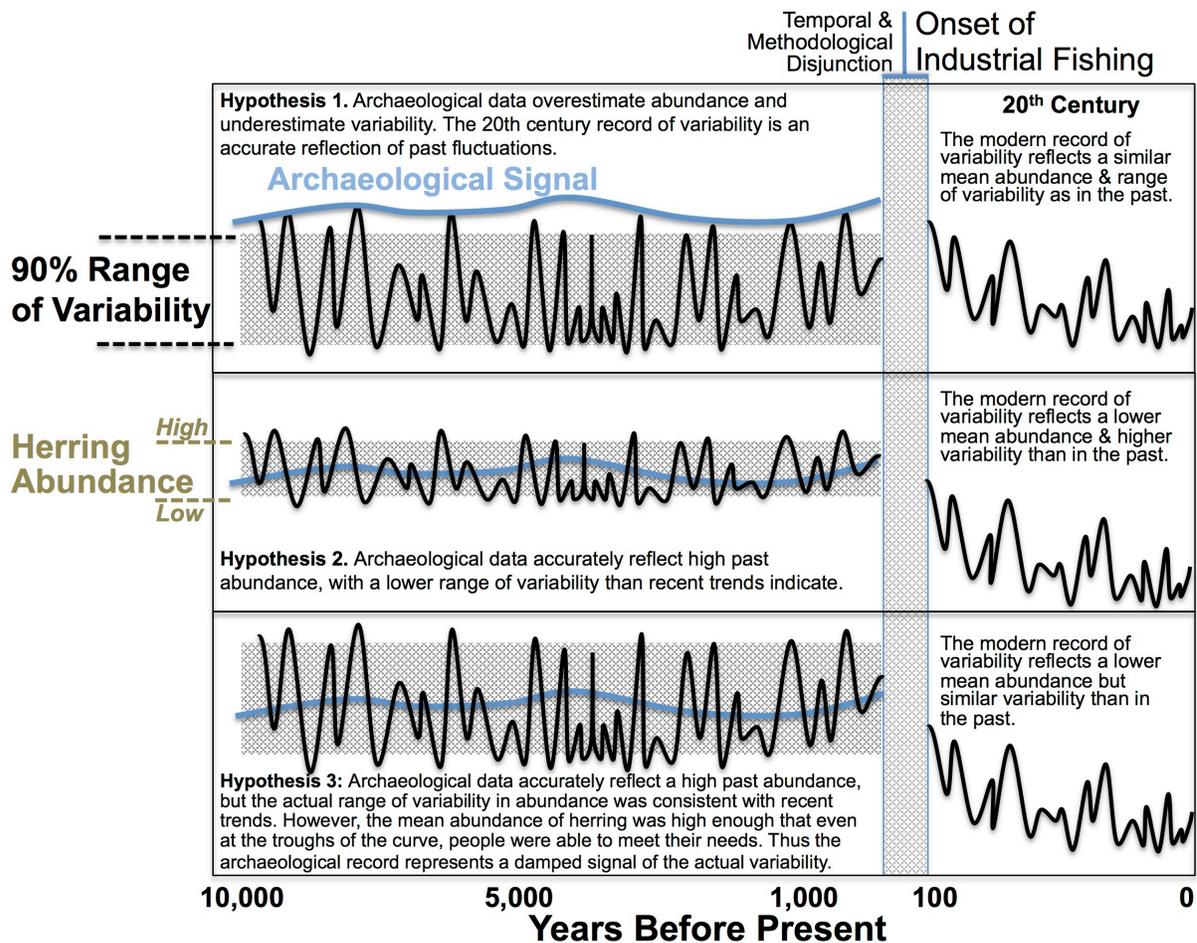


Figure 2.8. Schematic representing three alternative hypotheses regarding the relationship between modern and archaeological abundance and variability of herring populations. The left side of the figure combines the smooth archaeological signal (blue lines) with three hypothesized trajectories for actual populations (black lines), each shown with its range of variability (grey stippled rectangles). In each case, the end of the timeline following the onset of industrial fishing represents a caricature of the recent pattern of herring population dynamics, characterized by great variability, an overall decline in abundance, and some periods of very low abundance.

While the archaeological record shows consistency through time, the paleoceanographic record for the Northwest Coast illustrates considerable variability (e.g., Ivanochko, et al. 2008). Both ocean temperature and productivity vary throughout the late Holocene at different spatial and temporal scales, with some periods of interregional convergence (Anderson, et al. 2005a; Ersek, et al. 2012; Wright, et al. 2005). If ancient herring populations fluctuated in response to high frequency oceanographic variability (e.g.,

Tanasichuk 1997), the fluctuations were not of sufficient amplitude to influence the overall catch of ancient fishers (cf. Reitz, et al. 2008); the substantial variability in the paleoceanographic record is not matched by the archaeological record of herring. Moreover, it seems unlikely that climatic change alone is sufficient to account for substantial declines in Pacific herring populations and spawning distribution over the last 100 years (cf. Hsieh, et al. 2006; Lindegren, et al. 2013).

The most parsimonious explanation for the difference between the modern pattern of variability in herring abundance and the long-term archaeological record is the onset of industrial-scale commercial fishing. Dramatic reductions and spatial shifts in herring populations were observed by fisheries managers in British Columbia and Alaska in the 1930s (Carrothers 1941:111; Funk 2010; Munro and Clemens 1931; Taylor 1955:110; Tester 1933:289; 1935:7). A period of decline between AD 1910 and 1970 is evident in the well-dated sediment cores from southeast Vancouver Island (O'Connell and Tunnicliffe 2001:187). Since the 1970s, further population constrictions have been observed by non-Native bait fisherman in the Georgia and Johnstone Straits (BC), including the widespread absence of herring in over 170 locations that previously supported spawning (Schweigert and Linekin 1990).

Modern declines and contractions of the spawning range of Pacific herring are supported by recent syntheses of the traditional ecological knowledge of indigenous peoples in Alaska and British Columbia (Haida Marine Traditional Knowledge Study Participants, et al. 2011; Hebert and Thornton 2010; Hessing-Lewis, et al. 2011). These syntheses document quantifiable reductions in the magnitude of spawning events and loss of spawning locations in living memory. Furthermore, this shift in abundance is reflected in indigenous place

names, which highlight locations of formerly abundant herring, but where few herring are found today (e.g., *Ch'axa'y* or “Sizzling [with herring] Water”) (Reimer/Yumks 2011:237). Archaeological abundance of herring is additionally mirrored in indigenous place names and origin narratives. For instance, the 2,400 year-old site of Nulu on the Central BC Coast, where herring made up $85\pm 11\%$ of the fish assemblage (Cannon, et al. 2011), is the place where, according to Heiltsuk oral tradition, Raven first obtained herring (Boas 1932). Conversely, a culturally affiliated site at the Koeve River 25 km away from Nulu (Table 2.1), is not associated with herring or herring spawn either in ethnographic or modern ecological data and exhibits low archaeological herring abundance (10% NISP). In the northeastern Salish Sea in southern British Columbia, the place name of *Teeshoshum* (“waters white with herring spawn”) is associated with a ca. 800 year old assemblage comprised of 93% herring bones (Table 2.1). However, extensive herring spawning in this ecologically suitable location have not been documented since 1998 (Department of Fisheries and Oceans Canada 2012a).

Collectively, these sources of historical and ethnobiological data reinforce the contrast between the archaeological record and the dynamics of the modern fishery. In response to locally reduced or absent spawning populations, the current herring fishery in BC has contracted from its mid-20th century coast-wide focus and is now concentrated along the east coast of Vancouver Island, overlapping an area in which herring were super-abundant archaeologically (Department of Fisheries and Oceans Canada 2013; Therriault, et al. 2009). While other factors are also responsible for range contraction of harvested fish populations, range contractions are recognized as one of the effects of over-fishing (MacCall 1990; Worm and Tittensor 2011).

Historical Baselines As Context for Modern Dynamics

Historical baselines in natural resource management serve as reference conditions for understanding the context for modern population or ecosystem dynamics, providing both assessments of abundance and ranges of natural variability (Landres, et al. 1999; Rosenberg, et al. 2005). Our archaeological data, in combination with traditional ecological knowledge and early historic observations (Carrothers 1941; Funk 2010; Munro and Clemens 1931), suggest that late 20th century census data alone do not provide a sufficient baseline for assessing the abundance, distribution, and dynamics of Pacific herring in relation to industrial fishing since the 1880s. This discrepancy between recent and past dynamics is expressed in both temporal and spatial domains. In the temporal domain, the archaeological data challenge the notion that large fluctuations in abundance, including extremely low levels of abundance, are a regularly occurring component of population variability. In the spatial domain, our data argue against the idea that spawning was spatially erratic in the past, with little site fidelity (Hay, et al. 2009:1662). The archaeological data, in combination with the oral historical knowledge and early historic observations (Carrothers 1941; Funk 2010; Munro and Clemens 1931), suggest that industrial fishing already had a significant ecological impact on herring abundance and spawning location well before the initiation of coast-wide spawning censuses in British Columbia in 1938. Moreover, the historical baseline currently used for annual stock assessments that underpin current harvest allocations in BC begin only in 1951 (Department of Fisheries and Oceans Canada 2012b:11).

The recent history of erratic population fluctuations, declines, and shifting spawning distributions exhibited by Pacific herring populations are not unusual among industrially harvested populations of forage fish worldwide (Anderson, et al. 2008; Hsieh, et al. 2006;

Pikitch, et al. 2012; Pinsky, et al. 2011; Smith, ADM, et al. 2011). What is unique is our ability to provide a long-term temporal context for these recent dynamics. This is particularly relevant because these data reflect sustained continuous harvesting of herring populations for millennia prior to more than a century of modern industrial exploitation. Similar to historical research on the impacts of early industrial-era fishing on Atlantic cod (Rosenberg, et al. 2005) and herring in northern Europe (Barrett, et al. 2004; Poulsen 2008), and the long-term effects of human use of coral reefs (Kittinger, et al. 2011), the archaeological analyses synthesized here critically extend the temporal depth of ecological baselines for contemporary fisheries management.

Conclusion

Spatially and temporally extensive archaeological data on the relative abundance of herring bones in coastal archaeological sites along the Northwest Coast provide insight into the past distribution and abundance of Pacific herring and long-term human-herring interactions. Herring bones exhibit a remarkable degree of dominance within the archaeofauna across space and time in the majority of these records. Over the period represented well by the archaeological record (ca. 2,500-200 years BP), Pacific herring populations also appear to have exhibited higher abundance and greater consistency in their distribution than is indicated by the dynamics of industrially harvested populations over the past 50-100 years. The archaeological data indicate that in most parts of the study area, and particularly in the Strait of Georgia, herring remained consistently available to harvesters over thousands of years. Of the hypotheses posed in Figure 2.8, we reject hypothesis 1, that the archaeological data misrepresent the actual abundance and variability of herring. At present, we cannot distinguish between hypotheses 2 and 3: herring abundance appears to

have been consistently high, but we cannot resolve the magnitude of variability in abundance. The archaeological record, in combination with local and traditional knowledge, early historical records, and paleoecological records, suggest that spawning locations were formerly more abundant and geographically extensive than is recorded by modern surveys. These data, particularly in the context of high harvest levels during the early industrial fishery and the subsequent contraction of effective spawning range, indicate that the currently utilized ecological baseline of the mid 20th century is inadequate for modern management.

Our data support the idea (Hypotheses 2 and 3, Figure 2.8) that, if past populations of Pacific herring exhibited substantial variability, this variability was expressed around a high enough mean abundance such that there was adequate herring available for indigenous fishers to sustain their harvests while avoiding the extirpation of local populations. These records thus demonstrate a fishery that was sustainable at local and regional scales over millennia, and a resilient relationship between harvesters, herring, and environmental change that has been absent in the modern era. Archaeological data have the potential to provide a deep-time perspective on the interaction between humans and the resources on which they depend. Furthermore, it can contribute significantly towards developing temporally meaningful ecological baselines that avoid the biases of shorter term records.

Chapter 3. Towards a Historical Ecology of Pinniped and Sea Otter Hunting Traditions on the Coast of Southern British Columbia⁴

Introduction

Marine mammals (pinnipeds, cetaceans, and sea otters, *Enhydra lutris*) have been important to First Nations people in coastal British Columbia for millennia but their archaeological distribution is poorly known. While archaeological evidence of marine mammal hunting is known for numerous locations over the past 10,000 years of human occupation on the British Columbia Coast (e.g., Cannon 1991; Carlson 2003; Fedje, et al. 2005a; Matson 1976), it is remarkable that few studies have examined archaeological evidence of mammalian hunting traditions on broad regional and/or temporal scales. Considering the importance of these animals to the modern marine ecosystem, understanding the long-term human use and past distribution of marine mammals can add considerable perspective to contemporary knowledge of these ecologically important species and this highly valued marine ecosystem (cf. Jackson, et al. 2001; Lotze and Worm 2009; Pitcher 2005).

The occurrence of marine mammal bones in archaeological contexts reflects the direct use and long-term occupation of this region by coastal First Nations people. Such occurrences indicate that humans have been participants in this ecosystem for at least the past 10,000 years and as such, likely directly or indirectly affected the distribution, growth, behavior, and relative densities of marine mammals and their prey (cf. Crockford, et al. 2002;

⁴ This chapter has been published previously as: McKechnie, Iain and Rebecca J. Wigen (2011) *In Human Impacts on Seals, Sea Lions, and Sea Otters: Integrating Archaeology and Ecology in the Northeast Pacific*, edited by T. J. Braje and T. C. Rick, pp. 129–166. University of California Press, Berkeley. (c) 2011 by the Regents of the University of California. See preface for more information.

Etnier 2002a; Gifford-Gonzalez, et al. 2005; Lyman 2003b). In this chapter, we compile archaeological data on the distribution of pinnipeds and sea otters from archaeological assemblages along the coast of southern British Columbia. We evaluate the spatial and temporal extent of human hunting and explore the possible influence humans may have had on this aspect of the marine environment and conversely, discuss the potential significance that hunting these animals had to First Nations cultures in the region. Drawing on archaeological and ethnographic information, we ask three questions regarding the use of marine mammals by First Nations People over the past 8,000 years:

- What marine mammals did aboriginal people in Southern British Columbia most commonly utilize?
- How similar or how different are species occurrences and proportions relative to today?
- Is there evidence of specialized or regional hunting traditions and if so, what might have been the potential impacts of these activities on the ancient marine ecosystem?

Context

Recent assessments of Northwest Coast archaeology have emphasized the need to adopt a regional approach to characterizing patterns of aboriginal resource use (Butler and Campbell 2004; Cannon 2001). In discussing the role of salmon on the central Northwest Coast, Cannon (2001:185) has noted that:

“More important than improved recovery and analysis of fish remains from individual site locations is the pressing need to expand research strategies beyond the individual sites to encompass a variety of site locations within specific regions. This is the only way to gain a better appreciation of the extent of regional, seasonal, and longer-term temporal variability in the focus and intensity of local fisheries.”

Although Cannon's suggestion is directed towards the archaeological assessment of fisheries, it is broadly applicable to archaeological research on the Northwest Coast. To date, only a few regional studies of indigenous resource use have been conducted (Butler and Campbell 2004; Crockford, et al. 2002; Hanson 1991; Hanson and Kusmer 2001; Hebda and Frederick 1990; Hobson and Driver 1989; Moss 2008; Orchard and Clark 2005). These efforts have provided a host of insights but have been hindered by the small number of published zooarchaeological studies, a methodological concern on sampling adequacy and taxonomic identification, and a focus on characterizing the 'full range' of animal consumption including birds, fish, mammals, and shellfish (e.g., Croes and Hackenberger 1988; Driver 1993; Hanson 1991; Mitchell 1990a). Additionally, many of these studies have focused on demonstrating quantitative differences in tabular form making it difficult to assess the potential continuity and spatial associations between adjacent sites and regions.

In this chapter, we adopt an explicitly spatial approach to examining the archaeological expression of aboriginal hunting practices in southern British Columbia, focusing specifically pinnipeds and sea otters. We explore compositional patterns using zooarchaeological assemblage data from 75 temporally distinct assemblages from 58 sites spanning the past 8,000 years. We group assemblages into four broad temporal categories variously corresponding to broadly defined archaeological cultural historical 'periods' (300–1,200; 1,200–2,400; 2,400–5,000; 5,000–8,000 calibrated years BP) following Lepofsky et al. (2005; 2007) and Ames and Maschner (1999). These data provide context for considering the regional extent and potential influence that First Nations hunting practices had on the marine and terrestrial environments of southern British Columbia.

The Modern Marine Ecosystem

Our study area includes the western and eastern coasts of southern Vancouver Island, the Gulf Islands, and the British Columbia mainland and adjacent areas on the Olympic Peninsula in Washington State (approximately 40,000 km², Figure 3.1). This region is temperate with occasional winter snowfall at sea level, high annual rainfall on western Vancouver Island (260-340 cm), and much lower rainfall on southeastern Vancouver Island and the Gulf Islands (70-110 cm) (Environment Canada 2009). The terrestrial environment is heavily forested with the densest forest cover on western Vancouver Island. The least densely forested areas are on southeastern Vancouver Island and the Gulf Islands, which contains patchy oak savanna woodlands and prairies with evidence of anthropogenic fire regimes extending back at least 2,000 years (Brown and Hebda 2002).

The waters of the Strait of Georgia are heavily influenced by the seasonal input of freshwater from the Fraser River and other major rivers (Thomson 1981). Marine primary productivity is further influenced by nutrient-rich deep-water drawn into the Strait of Juan de Fuca from the north flowing California counter-current. This hyper-saline and oxygenated water is vertically mixed by the strong tidal currents in the Gulf Islands at which point this mixed surface water then flows back out the strait and northwards along the outer coast of Vancouver Island (Thomson, et al. 2007). The greatest annual primary productivity in the study area occurs off the coast of southwestern Vancouver Island (Ware and Thomson 2005), but strongly increases during Summer when wind-driven upwelling and prolonged sunlight along the continental shelf break facilitate massive blooms of plankton attracting a host of marine predators (Allen, et al. 2001).

The contemporary distribution of pinnipeds on the southern British Columbia coast is represented by six species occupying a range of habitats and exhibiting seasonal fluctuations in abundance (Table 3.1). Harbor seals (*Phoca vitulina*) are the most numerous and ubiquitous species which are present year-round (Department of Fisheries and Oceans Canada 2010). Northern fur seals (*Callorhinus ursinus*) are slightly more abundant but do not come ashore and are found almost exclusively on the continental shelf off western Vancouver Island, primarily between December and May (Olesiuk 2009b:57). Steller Sea lions (*Eumetopias jubatus*) while resident year-round, do not have rookeries in the study area and are only seasonally present in the Strait of Georgia during Winter and Spring (Bigg 1988; Olesiuk 2009a). California sea lions (*Zalophus californianus*) are present in lesser numbers, and elephant seals (*Mirounga angustirostris*) migrate to the southern BC coast seasonally (Table 3.1). Elephant seals have recently established a year-round haul-out on Race Rocks on the southern tip of Vancouver Island where at least two elephant seals pups have been born in 2009 and 2010 (Racerocks.com 2010).

The contemporary British Columbia sea otter population consists of 4,182 animals (Nichol, et al. 2009), which have increased from a re-introduced population of 89 animals transported from the Aleutian Islands to northern Vancouver Island in between 1969-1972 (Bigg and MacAskie 1978). This population has been increasing annually at a rate of 15% but has yet to entirely re-colonize its former habitat (Nichol, et al. 2009). A recent population reconstruction (Gregg, et al. 2008), incorporating habitat characteristics and contact-era (ca. AD 1774-1825) fur trade records, suggests that the British Columbia coast may have once supported a population of between 34,000 and 74,000 otters. Interestingly, this estimate

excludes the Strait of Georgia due to the absence of sea otters in published archaeological assemblages (i.e., Hanson and Kusmer 2001).

Until 1970, the federal Department of Fisheries and Oceans supported ‘population control’ programs, which offered incentives to reduce pinniped populations (particularly Harbor seals and Steller sea lions) (Jeffries, et al. 2003; Olesiuk 2009a). These controls ended when the marine mammal protections were implemented in 1970 (Olesiuk 2009b). Since this time, Harbour seal populations have increased dramatically from 10,000 animals to 105,000 animals (Department of Fisheries and Oceans Canada 2010). Harbour seals in particular were viewed as competitors with human fisheries, especially salmon, despite the fact that the bulk of their prey is composed of non-salmonids (Olesiuk, et al. 1990).

Historic Changes to the Marine Ecosystem

Marine mammals, particularly the trade of their highly valued pelts, were central throughout the process of early historic contact between First Nations and Europeans on the Northwest Coast of North America (Fisher 1977; Lutz 2008). Sea otters, fur seals, and then whales sequentially became the focus of international commercial industries, which rapidly diminished these culturally and ecologically significant animals over several decades. The corresponding impact of the sudden removal of these ecologically important animals is poorly known (due in part to the paucity of archaeological data and lack of long-term ecological studies) and this issue is a contemporary research concern for ecologists and managers throughout northern Pacific (e.g., Misarti, et al. 2009; Springer, et al. 2003).

The early ‘contact period’ on the Northwest Coast (ca. AD 1774-1812) focused on the trade of sea otter pelts obtained from the western coast of Vancouver Island as well as the

northern and central British Columbia Coast (Busch and Gough 1997; Dick 2006). Sea otter pelts were recognized as wealth items and chiefly regalia within aboriginal communities prior to contact with European trading vessels. Aboriginal exchange of pelts for highly valued European trade goods was therefore immediately incorporated into the indigenous economy and caused a large expansion of this particular hunting activity (Dick 2006; Lutz 2008). Over a few decades, the burgeoning trade led to an increasing scarcity of sea otters and increasing conflict between European and American traders and First Nation communities. European trading ships ceased to seek sea otter pelts on the southern British Columbia coast after 1812 following a series of dramatic incidents involving the destruction of European ships and crew as well as reprisal attacks on aboriginal villages (e.g., McMillan 1999:188).

After a period of several decades of infrequent interaction, the European colonial presence on the coast increased substantially during the mid 19th century. In the 1880's through the early 1900's, commercial demand for seal pelts in the European market fueled a commercial sealing industry, which targeted northern fur seals off British Columbia Coast and Washington State (Crockford 1996). Dozens of schooners operating out of Victoria and Seattle employed hunters from First Nations communities on western Vancouver Island and the Olympic peninsula to travel offshore where hunters would launch traditional dugout canoes and use harpoons to approach and capture fur seals 'sleeping' in the surface waters (Swan 1883). In 1880 alone, over 12,000 fur seals were harvested off the coast of Vancouver Island (Swan 1887:397). Growing international pressure concerning the declining stocks of fur seals at their breeding grounds in the Bearing Sea in the late 19th century (Elliott 1886)

eventually resulted in one of the first international treaties protecting marine wildlife in 1911, and ended the commercial harvest of fur seals in Canadian waters (Gay 1987).

Also during this time, a nascent whaling industry developed on the British Columbia coast during the mid 19th century but expanded significantly after 1905, regionally diminishing whale populations, particularly sperm whales (*Physeter macrocephalus*), fin whales (*Balaenoptera physalus*), and humpbacks (*Megaptera novaeangliae*) (Gregr, et al. 2000). Non-migratory populations of humpback whales residing in coastal inlets were among the first whales targeted (Merilees 1985; Webb 1988). Whaling continued on the British Columbia coast until it was halted in 1967.

Historic Changes Among Coastal First Nations

The dramatic changes described above occurred in the context of tumultuous and tragic social, economic, and demographic changes within aboriginal communities over the last two centuries. Particularly devastating were introduced diseases (particularly smallpox and measles), which swept through the coastal population in the 1790's and later in the 1850's and 1860's (Boyd 1999). These epidemics severely reduced the aboriginal population and correspondingly destabilized the highly structured social and political networks and dramatically reduced the scale and extent of the aboriginal subsistence economy. A large influx of European and Asian colonists in the mid to late 19th century introduced a host of new opportunities and challenges for sustaining and generating wealth in aboriginal communities. Many aboriginal people began to participate in the developing wage economy in forestry, fisheries, and agriculture on a seasonal basis (Lutz 2008). Among the highest wages were those offered to aboriginal hunters employed in the fur seal industry who earned

seasonal incomes well above European counterparts (Lutz 2008). This industry persisted until the 1911 international fur seal treaty between America, Japan, Russia and Canada mandated a halt to this once central economic activity.

Also during the late 19th century, anthropological fieldworkers began to document aboriginal peoples of the coast (e.g., Boas 1887). Numerous researchers compiled painstakingly detailed description and oral historical accounts of aboriginal lifeways including marine mammal hunting practices and rituals associated with hunting (e.g., Sapir and Swadesh 1939; Waterman 1920). Whaling was a particularly honored tradition among Nuu-chah-nulth peoples on the west coast of Vancouver Island and Makah peoples on the Olympic Peninsula (McMillan 1999) but sealing was also a respected skill in coastal aboriginal communities on both the east and west coasts of Vancouver Island (Drucker 1951; Elmendorf 1960; Suttles 1952). Hunters were typically chiefs or men of high status who underwent elaborate ritual and physical preparation (Arima 1988; Drucker 1951; Elmendorf 1960:86; Suttles 1952; Waterman 1920). Hunter's wives were obligated to observe ritual practices prior to and during the hunt and contributed to labor to butchering and cooking as well as preparing materials which comprised all aspects of hunting technology (e.g., preparing sinew, seal skin floats, cedar bark rope, etc.). Hunting took place from dugout canoes using harpoon technology with seal-skin floats or from land using clubs. A host of historic and ethnographic accounts are available for further investigating hunting practices and techniques, some of which are described further in the sections below.

Methods

To investigate the regional expression of marine mammal hunting practices, we compiled available zooarchaeological data from academic papers, graduate student theses,

and provincially reviewed archaeological permit reports on file at the British Columbia Archaeology Branch in Victoria or federally reviewed reports on file with Cultural Resource Management Services Division of Parks Canada (Calgary, AB) (Table 3.2). All sites are within 500 m of the coastline or along the banks of lower Fraser River (a major tidally influenced river draining into the Strait of Georgia). Sites that are more than 500 m from the ocean ('inland' sites) are not included in the present analysis because they have not been investigated to the same degree as shoreline shell midden sites and generally contain poorly preserved faunal assemblages.

All assemblages included in the analysis are from pre-contact archaeological deposits (ca. > AD 1774) and date to within the past 8,000 years. However, the majority of the assemblages date to the last 2,400 years. Most sites in the study sample (>90%) are from deposits which have been radiocarbon dated. Assemblages without radiocarbon ages are either from the upper layers of ethnographically identified village locations (assumed to date within the past 1,200 years) or are associated with temporally diagnostic artifact assemblages. To enable comparability between regions, we collapse assemblages into one of four broad temporal categories (300–1,200; 1,200–2,400; 2,400–5,000; 5,000–8,000 calibrated years BP, Table 3.2).

Table 3.1 Ecological characteristics for pinnipeds and sea otters in British Columbia.

Common Name	Northern Fur Seal	Harbour Seal	Steller Sea Lion	California Sea Lion	Elephant Seal	Sea Otter
Species	<i>Callorhinus ursinus</i>	<i>Phoca vitulina richardsi</i>	<i>Eumetopias jubatus</i>	<i>Zalophus californianus</i>	<i>Mirounga angustirostris</i>	<i>Enhydra lutris</i>
Mean Female Wt. (kg)	35-45	58	200-300	94	650	44
Mean Male Wt. (kg)	100-200	72.5	400-800	375	1800	33
Modern Period of Pup Dependency	7-8 months	One month	12-24 months	12-24 months	One month	5-8 months
Modern Birthing Season, Location	July – Nov., Bearing Sea - California	May - June, Throughout BC	May - June, N BC	May – July, California Oregon	Dec -March, California & Mexico	Year-round with peak in Spring
Modern Seasonal Occurrence in	March - June, with peak in May	Resident in BC year round	Resident in BC year round	Year round with peak Oct – May	Recently present year-round	Resident year-round
Prevalence in Archaeological Sites in Southern BC	Ubiquitous on western Vancouver Island	Ubiquitous	Common	Rare	Rare but increasing	Present on Western VI, rare/absent on Eastern VI
Estimated Contemporary Population in BC (2000-2010)	123,000	105,000	18,400-19,700	2,000-3,000	Fewer than 100	4,712
Management Status in Canada	Threatened	Not at Risk	Special Concern	Not at Risk	Not at Risk	Special Concern
IUCN Red List Status (2009)	Vulnerable	Least Concern	Endangered	Least Concern	Least Concern	Endangered
References	(Banfield 1974; Department of Fisheries and Oceans Canada 2007:5)	(Baird 2001: 668; Olesiuk 1999: 28)	(COSEWIC 2003)	(Bigg 1985:17; Hancock 1970; NOAA Fisheries Service 2009)	(Stewart 1999: 217-218)	(Estes 1999:182; Nichol, et al. 2009)

Zooarchaeological assemblages included in the analysis were identified using comparative osteological collections based at large universities in the region (e.g., Simon Fraser University, University of British Columbia, University of Victoria, and Washington State University) and/or at the Royal BC Museum in Victoria (RBCM). Individual bone specimens were identified to the lowest taxonomic level possible on the basis of their morphological similarity to comparative specimens. A majority of analyses have been

conducted by or with the consultation of a few individuals who have a long history of work in the region (e.g., Susan Crockford; Jon Driver; Gay Frederick [formerly Calvert & Boehm]; Gregory Monks; Rebecca Wigen). Researchers at the University of Victoria and the RBCM have assembled a comprehensive comparative collection of vertebrates in the North Pacific including marine and terrestrial mammals from multiple individuals of different age and sex classes. Other universities have less comprehensive collections, but include common mammals like deer and harbor seal. Identification and quantification criteria have been reviewed and standardized for consistency. For identifications that appear questionable, as in the case of northern fur seals identified from Burrard Inlet in North Vancouver (i.e., Galdikas-Brindamour 1972), revised assessments of earlier identifications are used (i.e., Trost 2005).

Faunal remains from the majority of sites included in the analysis were recovered from controlled excavations using standard 1/4" (6.35 mm) mesh. However, in one instance of salvage data recovery, mammal bones were collected by hand from excavated sediments (Site 46, Table 3.2). Mammal remains recovered from fine mesh bulk samples were not included in the analysis due to the small sample sizes and their lack of comparability with fauna from larger volumes of excavated sediment. In most cases, mammal bones were not recovered or were in very low numbers in these fine mesh bulk samples.

Faunal identification data are quantified by number of identified specimens (NISP), which includes individual skeletal elements or fragments that can be confidently attributed to taxonomic categories of family, genus, or species level designation (e.g., cervidae, deer, or mule deer). Highly fragmented remains that cannot be confidently assigned to family, genus, or species level are not included in the analysis (e.g., unidentified sea mammal).

Quantification of relative abundance is evaluated by comparing the percentage of identified specimens (NISP) from individual taxonomic categories to all other positively identified specimens (e.g., %NISP of pinnipeds).

Species or genus-specific taxonomic identifications are shown in Table 3.2 but for the purpose of this analysis, specimens have been lumped into larger categories of ‘marine’ and ‘terrestrial’ mammals. The marine category includes all pinnipeds (seals and sea lions), delphinids (porpoises, dolphins), and sea otters. River otters (*Lontra canadensis*) are also included in the marine mammal category, as they inhabit coastal waters throughout the study area (Banfield 1974). Whales have been excluded due to the highly fragmentary nature of these large elements, which make identification and quantification problematic (Huelsbeck 1988; Monks 2001). Canids and domestic dogs (the only domesticated animal in the region) have been excluded from this analysis since it is not clear they are used for dietary consumption (Crockford 1997).

Age and sex classification (based on epiphyseal fusion, eruption and wear of teeth) is not consistently recorded for most of the assemblages in this study. However, sex information is available for a small selection of the examined sites for adult-sized sea lions and fur seals (summarized in Table 3.3). Ideally, future analyses will examine incremental skeletal structures, such as growth lines in non-deciduous teeth as well as measuring the dimensions of diagnostic elements, which has been published for a handful of sites (e.g., Crockford, et al. 2002; Etnier 2002b).

The compiled assemblage data have been entered into to a geographic information system (GIS) and plotted over a series of geospatial layers depicting the major river drainages, the terrestrial topography and the 200 and 500 m bathymetric contour lines (Figure

3.2). Mammalian fauna from individual sites are represented as pie charts showing the relative abundance of mammals for different taxonomic categories. Our analysis examines the differences in the relative composition between marine and terrestrial mammals for all sites and time periods and then examines species-specific patterns for marine mammals.

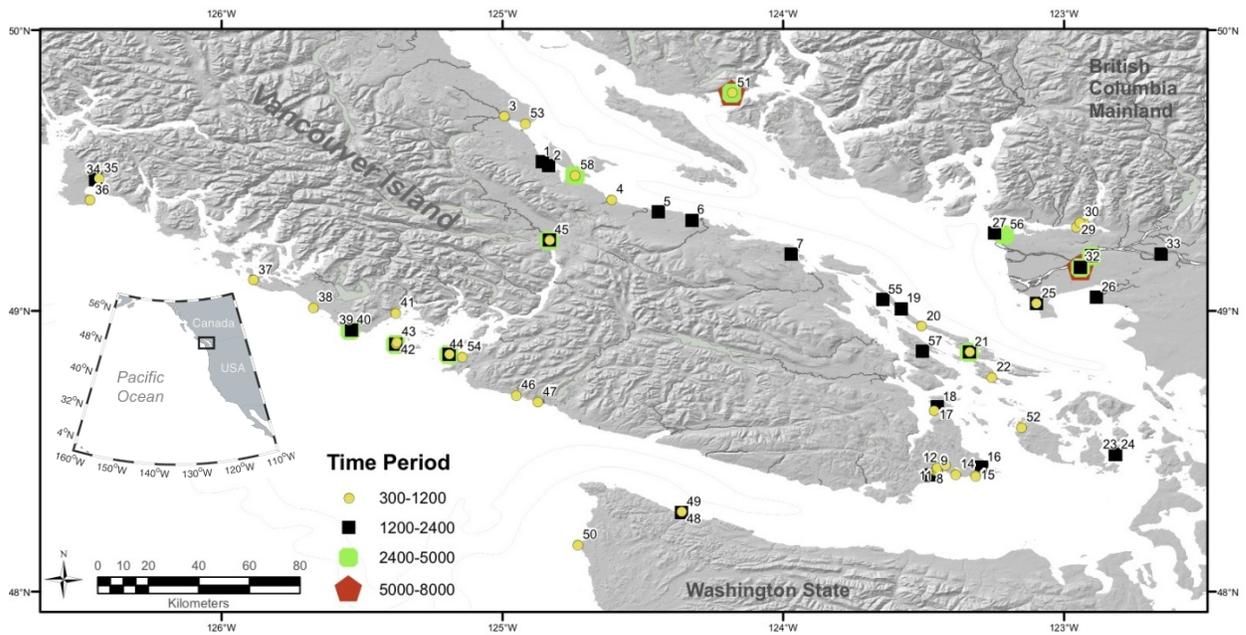


Figure 3.1. Map of the study area showing the distribution of archaeological assemblages used in the analysis and their chronological age-range.

Results

Seventy-five temporally distinct assemblages from 58 archaeological sites are included in this analysis, representing a combined total of 67,500 mammalian skeletal specimens (Table 3.2). Fifty-one assemblages are from the Strait of Georgia region, 21 are from the west coast of Vancouver Island, and three are from the Olympic Peninsula in Washington State. Site distribution is relatively more concentrated in areas impacted by modern development and sparse in other areas, particularly north of the city of Vancouver and along on southwestern Vancouver Island (Figure 3.1). Slightly more than half of the sites

(53%, N=31) were excavated as part of academically driven research projects while the remainder were cultural resource management projects mandated under heritage legislation in the province of British Columbia. The most recent temporal period (ca. 300-1200 cal BP) contains the greatest number of assemblages (N=36) and this progressively decreases with assemblage age (1200-2400 cal BP, N=26; 2400-5000, N=11; 5000-8000, N=2). This trend reflects a sampling bias towards younger sites associated with modern sea levels and a lack of research devoted to locating and sampling earlier Holocene archaeological assemblages (cf., Fedje, et al. 2004; 2011b). Nine sites span multiple temporal periods whereas the remaining sites fall into one of the four broadly defined temporal periods (Table 3.2). Assemblage size (NISP) ranges widely from a low of five mammalian elements (Site 38) to a high of 51,937 (Site 50) but over 70% of the assemblages have more than 50 identified specimens. The largest assemblage from Ozette (Site 50), was the product of a decades-long collaborative project between the Makah tribe and a team of archaeologists from Washington State University (Huelsbeck 1994; Samuels and Daugherty 1991). Sites with small assemblages (< 50 NISP) are included in the analysis as they represent additional locations with confidently identified taxonomic information.

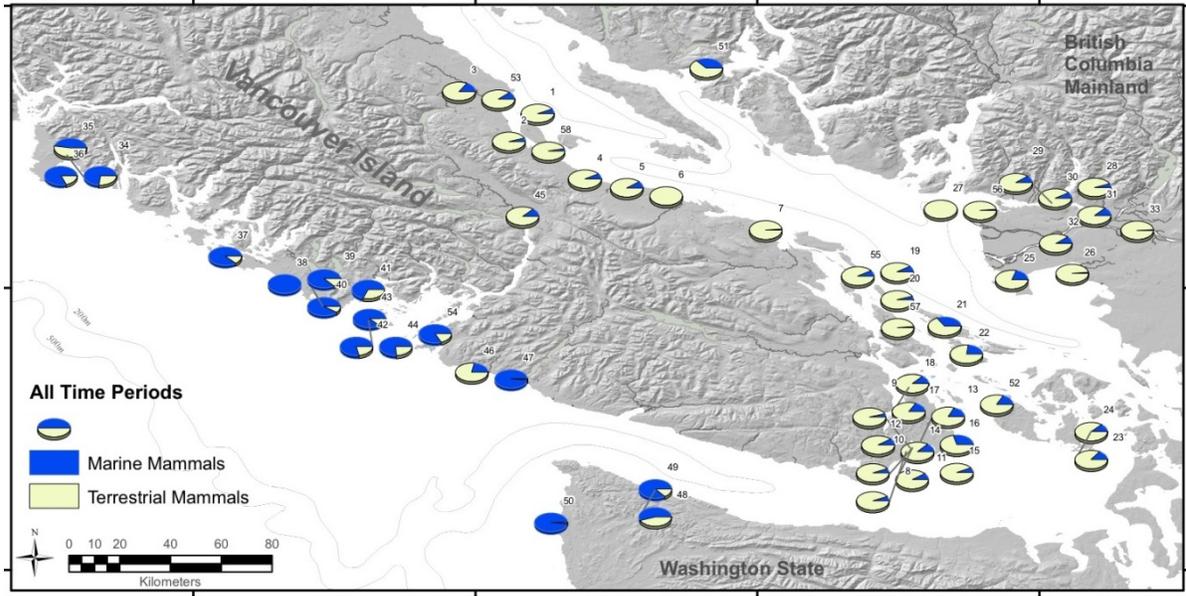


Figure 3.2. Relative composition of marine and terrestrial mammals (%NISP) for all sites in the study area (n=58). Chronologically distinct periods have been combined in this figure.

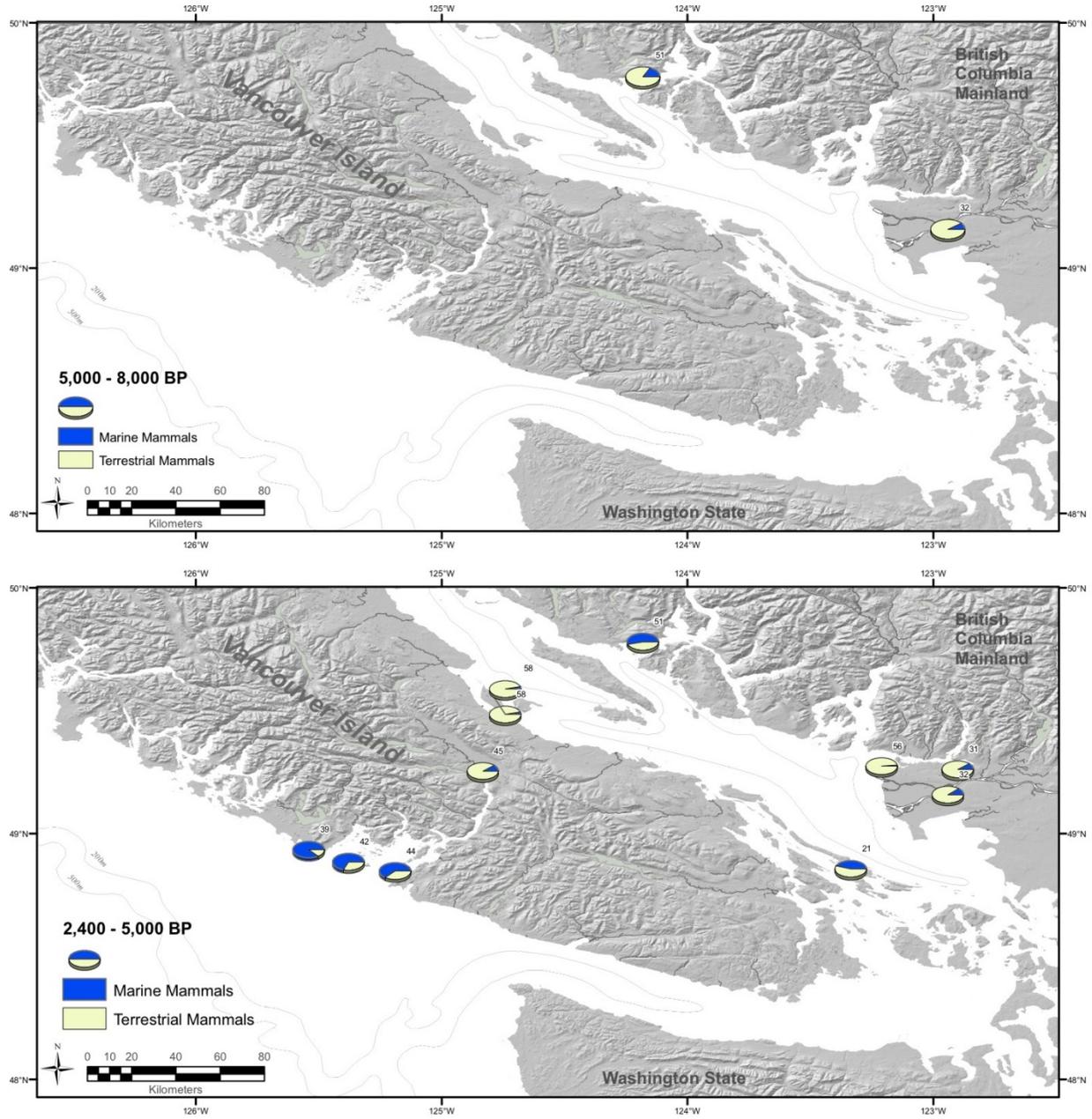
Spatial and Temporal Patterning

Figure 3.2 illustrates the relative abundance of marine and terrestrial mammals among all examined assemblages spanning the past 8,000 years and shows a sharply defined regional difference in the use of marine mammals and terrestrial mammals between the west and east coasts of Vancouver Island. Sites in the Strait of Georgia show remarkable consistency, with terrestrial mammals comprising the majority of all mammalian assemblages. Sites on western Vancouver Island in contrast, are composed, primarily, of assemblages with more than 75% marine mammals (Figure 3.2). Notable exceptions to this pattern occur at two sites on western Vancouver Island, which contain a higher percentage of terrestrial than marine mammals. One of these sites is a rockshelter in a sheltered area of Hesquiat Harbour (Site 35) and the other is located on a highly exposed linear coastline near a river that is navigable for 10 km upstream but where the surf makes it hazardous to launch canoes in most conditions (Site 46). In the Strait of Georgia, sites that show the greatest

percentage of marine mammals are in the Gulf Islands and the Saanich and Tsawwassen peninsulas (Sites 15-18, 21-24). Sites situated on the east coast of Vancouver Island show a consistently low relative percentage of marine mammals relative to elsewhere in the Gulf of Georgia. Shoemaker Bay (Site 45), a site at the head of an inlet, which deeply incises the western coast of Vancouver Island, has an assemblage dominated by terrestrial mammals that appears more similar to eastern Vancouver Island assemblages. Saltery Bay (Site 51), a multi-component site in the north of the study area, shows a notably high percentage of marine mammals relative to other sites in the Strait of Georgia.

Figure 3.3 depicts the chronological sequence of the relative composition of marine and terrestrial mammals over the four distinct time periods. Terrestrial mammals represent a majority of the two earliest assemblages in the Strait of Georgia and this pattern follows in subsequent time periods with the notable exception of Saltery Bay (Site 51). Similarly, sites on western Vancouver Island have a majority of marine mammals and this is consistently represented over the three temporal periods with available data (Figure 3.3). These persistent compositional patterns in regionally distributed mammal assemblages indicate remarkable continuity over long periods of time. However, temporal trends within particular sites are also apparent, although more subtle. Some individual sites have suggestive chronological changes in the relative composition of marine versus terrestrial mammals. For instance, Helen Point (Site 21) shows a relative decrease in marine mammal composition over three successive time periods which speculatively correlates with greater terrestrial mammal composition on southeastern Vancouver Island (Sites 8-18). In contrast, sites on southwestern Vancouver Island and Washington State appear to show a progressive increase in marine mammal percentages over the three time periods (sites 34-50). While these trends

are suggestive of regionalized subsistence economies, it is not within the scope of this paper to evaluate each of these possible local patterns in detail.



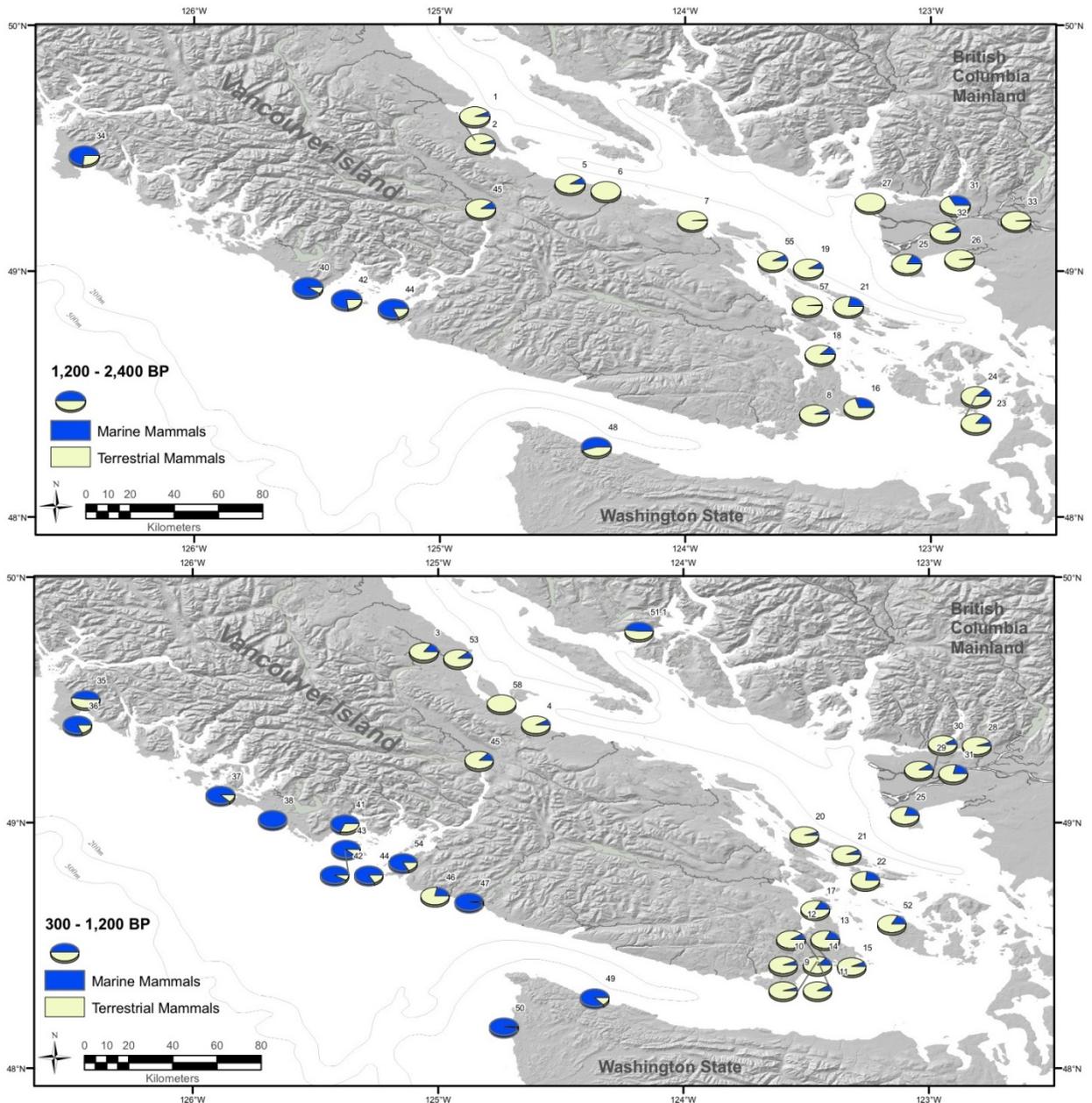
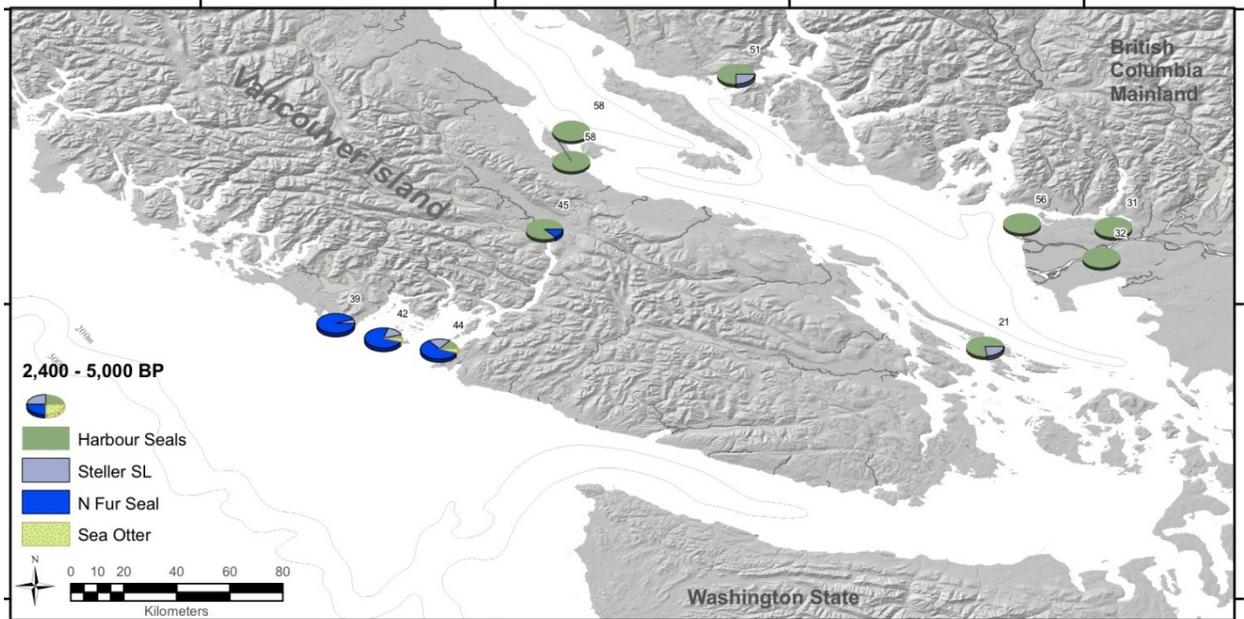


Figure 3.3. Relative composition of marine and terrestrial mammals (%NISP) for all sites in the study area according to temporal period.

Figure 3.4 shows the same temporal sequence of analyses shown in Figure 3.3, but depicts only the relative composition of three most common pinniped species (harbour seal, Steller sea lion, northern fur seal) and sea otter. This analysis purposefully excludes terrestrial and cetacean (delphinid) specimens, which correspondingly reduces sample size

and alters the representation of relative percentage (i.e., %NISP refers to just these species). Nevertheless, this analysis indicates that assemblages on western Vancouver Island are predominantly composed of northern fur seal, followed by Steller sea lion and harbor seal. Northern fur seals are strikingly absent from all sites in the Strait of Georgia and harbor seals predominate the marine mammal assemblages in the Strait of Georgia followed distantly by Steller sea lions. Sea otters are present at eight sites on western Vancouver Island and Washington and comprise substantial proportions of four of these assemblages (Sites 34, 36, 44, & 45). Sea otters are present at five sites in the Strait of Georgia dating to between 2400 and 300 yr BP (Sites 13, 23, 52, and 53), which contrasts with the findings of Hanson and Kusmer (2001) who observed a near absence of sea otters in this region. Where sea otters are present, they represent small proportion of the assemblages except for one small marine mammal assemblage (NISP=4), which is composed entirely of sea otter (Site 13). Steller sea lions also are present at sites on southern and western Vancouver Island but are found in greater densities on western Vancouver Island and in lower percentages along the Strait of Georgia (Figure 3.3).

California sea lions are identified in only six sites in the study area, all on the exposed Pacific coast (Table 3.2). Elephant seals are similarly present in small numbers at four sites in the western portion of study area (Sites 41, 42, 48, and 49). Guadalupe fur seals, whose skeletal morphology closely resembles the northern fur seal (Etnier 2002b), are only identified at one site, which also has the largest identified assemblage (Ozette, Site 50).



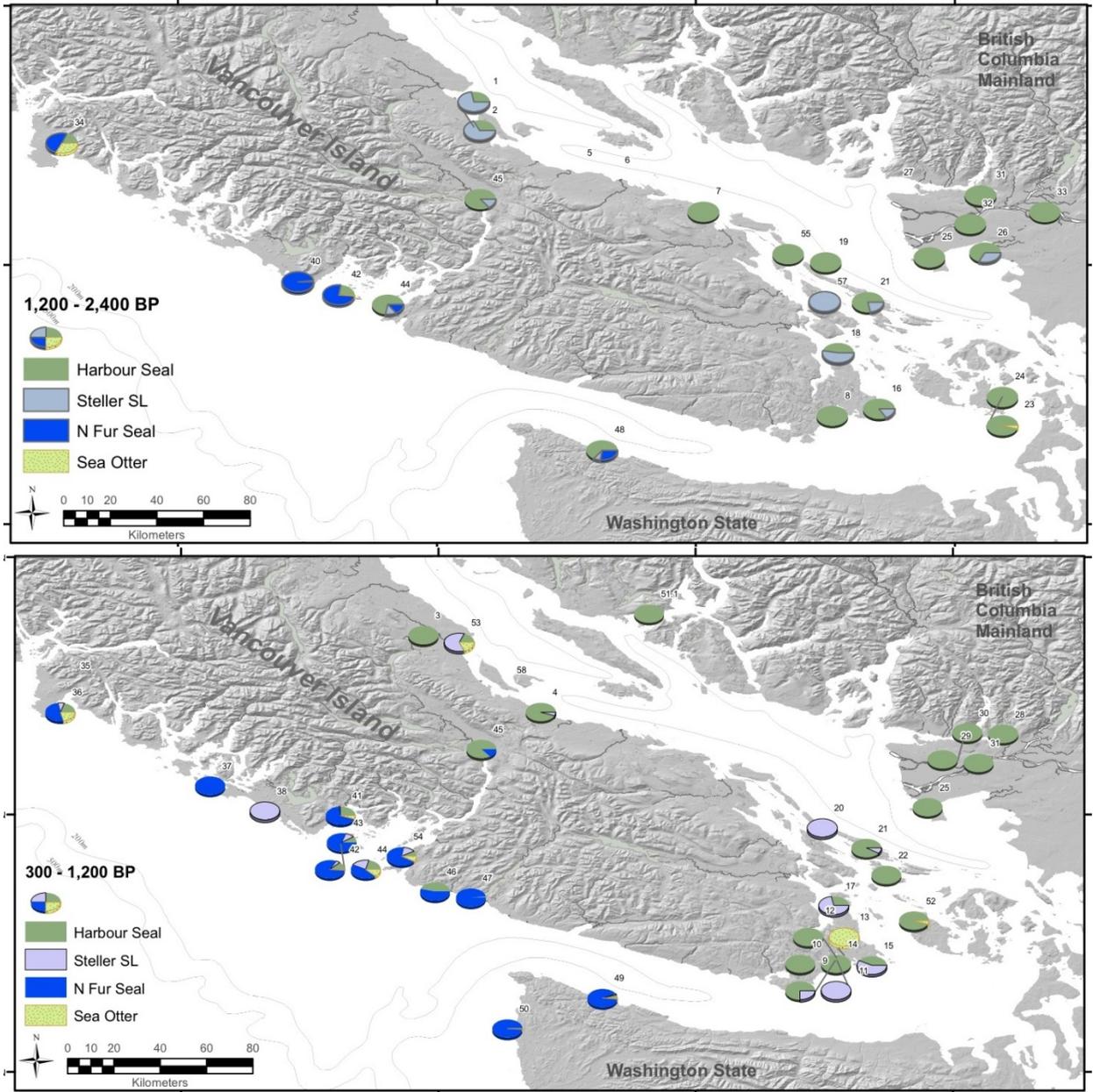


Figure 3.4. Relative abundance of marine versus terrestrial mammals for sites dating to within the four examined periods (5000-8000, 2500-5000, 1200-2500 and 300-1200 BP).

Table 3.2 Site Names, Locations, References, and Number of Identified Specimens (NISP) used in the analysis. All Mammal totals exclude whales and domestic dogs and canids.

No.	Region*	Site #	Period	Site Name	Reference	Harbor S.	Steller SL	N Fur Seal	C. Sea Lion	Guadelupe Fur Seal	Elephant seal	Sea Otter	Terrestrial Mammals	All Mammals
1	ecVI	DjSf-13	1200-2400	Buckley Bay	Wigen 1980	4	10	0	0	0	0	0	221	235
2	ecVI	DjSf-14	1200-2400	Tsable River	Wigen 1980	2	4	0	0	0	0	0	194	203
3	ecVI	DkSg-2	300-1200	Sandwich midden	Wigen 1980 citing Capes,1964	3	0	0	0	0	0	0	64	75
4	ecVI	DiSc-1	300-1200	Little Qualicum River	Bernick and Wigen 1990	18	1	0	0	0	0	0	243	263
5	ecVI	DiSc-26	1200-2400	Qualicum Beach Golf Course	Willows et al. 2008	0	0	0	0	0	0	0	10	11
6	ecVI	DhSb-3	1200-2400	Dogwood St., Parksville	Wilson et al. 2006	0	0	0	0	0	0	0	12	12
7	ecVI	DhRx-16	1200-2400	Departure Bay	Wilson and Crockford 1994:118	6	0	0	0	0	0	0	733	743
8	scVI	DcRu-74	1200-2400	Esquimalt lagoon Wet site	McKechnie, 2004:51, Table 19	3	0	0	0	0	0	0	63	67
9	scVI	DcRu-2	300-1200	Esquimalt Lagoon	Hanson 1991:Table 6 citing Stevenson 1978	9	3	0	0	0	0	0	254	266
10	scVI	DcRu-2	300-1200	Esquimalt/ Ft Rodd Hill	Crockford, 1997b	17	0	0	0	0	0	0	337	358
11	scVI	DcRu-78	300-1200	Ft Rodd Hill	Mitchell 1981	0	5	0	0	0	0	0	88	96
12	scVI	DcRu-136	300-1200	Esquimalt Harbour	Wigen 2002	5	0	0	0	0	0	0	53	58
13	scVI	DcRu-4	300-1200	Kosapsom	Stewart and Wigen 2003	0	0	0	0	0	0	4	19	23
14	scVI	DcRu-75	300-1200	Dallas Road	Wilson et al. 2003:Table 28	14	0	0	0	0	0	0	126	143
15	scVI	DcRt-16	300-1200	King George Terrace	Wilson et al. 2004:107, Table 38	3	4	0	0	0	0	0	111	119
16	scVI	DcRu-71	1200-2400	Eagles Nest	Eldridge 2000:40	11	2	0	0	0	0	0	54	77
17	scVI	DdRu-18	300-1200	Eventide Rd.	Weathers et al. 2007:29, Table 6	2	5	0	0	0	0	0	37	44
18	scVI	DdRu-5	1200-2400	Patricia Bay	Kanipe et al. 2006:264, Table 46	9	10	0	0	0	0	0	145	165

No.	Region*	Site #	Period	Site Name	Reference	Harbor S.	Steller SL	N Fur Seal	C. Sea Lion	Guadelupe Fur Seal	Elephant seal	Sea Otter	Terrestrial Mammals	All Mammals
19	Gulf Is	DgRu-3	1200-2400	Dionisio Point	Ewonus, 2006:39, Table 2	3	0	0	0	0	0	0	88	96
20	Gulf Is	DfRv-106	300-1200	Galiano Island	Mason et al. 1995:21, Table 4	0	1	0	0	0	0	0	20	21
21.1	Gulf Is	DfRu-8	300-1200	Helen Point	Boucher, 1976: Assemblages 12 ,13, & 14	12	1	0	0	0	0	0	180	194
21.2	Gulf Is	DfRu-8	1200-2400	Helen Point	Boucher, 1976: Assemblages 5 & 6	18	5	0	0	0	0	0	93	119
21.3	Gulf Is	DfRu-8	2400-5000	Helen Point	Boucher, 1976: Assemblages 1, 2, 3, & 4	187	54	0	0	0	0	1	360	664
22	Gulf Is	DhRt-1	300-1200	Pender Canal	Hanson, 1995:34	62	0	0	0	0	0	0	406	525
23	Gulf Is	45SJ169	1200-2400	Decatur Island-169	Lyman, 2003	24	0	0	0	0	0	1	154	179
24	Gulf Is	45SJ165	1200-2400	Decatur Island-165	Lyman, 2003	10	0	0	0	0	0	0	77	87
25.1	Mnlnd	DgRr-2	300-1200	Tsawwassen	Butler & Campbell 2004:353, citing Kusmer, 1994	4	0	0	0	0	0	0	16	20
25.2	Mnlnd	DgRr-2	1200-2400	Tsawwassen	Butler & Campbell 2004:353, citing Kusmer, 1994	1	0	0	0	0	0	0	5	6
26	Mnlnd	DgRr-1	1200-2400	Crescent Beach	Hanson 1991:Table 6, citing Ham 1982	2	1	0	0	0	0	0	805	820
27	Mnlnd	DhRr 18	1200-2400	Point Grey	Coupland 1991:89	0	0	0	0	0	0	0	16	16
28	Mnlnd	DhRr-6	300-1200	Belcarra (<i>Tum-tu-may-whueton</i>)	Trost 2005:116 citing Charlton 1977:226 &Galdikas-Brindamour 1972	10	0	0	0	0	0	0	227	239
29	Mnlnd	DhRr-8	300-1200	Cates Park (<i>Whey-Ah-Wichen</i>)	Trost 2005:116 citing Williams 1974	14	0	0	0	0	0	0	227	251
30	Mnlnd	DhRr-18	300-1200	Cove Cliff (<i>Say-Umiton</i>)	Trost 2005:112	7	0	0	0	0	0	0	123	133
31.1	Mnlnd	DgRr-2	300-1200	St. Mungo - late	Boehm 1973: Table VIII	4	0	0	0	0	0	0	15	19
31.2	Mnlnd	DgRr-2	1200-2400	St. Mungo - mid	Boehm 1973: Table VIII	3	0	0	0	0	0	0	6	9
31.3	Mnlnd	DgRr-2	2400-5000	St. Mungo - early	Boehm 1973: Table VIII	23	0	0	0	0	0	0	212	235
32.1	Mnlnd	DgRr-6	1200-2400	Glenrose Cannery-late	Imamoto 1976: Table 2.1	6	0	0	0	0	0	0	70	76
32.2	Mnlnd	DgRr-6	2400-	Glenrose Cannery-	Imamoto 1976: Table 2.1	23	0	0	0	0	0	0	193	216

No.	Region*	Site #	Period	Site Name	Reference	Harbor S.	Steller SL	N Fur Seal	C. Sea Lion	Guadelupe Fur Seal	Elephant seal	Sea Otter	Terrestrial Mammals	All Mammals
			5000	mid										
32.3	Mnld	DgRr-6	5000-8000	Glenrose Cannery-early	Imamoto 1976: Table 2.1	3	0	0	0	0	0	0	32	35
33	Mnld	DhRp-17	1200-2400	Port Hammond	Rousseau et al. 2003:101	3	0	0	0	0	0	0	264	267
34	wcVI	DiSo-9	1200-2400	Hesquiat DiSo9Combined	Calvert 1980: Tables 43 & 47	38	1	100	2	0	0	68	88	328
35	wcVI	DiSo-16	300-1200	Hesquiat rockshelter	Calvert, 1980: Table 39	0	0	0	0	0	0	0	66	126
36	wcVI	DiSo-1	300-1200	Hesquiat Village combined	Calvert, 1980: Tables 51, 55, 59, 63, & 67	86	41	228	29	0	0	90	155	844
37	wcVI	DgSI-67	300-1200	Chesterman Beach	Wilson 1994: Table 5	0	0	25	12	0	0	0	6	52
38	wcVI	DgSk-1	300-1200	Long Beach	Wigen, 2003: Table 2	0	1	0	0	0	0	0	0	5
39	wcVI	DfSj-100	2400-5000	Little Beach	Weathers et al. 2008; Wigen, 2008: Table 5	0	1	19	0	0	0	0	3	25
40	wcVI	DfSj-57	1200-2400	Spring Cove, Ucluelet	Spady& Wigen 2008: Table 15	1	0	49	0	0	0	0	5	57
41	wcVI	DfSi-5	300-1200	Ma'acoah	Monks 2006:224	32	2	84	14	0	1	6	71	224
42.1	wcVI	DfSi-16+17	300-1200	Tsishaa Late	McKechnie 2007a: Tables 17 & 18, including Frederick & Crockford 2005	28	13	214	1	0	0	3	29	344
42.2	wcVI	DfSi-16+17	1200-2400	Tsishaa Mid	McKechnie 2007a: Tables 17 & 18, including Frederick & Crockford 2005	14	0	49	0	0	1	1	25	109
42.3	wcVI	DfSi-16+17	2400-5000	Tsishaa Early	McKechnie 2007a: Tables 17 & 18, including Frederick & Crockford 2005	2	7	35	0	0	0	2	131	408
43	wcVI	DfSi-26	300-1200	Clarke Island	McKechnie 2007: Tables 17 & 18	6	7	56	0	0	0	0	9	80
44.1	wcVI	DfSh-7	300-1200	Huu7ii late	Frederick et al. 2006: Tables 6, 8 & 10	21	24	46	0	0	0	12	49	298
44.2	wcVI	DfSh-7	1200-2400	Huu7ii mid	Frederick et al. 2006: Tables 6, 8 & 10	5	1	1	0	0	0	0	3	17
44.3	wcVI	DfSh 7	2400-5000	Huu7ii Early	Frederick et al. 2006: Tables 6, 8 & 10	9	16	39	0	0	0	3	65	169
45.1	wcVI	DhSe-2	300-1200	Shoemaker bay Late	Calvert and Crockford 1982:186	75	0	11	0	0	0	0	781	889
45.2	wcVI	DhSe-2	1200-2400	Shoemaker bay Mid	Calvert and Crockford 1982:186	13	2	0	0	0	0	0	182	201
45.3	wcVI	DhSe 2	2400-	Shoemaker bay	Calvert and Crockford 1982:186	7	0	1	0	0	0	0	91	101

No.	Region*	Site #	Period	Site Name	Reference	Harbor S.	Steller SL	N Fur Seal	C. Sea Lion	Guadelupe Fur Seal	Elephant seal	Sea Otter	Terrestrial Mammals	All Mammals
			5000	Early										
46	wcVI	DeSf-6	300-1200	Klanawa	McKechnie, 2007b:7	7	0	8	0	0	0	0	59	75
47	wcVI	DeSf-2	300-1200	Tsuxwkwaaada	McKechnie 2005: Table 1	3	0	185	0	0	0	0	3	191
48	WA	45CA213	1200-2400	Hoko R. Wet/Dry site	Croes 1995: 71	7	1	3	0	0	0	0	10	22
49	WA	45CA21	300-1200	Hoko R. Rockshelter	Wigen 2005: Table 4.4	114	40	2425	0	0	1	40	423	3318
50	WA	45CA24	300-1200	Ozette	Huelsbeck 1994:28 w additions from Etnier 2007:200	377	10	47296	1	34	2	501	708	51007
51.3	Strait of Georgia	DkSb-30	5000-8000	Saltery Bay	Pegg et al. 2007: Table 20	17	0	0	0	0	0	0	108	129
51.2	Strait of Georgia	DkSb-30	2400-5000	Saltery Bay	Pegg et al. 2007: Table 20	6	2	0	0	0	0	0	76	163
51.1	Strait of Georgia	DkSb-30	300-1200	Saltery Bay	Pegg et al. 2007: Table 20	3	0	0	0	0	0	0	14	27
52	Gulf Is	45-SJ-24	300-1200	English Camp	Pegg 1999:69	20	0	0	0	0	0	1	310	372
53	Strait of Georgia	DKSf-4	300-1200	Comox Harbour Site	Simonsen 1990:35, Table 11	2	7	0	0	0	0	2	262	292
54	wcVI	DfSg-2	300-1200	Aguilar House	Engish 2006:28	2	4	19	0	0	0	2	6	36
55	Gulf Is	DgRv-2	1200-2400	Shingle Point	Matson et al. 1999:61-71	4	0	0	0	0	0	0	107	116
56	MnInd	DhRt-6	2400-5000	Locarno Beach	Brolly and Muir 1993:52, Table 12, excluding 2mm mesh	1	0	0	0	0	0	0	67	68
57	Gulf Is	DfRu-3	1200-2400	Harbour House, Saltspring	Brolly et al. 1993:72, Table 8	0	1	0	0	0	0	0	127	129
58.1	ecVI	DiSe-10	300-1200	Denman - Southern Rckshltr	Eldridge 1987:5-57, Table 5-9	0	0	0	0	0	0	0	7	7
58.2	ecVI	DiSe-10	2400-5000	Denman - Northern Rckshltr	Eldridge 1987:5-59, Table 5-10	2	0	0	0	0	0	0	57	59
58.3	ecVI	DiSe-10	2400-5000	Denman - Blufftop Hunting Ritual	Eldridge 1987:5-67, Table 5-16	1	0	0	0	0	0	0	26	27

* ecVI-East Coast Vancouver Island, scVI-South Coast Vancouver Island, Gulf Is-Gulf Islands, wcVI-West Coast Vancouver Island, MnInd-Mainland of British Columbia, WA-Washington State.

Age and Sex Data

Due to the striking disparity between the archaeological and modern distributions of northern fur seal, age and sex data for this once commercially significant species have been discussed elsewhere in great detail (Burton, et al. 2001; Calvert 1980; Crockford, et al. 2002; Etnier 2002a, 2007; Gifford-Gonzalez, et al. 2005; 2011; Gustafson 1968; Moss, et al. 2006; Newsome, et al. 2007). These studies have identified adult males and females as well as immature pups less than 6 months of age in a variety of sites in the study area. Combining archaeological data from Ts'ishaa (Site 42) with historic accounts from schooner captains, aboriginal hunters, and merchants involved in the sealing industry of the 1880s (Swan 1883, 1887), Crockford et al. (2002:170) argue for the presence of a non-migratory breeding population of fur seals capable of giving birth in kelp-beds or kelp rafts at sea. Subsequent studies have used stable isotopes to posit the existence a mid-latitude breeding distribution in the Pacific Northwest (Newsome, et al. 2007). However, definitive evidence of a terrestrially-based northern fur seal rookery remains to be identified.

Age and sex data from few species other than fur seal have been compiled. For sites in the study sample, a small portion of Steller sea lion skeletal remains from a limited number of sites has been confidently sexed. Table 3.3 shows the breakdown of sexed elements for sites where the information was available from controlled excavations. Although the sample is small (NISP=19), 95% of the sexed elements are from adult males with only two elements out of 40 either unknown or female. This pattern is similar to data from the Oregon Coast, which indicates that Steller sea lions from archaeological contexts are primarily adult males (Lyman 2003b). The incidence of females and/or juveniles of either

sex are very low with only one definitively female element found on southeast Vancouver Island (Table 3.3).

Additional Steller sea lion sex and age information comes from fauna collected from archaeological contexts during monitoring of construction projects (Table 3.3). Monitoring samples are collected without screening and have only general provenience. However, males dominate four large assemblages from the southern Strait of Georgia region. For example, at Patricia Bay (Site 18), at least 74 male Steller sea lion elements have been identified in contrast to only one female and three juveniles of indeterminate sex (Kanipe, et al. 2007; Wigen 2007b:24). Explanation for this pattern of male dominance could relate to seasonal availability of Steller sea lions and the differential behavior of the females and males at rookeries and haulout sites and/or preference on the part of the human hunters.

Steller sea lions breed at communal rookeries in northern British Columbia during the summer but spend the winter at haulout sites throughout British Columbia (Olesiuk 2009a). Since the first survey in British Columbia in 1913 (Newcombe and Newcombe 1914), the most southerly sea lion breeding rookery is located on the north end of Vancouver Island. Non-breeding animals of both sexes use a limited number of established year-around haulouts found mainly on the west coast of Vancouver Island. In the winter, individuals of both sexes use a wider range of haulouts including the Strait of Georgia and southern Vancouver Island. This pattern suggests both males and females should be available to hunters in the winter, so it appears seasonal distribution does not explain the hunting pattern. Recent studies of the behavioral responses to human disturbance of hauled out Steller sea lions note that females and pups are the first to leave followed by the sub-adult males and, finally, the bulls (COSEWIC 2003; Szaniszlo 2005). The dominance of males in the

archaeological sites may be a result of this behavioral pattern, with the males being easier for the hunters to target. Additionally, haulouts of ‘bachelor males’ are commonly present near rookeries and may have also been targeted by hunters. The extremely large size of males and these behavioral characteristics suggest that males were hunted while onshore rather than offshore as documented for fur seals.

Table 3.3 Sex Distribution of Steller Sea Lion Remains from Selected Sites.

Region*	Site	Total NISP	Male	Female	Unknown	Reference
ecVI	DiSe-7, Deep Bay	1	1			Wilson et al. 2004b:44
scVI	DcRt-16, King George Terrace	4	4			Wilson et al. 2004a:94
scVI	DdRu-5, Pat Bay	10	10			Kanipe et al. 2006:269
scVI	DcRu-136, Esquimalt Lagoon	2	2			Wigen 2002
Gulf Is	DfRv-106, Galiano Island	1	1			Mason et al. 1995:22
wcVI	DiSo9-II, Hesquiat	1		1		Calvert 1980:155
wcVI	DiSo1-I, Hesquiat	13	2		11	Calvert 1980:156
wcVI	DiSo1-II, Hesquiat	1	1			Calvert 1980:157
wcVI	DiSo1-III, Hesquiat	12	3		9	Calvert 1980:158
wcVI	DiSo1-IV, Hesquiat	14	2	1	11	Calvert 1980:159
wcVI	DjSf100, Little Beach	1		1		Wigen 2008:11
wcVI	DfSi-26, Clarke Island	7	4		3	McKechnie 2007a:30
wcVI	DfSi-16, Ts'ishaa	20	7		13	Unpublished data in Frederick and Crockford 2005 and McKechnie 2007
wcVI	DfSh-7, Huu7ii	9	7	2		Unpublished data in Frederick et al. 2006
Total		96	44	5	47	
		%	90%	10%		
Sexable						

* ecVI = East Coast Vancouver Island, scVI = South Coast Vancouver Island, Gulf Is = Canadian Gulf Islands, wcVI = West Coast Vancouver Island,

Harbor seals and sea otters are more difficult to sex, as sexual dimorphism is less extreme. In most cases, no information has been recorded about the sex of individuals. Age for harbor seals has been recorded in a few site reports (e.g., Frederick and Crockford 2005; Frederick, et al. 2006a; Wigen 2007b), indicating that harbor seals of all ages were regularly hunted in all areas. No age or sex information is available for the few identified California sea lion or elephant seal elements.

Steller sea lions are present in sites along the southwestern portion of the study area, suggesting they may have been moderately abundant in the ancient environment. Elephant seals, California sea lions, and Guadalupe fur seals rarely occur in the assemblages, suggesting they were not commonly present at this latitude. However, taxonomic identifications of male California sea lions may be confused with female Steller sea lions (personal observations) and similarly, Guadalupe fur seals appear similar to northern fur seals (Etnier 2002b).

Discussion

This analysis has identified distinct regional patterns in marine and terrestrial mammal assemblages from archaeological sites on western Vancouver Island and the Strait of Georgia. These differences provide a basis for inferring that aboriginal hunting practices dramatically differed in focus between these two regions. In particular, aboriginal peoples in the Strait of Georgia region did not hunt marine mammals to the same degree as was practiced by aboriginal peoples along the Pacific coast of Vancouver Island and Washington state. Rather, terrestrial mammals appear to be relatively more important in the Strait of Georgia region and relatively less so on the exposed Pacific coast.

These geographic patterns are robust at least over the past 5,000 years and have implications for a number of perspectives in anthropology and ecology. Of particular anthropological relevance is the apparent coherence and continuity of aboriginal marine and terrestrial hunting patterns within each of the two areas. This difference is most strongly apparent in the relative composition of marine versus terrestrial mammals (Figure 3.2 and Figure 3.3) and among the individual pinniped species (Figure 3.4). For specific localities within these two regions, variation in marine mammal use also appears to be spatially patterned, such as the slightly higher abundance of marine mammals in assemblages along southeastern Vancouver Island and in the Gulf Islands (Figure 3.2). These archaeological patterns are an outcome of the direct participation of generations of aboriginal people in this marine ecosystem. Such patterns reflect a continuity of skillful cultural knowledge and practical engagement with these marine environments.

These regional differences are consistent with a host of ethnographic accounts and observations (e.g., Boas 1887; McMillan 1999; Suttles 1952), which identify the aboriginal peoples who occupy these two regions as belonging to two culturally and linguistically distinct groups (Wakashan speaking peoples [Nuu-chah-nulth, Ditidaht, Makah] and Salish speaking peoples). During the post-contact era (ca. AD 1774-1860) and continuing among First Nations today, these cultural differences include distinct patterns of residence, conventions of artistic representation, ritual practice, and a host of other regionally unique forms of cultural expression (*ibid.*). Our analysis provides insight into an aspect of these rich cultural histories, suggesting that cultural distinctions between regions and cultural similarities within regions have great antiquity in regards to hunting practice. Indeed, since our data relate to an important subsistence activity (hunting), such regional expressions can

be hypothesized to have contributed structure to cultural history and community identity.

This is illustrated in a 1922 quote discussing the biography of Tom Sayach'apis (ca. 1835–1927), a respected cultural historian of the Tseshaht, a Nuu-chah-nulth Nation on southwestern Vancouver Island:

Tom ate very little meat of land mammals in his early days. Indeed, like most of the [west] Coast people, he had a prejudice against deer meat and it was not until as a middle-aged man, he had come into contact with some of the deer hunting tribes of the interior of the island, that he learned to prize it, though to this day, venison has not for him the toothsome appeal of a chunk of whale meat (Sapir 1922:304).

From an ecological perspective, such strong geographic patterning as seen through a lens of human hunting activity is relevant for considering the long-term ecological role of marine mammal species in the study area. Our data represent a unique and otherwise unattainable record of marine mammal abundance and distribution over the Holocene. This information helps contextualize contemporary marine mammal ecology by greatly extending temporal and geographic knowledge of these important species. In this regard, it is notable that the three most abundant pinnipeds in the archaeological assemblages (northern fur seals, harbor seals, and Steller sea lions) are also the three most numerically abundant in the contemporary environment (Table 3.1). The similarity in rank-ordered abundance between our archaeological data and contemporary pinniped population estimates indicates these three species have exhibited remarkable demographic resilience to human harvesting.

The stable long-term trends observed in the archaeological data stand in contrast to the dynamic historical events documented over the past 200 years which resulted in the rapid extirpation of the sea otter (ca. AD 1774-1811) and culling of pinniped populations (ca. AD 1868-1970). In this context, it seems important to note that the sudden cessation of marine

mammal hunting over the past 40 years appears to be unprecedented in a record spanning at least the past 5,000 years. The closest possible parallels to this sudden reduction in hunting intensity and corresponding population increase likely occurred after European diseases dramatically reduced aboriginal populations in the early contact era (ca. AD 1774-1811) and again in the mid-19th century, just prior to the beginning of the commercial fur seal industry (Boyd 1999).

While it is striking to note the ongoing demographic consequences of historic-era commercial hunting, equally important are possible behavioral and ecological changes that occurred among targeted taxa over the Holocene. For instance, our compiled archaeological results indicate that aboriginal peoples regularly hunted fur seals for a minimum of 5,000 years on the exposed Pacific coasts of Vancouver Island and northwestern Washington. These observations correspond with the locations of fur seal hunting mentioned in historic-era harvest log-books (Olesiuk 2009b:42) indicating that the continental shelf off southwestern Vancouver Island has long been a major focus of fur seal foraging activity. However, many of these same historic-era harvest records (ca. AD 1891-1911) also indicate a strongly seasonal presence of fur seals at this latitude between January and May (Olesiuk 2009b:54), which contrasts with zooarchaeological data including osteometric evidence for localized breeding (Crockford, et al. 2002; Etnier 2002a; Gustafson 1968), and geochemical evidence for non-migratory mid-latitude foraging and prolonged pup weaning dating from the mid-Holocene (Newsome, et al. 2007). Tantalizingly suggestive historic accounts compiled from interviews with commercial fur sealers conducted a decade prior to the historic log-book-based records mentioned above, describe non-migratory behavior involving giving birth at sea in kelp beds and observing fur seals in the Strait of Georgia during late-

summer when the migratory populations are in the Bering Sea (Crockford et al. 2002 citing Swan 1883). These data suggest historic-era commercial harvests may have eliminated or altered a behaviorally unique sub-population of fur seals and archaeological data yield important insight into the previously more diverse ecology of this currently strictly pelagic pinniped.

Although the absolute number of animals harvested cannot be quantified with our zooarchaeological data alone, our analysis has several implications concerning potential human impacts on pinniped and sea otter populations. Firstly, our data indicate a regional focus on specific pinniped species, which implies that aboriginal peoples in these regions targeted specific taxa with regularity (e.g., annually or seasonally) as suggested by ethnographic accounts (e.g., Arima 1988; Suttles 1952). Secondly, our data represent only a small percentage of the approximately 4,000 currently documented coastal shell midden sites present in the study area (British Columbia Archaeology Branch n.d.). Thus, the collective impact of aboriginal hunting may be considerably greater than previously recognized if these regional patterns apply to several thousand unexamined sites. Finally, the temporal and spatial consistency of hunted marine mammals in these two regions indicates a degree of stability and continuity to aboriginal resource harvesting practices, which demonstrates the capacity for sustained harvesting in antiquity (Etnier 2007).

Repetitive and consistent human participation in an ecosystem provides structure to ecological interactions (Balée 2006; Hobbs and Fowler 2008; Liu, et al. 2007). However, determining and/or identifying ‘human impacts’ in such an archaeological context is challenging as these ecosystems may represent the end-point of centuries or millennia of human hunting. Future analyses that can incorporate more fine-grained osteometric

information on age and sex distribution will yield much greater insight into these ecological impacts.

Considering the ecological dimensions of human subsistence activity in coastal environments, Fedje et al. (2004) offer a distinction that seems to encompass the regional differences we observe in our analysis of mammalian hunting practice; the concept of “maritime” and “coastal adaptations.” These authors define a “maritime adaptation” as on which is:

“heavily reliant upon marine and coastal resources for the majority of subsistence needs. In contrast, a ‘coastal adaptation’ involves the fluent use of coastal and marine resources for at least some, and probably a significant portion, of the subsistence needs of a group of people. Coastal adaptations should therefore include the possibility of considerable use of terrestrial resources and inland areas” (Fedje, et al. 2004:112).

This synthetic statement helps characterize the regional differences observed in our analysis suggesting that aboriginal peoples in the Strait of Georgia ‘adapted’ themselves to terrestrial mammal hunting more extensively than aboriginal peoples on western Vancouver Island.

This observation is consistent with ethnographic and archaeological information from Coast Salish peoples in the Strait of Georgia region where widespread aboriginal burning practices aimed to enhance habitat for economically important plants such as camas and berries as well as entice foraging ungulates into recently burned areas with young re-growth (Brown and Hebda 2002; Suttles 1987; Weiser and Lepofsky 2009). Conversely, on western Vancouver Island, the logistics of hunting pelagic pinnipeds likely facilitated other forms of offshore subsistence activities (e.g., deep water fishing or birding) as well as voyaging and trading or vice versa (Arima 1988; McMillan 1999).

However, while the concept of “adaptation” (defined as ‘the suiting of one thing to another’) may help characterize human hunting activity expressed over thousands of years, a term that is more appropriately scaled to human lifetimes is ‘tradition’ (defined as ‘the act of handing down’). Considering long-term hunting practices as ‘traditions’ accommodates the intergenerational transference of complex hunting knowledge in a way that anthropological uses of ‘adaptation’ often under-specify or assume outright (cf., Moss 2008).

The regionally consistent patterns of terrestrial and marine mammal use were additionally constrained or enabled by environmental differences between the two regions. For instance, the open prairie oak savanna woodlands of the Strait of Georgia versus the very moist dense coastal rainforest on western Vancouver Island (Suttles 1987) or the higher primary productivity on the exposed Pacific coast versus the Strait of Georgia (Ware and Thomson 2005). However, while it is essential to consider the environmental factors that may contribute how aboriginal peoples may have focused on marine or terrestrial mammals, these factors cannot adequately explain how or why generations of people choose to participate in an ecosystem in a particular manner. Rather, explanations that posit an environmental imperative for human action risk imposing a deterministic assumption about human actions when that is not the case. Thus, although the relative contribution of hunting was undoubtedly constrained or enabled to some degree by the presence or absence of animals in different regions within the study area, human agency cannot be ignored. Rather than a simple consequence of available resources, social factors critically underpin the hunting practice in ways that may be much more meaningful than the simple availability of resources. Hunting was a conscious decision first and then a reflection the environmental availability.

In contrast to an environmentally determined model of human subsistence, aboriginal peoples the Northwest Coast are increasingly recognized as highly active in “managing” subsistence resources through explicit cultural definitions of harvesting practice and etiquette including selective harvesting, seasonal restrictions on use and/or consumption, and proprietorship over resources which was contingent on sustained productivity (Berkes and Turner 2006; Hunn, et al. 2003; Moss 2011a; Trosper 2009; Weiser and Lepofsky 2009). The data presented here suggest that generations of people actively chose to pursue an elaborate, highly structured, and specialized activity – primarily pelagic marine mammal hunting or primarily terrestrial mammal hunting in different regions. These hunting traditions embody the skill, training, and cooperation, which develop over years, and decades among groups of individual hunters and which are passed on to subsequent generations in a community of continuous social practice (cf., Bourdieu 1977). The consistency and continuity with which certain species were utilized in the archaeological assemblages over 5,000 years suggests that similar cultural practices informed aboriginal peoples’ hunting behavior in the archaeologically documented past.

Conclusions

We posed three questions at the beginning of this chapter:

- What marine mammals did aboriginal people in Southern British Columbia most commonly utilize?
- How similar or how different are species occurrences and proportions relative to today?
- Is there evidence of specialized or regional hunting traditions and if so, what might have been the potential impacts of these activities on the ancient marine ecosystem?

In answer to the first question, fur seals, harbor seals, and Steller sea lions respectively appear to be the most heavily utilized pinnipeds on the southern BC coast over the last 8,000 years. Sea otters appear to be utilized by peoples on western Vancouver Island and the Olympic Peninsula, and are present only in low numbers at several sites in the Strait of Georgia. The least utilized pinnipeds appear to be California sea lions, elephant seals, and Guadalupe fur seals, which are rare but are found in sites along the southwestern margin of the study area. These are relative differences however, and thus even small relative percentages may represent large numbers of harvested animals.

In regards to the second question, our data expand knowledge of the range and relative composition of marine mammal species that are currently threatened or endangered (Table 3.1). Examining the archaeological distribution of these species provides context for understanding their recovery since historical over-exploitation and the extent to which aboriginal peoples may have influenced the marine ecosystem before the historic-era fur trade. Considering the fact that the 58 examined sites represent less than 1% of the approximately 4,000 currently documented coastal shell midden sites present in the study area (British Columbia Archaeology Branch n.d.), the perspective gained here hints at the potential cumulative influence of large indigenous human populations in the region. The extent of this influence is unknown at this point, but did not appear to have reached the stage where people dramatically change their hunting patterns. Such basic insights help refine our understanding of the influence of human activity on the environment and, conversely, the influence of animals on human activity.

And finally, this study indicates that aboriginal people on the outer coast of Vancouver Island and Washington state developed a specialized hunting tradition targeting

northern fur seals. This conclusion is further supported by several ethnographic and historic sources (e.g., Arima 1988; Sapir and Swadesh 1955; Swan 1887; Waterman 1920) and by artifactual data from pre-contact archaeological sites in the study area (cf., McMillan 1999; Samuels and Daugherty 1991). Ethnographically, such hunting activity involved paddling considerable distances offshore, sometimes beyond sight of land, to stealthily approach ‘sleeping’ fur seals to within range for launching a harpoon. Such specialized journeys entailed considerable physical risks and logistical preparation. Ethnographic accounts emphasize how participants ritually engaged in elaborate physical and spiritual training and how hunters utilized specifically designed canoes, sharpened paddles, unique harpoons, yew-wood throwing sticks, seal skin floats to tire harpooned animals, as well as long lengths of cedar-bark and elk-hide rope (Arima 1988; Sapir and Swadesh 1955; Waterman 1920).

In contrast to western Vancouver Island and northwestern Washington, aboriginal peoples in the Strait of Georgia appear to have developed marine mammal hunting traditions that targeted harbor seals and to a lesser extent Steller sea lions. As discussed previously, harbor seals are non-migratory, nearshore foragers who regularly ‘haul-out’ on land and are the most common seal present on the coast today (Department of Fisheries and Oceans Canada 2010; Jeffries, et al. 2003). Ethnographic accounts describe hunting ‘hauled-out’ harbor seals from boats, by hand with clubs, or by stealthily placing nets in the water below haul-out areas, particularly outside sea caves (Suttles 1952; Waterman 1920). Steller sea lions, on the other hand, occur seasonally in the Strait of Georgia during winter and spring when herring aggregate prior to spawning (COSEWIC 2003). Ethnographically, sea lions were hunted by numerous Coast Salish peoples although a few groups were recognized as particularly skilled specialists (Suttles 1952). Ethnographic descriptions of hunting both

Steller sea lions and harbor seals were associated with elaborate forms of physical and spiritual preparation, which occurred prior to and during the hunt and were observed by both hunters and their wives (Elmendorf 1960; Suttles 1952).

While hunting practices documented in archaeological contexts represent only a small portion of the rich ancestral pasts of coastal First Nation communities, zooarchaeological data represent a readily available source of information that broadens our contemporary understanding of ancient coastal lifeways and cultural environments. Such ecologically significant marine data are essentially non-existent outside of archaeological contexts and future research will benefit from additional analyses of new sites, regions, and time periods as well as more detailed osteometric observations. The compilation of zooarchaeological information explored in this paper suggest coherent patterns indicating the persistence of hunting traditions practiced continuously over 5,000 years. These patterns help unravel the complex interwoven cultural and ecological histories and environments on the Northwest Coast.

Chapter 4. Re-Calibrating Archaeological Chronologies on the Northern Northwest Coast: Radiocarbon Data from Prince Rupert Harbour⁵

This chapter investigates the methods by which radiocarbon dating and radiocarbon calibration has been practiced and interpreted by archaeological researchers on the northern Northwest Coast. We note that past efforts to report and interpret archaeological chronologies have used a variety of approaches and we suggest this affects the current understanding of the region's human past. This paper attempts to add clarity to the process of radiocarbon dating and radiocarbon calibration with a focus on interpreting radiocarbon dates obtained on marine or marine-influenced organisms (particularly marine shell and bone collagen). We first discuss the process of radiocarbon dating and radiocarbon calibration, highlighting some of the complexities and nuances of the method. We then discuss three important radiocarbon datasets that underpin the archaeological chronology of social history and culture change in the region; 1) terminal village occupation dates on shellfish compiled by Archer (2001), and 2) human burial dates compiled by Cybulski (1975), and 3) this same dataset reanalyzed by Ames (2005).

We then compile a database of currently existing paired marine and terrestrial dates to derive a regionally specific marine reservoir estimate (Delta-R or ΔR) that allows us to integrate these different datasets into the same chronological timescale. Our resulting recalibrations refine previously identified chronological and settlement patterns and in some cases shift the understood age of past events by up to 500 years. These chronological shifts

⁵ This chapter is co-authored with Morley Eldridge. See preface for more information.

and patterns have implications for archaeological understandings of the antiquity of social complexity, warfare, and settlement patterns within the region.

The Importance of Calibration in Radiocarbon Dating

Radiocarbon dating is the most widespread method for evaluating the chronology of archaeological phenomena within the past 40,000 years. However, many levels of uncertainty underlie this chronological method and these are not always well understood by archaeologists (Bronk Ramsey 2008). Most archaeologists are familiar to a degree with how radiocarbon dating works – it is a method that measures the rate of decay of radioactive carbon isotopes (denoted as ^{14}C) relative to stable carbon isotopes ($^{13/12}\text{C}$), a measurable difference that begins when organic tissue stops growing – hence the cessation of carbon uptake. The half-life of radiocarbon is approximately $5,730\pm 40$ years, meaning that half the radioactive carbon (^{14}C) present in a living organism will have decayed in this time (Godwin 1962).

Radiocarbon dates provide a result in ‘years before present’ and an instrumental measurement error (e.g., $4,500\pm 50$ ^{14}C yr bp)⁶. However, a crucial aspect of radiocarbon dating is that radiocarbon time (i.e., radiocarbon years) is *not equivalent to* conventional time (years measured by the astronomical 365 day-long year). Thus, calibration is necessary to convert radiocarbon years into historically equivalent and comparable measures of time. This is because radiocarbon ‘years’ (^{14}C yr bp or RYBP) are variably affected by changes in the

⁶ We encourage researchers to follow international convention when reporting normalized radiocarbon dates (“radiocarbon years bp” \pm error), and calibrated dates (“cal yr BP” or “cal yr BC/AD”) along with a one or two sigma age range. We also encourage researchers to submit their dates to both the Canadian Radiocarbon Database (CARD) and any shell wood pair data to the CHRONO Marine Database. The greater the available information, the greater the chance our collective archaeological knowledge will appropriately incorporate both the ambiguity and the qualified certitude in our regional archaeological chronologies (cf. Gero 2007).

global carbon cycle, which is a product of global climate change and solar radiation that influences the concentration of ^{14}C in the atmosphere and ocean at different points in the earth's history (Guilderson, et al. 2005). This fluctuation is particularly influenced by changes in the global carbon cycle such as forests expanding following deglaciation, major changes in ocean circulation, increased carbon emissions during the industrial revolution, atomic bomb testing, and ongoing land clearance and burning of fossil fuels. Radiocarbon calibration (often known simply as calibration) is a probabilistic method for reconciling the variation in ^{14}C with conventional time, thereby allowing for a measurement of radiocarbon years (^{14}C yr bp or RYBP) to be converted into an age estimate in chronological years before present or calendrical (BC/AD) years (Bowman 1990).

Due to the uncertainties inherent in the dating method (measurement error) and the uncertainties of past global carbon (calibration error) the resulting value of a given calibrated radiocarbon age is more appropriately considered an age-range within which a dated sample has a probability of occurring (rather than a single number with a standard error). Since radiocarbon varies depending on global climatic change, the same period in time can be represented by different amounts of ^{14}C variation and *vice versa*. Calibration of radiocarbon years is further complicated for samples taken from marine or marine influenced contexts; these require a second form of calibration for the marine reservoir effect discussed at length in a following section.

Calibrating Radiocarbon Age Estimates

While the radiocarbon method was invented in the mid-20th century (Libby, et al. 1949), it was not until the 1980s that radiocarbon calibration 'curves' became commonly

available for use in archaeology (Bowman 1990). The most widely used calibration curve developed from an increasingly refined series of dendrochronologically dated tree-ring sequences constructed from the Pacific Northwest (Stuiver 1982) and preserved in peat bogs in Germany and Ireland (Pearson and Stuiver 1986; Stuiver and Pearson 1986; Stuiver, et al. 1998). Researchers radiocarbon dated individual tree rings, each of which had a known-age and compared the difference between the measured radiocarbon age and the actual age to produce a graphical representation of this relationship (Figure 4.1).

This ‘curve’ essentially documents the concentration of atmospheric ^{14}C as preserved in the individual tree growth rings. The most crucial feature of the curve is the overall rate of ^{14}C decline over time but also the undulations that occur over shorter-time periods (due to variations in atmospheric ^{14}C which is influenced by variations in solar activity and other processes of global carbon circulation) and the varying thickness of the curve itself that reflects the relative confidence that a date of a certain age falls within a calendar age-range (due to measurement limitations). These features are discussed in two short examples.

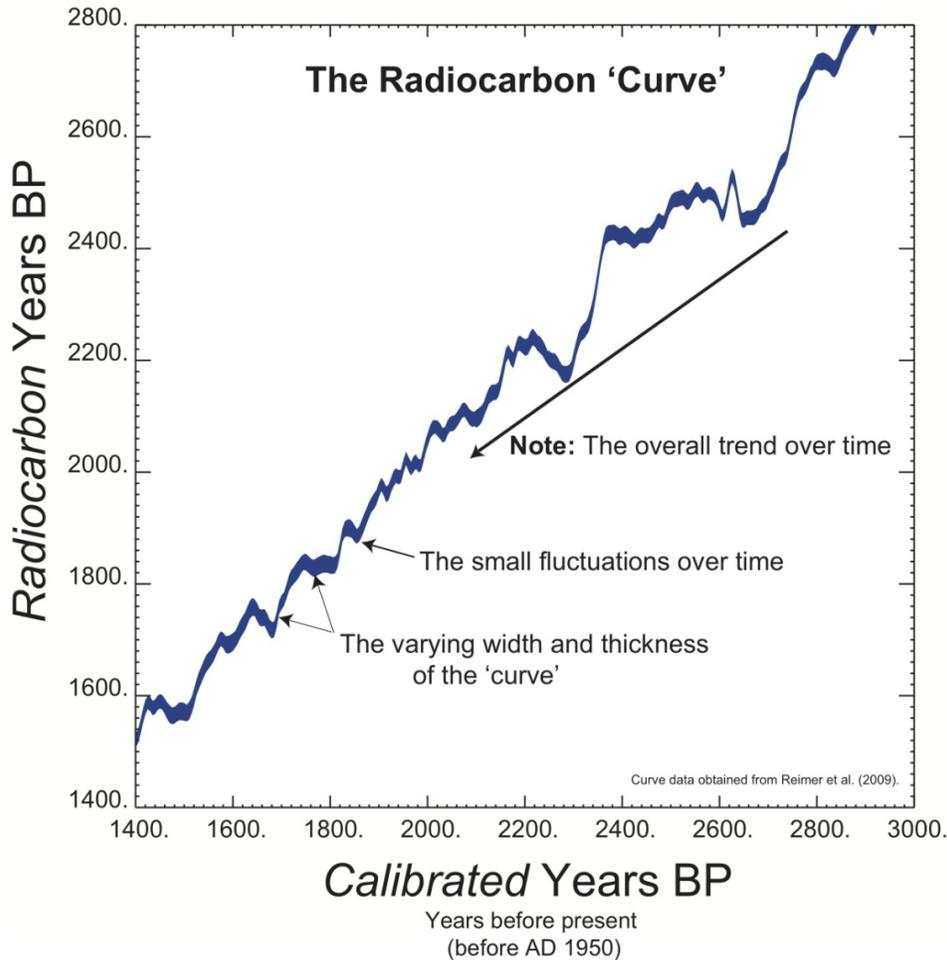


Figure 4.1 A 2,400 year-long section of the atmospheric radiocarbon curve covering the period between 1,400 and 3,000 years before present (Reimer et al. 2009). Figure modified from a graphical output of CALIB 6.1 (Stuiver and Reimer 1993).

Variability in Radiocarbon Years

Consider a radiocarbon date obtained from the leaf of a terrestrial plant (one that derived its carbon from the atmosphere), yielding a measure of 4000 ± 25 radiocarbon years before present (^{14}C yr bp). When calibrated using the 2009 radiocarbon curve⁷ at a 95.5%

⁷ The internationally recognized radiocarbon curve is refined approximately every four years at an international meeting. The latest curve (INTCAL13) was published September 22, 2013 (Reimer, et al. 2013) and has not yet been incorporated into the dates reported in this dissertation.

confidence interval (i.e., the 2-sigma calibrated range⁸), the resulting age estimate falls between 4,520 and 4,080 years ago. Thus, the process of calibration adds between 80-520 calendar years to this particular radiocarbon age and also significantly increases the apparent uncertainty (from ± 25 to up to ± 220 years). In addition, differences between radiocarbon and calibrated radiocarbon ages vary over time as a result of changes in the shape of the curve.

Variable Uncertainty in the Atmospheric Calibration Curve

Consider another date from a terrestrial plant leaf, $9,500 \pm 25$ ¹⁴C yr bp. When calibrated at a 95.5% confidence interval, this date has a calibrated age-range estimate of between 10,670 and 11,070 years ago. Thus, in contrast to the example above, this calibration increases the numeric difference between the radiocarbon date and calibrated age range by 1,170 to 1,570 years. The statistical uncertainty of this calibrated sample at the a 95.5% confidence interval is slightly less, approximately ± 200 years. It could be reduced further by examining the fluctuations in the curve for the period of time in question as shown in Figure 4.2. These transformations and increased uncertainties are integral to translating radiocarbon time into conventional (calendrical/astronomical) time and illustrate how some periods in time have increased uncertainty regardless of the precision of individual radiocarbon measurements (Guilderson, et al. 2005).

⁸ Probability is simply an expression of the likeliness of something occurring. The convention in analytical statistics is to calculate uncertainty in terms of standard deviations (which can be approximated as the average difference of a set of values from its average) often called ‘sigmas’ or ‘standard deviations’. In a normal distribution (where there is a central tendency to the values) 1-sigma encompasses about 67% of the probability and 2-sigmas encompasses about 95%. Sigmas are thus notations for quantifying confidence and are sometimes displayed using the symbol σ . In describing the 2-sigma calibrated range, this is specific to the calibration probability and does not refer to the uncertainty for the individual date.

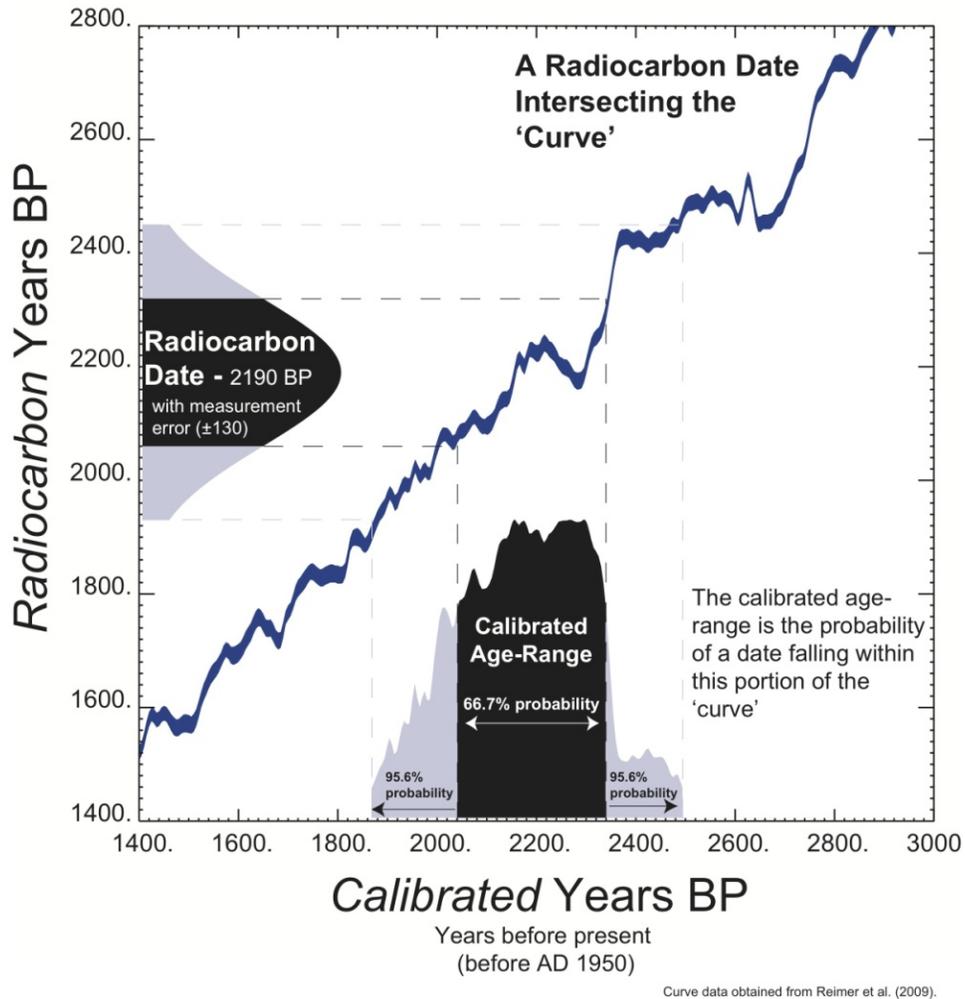


Figure 4.2. Example of calibration effects on a radiocarbon date with a large error range. The vertical height of the ‘calibrated age-range’ shown on the x-axis represents the relative probability of the date occurring during a particular period.

‘Correcting’ for Isotopic Fractionation

In addition to the fluctuations in the global carbon cycle, radiocarbon measurements are further influenced by molecular transformations as carbon is differentially incorporated into organic tissues and ‘hardparts’ such as bones and shells. These alterations have a smaller magnitude than the differences between marine and terrestrial carbon, but can still result in an age estimate being shifted by hundreds of years. Since the carbon-14 isotopes are slightly heavier (because of their additional neutrons), they have a greater inertia and react slower

than carbon 12 (^{12}C) and carbon 13 (^{13}C) isotopes (Stuiver and Polach 1977). In other words, a plant that absorbs atmospheric carbon will have a particular carbon 14 value; but that same carbon 14 will be slightly depleted when absorbed by a herbivore consuming plant tissues. Likewise this difference would be slightly larger in a carnivore that regularly consumes herbivores that in turn regularly consumes plant tissues and so on. Thus, even though these different organisms may have lived at exactly the same time, the ^{14}C levels in their tissues will exhibit slight differences, thus requiring further adjustment based on their trophic level.

Fortunately, these differences in normalization have been determined by measuring the ratio of the stable carbon isotopes (^{13}C to ^{12}C) in a variety of organisms (Stuiver and Polach 1977). Since ^{13}C and ^{12}C stable isotopes do not change over time, the measured difference is exactly half that of the difference between the ^{12}C and the ^{14}C atoms, allowing for an accurate estimate of ^{14}C in the original organism from the measured levels of ^{13}C to ^{12}C in the sample. Although direct measurements are often not available for samples analysed prior to the 1970s values can be retroactively estimated if the type of dated organism is known (e.g., 0.0 for shellfish, -25.0% for terrestrial charcoal)⁹ (Stuiver and Polach 1977) but see Southon (2011) for further discussion.

⁹ Most modern radiocarbon laboratories tend to provide a direct measurement of the $\text{C}^{12/13}$ ratio prior to processing a sample so that the value can be factored into the normalization formula but exceptions still exist. In those cases, without directly measuring the isotopic fractionation, radiocarbon samples are 'normalized' according to assumed values (Stuiver and Polach 1977) which for C3 plants is typically -25.0 and for C4 plants ranges between -9 and -12. Assumed values are commonly indicated by a lack of a decimal place (e.g., -25 rather than -24.5).

Calibrating Radiocarbon Age Estimates for Marine Samples

The global carbon cycle has two primary domains— the atmosphere and the ocean — within which carbon circulates at dramatically different rates. For instance, atmospheric carbon circulates virtually instantaneously throughout the globe but marine carbon circulates at much slower rates as much of the carbon is ‘trapped’ in deep-ocean currents for hundreds of years before it is released once again into the biosphere through upwelling. This temporal lag in marine radiocarbon is known as the marine ‘reservoir’ (Stuiver and Braziunas 1993). On a global scale, marine carbon circulates an average of 405 years behind the rate of terrestrial carbon (Hughen, et al. 2004) but there is considerable variation regionally and over time. The difference between the global average and the local average of marine reservoir time is known as the ΔR (hereafter Delta-R). Thus, marine or marine influenced samples require additional calibration compared with terrestrial/atmospheric samples, as shown by the following example.

Example 3 - Calibrating a Marine Date

Consider a date on a marine clamshell from the same archaeological deposit as the 4000 ± 25 ^{14}C yr bp plant leaf discussed in Example 1. Because this clam absorbed its carbon from the marine environment (via filter feeding on marine plankton), the radiocarbon age will likely appear significantly ‘older’ in radiocarbon time than a contemporaneously deposited terrestrial sample (e.g., wood charcoal). Thus, estimating the age of this ‘marine date’ requires additional calibration for the local marine reservoir, incorporating both the global reservoir value (R) *and* the Delta-R value, the values for which are derived from two methods discussed below.

Method 1: Dating Modern Known-Age Shells Collected in the Historic Era

The first of the two principal methods for estimating the age of the marine reservoir is to radiocarbon date living shells that were collected from a known place on a known date prior to the commencement of atomic bomb testing in the 1940s (which significantly disrupted the global carbon cycle). Because oceanic currents are relatively stable, this method provides a historical estimate of the local marine reservoir (Delta-R) that can be applied to radiocarbon calibration of marine samples. However, marine reservoir can be particularly variable in large estuary environments where there is considerable influx of freshwater from rivers, which dilutes (and thus lowers) the marine carbon absorbed by organisms living in those environments (Rick, et al. 2012). Conversely, deepwater fjords in proximity to glacial-fed rivers and tidewater glaciers may contain significant quantities of ‘old’ meltwater ‘trapped’ in glacial ice for thousands of years (hence older carbon) (Hutchinson, et al. 2004).

On the Northern Northwest Coast a recent study (McNeely, et al. 2006) has dated a series of historic marine shells collected from Haida Gwaii and Southeast Alaska prior to atomic testing in the mid-20th century (Figure 4.3). For example, they obtained a radiocarbon date on a giant razor clam (*Ensis siliqua*) collected in AD 1937 from Masset on northern Haida Gwaii that returned a radiocarbon age of 850 ± 40 ¹⁴C yr bp. Thus, even though this clam lived during the early 20th century (and died in 1937), it absorbed ‘older’ marine carbon that had been circulating in the ocean for approximately 690 years. This 690-year difference includes the global average of marine carbon circulation of 405 years plus 285 years for the local marine reservoir effect. This local difference is due to ‘upwelling’ of ‘older’ carbon as deep oceanic currents collide with the continental shelf immediately west and south of Haida Gwaii and then circulate throughout Hecate Strait (Thomson 1981).

McNeely et al.'s (2006) data are relevant to the interpretation of archaeological chronologies based on marine shell dates but unfortunately lack observations from Prince Rupert Harbour. Nevertheless, results from this study reveal regional differences and sub-regional variability in the marine reservoir age for both Southeast Alaska and Haida Gwaii (Figure 4.3). Of particular significance are the comparatively low Delta-R values from Haida Gwaii relative to deep-water fjords and channels of Southeast Alaska, which have Delta-R values consistently above 400 (Figure 4.3). This is likely a reflection of several large active glaciers and ice fields in coastal Southeast Alaska releasing particularly old freshwater carbon into the deep and potentially slowly circulating coastal fjords. While the sample remains small, the Southeast Alaska data also indicate a west-to-east trend of increasing Delta-R values closer to the mainland coast (Figure 4.3).

Currently, there are no available data for Prince Rupert Harbour, thereby limiting the direct utility for interpreting marine influenced radiocarbon ages for sites in this area. A further complicating factor in the use of this method is that oceanic circulation patterns during the early 20th century or historic era may not be very representative of marine circulation during previous millennia. On the Northwest Coast, the early 20th century is the 'end' of the 'Little Ice Age' and is associated with significant receding of glaciers and an increase in associated meltwater (Menounos, et al. 2009).

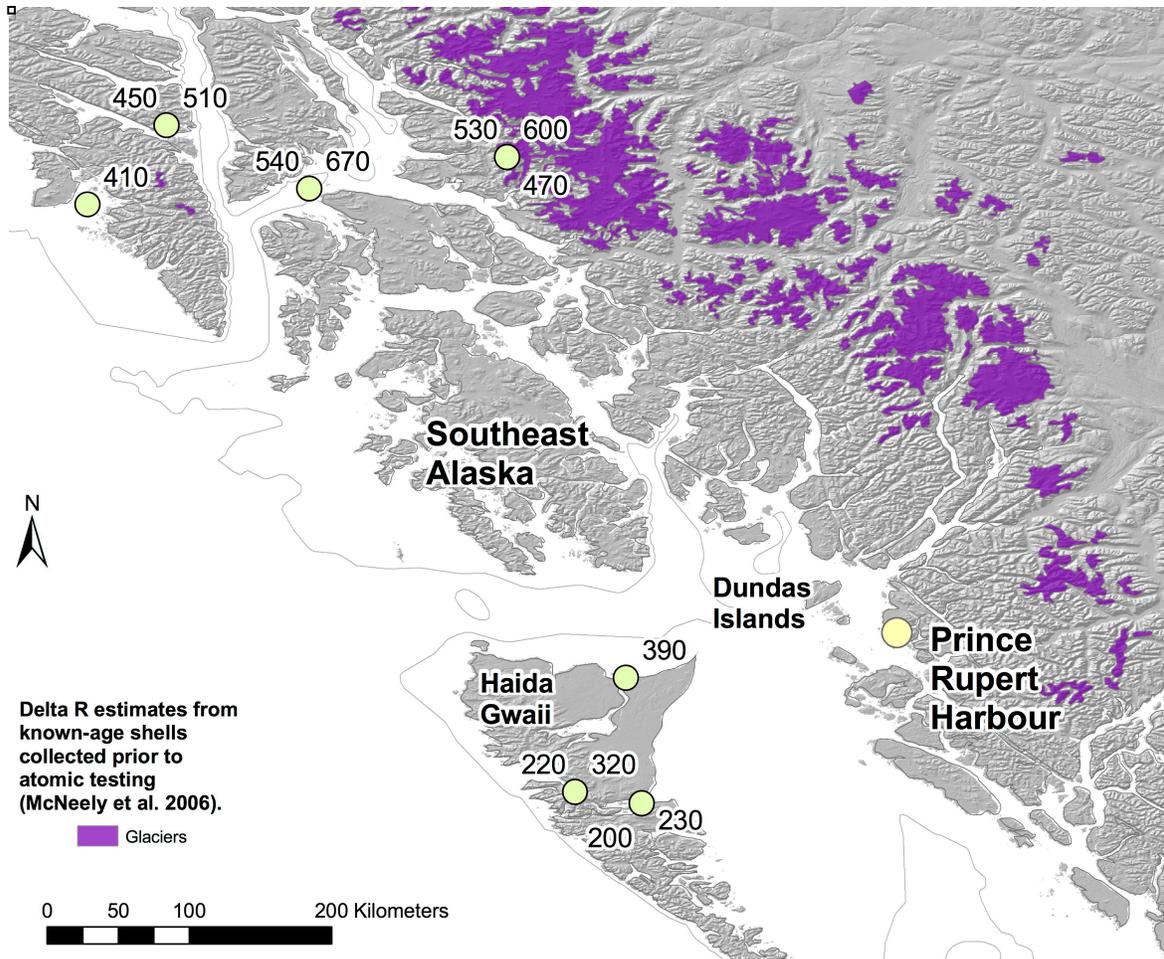


Figure 4.3. Map of the northern Northwest Coast showing the location and local marine reservoir age (Delta-R value) for radiocarbon dated shellfish of known age collected from the northern Northwest Coast prior to atomic testing in the mid 20th century (data from McNeely et al. 2006). Also shown are the locations of late 20th century glaciers (data from www.geogratis.cgdi.gc.ca).

Method 2: Dating ‘Shell-Wood’ Pairs from Archaeological and Paleoecological Contexts

The second method for obtaining a local estimate of marine reservoir age is to date contemporaneously deposited marine and terrestrial carbon samples to identify the marine reservoir age from a pre-modern context by the difference in age between the two samples. Thus, in contrast to dating early 20th century marine shell discussed above, this method can assess the magnitude of the marine reservoir *prior to the modern era* and therefore, is more appropriate for assessing the marine reservoir during the archaeological period of interest.

This method consists of estimating the total marine reservoir age at particular points in the past (expressed as $R[t]$) by dating depositionally ‘paired’ terrestrial and marine samples from coastal archaeological or paleoecological contexts and subtracting the global reservoir estimate from the combined age difference. This method is appropriate only if marine and terrestrial organic remains are short-lived and were contemporaneously deposited in archaeological contexts such as rapidly accumulating shell midden or a paleoecological context such as wave cut terrace or delta (Southon, et al. 1990; Southon and Fedje 2003).

Because archaeological and paleoecological deposits contain long temporal records, this method allows for the assessment of changes in reservoir age at a variety of temporal and spatial scales (Ingram and Southon 1996). For instance, Kennett et al. (1997) dated multiple paired archaeological marine and terrestrial samples from southern California and estimated temporal fluctuations in the reservoir age over the past 10,000 years that could be linked to changes in paleoclimate and upwelling intensity. This in turn allowed for a more refined chronology of the palaeoceanography and the pre-contact cultural dynamics of pre-colonial Southern California (Kennett and Kennett 2000).

The drawback to this method is that geological and archaeological researchers must be very attentive to the strength of the stratigraphic association for each sample and recognize the potential interpretive hazards of each data point. In addition, the age difference between samples is less precise than Method 1 because both must rely on age estimates rather than known dates.

To recap, the total marine reservoir is a combination of the global reservoir and the local correction (Delta-R) and can be estimated over time and regionally. The local component of reservoir correction is expressed as Delta-R. Considering our 4600 ± 25 ^{14}C yr

bp shell date example once more, if we know that the Delta-R for this period is 350 ± 50 radiocarbon years for this point in time, it is possible to more accurately estimate the calibrated age of this shell using online calibration software (e.g., CALIB). This sample produces an age range estimate between 4180-4510 calibrated years BP (at 95.5% probability) and therefore appears more recent than the original measured age and is much more consistent with the original $4,000 \pm 25$ ^{14}C yr bp estimate on the (presumably) contemporaneous leaf in the example that started this discussion.

Animals who consume both marine and terrestrial carbon

Humans, bears, and dogs are among many organisms that ingest substantial amounts of foods (and hence carbon) ‘mixed’ from both the marine and terrestrial environment. Radiocarbon ages obtained on their bones require a modified form of marine calibration involving estimating the proportion of marine carbon in their diets. Fortunately, the proportion of marine carbon in the diet can be estimated using the commonly applied $^{13}/^{12}\text{C}$ stable isotope ratio measurement that documents the differential uptake of marine and atmospheric carbon by comparison to a regionally specific food web model (e.g., Chisholm, et al. 1982, 1983; Chisholm 1986; Szpak et al. 2009). Calibration programs such as CALIB and OXCAL offer a way to incorporate the percentage of marine carbon in the diet (if known) and calibrate the result using on marine curve. Figure 4.4 provides a summary of the interpretive steps needed in calibration a ‘mixed’ marine and terrestrial sample as well as for strictly terrestrial and strictly marine samples.

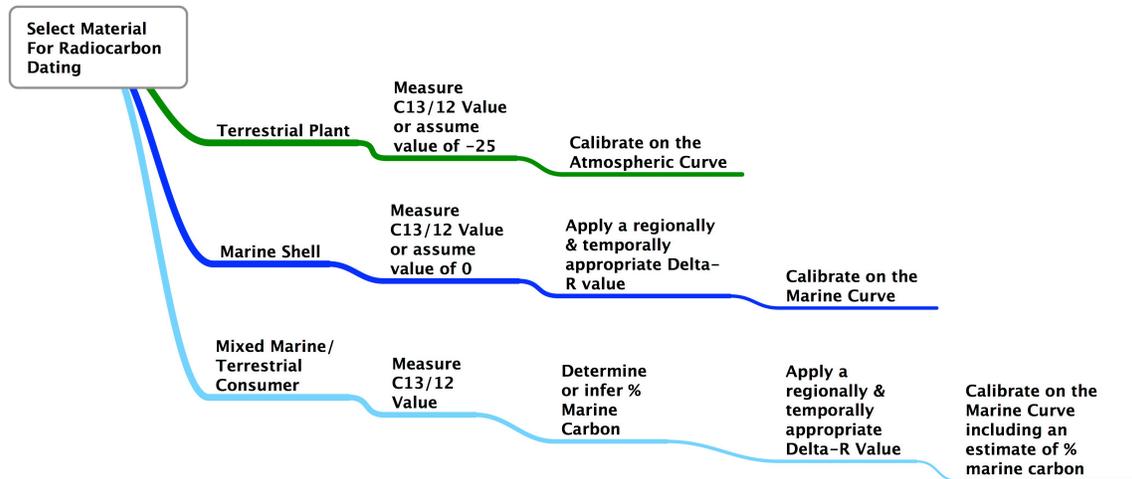


Figure 4.4. Schematic depicting the steps required for radiocarbon calibration. Note the high number of steps required for calibrating mixed marine and terrestrial samples. Assuming an isotopic value of -25 for charcoal is really only appropriate for northerly latitudes that lack C4 plants (Teeri and Stowe 1976).

Estimating Marine Reservoir in Highly Migratory Animals

A further complicating factor is the difficulty of interpreting radiocarbon dates on migratory marine animals. For instance, many marine mammal species are highly migratory and forage far offshore throughout the Pacific Ocean meaning their marine carbon is derived from a variety of sources. Japanese researchers have extensively dated archaeological northern fur seal (*Callorhinus ursinus*) bones and associated human remains from Jomon period sites in Japan (Yoneda, et al. 2004). The highly migratory fur seals returned radiocarbon ages consistently older than contemporaneously deposited human remains. This same study further demonstrated that both fur seal and human remains exhibited respectively older radiocarbon ages than contemporaneously deposited terrestrial mammal bones (Yoneda, et al. 2004). On the Northwest Coast, researchers seeking to directly date whalebone or salmon or any number of highly migratory species should consider this additional uncertainty of the Delta-R estimate.

Variable Reporting of Radiocarbon Dates and Calibration Results

Despite the long history of radiocarbon dating, the convention of reporting calibrated radiocarbon ages remains somewhat of a marginal practice in some regions and time periods even through some journals offer very specific recommendations (e.g., Canadian Journal of Archaeology¹⁰). The perceived complexity of radiocarbon calibration combined with the diversity of approaches taken by different researchers and research teams, and the quickening pace of research has contributed to considerable variation in the reported radiocarbon record along the northern Northwest Coast. Given the fact that observations have been compiled over 40 years and with different research goals and standards in mind, such variation is entirely understandable. However, this has led to a circumstance where different sets of dates have not been directly compared because they differ in their marine or terrestrial content and have not been placed on a singular calibrated timescale. More importantly, published and repetitively cited accounts of the age of certain cultural events and epochs are understood to have occurred during particular time periods when these ages are more appropriately unanchored points in radiocarbon years lacking appropriate temporal uncertainty.

In contrast, all archaeologists report and regularly discuss un-calibrated radiocarbon dates (e.g., 285±50 ¹⁴C yr bp) despite the fact that the actual age-range of a given set of dates may not be directly comparable or change significantly when calibrated (especially if marine influenced). While this may be seen to be necessary for disciplinary discourse, it neglects the fact that a given radiocarbon result may not be the same time scale. For instance, two books concerning archaeology on the Northwest Coast (Ames and Maschner 1999; Fedje and

¹⁰ <http://canadianarchaeology.com/caa/publications/cja/guidelines-cjajca-authors>

Mathewes 2005) do not attempt to calibrate radiocarbon dates but rather, offer readers a conversion table that lists a limited series of atmospheric radiocarbon dates in relation to their ‘true’ age in astronomical years. While this convention is welcome (it reduces translation error when discussing dates), it perpetuates a ‘floating’ chronology that is not tied to the astronomical (calendrical) timescale which becomes confusing when dealing with more than a handful of calibrated ages whose differences and similarities may be non-linearly different when calibrated. As a result, many researchers continue to report and discuss radiocarbon dates in un-calibrated radiocarbon years and do not use the full potential of current calibration methods. This is unfortunate because it decreases the accuracy and utility of radiocarbon dates used in archaeological interpretations.

Unfortunately for the archaeologist, achieving sufficient and clear knowledge of the process of radiocarbon calibration is hindered in part by different commercial or research laboratories, whose calibration estimates may not always be the most up-to-date or appropriate for a given region, time period, or context, particularly for marine or marine influenced samples. Moreover, different laboratories often have slightly differing reporting conventions and terminologies that make it difficult to interpret and compare radiocarbon results¹¹. To complicate matters further, academic journals in archaeology have a range of radiocarbon reporting standards and some major journals appear to lack consistently applied standards. These challenges add to the general level of confusion about the process and utility of calibration.

¹¹ For instance, Beta Analytic, a major North American Lab, reports both a ‘measured’ radiocarbon age and a ‘conventional’ (aka. ‘normalized’) radiocarbon age but does not clearly indicate that the difference is a correction for isotopic fractionation and may create confusion in deciding on which age estimates to subject to calibration.

Fortunately, researchers can retroactively re-calibrate adequately reported radiocarbon dates¹². This can be quickly accomplished using free online software such as *CALIB* or *OxCAL*¹³. These programs enable researchers to calibrate large sets of dates and produce tabular and graphical representations of the calibrated age-ranges. Indeed, many academic radiocarbon laboratories (e.g., UC Irvine) no longer conduct the additional interpretive step of calibration. Rather, they leave such decisions up to the individual researchers in recognition that critical contextual details that underlie calibration are best achieved by researchers who selected and submitted the dated material. This is a positive step and we hope will encourage the wider adoption of calibration on the Northwest Coast. Following Bronk Ramsey (2008:249) we contend that “more than ever, it is necessary for users of radiocarbon to understand and engage with the science that underlies the method.”

Problems in Interpreting the ‘Calibrated Intercept’

One formerly widespread format for archaeological reporting of calibrated radiocarbon dates is to report the ‘calibrated intercept’ (Bowman 1990). This intercept is the point at which a radiocarbon age (the number before the “±”) ‘intersects’ the calibration curve. However, due to fluctuations in the width and thickness of the curve (Figure 4.1) and the change from a bell-curve from the radiocarbon age to an irregular curve in the calibrated age-range, there is rarely a ‘single’ point or number at which this intersection occurs and

¹² One issue that can be extremely confusing and could lead to duplicated data when examining a date, is that multiple laboratory names are occasionally published for the same samples. For instance, TO-2352 is the laboratory number in CARD and MacDonald and Inglis 1981, whereas Coupland, et al. (2003:154) references the same date as ISOTRACE-2352. Both are correct, as radiocarbon laboratories often subcontracted out specialized work (such as early accelerator dates), and in these cases both laboratories issued their own numbers. Identification of specific radiocarbon samples is necessary to evaluate and, where appropriate, modify calibration methods.

¹³ Calibration programs are available for free download or online calculation Calib: <http://calib.qub.ac.uk/calib/> or Oxcal: <http://c14.arch.ox.ac.uk>

often the curve is intersected in two or more places and may even have relatively equal probabilities (Figure 4.2). Thus, while the intercept number is intuitively appealing, it is no longer considered an acceptable reporting convention (Telford, et al. 2004). Rather than a single numerical age bounded by an error estimate, a more appropriate representation of a calibrated age is the probability of a date occurring within an estimated time frame. Free calibration programs readily calculate both the 1-sigma and 2-sigma calibrated age-ranges, representing the 68.3% probability and 94.5% probability respectively. While some may find that reporting and discussing an age-range is awkward, it remains the most justifiable way to succinctly characterize the uncertainty of a calibrated age estimate. Fortunately, calibration programmes also provide researchers with an effective and efficient method for representing the probability visually through graphical imagery (e.g., Figure 4.7). As several Northwest Coast researchers have shown, these graphical features readily accommodate the detailed analysis of individual dates (e.g., Ames 2012:180; Grier 2006:102) or show the levels of relative probability for a series of dates (e.g., Lepofsky, et al. 2005:274; Morin, et al. 2008/09:24). Visual tools illustrate the relative temporal distribution of a suite of dates as well as show the undulations and features of the calibration curve itself. Through such graphical analyses, it is possible to identify chronological similarities and differences that may not be readily apparent in tabular form.

Problems in Summarizing Multiple Dates

A persistent problem related to the intercept concept are summary figures such as histograms commonly employed to illustrate trends from multiple dates and sites over time both on the un-calibrated (Fladmark 1975:298) and calibrated timescales (Maschner

1991:930). For instance, a recent study from the Great Basin (Louderback, et al. 2011) presents a series of un-calibrated radiocarbon dates in histograms with 150-250-year bin categories to evaluate paleo-demographic sequences. Curiously, this study does not attempt to calibrate these compiled dates but if this had been conducted, the individual dates would likely span more than one histogram bin category and therefore blur the sharp peaks and troughs inferred to represent demographic trends. An alternative and more appropriate method of displaying the cumulative results of multiple radiocarbon dates is by calibrating a set of dates on a single linear timescale using the ‘summed probability’ method discussed below.

Summed Probability as an Analytical Method

Summed probability is a Bayesian method for pooling or combining the statistical probabilities from multiple calibrated radiocarbon dates into a singular age-range on the calendrical (linear) time scale. The method provides a statistically robust way to combine the calibrated age-range for a series of dates and hence is suitable for assessing the radiocarbon chronology from multiple archaeological contexts (Figure 4.5). It is particularly useful for combining the probabilities from sets of radiocarbon dates to evaluate whether they cluster in time, are spread over a long interval, or exhibit modes and/or troughs potentially indicative of an archaeological phase or event. Archaeologists have used summed probabilities of radiocarbon datasets to refine archaeological chronologies for some time (Eighmy and LaBelle 1996; Gregory 2001) but as the use of freeware calibration tools such as Calib and OxCal have proliferated, the method has been increasingly applied to address a wide range of hypotheses such as the assessment of cultural historical phases (Ames 2012; Lepofsky, et al. 2005; Morin, et al. 2008/09), proxies for paleo-demography (Peros, et al. 2010; Williams

2013), and indicative of population migrations and colonization events (Buchanan, et al. 2008; Collard, et al. 2010; Hamilton and Buchanan 2007).

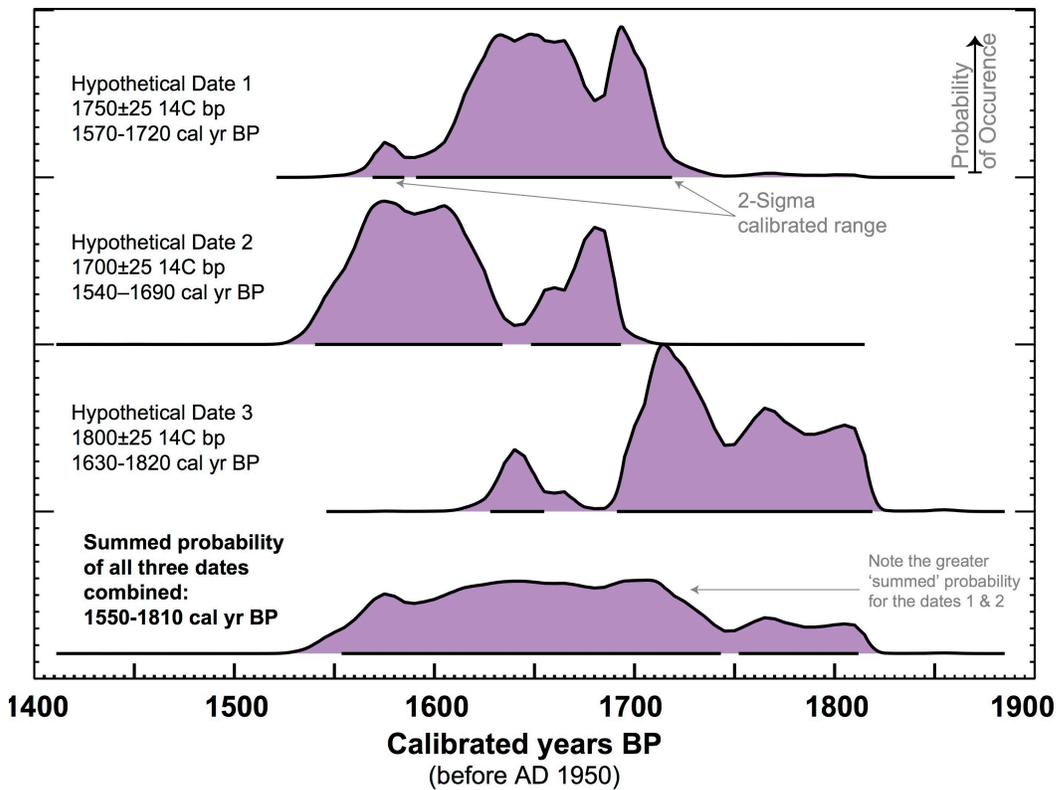


Figure 4.5. An example of three typical radiocarbon dates on terrestrial charcoal calibrated using the 2009 atmospheric curve and underlain by the summed probability of these three dates. Model produced using Calib 6.10 (Reimer et al. 2009).

A flurry of recent research has identified several interpretive and methodological concerns with summarizing radiocarbon data using summed probabilities (Bamforth and Grund 2012; Guilderson, et al. 2005; Steele 2010; Williams 2012). A recent review by Williams (2012) identifies that summed probability profiles are not direct paleo-demographic proxies but are subject to several potential biases, including small sample sizes, taphonomic loss of older sites (Surovell and Brantingham 2007), and calibration effects such as plateaus in the radiocarbon curve that constrain or exaggerate the resolution of some age-ranges. In this latter instance, a given set of dates that concentrates along a relatively 'flat' portion of

the curve may cause a spuriously high summed probability that would not be as prominent if the same a cluster of dates were taken from a ‘steep’ part of the calibration curve (*see* Guilderson et al. 2005 for some examples). Other researchers have identified that the inclusion or exclusion of even a single dataset of dates may influence the shape of the summed probability curve and hence a demographic trends resulting from it (Steele 2010). Bamforth and Grund (2012) have demonstrated that with simulations wherein the periodicity (chronological spacing) of dates directly impacts on the shape of a summed probability profile and that this is particularly strong during the dramatic fluctuations in the radiocarbon curve during the Pleistocene-Holocene transition.

While these researchers caution against uncritical and overly detailed interpretation of the undulations within summed probability profiles, they by no means dismiss the analytical potential of the approach. Rather, the bulk of caution is directed at using summed probabilities as proxies for trends in human demography without examining the many complex factors underlying this method. For instance, the shape and modality of the summed probability can be influenced by but also evaluated against major perturbations in the radiocarbon curve (Bamforth and Grund 2012; Buchanan, et al. 2011; Guilderson, et al. 2005; Williams 2012). The taphonomic fact that older sites are less likely to survive to the present (Surovell and Brantingham 2007) can be considered and even modelled for a given area (Williams 2012). Sample sizes and sample contexts can be evaluated and the strength of the claim can be adjusted accordingly. These studies critically highlight the continued importance of archaeological context as well as an understanding of the constraints of the radiocarbon method, particularly when interpreting what is often a partial and imperfectly sampled archaeological record. The summed probability method remains the most suitable

method for examining the relative distribution of dates from well-sampled archaeological landscapes over broad periods of time.

Unlike the studies described above, our use of summed probability is not to evaluate demographic trends using a the largest number of available dates, but to apply this method to systematically collected dates from the terminal deposits of individual village sites and individual dates on individual human burials. These targeted dating criteria are therefore much less subject to the vagaries of conventional archaeological chronologies (e.g., date the deepest deposit, etc.) and offer a chance to evaluate these interpretively significant radiocarbon datasets on a single calibrated time scale.

Recalibrating the Radiocarbon Record for Prince Rupert Harbour

In light of the insights and challenges presented above, the remainder of the paper focuses on the radiocarbon record for the northern Northwest Coast. We use marine reservoir estimates and the summed probability method to re-evaluate the regional archaeological chronology with the aim of integrating interpretively significant datasets that derive from marine, marine-influenced, and terrestrial radiocarbon dates. In particular, we examine 1) dates on village abandonment in Prince Rupert Harbour and 2) dates on human remains from Prince Rupert Harbour. We focus on this area as it has been subject to intensive and sustained archaeological research for over 40 years and analyse these particular datasets as they represent an important set of radiocarbon observations that underpin the cultural chronology of the northern Northwest Coast during the past 3,000 years.

Methods for Estimating Marine Reservoir on the Northern Northwest Coast

Despite the prevalence of radiocarbon dates on marine and marine influenced samples in archaeological and paleoclimate records, the northern Northwest Coast lacks a time series estimate of Delta-R. Previous research by Southon et al. (1990) and Southon and Fedje (2003) presented an extensive, data-rich study of the total $[R(t)]$ marine reservoir effects for three areas of the British Columbia Coast, but do not provide a specific estimate of Delta-R. Rather they provide only a total marine reservoir correction value, which is not useful for calibration because particular Delta-R values are required for each dated sample when using calibration programs¹⁴. Another paper by Deo et al. (2004) constructed a Delta-R curve for the southern Northwest Coast, but this only covers the past 3,000 years and is applicable to a very specific region of the Salish Sea.

The lack of a published Delta-R estimate or a time series of estimates as well as the perceived complexity of calculating Delta-R values has led to several differing conventions for researchers calibrating marine influenced samples. For instance, many researchers simply subtract an average of the total reservoir age offset (often noted as 600 or 650 years) from normalized marine shell dates and then calibrate the date on the atmospheric curve as if it was terrestrial source material (e.g., Fedje and Mathewes 2005; McLaren 2008; Orchard 2009). Others, including ourselves (Eldridge, et al. 2008), have previously used various estimates for Delta-R based on generalized estimates for the whole Northwest Coast (following Ames 2005 citing Stuiver and Braziunas 1993:156) or specific unpublished estimates recommended by specialists (Moss 1989: citing a personal communication from

¹⁴ Delta-R values should not be calculated simply by subtracting the average global reservoir (405 years) from the total reservoir as the global reservoir value also fluctuates through time (Reimer et al. 2009).

Stuiver). Some researchers (e.g., Coupland et al. 2006; 2010) have avoided the issue of marine reservoir by exclusively dating charcoal, which is subject to its own possible error from the ‘old wood’ effect¹⁵ (Moss 2011a:6; Schiffer 1986).

Estimating Delta-R for Prince Rupert Harbour and the Dundas Islands

Given the considerable numbers of marine and marine influenced radiocarbon dates obtained from sites in and around Prince Rupert Harbour and the lack of a regionally specific reservoir correction (Delta-R), we created a local record of marine reservoir by compiling all available information into a regional time series (Table 1, Figure 4.6). This record contains 10 dates from 5 shell-wood pairs spanning the past 7,000 years, and which were reported in McLaren (2008) and Southon and Fedje (2003) from the Dundas Islands and Prince Rupert respectively. Each of these marine – terrestrial pairs has been appropriately normalized for isotopic fractionation and dated using accelerator mass spectrometry (AMS) at either Lawrence Livermore National Laboratories or the Keck Carbon Cycle AMS facility at the University of California Irvine. Terrestrial charcoal from these samples was specially obtained using a microscope and selecting identifiably deciduous or recent growth plant remains while the outermost growth margin from shells was submitted for dating (personal communications with Fedje and McLaren, 2008). The Dundas Islands data were obtained from archaeological deposits at Far West Point (GcTr-6) and the Connell Island Site (GcTr-7) and date within three broad intervals in the late, middle, and early Holocene (McLaren 2008; McLaren, et al. 2011). The Prince Rupert data were obtained from archaeological deposits on Tugwell Island just off the northern entrance to the Harbour and date to within

¹⁵ This phenomena represents the potential for wood or charcoal to come from old-growth trees or driftwood, the inner parts of which have the potential to be centuries older than the age at which it was deposited.

the late Holocene (Southon and Fedje 2003:107). There are additional shell wood-pair data from Kitimat, 120 km southeast of Prince Rupert (ibid.), but these data were excluded as they date exclusively to the late Pleistocene and were obtained on burrowing shellfish from freshwater-influenced estuary subject to freshwater reservoir effects (e.g., Ingram and Southon 1996; Rick et al. 2012).

For each terrestrial date in this modest database, we determined the global marine reservoir for that particular point in radiocarbon time [R(t)] using the raw observations that comprise the *Intcal04/09* calibration curve, kindly provided to us by Paula Reimer (Personal Communication, 2008, 2013¹⁶). These data show the finest existing temporal record for the terrestrial ages that collectively make up the published *Intcal04/09* calibration curve (Reimer, et al. 2004; Reimer, et al. 2009). The difference in age between coeval *Marine04* and *IntCal04* dates reveals the known global difference between ocean circulation and atmospheric circulation and thus represents the most specific estimate of global R(t) values through time. After assigning a total reservoir estimate [R(t)] and its error based on the terrestrial radiocarbon age of each of the five shell-wood pairs in the sample, we then subtracted the local shell-wood pair difference from the total (global) reservoir estimate to derive a single Delta-R estimate for each datapoint (± 1 standard deviation). The resulting Delta-R values are then plotted over time (Figure 4.6) and overlaid by polynomial curve to infer temporal trends. The resulting figure represents the current temporal record of marine reservoir for Prince Rupert and the Dundas Islands.

16 These data are also available from the *Radiocarbon* journal website: www.radiocarbon.org

This marine reservoir record spans 7,000 years and indicates only moderate fluctuation in regionally specific marine reservoir (Delta-R) during the mid-to-late Holocene (Figure 4.6). Notably, the two similar elevated estimates for the Dundas Islands show virtually no difference between the early and mid-Holocene (Delta-R values of 215, 225 respectively). The two late-Holocene marine–terrestrial pairs from Tugwell Island just outside Prince Rupert Harbour are slightly elevated relative to the two mid and early-Holocene pairs from Dundas (Figure 4.6). This may be due to the proximity of Prince Rupert to the estuarine Skeena River mouth (~25km southeast). However, this may also reflect a climatic influence during this period which overlaps with the ‘neoglacial’ expansion between 3,500-1,000 calendar years ago, when regional climate was colder relative to earlier periods (Menounos, et al. 2009:2063). Similarly, the most recent shell-wood pair (from late period deposits in the Dundas Islands) is slightly elevated relative to the middle and early Holocene shell-wood pairs which occurs during the onset of the ‘little ice age’ (ibid). Overall, the observed fluctuation in reservoir age over time is low to moderate but the temporal trends appears broadly similar to the more variable pattern identified for Haida Gwaii by Southon and Fedje (2003:100).

Prince Rupert Delta-R

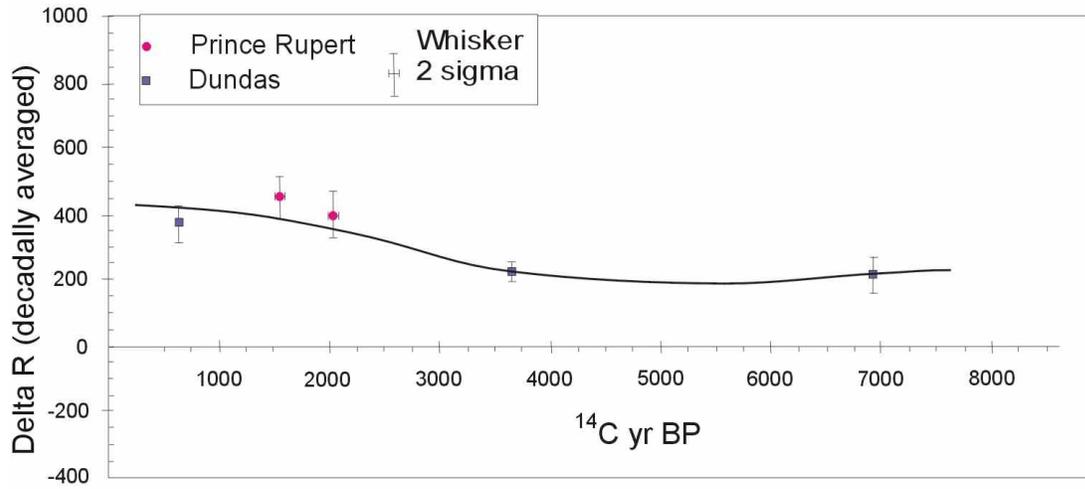


Figure 4.6. Local marine reservoir (Delta-R) estimates over the Holocene for marine–terrestrial pairs from Prince Rupert Harbour and the Dundas Islands (error bars represent ± 1 standard deviation). Source data obtained from Southon and Fedje (2003) and McLaren (2008). The Delta-R estimate during the last 3,000 years is of the greatest relevance to the datasets presented in this paper.

Table 4.1 Paired marine and terrestrial radiocarbon dates from Prince Rupert Harbour and the Dundas Islands and estimates of the local marine reservoir value depicted in Figure 4.6.

Lab #	Marine Material	¹⁴ C Date	±	Lab #	Terrestrial Material	¹⁴ C Date	±	Total Age Offset	±	R(t) Poly	Local Delta-R poly	±	Reference
CAMS-49626	<i>Saxidomus</i>	2370	50	CAMS-49625	charcoal	1560	40	810	60	355	455	60	Southon and Fedje 2003:107
CAMS-49624	<i>Protothaca</i>	2780	50	CAMS-49623	charcoal	2040	50	740	70	340	400	70	Southon and Fedje 2003:107
UCIAMS-21882	Shell	4200	15	UCIAMS-21985	charcoal	3645	25	555	30	330	225	30	McLaren 2008:222
UCIAMS-21881	<i>Mytilus</i>	7510	20	UCIAMS-21984	charcoal	6925	50	585	55	370	215	55	McLaren 2008:224
UCIAMS-21980	<i>Mytilus</i>	1395	15	UCIAMS-21983	charcoal	640	60	755	60	385	370	60	McLaren 2008:240

Table 4.2 Recalibrated radiocarbon dates on shell from the uppermost shell midden layers in village sites in Prince Rupert Harbour reported by Archer (1992, 2001).

Lab Number	Site Number	¹⁴ C Age	¹⁴ C Age ±SD	Delta-R Value	Delta-R ±SD	2-sigma Cal BP	Dated Material	Reference
WSU-4366	GbTo-2	1705	90	390	60	650-1090	marine shell	Archer 1992:4
WSU-4367	GbTo-4	1980	90	360	60	940-1370	marine shell	Archer 1992:4
WSU-4368	GbTo-4	2980	70	300	60	2150-2670	marine shell	Archer 1992:4
WSU-4369	GbTo-7	2720	100	320	60	1770-2320	marine shell	Archer 1992:4
WSU-4370	GbTo-7	2360	95	350	60	1320-1830	marine shell	Archer 1992:4
WSU-4371	GbTo-8	2130	90	360	60	1083-1550	marine shell	Archer 1992:4
WSU-4372	GbTo-8	2550	70	340	60	1570-2030	marine shell	Archer 1992:4
WSU-4373	GbTo-9	2490	90	340	60	1480-2000	marine shell	Archer 1992:4; Archer 2001:212
WSU-4374	GbTo-9	2360	90	350	60	1330-1820	marine shell	Archer 1992:4; Archer 2001:212
WSU-4375	GbTo-28	1900	90	360	60	880-1300	marine shell	Archer 1992:4

Lab Number	Site Number	¹⁴ C Age	¹⁴ C Age ±SD	Delta-R Value	Delta-R ±SD	2-sigma Cal BP	Dated Material	Reference
WSU-4376	GbTo-28	2600	70	330	60	1650-2120	marine shell	Archer 1992:4
WSU-4377	GbTo-32	2435	100	350	60	1380-1930	marine shell	Archer 1992:4; Archer 2001:212
WSU-4378	GbTo-32	2220	70	350	60	1250-1640	marine shell	Archer 1992:4; Archer 2001:212
WSU-4379	GbTo-46	2530	95	340	60	1510-2060	marine shell	Archer 1992:5; Archer 2001:212
WSU-4380	GbTo-46	2590	95	340	60	1570-2130	marine shell	Archer 1992:5; Archer 2001:212
WSU-4381	GbTo-57	2470	90	340	60	1460-1980	marine shell	Archer 1992:5; Archer 2001:212
WSU-4382	GbTo-57	2220	65	350	60	1250-1620	marine shell	Archer 1992:5; Archer 2001:212
WSU-4383	GbTo-59	2870	70	310	60	1980-2470	marine shell	Archer 1992:5
WSU-4384	GbTo-59	3200	80	290	60	2360-2880	marine shell	Archer 1992:5
WSU-4385	GbTo-64	2370	60	350	60	1380-1800	marine shell	Archer 1992:5
WSU-4386	GbTo-64	3840	60	250	60	3290-3700	marine shell	Archer 1992:5
WSU-4387	GbTo-66	2500	60	340	60	1530-1940	marine shell	Archer 1992:5; Archer 2001:212
WSU-4388	GbTo-66	2590	90	340	60	1590-2120	marine shell	Archer 1992:5; Archer 2001:212
WSU-4389	GbTo-70	2445	90	340	60	1410-1930	marine shell	Archer 1992:5; Archer 2001:212
WSU-4390	GbTo-70	2510	100	340	60	1490-2050	marine shell	Archer 1992:5; Archer 2001:212
WSU-4391	GbTo-77	3210	100	290	60	2350-2940	marine shell	Archer 1992:5; Archer 2001:212
WSU-4392	GbTo-77	2925	100	300	60	2030-2670	marine shell	Archer 1992:5; Archer 2001:212

Lab Number	Site Number	¹⁴ C Age	¹⁴ C Age ±SD	Delta-R Value	Delta-R ±SD	2-sigma Cal BP	Dated Material	Reference
WSU-4393	GbTo-78	2760	90	320	60	1830-2330	marine shell	Archer 1992:6; Archer 2001:212
WSU-4394	GbTo-78	2425	80	350	60	1400-1880	marine shell	Archer 1992:6; Archer 2001:212
WSU-4395	GbTo-89	2450	70	340	60	1470-1920	marine shell	Archer 1992:6; Archer 2001:212
WSU-4396	GbTo-89	2490	90	340	60	1480-2000	marine shell	Archer 1992:6; Archer 2001:212
WSU-4397	GbTn-9	2710	90	320	60	1780-2300	marine shell	Archer 1992:6
WSU-4398	GbTn-9	4090	70	240	40	3600-4050	marine shell	Archer 1992:6
WSU-4399	GcTo-6	2310	70	350	60	1300-1730	marine shell	Archer 1992:6; Archer 2001:212
WSU-4400	GcTo-6	2140	90	360	60	1100-1570	marine shell	Archer 1992:6; Archer 2001:212
WSU-4401	GcTo-27	2280	95	350	60	1270-1750	marine shell	Archer 1992:6
WSU-4402	GcTo-27	2695	70	330	60	1790-2270	marine shell	Archer 1992:6
WSU-4403	GcTo-28	2440	100	340	60	1400-1950	marine shell	Archer 1992:6
WSU-4404	GcTo-28	2290	90	350	60	1280-1750	marine shell	Archer 1992:6
WSU-4405	GcTo-39	2280	90	350	60	1270-1730	marine shell	Archer 1992:6
WSU-4406	GcTo-39	2430	100	340	60	1390-1930	marine shell	Archer 1992:6
WSU-4407	GcTo-51	2580	100	340	60	1550-2130	marine shell	Archer 1992:7
WSU-4408	GcTo-51	2070	90	360	60	1030-1500	marine shell	Archer 1992:7
WSU-4409	GcTo-52	2360	75	350	60	1350-1810	marine shell	Archer 1992:7; Archer 2001:212
WSU-4410	GcTo-52	2530	90	340	60	1520-2050	marine shell	Archer 1992:7; Archer 2001:212

Recalibrating Marine-Influenced Dates from Prince Rupert Harbour

Using this marine reservoir time series, it is possible to re-calibrate marine and marine-influenced radiocarbon dates from Prince Rupert Harbour and the Dundas Islands on a single integrated timescale. Thus, we reviewed and compiled all available information on each archaeological date from the region, including the type of dated material (e.g., charcoal, shell), both the standard and normalized radiocarbon ages, and we compiled the measured estimates for the percentage of marine carbon in the diet of dated human remains discussed below. For each marine or marine-influenced date, we derived an age-specific Delta-R value, an uncertainty for Delta-R and then re-calibrated all dates using the CALIB calibration programme (*Calib* 6.1.1) using the appropriate calibration curve for each individual date (i.e., atmospheric, marine, or mixed marine-terrestrial). Outputs for these re-calibrations are presented in 2-sigma calibrated age-ranges (Table 2) as well as in summarized summed probability plots presented in Figure 4.7 and Figure 4.8.

We re-evaluate the chronology of three series of radiocarbon dates from Prince Rupert Harbour: 1) dates on settlement history and village abandonment by David Archer (1992, 2001) and 2) dates obtained on human remains obtained during the North Coast Prehistory Project (Ames 2005; MacDonald and Inglis 1981).

Calibration Issues in Village Abandonment Dates from Shell

The first radiocarbon dataset we consider is from the extensive settlement history study of Prince Rupert conducted by David Archer (1992, 2001) who systematically dated shells collected from the upper layers from 23 village sites to evaluate the hypothesis that there was a period of widespread village abandonment in Prince Rupert Harbour.

Archer's initial study was based on 45 dates from 23 sites (1992) but he later refined this to a much smaller sample of 22 dates from the 11 village sites based on strict chronological criteria (2001). Each dated site had spatial and architectural characteristics that were hypothesized to be associated with either 'egalitarian' or 'ranked' village social organization based on the variation in house size and the configuration of house platforms. As observed by Archer, dates of 'abandonment' from these two types of sites sequentially clustered in time around AD 100, but the 'egalitarian' villages were abandoned first followed after by the 'ranked' villages. Archer interpreted the overall clustering in time of these dates as reflecting widespread abandonment of the harbour locality around AD 400 (Archer 2001:214). He interpreted further detail in the sequence of this abandonment as relating to the type of village that was abandoned first and argued this reflected evidence of a dramatic increase in social ranking throughout Prince Rupert Harbour immediately followed by widespread regional village abandonments.

This innovative settlement study was pioneering in its effort to consistently stringent household measurements and sampling criteria to a series of sites within a small area in order to characterize settlement history. Archer's radiocarbon methodology entailed dating relatively short-lived marine shells from the top of shell midden (terminal) deposits and calibrating these dates using an estimated marine reservoir age. However, as discussed below, there are complexities with his application of calibration techniques to this radiocarbon dataset that warrant further evaluation.

Archer's 2001 study employed stringent chronological criteria so that only half of his original dates presented in his 1992 report were retained as representative of 'village abandonment'. A key aspect of his 2001 criteria specified that two dates on marine shell

(obtained from the two separate areas of a village) needed to overlap at a 2-sigma calibrated age-range for inclusion. However, this range depends on the methods and calibration curve used to calibrate the dates. Moreover, the methodology for calibration differ between Archer's 1992 and 2001 publications. In 1992, Archer subtracted 650 years from the un-calibrated radiocarbon ages and added 50 years to the standard deviation (1992:4). He then calibrated these 'corrected' dates using the then internationally recognized atmospheric calibration curve (Stuiver and Pearson 1986). This was a thoroughly appropriate treatment of these data at the time. However, in 2001, Archer presents only a subset of these original data (22 of 45 dates) and more importantly, rather than correcting and calibrating these dates, he appears to simply subtract 650 years from the un-calibrated age and adds 15 years to the standard deviation (2001:212). Thus, he does not technically calibrate these radiocarbon dates but only provides the original radiocarbon age (^{14}C yr bp) minus 650 years. Moreover, he presents these same data in a figure that show these dates on the calendrical (calibrated) time scale, thus implying they are calibrated but without showing a calibrated age-range or describing the method by which these singular age estimates were determined. Given the known differences between calibrated and non-calibrated radiocarbon dates, and the uncertainty of estimating marine reservoir, we feel this important dataset can be usefully recalibrated on the marine curve using a temporally specific Delta-R . The results of these recalibrations are presented below.

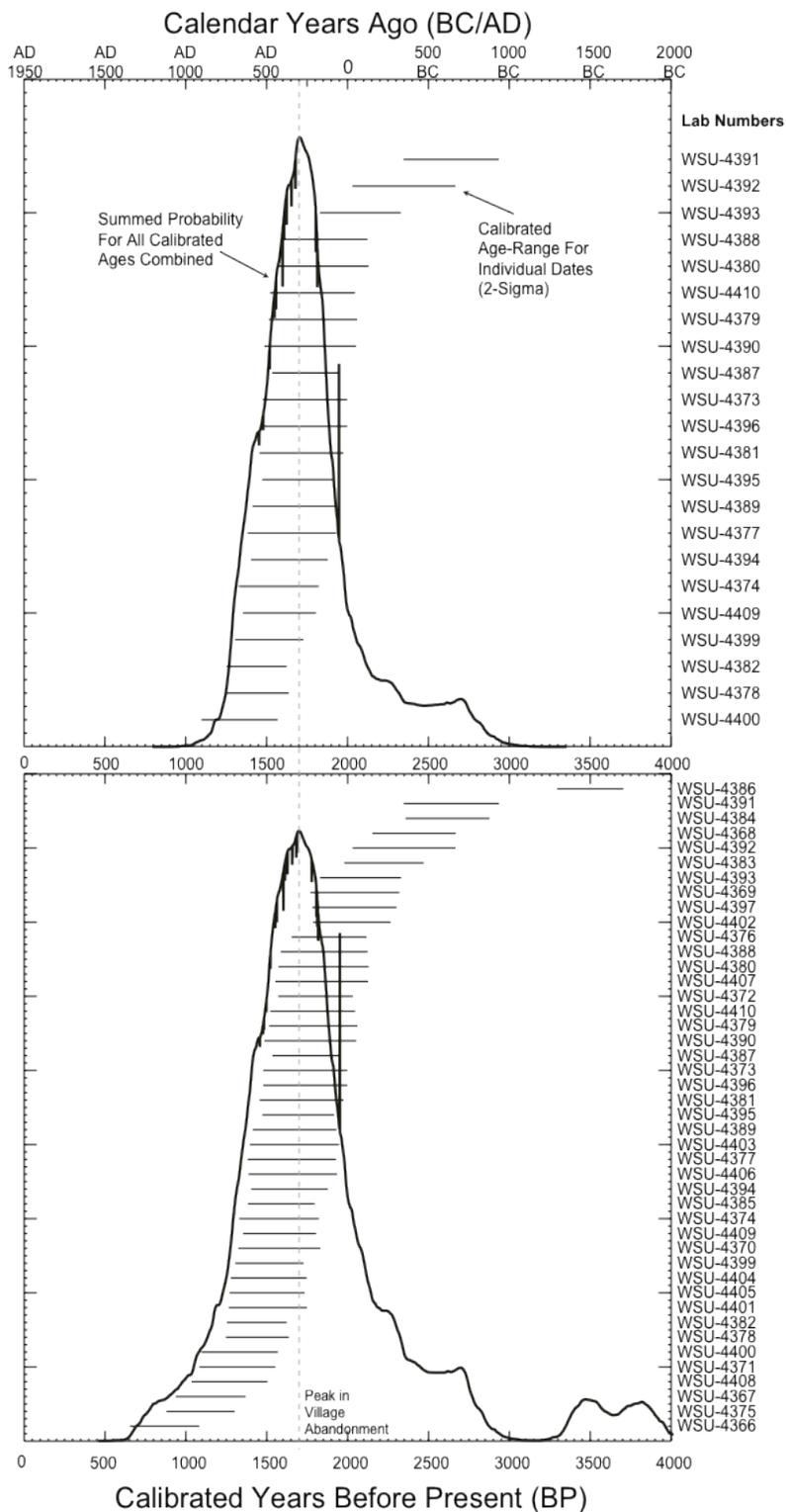


Figure 4.7. Village abandonment data obtained from Archer 2001 (top) and Archer 1992 (bottom) but presented on calibrated time scale. Horizontal lines represent calibrated age-ranges for individual dates (at 2-sigma) and the dark black line represents the summed probability of all of the dates combined. Dashed vertical line indicates a peak in summed probability that is identical in both reported datasets.

Recalibration of Prince Rupert Harbour Village Abandonment Dates

Our recalibration of both Archer's abridged (2001) and original (1992) data on shell dates from the upper layers of multiple village sites in Prince Rupert Harbour confirm that these two series of dates strongly cluster in time (Figure 4.7). Our results also indicate the probable peak of abandonment seems to have occurred around 1700 cal yr BP (ca. AD 300) which support Archer's original contention for a widespread abandonment of villages occurring roughly the same period. Importantly, the large spike in summed probability is nearly identical between Archer's much larger original (1992) sample which includes a variety of dates that were 'rejected' because of a lack of calibrated overlap with other dates from the same site or from potential site disturbance.

Thus, the overall similarity of the two probability plots, particularly the strong and relatively sudden peak in summed probability around 1700 years ago, strengthens Archer's original claim for inferring something most remarkable in the archaeological record: a broadly contemporaneous abandonment of more than a dozen villages in a small area over a relatively short archaeological timeframe. This overlap in time is additionally notable due to the fact that the previous dataset was inconsistently calibrated. The summed probability plot of the larger dataset does reflect a less narrowly defined temporal window than Archer's refined sub-sample (2001) and further distinctions could be made based on the category of 'egalitarian' and 'ranked' village sites but we do not evaluate this distinction here.

The inherent uncertainty in radiocarbon calibration and the error-ranges in the current dataset precludes us from determining if this process of village 'abandonment' occurred in the space of a few years or decades, but it is notable that bulk of abandonments appear to span the period between 1200 and 2000 cal yr BP. However, the fact that nearly two-thirds

of the radiocarbon dates include the year AD 300 in their two-sigma ranges strongly suggests to use that a series of village sites stopped accumulating around that period in time.

Archer's study did not include all identified village sites in the harbour – some villages were purposefully excluded as they were currently occupied (e.g., Metlakatla) and other untested sites may have been occupied throughout the late pre-contact period up through the early historic-era but await future investigation. Archer's larger (1992) sample indicates a more prolonged period of occupation as it includes a few younger dates that may represent abandoned villages being subsequently reoccupied for brief periods or subsequent disturbance to the site deposits (e.g., GbTo-2, GbTo-4 and GbTo-28, see appendix). Ames (2005:110) also notes that some sites (e.g., Grassy Bay) seem to begin to be occupied after this period. Thus, despite the discrepancies between Archer's original (1992) and later (2001) presentation of these radiocarbon data, as well as the complex issue of marine calibration, our data confirm and strengthen Archer's hypothesis in regards to a relatively narrow period of village abandonment and place these results firmly on the calibrated time scale. This important dataset can now be compared to the dates on human remains discussed below.

Marine Influenced Human Burial Dates in Prince Rupert Harbour

The North Coast Prehistory Project (1966-1980), directed by George MacDonald of the Canadian Museum of Civilization, identified and excavated a variety of shell midden sites and obtained a large number of radiocarbon dates directly on human remains recovered from burial interments (n=40), several of which are associated with elaborate burial goods interpreted to reflect emergent social differentiation and the antiquity of warfare (Ames 2001, 2005; Cybulski 1975, 1990, 1999; Fladmark, et al. 1990; MacDonald and Inglis 1981;

MacDonald and Cybulski 2001). Even though more than 40 years have passed since this multi-year excavation project, this particular set of radiocarbon dates on human interments presently comprises more than 20% of the currently reported dates in Prince Rupert Harbour and remains among the most intensively dated and studied burial population on the Northwest Coast (Cybulski 2006).

The issue of calibrating radiocarbon dates on human remains in Prince Rupert Harbour has long been identified as a topic of interpretive concern. Cybulski (1992; 1996:65) noted that a date on a decapitated human burial from the Lachane site (GbTo-33) was “uncorrected for possible fluctuations in atmospheric ^{14}C or marine reservoir influences.” In his summary of the North Coast Prehistory Project, Ames (2005:50) endeavoured to compile and calibrate all available radiocarbon dates from the harbour locality and has a lengthy discussion regarding the marine reservoir and Delta-R values and whether to apply them in the calibration of human remains dates. He notes the lack of an estimate for Delta-R values and highlights the variation in values applied by different researchers. Ames also mentions that stable isotope measurements by Chisholm et al. (1982, 1983) indicate the diet of pre-contact peoples in Prince Rupert Harbour was predominantly marine-based (and thus subject to the marine reservoir). However, Ames does not apply such a correction when calibrating these dates. Rather, he states that while “some correction seemed in order... I had no basis for making it, if, indeed it was necessary” (Ames 2005:50). Based on a review of existing and newly available data, this chapter offers a basis for revising this statement by compiling existing information about the age of the marine reservoir and marine diet estimations in Prince Rupert Harbour and the Dundas Islands. Indeed, the present study was prompted by our suspicion that the discrepancy between the dates on human remains and village

abandonment dates (discussed below) might be reduced and/or reconciled if both radiocarbon datasets were calibrated appropriately, although at the time we did not realize the complexity of this task.

Researchers working elsewhere on the northern Northwest Coast have addressed the challenge of interpreting radiocarbon ages on human remains by using isotopically derived estimates of marine diet and to determine if a date should be calibrated on a marine, terrestrial, or mixed marine-terrestrial curve. In Southeast Alaska, Dixon and colleagues used the isotopic composition of human bone obtained from an early-Holocene site (Dixon, et al. 1997:703) to demonstrate this individual had an overwhelming marine-based diet and subsequently calibrated the age of this individual using the marine curve (Fedje, et al. 2004:113; Kemp, et al. 2007:606). Researchers and First Nations descendants working with *Kwaday dan ts'inchi*, the 'man long ago found,' whose remains were recovered from a receding glacier in northwestern BC (700km NW of Prince Rupert), radiocarbon dated both his clothing and his bone collagen as well as measuring carbon and nitrogen isotopes to determine his long-term diet (Richards, et al. 2007). They then used these values along with dates on associated terrestrial artifacts to best estimate the calibrated age-range when the individual died (ibid:721-723). Unfortunately, the Little Ice Age climatic anomaly during this period, associated with a 'flat' part of the calibration curve, makes the calibrated age ranges particularly broad for this particular case.

Correcting for marine reservoir can thus be greatly strengthened by using available isotopic data to ensure the appropriate curve is used. Within Prince Rupert Harbour and nearby Lucy Island, existing carbon isotopic data are available from at least 11 human burials (Chisholm, et al. 1983:397; Cui, et al. 2013:4; Cybulski 2001) with carbon isotope values

($\delta C^{12}/C^{13}$), and range from -16.9 to -11.6 (Table 4.3). According to the conversion formula applied to five individuals by (Chisholm, et al. 1983:397), this represents interpreted values of marine protein intake of 85%, 88%, 97%, 99%, and 100% respectively.¹⁷ From this sample, an estimated value of $90\pm 10\%$ marine protein can be considered conservative given the preponderance of higher marine dietary components noted elsewhere on the Northwest Coast (Chisholm 1986; Chisholm et al. 1982, 1983; Richards et al. 2007:721). While only three of these individuals have been directly radiocarbon dated (S-1729, GSC-2886, and GSC-2888), the remainder are from dated sites or associated with other dated individuals (Table 4.3). The Canadian Archaeological Radiocarbon Database (*CARD*) lists an additional two individuals from Garden Island (GbTo-23) with measured $\delta C^{12}/C^{13}$ values of -14.3 (GSC-2888) and an outlier with a value of -16.9 (GSC-2886). Presumably, this latter individual could be from an interior or upriver location with poor salmon runs and no other marine protein intake.

The presence of non-local marine reservoir values in marine foods further complicates the determination of an appropriate Delta-R for radiocarbon dated human remains. Indigenous populations on the Northern Northwest coast regularly consumed pelagic and highly migratory marine mammals, birds, and fish, especially salmon (Ames 1998; Brewster and Martindale 2011; Coupland, et al. 2010; Moss 2007a). Many of these subsistence resources, including shellfish (Burchell, et al. 2013), could be smoked, dried and/or stored as well as transported and extensively traded during seasonal excursions (Ames

¹⁷ These isotopic estimates lack corresponding nitrogen measurements (N^{15}/N^{14}) which might help further refine estimates of marine derived protein intake. However, since the region lacks C4 plants and the range of C^{12}/C^{13} values for prey species is relatively well constrained at this latitude (Szpak, et al. 2009:2738; Szpak, et al. 2012), these estimates are remain the best current estimate until future studies can be conducted.

2002; Martindale and Jurakic 2004). Thus, estimates for Delta-R specific to local conditions remain potentially variable for both humans and their protein sources in the absence of specific data such as series of human-charcoal and salmon-charcoal paired dates from different localities. While trade and exchange as well as the consumption of migratory marine animals adds a level of uncertainty to the calculation of Delta-R values, our use of a local Delta-R for calibrating dates on human remains (Table 4.4) is certainly preferable to previous approaches that have not applied any correction for marine content.

Table 4.3 Available carbon isotope values on directly dated and undated human remains from Prince Rupert Harbour and surrounding locations.

Site #	Burial Number	¹⁴ C Lab#	¹⁴ C Date	± SD	Estimated Marine Protein ¹ (Chisholm et al. 1983)	Delta C ¹³	Reference
GbTo-23 Garden Island	201	GSC-2886	2660	260		-16.9	(Cybulksi 2001)
GbTo-23 Garden Island	197	GSC-2888	2620	70		-14.3	(Cybulksi 2001)
GbTp-1 Lucy Island	Ancient 938	Beta-294715	5530	40		-12.9	(Cui, et al. 2013:4)
GbTp-1 Lucy Island	Ancient 939	Beta-317343	5930	40		-11.6	(Cui, et al. 2013:4)
GbTo-33 Lachane	455	S-1729	2300	70	99%	-13.0	(Chisholm, et al. 1983:397; Chisholm 1986:143)
GbTo-31 Boardwalk	328				85%	-14.1	(Chisholm, et al. 1983:397; Chisholm 1986:143)
GbTo-31 Boardwalk	330				88%	-13.9	(Chisholm, et al. 1983:397; Chisholm 1986:143)
GbTo-36 Baldwin	509				97%	-13.2	(Chisholm, et al. 1983:397; Chisholm 1986:143)
GbTo-36 Baldwin	515				100%	-12.7	(Chisholm, et al. 1983:397; Chisholm 1986:143)
GgTj-6 Greenville	2D-48				93%	-13.5	(Chisholm, et al. 1983:397; Chisholm 1986:143)
GgTj-6 Greenville	3D-23				86%	-14	(Chisholm, et al. 1983:397; Chisholm 1986:143)
TOTALS	N=10		N=5		93 ±12%	13.6 ±1.3	

¹ This estimate has an uncertainty of ±10% (Chisholm et al. 1983:397).

Table 4.4 Recalibrated radiocarbon dates on human bone collagen compiled from existing literature as synthesized by Cybulski (1992) and Ames (2005) and including moving average Delta-R estimates and estimated marine protein content based on Table 4.3.

Lab #	Site	¹⁴ C Age	¹⁴ C Age ±SD	Delta-R	Delta-R ±SD	% Marine Carbon	Material	Cal yr BP (2-sigma)	Reference
S-2549	GbTo-30 Parizeau Pt	1640	90	450	60	90	collagen	640-1040	Cybulski 1992, Cited in Ames 2005
S-1430	GbTo-31 Boardwalk	1820	70	450	60	90	collagen	800-1210	Cybulski 1992, Cited in Ames 2005
S-1428	GbTo-23 Garden Island	1930	85	425	60	90	collagen	930-1310	Cybulski 1992, Cited in Ames 2005
S-1663	GbTo-33 Lachane	1930	60	425	60	90	collagen	960-1280	Cybulski 1992, Cited in Ames 2005
S-1731	GbTo-33 Lachane	1930	70	425	60	90	collagen	950-1290	Cybulski 1992, Cited in Ames 2005
S-1599	GbTo-36 Baldwin	1940	80	425	60	90	collagen	940-1310	Cybulski 1992, Cited in Ames 2005
S-1738	GbTo-36 Baldwin	2040	80	400	60	90	collagen	1060-1480	Cybulski 1992, Cited in Ames 2005
S-1667	GbTo-31 Boardwalk	2050	70	400	60	90	collagen	1080-1480	Cybulski 1992, Cited in Ames 2005
S-1732	GbTo-33 Lachane	2080	80	375	60	90	collagen	1130-1540	Cybulski 1992, Cited in Ames 2005
S-1733	GbTo-31 Boardwalk	2090	150	375	60	90	collagen	1000-1700	Cybulski 1992, Cited in Ames 2005
S-1740	GbTo-33 Lachane	2200	110	350	60	90	collagen	1250-1770	Cybulski 1992, Cited in Ames 2005
S-1736	GbTo-31 Boardwalk	2260	80	350	60	90	collagen	1320-1770	Cybulski 1992, Cited in Ames 2005
S-1734	GbTo-31 Boardwalk	2270	80	350	60	90	collagen	1330-1780	Cybulski 1992, Cited in Ames 2005
S-1729	GbTo-33 Lachane	2300	70	350	60	90	collagen, Delta C ¹³ = -13.0	1380-1800	Cybulski 1992, Cited in Ames 2005 and Chisholm 1986:143
S-1728	GbTo-33 Lachane	2320	70	325	60	90	collagen	1410-1840	Cybulski 1992, Cited in Ames 2005
S-1730	GbTo-33 Lachane	2320	70	325	60	90	collagen	1410-1840	Cybulski 1992, Cited in Ames 2005
S-1283	GbTo-36 Baldwin	2320	80	325	60	90	collagen	1400-1860	Cybulski 1992, Cited in Ames 2005
S-1282	GbTo-33 Lachane	2390	80	325	60	90	collagen	1490-1950	Cybulski 1992, Cited in Ames 2005
S-2548	GbTo-30 Parizeau Pt	2430	90	325	60	90	collagen	1511-2015	Cybulski 1992, Cited in Ames 2005
S-1665	GbTo-31 Boardwalk	2510	70	300	60	90	collagen	1680-2120	Cybulski 1992, Cited in Ames 2005
S-1735	GbTo-31 Boardwalk	2510	100	300	60	90	collagen	1590-2160	Cybulski 1992, Cited in Ames 2005
S-1664	GbTo-31 Boardwalk	2530	70	300	60	90	collagen	1690-2130	Cybulski 1992, Cited in Ames 2005
S-1427	GbTo-18 Dodge Island	2565	80	300	60	90	collagen	1700-2200	MacDonald and Inglis 1981
S-1739	GbTo-33 Lachane	2610	100	300	60	90	collagen	1740-2300	Cybulski 1992, Cited in Ames 2005
GSC-2888	GbTo-23 Garden Island	2620	70	300	60	90	human bone, C ^{12/13} = -14.3	1818-2274	MacDonald and Inglis 1981 and Cybulski in CARD

Lab #	Site	¹⁴ C Age	¹⁴ C Age ±SD	Delta-R	Delta-R ±SD	% Marine Carbon	Material	Cal yr BP (2-sigma)	Reference
GSC-2886	GbTo-23 Garden Island	2660	260	300	60	90	collagen Delta C ¹³ = -16.9	1470-2720	MacDonald and Inglis 1981 Cybulski in CARD 2001
S-1429	GbTo-23 Garden Island	2670	85	300	60	90	collagen	1850-2320	Cybulski 1992, Cited in Ames 2005
S-1425	GbTo-18 Dodge Island	2700	80	300	60	90	collagen	1890-2330	MacDonald and Inglis 1981 cited in CARD
S-2723	GbTn-19- Ridley	2710	150	300	60	90	collagen	1720-2550	MacDonald and Inglis 1981 cited in CARD
S-1666	GbTo-31 Boardwalk	2750	80	275	60	90	collagen assoc w copper	1940-2440	Cybulski 1992, Cited in Ames 2005
S-1432	GbTo-31 Boardwalk	2760	90	275	60	90	collagen	1930-2480	Cybulski 1992, Cited in Ames 2005
S-1285	GbTo-31 Boardwalk	2790	80	275	60	90	collagen	1980-2520	Cybulski 1992, Cited in Ames 2005
S-1426	GbTo-18 Dodge Island	2930	80	275	60	90	collagen	2190-2700	MacDonald and Inglis 1981
S-1595	GbTo-23 Garden Island	2980	70	275	60	90	collagen	2280-2740	Cybulski 1992, Cited in Ames 2005
S-1284	GbTo-31 Boardwalk	2980	85	275	60	90	collagen	2280-2740	Cybulski 1992, Cited in Ames 2005
S-1431	GbTo-31 Boardwalk	3040	130	275	60	90	collagen	2200-2880	Cybulski 1992, Cited in Ames 2005
S-1598	GbTo-36 Baldwin	3100	70	250	60	90	collagen	2390-2860	Cybulski 1992, Cited in Ames 2005
S-1433	GbTo-33 Lachane	3210	90	250	60	90	collagen	2500-3070	Cybulski 1992, Cited in Ames 2005
S-1741	GbTo-33 Lachane	3280	85	250	60	90	collagen	2680-3160	Cybulski 1992, Cited in Ames 2005
S-3361	GbTo-36 Baldwin	3370	90	250	60	90	collagen	2750-3250	Cybulski 1992, Cited in Ames 2005

Recalibrating Radiocarbon Dates on Human Remains from Prince Rupert Harbour

The radiocarbon dates obtained on human remains from Prince Rupert Harbour were obtained from a multi-site burial population examined by Cybulski (1975). Dates were presented in summarized form in MacDonald and Inglis (1981:44) and re-presented in Ames (2005). These dates were also submitted to the Canadian Radiocarbon Database (*CARD*) database by Cybulski (www.canadianarchaeology.ca/). For our re-calibrations, we sought to compare our recalibrations using the ‘mixed’ marine-terrestrial curve and incorporating a predominantly marine diet estimate with Ames’ (2005) two sets of calibrations based on 1) the atmospheric (terrestrial) radiocarbon curve (without a marine reservoir correction) and 2) entirely on the marine curve. To accomplish this, we first reviewed reported dates and available isotopic data to ensure each was normalized appropriately and assumed a predominantly marine diet for the burial population (90% marine protein). This estimate seems conservative given the high frequency of higher values (higher marine dietary components) noted in the harbour and elsewhere on the Northwest Coast (e.g., Chisholm 1986; Chisholm et al. 1982, 1983; Richards et al. 2007:721).

With these estimates, we recalibrate dates on human remains contrasting three different calibration methods using the CALIB programme to demonstrate the chronological consequences of calibration treatments (Figure 4.8).

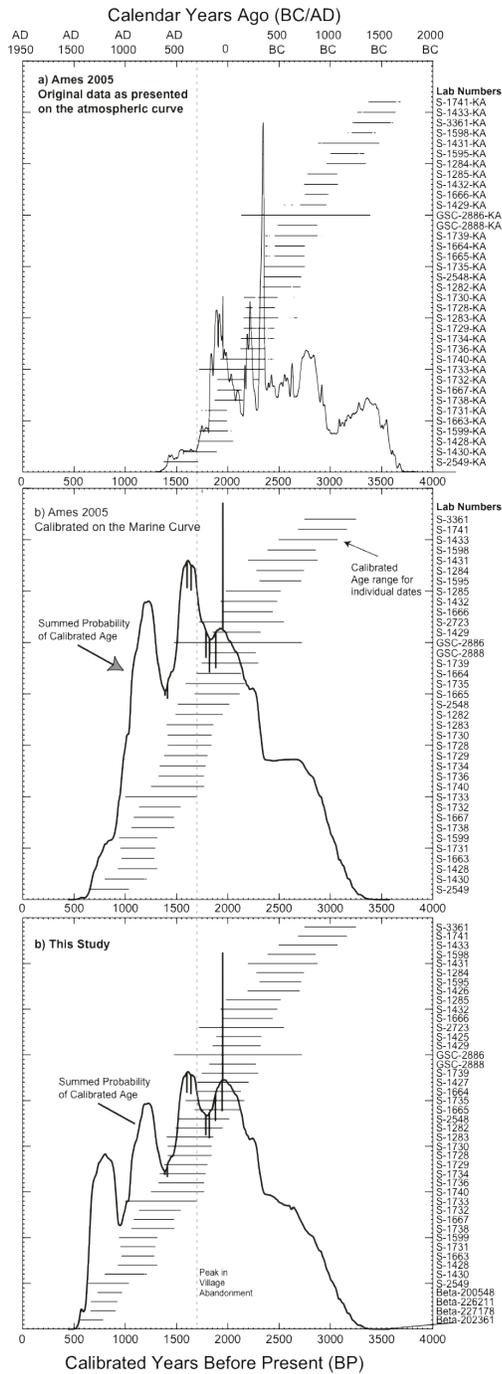


Figure 4.8 Comparison of different calibration criteria applied to radiocarbon dates on human remains from Prince Rupert Harbour. The top figure depicts Ames’ (2005) original dataset and analytical assumptions calibrated on the atmospheric (terrestrial) curve without a marine reservoir correction. The middle figure also presents Ames dataset but uses the marine calibration curve with a generic Delta-R estimate of a 390 ± 25 discussed by Ames (2005:50). The bottom figure represents our reanalysis of all available data using an estimate of a 90% marine diet and a moving average of Delta-R (derived from Figure 4.5). Horizontal lines overlaid onto the summed probability profile represent calibrated age-ranges for individual dates (at 2-sigma).

The top plot in Figure 4.8 shows the summed probability of Ames' (2005:108) calibration method, reflecting the combined profile of individual dates on human remains calibrated on the atmospheric curve and assuming a 100% terrestrial diet. This summed probability plot reveals multiple dramatic spikes and a profound drop just after 1700 cal yr BP. These data appear broadly similar to Ames (2005:108), whose Figure 5.31 depicts a histogram of calibrated intercepts (cf. Telford et. al. 2004) indicating a large spike in frequency between 300 BC and 200 BC followed by another spike between AD 0 and AD 100. This calibration treatment indicates that the burial dates span a period of 3,000 years but abruptly ends after 1400 cal yr BP (AD 400).

In contrast, the middle plot also shows Ames' (2005) sample of dated human remains, but calibrated on the marine curve and incorporating a Delta-R value of 390 ± 25 , a generic value for the entire Northwest Coast (Stuiver and Braziunas 1993:156) and commonly recommended by Beta Analytic (e.g., Ames 2005:50). This plot is greatly smoothed relative to the top plot, reflecting the slow circulation of carbon in the marine domain relative to the atmospheric curve. Due the inclusion of a local marine reservoir effect, this plot shifts the age-range for this set of dates forward in time by nearly 1,000 years and also alters the shape and modularity of the summed probability profile. In this treatment, the greatest frequency of dated human remains post-dates the peak in village abandonment ca. 1700 cal yr BP.

The bottom plot in Figure 4.8 depicts our re-calibration treatment on the marine calibration curve, incorporating a locally derived and temporally specific Delta-R (Figure 4.6), and assuming a 90% marine diet among the dated individuals. This plot also includes additional dated human burials not reported in Ames 2005 (e.g., GbTo-18, Dodge Island). Overall, this plot demonstrates the frequency of dated burials is highest just prior to and

following the peak in village abandonments around 1700 cal yr BP and decreases after approximately 1500 cal yr BP, nearly a millennium after Ames's previous analysis suggests (2005:111). These re-calibrations indicate this sample of human burials spans a 3,000-year time span, abruptly ending at 500 calibrated years BP; slightly later than the marine recalibration of Ames' 2005 data (Figure 4.8b), and dramatically later than his original calibrations (Figure 4.8c).

Our revised calibrations of Ames' compiled data and using a slightly larger sample considerably shifts the archaeological chronology of human interments in Prince Rupert Harbour, particularly in relation to Archer's settlement data on village abandonment. This integrated chronology indicates dated human interments predate as well as significantly post-date the period of village abandonment. It is notable that the bulk of the dated interments appear are most frequent in the centuries immediately preceding and following the peak of village abandonments (ca. 1700 cal yr BP). This is followed by two moderate peaks of increased probability at approximately 1200 and 800 cal yr BP respectively. The sequential periodicity of these three peaks is intriguing but it may be due to plateaus in the radiocarbon curve (cf. Guilderson et al. 2005) and/or the sampling of multiple interments from a single contemporaneous deposit from a limited number of sites (cf. Geib and Hurst 2013). The relatively large error ranges for these dates and the relatively broad calibrated age-ranges also increases the chance these are artifacts of cumulative probabilities (Bamforth and Grund 2012). However, this periodicity may also relate to a temporal clustering of burial interments on a regional scale as observed in subterranean cairn and mound burials on the southern Northwest Coast (Brown 2003; Lepofsky, et al. 2000).

Regardless of the factors that may influence these individual undulations, this integrated set of recalibrated dates demonstrates a robust and broader pattern of burial interments both preceding and succeeding the peak period of village abandonment. In particular, this dataset indicates the bulk of dated burials occur after the period of village abandonment. This suggests that the individuals interred at these no-longer accumulating village sites may have maintained affinities with the kin-groups or lineages who formerly occupied them. Support for such a pattern is observed in Tsimshian oral histories (adawx) which speak of a temporary abandonment of the Harbour after approximately 2000 years ago followed by a re-establishment of more aggregated seasonal Tsimshian settlements in Metlakatla Pass (Martindale and Marsden 2003:14). The broad temporal overlap also indicates a continuity of burial interments during the period when these villages remained intensively occupied (i.e., prior to ca. 1700 cal yr BP). Future research into Prince Rupert burial practices and village settlement histories might productively consider how human interments might be placed into previously deposited shell midden such as the presence of culturally sterile sediments overlaying shell midden deposits (e.g., Ames 2005:248-249).

Interpretive Implications of Recalibrations on Individual Dates

In addition to the considering the insights provided by modelling the summed probability profiles, our recalibrations revise the understood age-ranges of several individual burials that have been identified as important social and historical markers of social differentiation, large-scale migrations, warfare, and regional trade and interaction (Ames 2001; Cooper 2012; Cybulski 1994; Martindale and Marsden 2003; Matson and Coupland 1995).

Of particular significance are the dates on human interments associated with copper artifacts which are interpreted to be socially valuable and widely traded prestige items. The copper artifacts associated with dated human interments from Prince Rupert Harbour are among the earliest dated evidence for copper (ca. 2000 cal yr BP) in northwestern North America (Ames 2005:234; Cooper 2007). This broadly traded material has not been sourced but the closest archaeologically identified source in is the Copper River in Alaska over 1200 km northwest of Prince Rupert (Cooper 2007). The earliest dated interment (Burial 325, S-1666) is a young male (12-16 yr) associated with copper (including disc earrings and copper staining on several long bones) (MacDonald and Cybulski 2001:11) that has been previously interpreted by Ames (2005:214) to date to between 1020 – 800 BC (2970-2750 cal yr BP). In contrast, our recalibrations indicate this individual is approximately 800 years younger, dating to between 240 BC and AD 30 (2190-1980 cal yr BP). While this age-range is significantly more recent than previously postulated (Ames 2005; MacDonald 1983), this date remains considerably older than the earliest documented copper artifacts from the south-central Alaska and the Yukon, which post date AD 1000 (Cooper 2012:580) as well as older than dates associated with copper on the southern BC Coast (Blake 2004:110-111; Lepofsky, et al. 2000:400).

Burial 322 (S-1667) also contained a “copper-wrapped wood bead,” several copper stained element an amber bead and over 250 shell disc beads including 25 dentalium beads (MacDonald and Cybulski 2001:11). Ames (2005:209) calibrates this individual to between 190 BC to AD 60 whereas our re-calibrations indicate a date of between AD 640 and AD 810. Similarly, a date on an elderly male with a carved raven pendant (Burial 410, S-1432) was originally calibrated by Ames (2005:215) to between 1100 BC and 800 BC whereas our

revised calibration indicates an age range of between 300 BC and AD 10. Our recalibrations thus support earlier contentions for an alternate source for copper on the British Columbia Coast (Acheson 2003; Cooper, et al. 2008:1734; de Laguna, et al. 1964:204; Rapp, et al. 1990) and indicate these dates from Prince Rupert Harbour remain the earliest associated with copper artifacts on the Northwest Coast.

In sum, our re-calibrations and summed probability profiles shift and refine current understanding of archaeological chronologies in Prince Rupert Harbour. They highlight the interpretive relevance of re-engaging with the existing radiocarbon record with regard to settlement dynamics and burial practices as well as the age of prestige technologies such as copper associated with human burials. However, we must caution that our re-calibrations have effectively broadened the uncertainty associated with individual dates despite being placed on a calendrical timescale. Rather than a single point in time bracketed by an evenly distributed uncertainty (\pm), these individual dates now incorporate an uncertainty for the global and local marine reservoir age, an assumed estimate and source of percentage of marine protein in the diet (in the case of human remains), as well as an instrumental uncertainty in the original radiocarbon measurement and finally, a calibration uncertainty. Despite this compounded uncertainty, these calibration methods are considerably improved relative to previous interpretations of radiocarbon dates commonly presented simply in radiocarbon years without calibration or lacking an appropriate incorporation of marine reservoir effects and influences. Moreover, this increase in uncertainty is greatly narrowed and countered by calibrating sets of radiocarbon dates from multiple sites and features into ‘summed probability profiles’ that combine and thereby reduce temporal uncertainty for a given group of dates. This renewed focus reveals peaks and troughs in the periodicity of

historical phenomena such as the patterns of village abandonment and the frequency of human burials, but continues to require cautious interpretation and will be subject to revision as future research progresses.

For example, there will be opportunities to further refine and re-evaluate archaeological chronologies and calibration techniques that highlight the interpretive limitations of the current dataset. However, our current effort has served to place previously disparate historical phenomena in and around Prince Rupert Harbour onto a singular calibrated (calendar) time-scale. Combined with the insights that will come from future research, such an approach has the potential to reconcile and refine the archaeological knowledge of the timing of culture historical events in and around Prince Rupert Harbour.

Conclusions

A central conclusion that became abundantly clear during the preparation and revision of this chapter is that archaeologists must increasingly confront, acknowledge, and contend with the uncertainty and complexity of radiocarbon calibration (Bronk Ramsey 2008; Geib and Hurst 2013). This is particularly critical in order to successfully overcome the collective legacy of previously published archaeological chronologies that include marine and marine influenced radiocarbon dates.

Another key conclusion of this paper is that additional dating and estimation of marine reservoir values are needed to refine our understanding of archaeological chronologies on the Northwest Coast. The modest marine reservoir time series along the northern coast presented in this paper will benefit from additional shell-wood pairs in good association which will refine the regionally specific Delta-R estimate and better characterize its temporal and spatial variability. If community support for additional radiocarbon dating of

human burials can be attained (e.g., Cui, et al. 2013), additional dating of these remains paired with charcoal and or salmon will help resolve the still unknown difference between mixed-marine and terrestrial carbon sources (cf. Cybulski 2010). In particular, paired dates from human collagen and associated elderberry seeds from box burials would help demonstrate the offset between marine influenced human collagen and terrestrial dates (cf. Cybulski 1992) as elderberry seeds represent only one year of growth and therefore are not subject to potential “old wood” problems (e.g., Kennett, et al. 2002).

As noted, highly migratory marine species (e.g., grey whales, salmon, and fur seals) can have very different reservoir values than contemporary local marine species. Rockfish-charcoal and salmon-charcoal pairs may also provide an estimate of the local and migratory Delta-R estimate respectively. Salmon bones (and their carbon) may therefore need a very different Delta-R than local shell or fish; and humans and other animals such as bears that derive a large part of their diet from salmon may also differ as a result.

Another conclusion is that field archaeologists should be advised to hesitate before radiocarbon dating shell at sites close to large estuaries or melting glaciers as there is considerable potential for estuarine and glacially influenced environments to substantially affect Delta-R values (e.g., Hutchinson, et al. 2004; Rick, et al. 2012; Ulm 2002, 2006). This can vary significantly depending on the amount of glacial melt-water, limestone substrate, or freshwater precipitation. Thus, where samples or funds are limited, it may be best to avoid shell and marine mammal bones altogether and instead date terrestrial mammal bone or deciduous charcoal (e.g., rapidly growing botanical remains such as needles, twigs, and berries). More detailed macro and microscopic examination, documentation, and description of dating material is also warranted particularly for the most commonly dated material –

charcoal. Researchers working in other regions with higher resolution archaeological chronologies are increasingly identifying the species of all dated samples. While this remains uncommon on the Northwest Coast, increased attention to the identifying charcoal to species of dated samples as well as direct dating of relatively short-lived terrestrial animals such as deer bone is commonly recovered in coastal sites but deer on the outer coast often consume substantial amounts of marine plants requiring $^{13/12}\text{C}$ isotopic and or mixed marine reservoir correction.

We also recognize that further research into marine reservoir effects may not ultimately result in the *refinement* of existing archaeological chronologies but rather the opposite – *a broadening of the temporal uncertainty* for marine or marine influenced radiocarbon dates (cf. Geib and Hurst 2013; Gero 2007). Our study has compiled existing information on the marine reservoir and Delta-R and shown it to be mildly variable through the Holocene. However, this record is still relatively sparse and it would be desirable to add many more data points as this will increase our level of confidence in the calibrated age-range of a particular sample or set of samples and may result in a broadening the calibrated uncertainty for a set of dates, reflecting an increase in accuracy but a reduction in precision. Following from Ames (2005), this study is only the second on the northern Northwest Coast to attempt to compile and recalibrate a series of previously published marine and marine influenced dates on a single calendrical – calibrated time scale. However, it will undoubtedly not be the last, particularly as these interpretively significant and often-irreplaceable datasets become increasingly integrated with or re-evaluated by contemporary research. As in many areas of the coast, North Coast researchers must confront the implications and observations of earlier work in order to collectively contribute to a richer cultural history.

Chapter 5. Zooarchaeological Analysis of the Indigenous Fishery at the Huu7ii Big House & Back Terrace, Huu-ay-aht Territory, Southwestern Vancouver Island¹⁸

This chapter describes the archaeology of the Indigenous fishery at the Huu7ii¹⁹, a large archaeological site (DfSh-7) on what is now called Diana Island across a channel from the contemporary community of Bamfield in southern Barkley Sound (Figure 1.1). The name ‘Huu-ay-aht’ translates as the ‘people of Huu7ii’ and is an Nuu-chah-nulth placename which identifies this locality as a place from which Huu-ay-aht came to be an autonomous community in the distant past (Huu-ay-aht First Nations 2000:36). This location has extensive shell midden deposits stretching over 300 meters of shoreline site and as much as 100 meters inland with at least 10 large and topographically well-defined house platforms arranged in an arc facing the modern shoreline (Mackie and Williamson 2003:110). Excavations by a team of non-Indigenous archaeologists and Huu-ay-aht community members with support of the Huu-ay-aht First Nations were conducted in 2004 and 2006 and focused on a large area within the single largest house platform (House 1) and two areas of an elevated terrace containing older mid-Holocene deposits (McMillan, et al. 2008; McMillan and St. Claire 2012).

¹⁸ This Chapter has been previously published as: McKechnie, Iain (2012) Zooarchaeological Analysis of the Indigenous Fishery at the Huu7ii Big House and Back Terrace, Huu-ay-aht Territory, Southwestern Vancouver Island. In *Huu7ii: Household Archaeology at a Nuu-chah-nulth Village Site in Barkley Sound*, by Alan D. McMillan and Denis E. St. Claire, pp. 154–186. (c) 2012 Archaeology Press, Simon Fraser University, Burnaby, BC. For more archaeological and ethnographic context for the site, readers are referred to the monograph in which this chapter appears as well as Alexander Mackie and Laurie Williamson’s 2003 chapter on settlement archaeology in this portion of Huu-ay-aht territory.

¹⁹ The name Huu7ii includes the numeral ‘7’ to represent a glottal stop (where there is a purposeful pause). The name can be pronounced as ‘Hoo...aye’ with a pause between the two syllables.

This chapter examines fine-screened fish remains from 12 ‘column samples’ recovered during fieldwork conducted in 2004 and 2006. I coordinated the excavation, recovery, and analysis of these small ‘columns’ of precisely excavated archaeological sediment (Figure 5.1, Figure 5.4, and Figure 5.5). The goal of this research was to use this detailed recovery strategy to investigate how residents utilized fish over the past 5,000 years of human history represented at this large village settlement. Column sample excavation and analysis aimed to complement the analysis of larger vertebrate fauna recovered from excavation units that used larger ¼” mesh sizes (Frederick 2012). The principal advantage of column sampling is that it provides a much more accurate assessment of the relative proportion and actual number of fish, mammal, and bird bones present in the site deposits (Casteel 1976a; McKechnie 2005a; Stewart and Wigen 2003).

Methods

Column samples were recovered as contiguous bulk samples from the sidewalls of excavation units (Figure 5.1). Column sample level dimensions were 20x10x5cm (1 litre of excavated matrix per individual level), with the exception of a column sample from the back terrace, which measured 20x20x5cm (2 litres per level, *see* Table 5.1). Column samples were excavated in 5cm arbitrary levels within which stratigraphically distinct layers were separated. Vertical elevations were referenced to an arbitrary datum elevation as well as recorded in depth increments below ground surface.

Due to the considerable effort required to process each recovered column sample level, not all excavated columns or column sample levels could be subject to comprehensive faunal identification. Twelve column samples, six from the 2004 excavations and six from the 2006 excavations were selected for zooarchaeological identification and analysis (Figure

5.3 and Figure 5.2). These samples represent the greatest horizontal and vertical extent of the excavated deposits that focused on the House 1 deposits which date to between approximately 1,500 and 400 years ago and two areas of the older back terrace deposits which date to between approximately 5,000 and 3,000 years ago.

Eight column samples were examined from separate areas of House 1; four span the length of occupation and known depth-range while the remaining four were collected from the upper 'house floor' portions of the deposits exposed during block excavations in 2006 (Figure 5.2). Two column samples were examined from two separate areas of the back terrace deposits (Figure 5.3). An additional column sample was obtained near the mouth of the creek on the northern and western portion of the site in 2004. This small assemblage was obtained from shell midden deposits encountered during the construction of the field camp privy.



Figure 5.1 Excavating column samples from the sidewall of excavation units (left). Bulk sediment samples were removed in 5cm levels, wet-screened through 1mm mesh, and material larger than 1mm saved. Vertebrate fauna larger than 2mm was picked from the samples in the laboratory by supervised volunteers (centre and right).

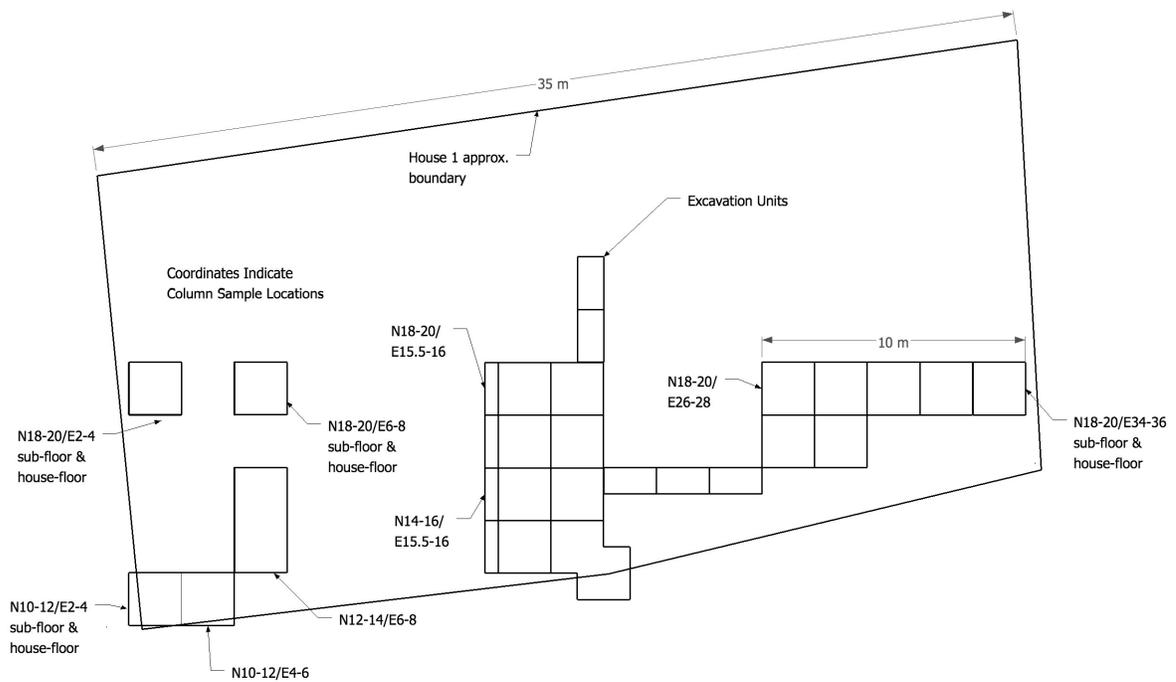


Figure 5.2. Plan view showing column samples locations recovered from the House 1 excavations. Large squares are 2x2m excavation units and coordinates with arrows indicate the location of individual column samples.

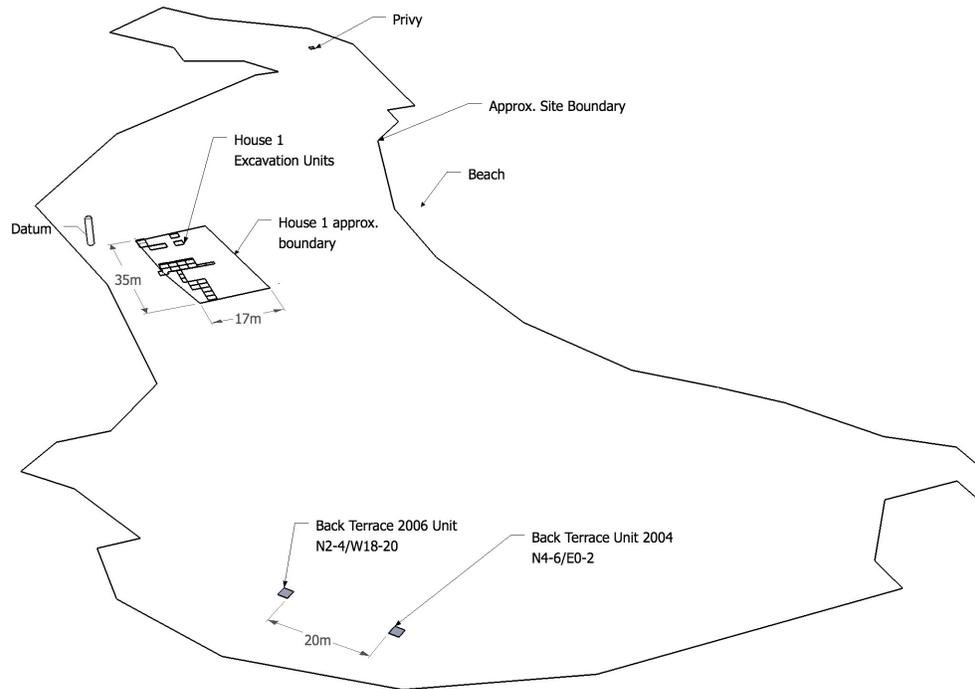


Figure 5.3. Perspective view of the Huu7ii village looking west showing the location and layout of the House 1 excavation units and the location of the back terrace units.



Figure 5.4. Photo of column sample taken from the north wall of the back terrace unit (N4-6/E0-2) which has initial and terminal dates that span between 5,000 and 3,000 years ago.



Figure 5.5. Photo of column sample taken from the South wall of unit N18-20/E2-4. This excavation unit reached a depth of 230 cm below surface and has an initial date of approximately 1,500 years BP.

Processing

Column samples were removed in 5-cm levels and wet-screened through 1-mm mesh. After each matrix sample had been wet-screened and had sufficient time to dry, sediments were passed through 2-mm mesh using nested geological brass sieves. Vertebrate fauna was systematically collected from 2-mm mesh in well-lit laboratory conditions by volunteer ‘rockwashers’ at the University of Victoria who graciously donated many evenings picking through these numerous samples (see Figure 5.1). Through their collective efforts, a large number of samples were processed, a task that would have taken an inordinate amount of time for a single person.

After processing was completed, shell, bone, rock, and charcoal constituents from individual samples were weighed and these data were entered into an *Excel* spreadsheet. Vertebrate fauna from each individual column sample was retained while the remaining sample constituents were placed back in the original sample bag. Processed non-vertebrate faunal samples were then delivered to the repository at the Royal BC Museum.

Identification

Vertebrate fauna was morphologically identified with the aid of a binocular dissecting microscope (6.3-40x) and the use of the comparative skeletal collection at the University of Victoria Zooarchaeology Laboratory. Identification data were recorded by skeletal element in a row and column database, noting relevant osteological, taphonomic, and provenience information. This database was then converted to a working spreadsheet and finally imported into a stable relational database (*FileMaker Pro*). With the exception of fish spines, ribs, branchials, scales, and gill-rakers, identification was attempted for all skeletal elements recognizable to species, genus or family level. Confidence codes were assigned to each

examined specimen to indicate the certainty of identification (for criteria, see Frederick and Crockford 2005). Briefly specimens were considered ‘identified’ (NISP) if they could be confidently assigned to a taxonomic level of family, genus, or species. The remaining specimens were classified as unidentified fish, bird, mammal, or unidentifiable bone (NSP).

Considerable effort was taken to employ identical identification and quantification procedures for both column and unit sample fauna (i.e., Frederick 2012) including the use of the same comparative collection. However, some species level designations, such as distinguishing different species of greenling (*Hexagrammos* sp.) was attempted much less frequently in the column sample assemblage due to a lack of equivalent confidence between analysts.

Quantification

NISP – Number of Identified Specimens

The primary means of quantification used in this analysis as well as in the excavation unit assemblage (Frederick 2012) is the number of identified specimens (NISP). This measure represents the number of skeletal specimens that can be confidently identified to family, genus, or species. NISP is an indivisible quantitative measure fundamental to all zooarchaeological assemblages and is readily compared across archaeological contexts. NISP data are typically expressed in terms of the relative abundance (% frequency) of a particular item relative to all other identified specimens from a taxonomic class (e.g., herring is 81.3% of all identified fish remains). NISP does not include specimens that are only recognizable as ‘fish,’ which were designated as ‘NSP’ (see Table 5.1).

Ubiquity – Frequency of Occurrence

Ubiquity is an additional measure of abundance based on the presence or absence of items in a number of archaeological contexts. Ubiquity is calculated as the percentage of discrete contexts in which a certain taxon is found (frequency of occurrence). For example, herring can be considered ‘ubiquitous’ in the assemblage because this species is present in over 90% of the 168 examined column samples levels at the site. Ubiquity is used here to supplement the interpretations of abundance as it is not dependent on the proportion of other species.

MNI – Minimum Number of Individuals

MNI is defined as the most commonly occurring, non-repeatable skeletal elements observed in a temporally distinct paleontological or archaeological context (Lyman 2008). There are several well-known methodological problems with MNI (Grayson 1984; Lyman 2008). MNI estimates are ultimately *derived* from NISP data and therefore cannot be used as an independent measure. The estimates produced by MNI calculations are particularly affected by how archaeological units of analysis (time periods and depositional events) are defined – the smaller the number of categories, the fewer individuals. Conversely, the larger number of analytical categories, the higher the minimum estimates, which also increase the probability that single individuals might be counted more than once.

Such uncertainty has makes the use of MNI problematic, particularly for large mammals such as whales and seals whose large skeletal remains may be widely distributed in an archaeological context due to food sharing, differential butchery, transport, and consumption as well as use of bone to make tools and or extract oil (e.g., Monks 2003). However, such factors are arguably much less likely for smaller-bodied fish that are much

more likely to be redistributed and discarded as individual animals than would be larger-bodied animals.

The benefits to employing MNI estimates is the ability to translate numbers of bone elements to an estimate of the total number of animals represented in a given depositional context. Such a conversion allows for a more detailed comparative assessment of the relative contribution of individual animals, and may differ substantially from the %NISP estimate but is in no way a substitute for it. Given that the column sample faunal assemblage is comprised of small discrete volumes of spatially and temporally distinct deposits, I deemed it worthy of considering the use of MNI estimates for the column sample fish assemblage. A particular motivation was to address the notion that Pacific herring, the most abundant fish in the assemblage, might comprise a relatively less important role in the assemblage if faunal counts are converted to MNI.

Thus, I calculated fish MNI by using the most numerous non-repetitive elements present in an individual column sample level (1-2 litres of sediment). If many more repeatable elements such as vertebrae were present in a particular sample, I divided this count by the number of elements for particular fish taxa (e.g., 55 vertebrae per herring).

NISP and MNI Per Litre and Cubic Metre

In addition to NISP, ubiquity, and MNI, I also calculate the number of identified specimens per litre (NISP per litre) and the minimum number of individuals (MNI) per litre. These latter measures are derived from the combined excavated volume of individual column sample levels (e.g., 1 litre per 5cm level) and are then scaled up to cubic metres (i.e., 1,000 litres). These measures provide an “absolute” measure of abundance as opposed to relative

percentage data (where a change in the abundance of a particular taxon may reflect a change in the abundance of another species).

Importantly, these estimates do not account for variability within individual column level samples but rather, are generated by dividing the total number of specimens by the total examined volume. As such, these precise estimates should be considered tentative but nevertheless distinct from relative percentage data. They are used here to supplement and strengthen the overall abundance estimates by providing another level of scrutiny in assessing the taxonomic composition and temporal trends in the assemblage.

Fish Size Estimations

To measure fish size and trends in size over time, I used digital calipers ($\pm 0.1\text{mm}$) to measure a select number of herring, greenling, rockfish, salmon, and hake skeletal elements. Estimating fish size is possible due to the predictable relationship between the dimension of individual bones and the length of individual fish (Casteel 1974). Here, I use published regression formulae for rockfish, greenling, and Irish lord (Orchard 2003) as well as new formulae I developed for hake and herring (McKechnie 2010a; McKechnie and Tollit n.d.). These regressions were based on comparative collections at the Zooarchaeology Lab at the University of Victoria and the National Marine Mammal Laboratory located in the NOAA Sand Point facility in Seattle, Washington.

To estimate fish length for herring, I measured the greatest width of the 1st and 2nd vertebrae of herring (McKechnie and Tollit n.d.). For hake, I measured the width of the articular surface of the quadrate (McKechnie 2010a). For salmon, I measured the greatest transverse diameter of whole salmon vertebrae to attempt to distinguish salmon species from their relative size distribution (Cannon and Yang 2006).

Table 5.1 Column samples containing identified fish remains screened through 2mm mesh.

Column Sample	Ex. Date	Number of levels	Excavated Volume (Litres)*	Recovered Volume (Litres)*	Orig. wt. (kilograms)	Unid. Fish (NSP)	NISP fish	Total Fish	NISP / Litre (ex. Vol.)
N2-4/W18-20 Back terrace	2006	25	25.0	24.75	33.807	2,110	11,439	13,549	457.6
N4-6/E0-2 Back terrace	2004	17	34.0	42.25	51.821	2,061	5,920	7,981	174.1
N10-12/E2-4 W. wall	2004	19	19.0	24.3	25.063	3,855	2,928	6,783	154.1
N12-14/E6-8 S. wall	2004	12	12.0	16.25	16.802	1,320	1,086	2,406	90.5
N18-20/E2-4 S. wall	2004	21	21.0	25.5	28.632	2,477	2,033	4,510	96.8
N18-20/E6-8 E. wall	2004	21	21.4	30.95	34.663	4,674	3,834	8,507	179.2
N10-12/E4-6 S. wall	2004	1	1.0	0.75	0.750	96	99	195	99.0
N14-16/E15.5-16 E. wall	2006	6	6.0	8.65	9.075	875	855	1,730	142.5
N18-20/E15.5-16 W. wall	2006	8	8.0	8.6	10.103	812	739	1,551	92.4
Privy Pit	2004	4	4	4.4	5.794	210	33	243	8.3
N18-20/E26-28 W. wall	2006	9	9.0	11.75	11.991	1073	717	1,790	79.7
N18-20/E34-36 E. wall	2006	25	25.0	32.5	36.338	4,185	2,795	6,980	111.8
Total		N=168	185.4	230.65	264.839	23,748	32,492	56,225	175.2

* Excavated volume is based on the dimensions of the excavation whereas recovered volume is based on the volume of sediment recovered and measured using water displacement.

Table 5.2. List of identified taxa (NISP) in the column sample assemblage.

Fish		Back Terrace	House 1	Total
Pacific herring	<i>Clupea pallasii</i>	16,470	9,930	26,400
Anchovy	<i>Engraulis mordax</i>	347	1,519	1,866
Salmon	<i>Oncorhynchus</i> sp.	146	1,616	1,762
Greenling sp.	<i>Hexagrammos</i> sp.	184	527	711
Hake	<i>Merluccius productus</i>	3	637	640
Rockfish sp.	<i>Sebastes</i> sp.	61	276	337
Dogfish shark	<i>Squalus acanthias</i>	42	257	299
Perch sp.	Embiotocidae	64	26	90
Sablefish	<i>Anoplopoma fimbria</i>	1	64	65
Petrale sole	<i>Eopsetta jordani</i>		43	43
Flatfish sp.	Pleuronectiformes	2	25	27
Lingcod	<i>Ophiodon elongatus</i>	1	26	27
Ratfish	<i>Hydrolagus colliei</i>	5	18	23
Irish lord sp.	<i>Hemilepidotus</i> sp.	1	18	19
*Prickleback sp.	Stichaeidae	2	13	15
Pile perch	<i>Damalichthys vacca</i>	1	12	13
Sculpin sp.	Cottidae	1	11	12
Plainfin midshipman	<i>Porichthys notatus</i>		12	12
White-spotted greenling	<i>Hexagrammos stelleri</i>	7	2	9
Cabezon	<i>Scorpaenichthys marmoratus</i>		8	8
*Eulachon	<i>Thaleichthys pacificus</i>	6		6
*Clingfish sp.	Gobiesocidae	6		6
Herring/sardine	Clupeidae	3	3	6
Skate sp.	<i>Raja</i> sp. (unident.)		5	5
*Tomcod	<i>Microgadus proximus</i>		4	4

Fish		Back Terrace	House 1	Total
Halibut	<i>Hippoglossus stenolepis</i>	3	1	4
*Smelt sp.	Osmeridae		3	3
Pacific cod	<i>Gadus macrocephalus</i>		2	2
Red Irish lord	<i>Hemilepidotus hemilepidotus</i>	1	1	2
Buffalo sculpin	<i>Enophrys bison</i>		2	2
Gadid (not hake)	Gadidae, not hake		1	1
*Sand lance	<i>Ammodytes hexapterus</i>	1		1
*Capelin	<i>Mallotus villosus</i>		1	1
*Shiner perch	<i>Cymatogaster gracilis</i>	1		1
*Atka mackerel	<i>Pleurogrammus monoptyerygius</i>		1	1
Dover sole	<i>Microstomus pacificus</i>		1	1
Starry flounder	<i>Platichthys stellatus</i>		1	1
*Gunnel sp.	Pholididae		1	1
<i>Total NISP Fish = 32,459 (Back terrace=17,539, House 1=15,067, Privy pit=33)</i>				
Marine Mammals				
Porpoise/Dolphin	Delphinidae/Phocoenidae		3	3
P. white-sided dolphin	<i>Lagenorhynchus obliquidens</i>		3	3
Whale sp.	Cetacea	1	1	2
Harbour porpoise	<i>Phocoena phocoena</i>		1	1
Harbour seal	<i>Phoca vitulina</i>		1	1
Fur seal	<i>Callorhinus ursinus</i>		1	1
Pinnepedia, sm	Pinnepedia		1	1
Dall's porpoise	<i>Phocoena dalli</i>		1	1
<i>Total NISP Marine Mammals = 13</i>				
Terrestrial Mammals				
Canid	Canis sp.		4	4
Rodent (vsm)	Rodentia (vsm)	2		2
*Vole sp.	<i>Microtus</i> sp.	1		1
Mouse/vole sp.	Rodentia (vsm)	1		1
Rodent (sm)	Rodentia (sm)	1		1
Deer sp.	<i>Odocoileus</i> sp.		1	1
*Shrew sp.	Soricidae		1	1
<i>Total NISP Terrestrial Mammals = 11</i>				
Domestic Mammals				
Domestic Dog	<i>Canis familiaris</i>		7	7
Reptiles				
*Unid. frog	Amphibian	1		1
Bird				
Duck (med)	Anatidae (med)		1	1
Grand Total (NISP)		17,367	15,125	32,492

* Taxa found in the column samples but not in the excavation unit assemblage.

Results

The examined assemblage contains a total of 32,459 identified specimens (NISP) and a total of 57,890 skeletal specimens (including unidentified fish, birds, mammals). This examined assemblage comes from 168 discrete column sample levels representing a total excavated volume of 185.4 litres. Vertebrate remains are present in every examined sample.

Fish are the overwhelmingly dominant taxonomic group in the column assemblage. Fish represent 99.9% of the total identified assemblage (NISP) and more than 99% of the taxa in each of the 12 examined column samples (Figure 5.15). Mammal and bird specimens are significantly less abundant although they are frequently encountered in the column sample assemblage. The majority of mammal and bird specimens are small, unidentifiable fragments of what were much larger once-complete elements. The extremely low proportion of identifiable mammal and birds in the column sample assemblage stands in contrast to the excavation unit assemblage, which has a much larger assemblage of identified (NISP) mammalian and bird remains (Frederick 2012).

Taxonomic Richness

Thirty-two unique fish taxa were recovered from the column sample assemblage (Table 5.2). Ten of these fish taxa as well as two small mammal taxa are not present in the excavation unit assemblage (Frederick 2012). These taxa are small-bodied and represent relatively minor proportions of the overall assemblage (denoted with asterisks in Table 5.2). It is notable that 12 of these taxa were not identified in the excavation unit assemblage, as their small bones are likely to have passed through the larger mesh sizes used during field-based faunal recovery in ¼" mesh screens.

By contrast, the excavation unit assemblage contains the same number of fish taxa (n=32) but includes 12 species that *were not identified* in the column sample assemblage²⁰. These species also represent relatively minor components of the assemblage or were only identified to a genus level in the column sample assemblage (i.e., greenlings, perches, sculpins, and flatfish). Two of the largest species (sevengill shark and bluefin tuna) are rare in the site as a whole. Considering that the excavation unit assemblage is numerically larger and represents a dramatically larger examined volume (Frederick 2012), the absence these in the column sample assemblage is relatively unsurprising. However, it is important to consider how such small proportions may indeed represent significant and sizable contribution to the fishery, especially considering the un-sampled portions of the site and the time depth of human occupation. The adequacy of the sample is further discussed in Section 4.

Contrasting the Column and Excavation Unit Assemblages

The analysis of vertebrate fauna from 2-mm mesh identified a similar suite of fish species as the ¼-inch excavation unit assemblage but resulted in a much greater recovery of small fish bones and thus a much greater number of bones per litre of examined volume. One of the interpretive consequences of such a shift is a dramatic change in the relative abundance of taxa present in the deposits. This shift has been widely observed by researchers working with fish assemblages throughout the Pacific (Casteel 1976a; McKechnie 2005a; Nagaoka 1994; Partlow 2006; Stewart, et al. 2003).

²⁰ Sevengill shark, Bluefin tuna, Great sculpin, Spinyhead sculpin, Striped seaperch, Rock greenling, Kelp greenling, Rock sole, English sole, Sand sole, and Pacific sanddab.

Figure 5.6 compares the relative percentage of the fine-screen column sample with the excavation unit assemblage, which illustrates the dramatic extent of the contrast. Notably, herring represent less than 4% of the excavation unit assemblage but they vastly outnumber all other fish in the column sample assemblage (81% NISP). This numerical dominance dramatically alters percentage data for all other species and has vital consequences for interpreting subsistence and resource harvesting practices in the site as a whole.

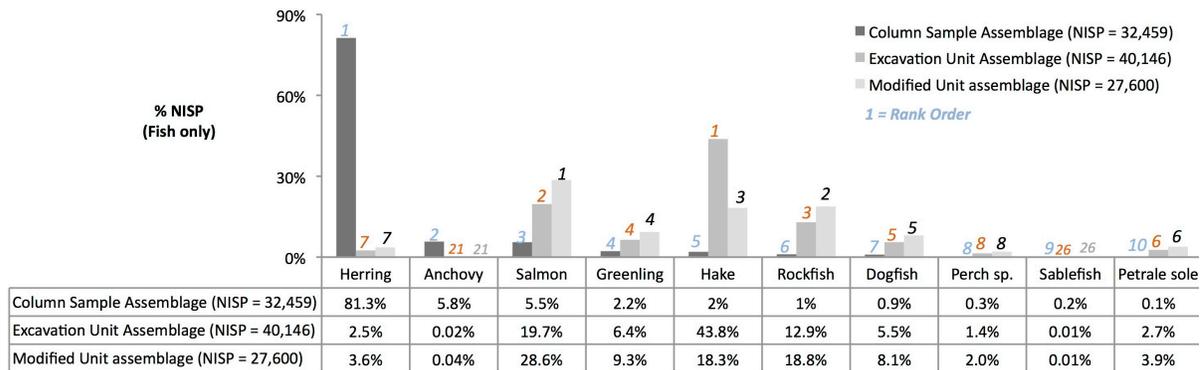


Figure 5.6. Comparison between the relative abundance of fish remains in the column sample assemblage (2mm mesh) and the excavation unit assemblage (1/4-inch mesh) for the 10 most numerous taxa in the column assemblage. Numbered bars indicate rank order abundance.

Within the excavation unit assemblage, hake numerically dominate followed by salmon, rockfish, greenling, and dogfish (Figure 5.6). However, there was a single deposit containing several thousand hake specimens (a specific unit in the sub-floor deposits of House 1). As this does not adequately represent the overall composition of the unit assemblage (across space and time), fish from this particular deposit were subtracted and percentage data recalculated (Frederick 2012). Figure 5.6 illustrates this ‘modified’ total, indicating that salmon are the most abundant fish taxa, followed by rockfish, hake, greenling and dogfish. Thus, while excavation unit assemblage provides invaluable perspective on the large-volume excavation, the collection strategy dramatically under-represents the taxonomic abundance of small fish and thus, fish in the site as a whole.

Abundance and Ubiquity

Figure 5.7 illustrates the overall composition of the column sample fish assemblage according to two analytically distinct measures of abundance (%NISP and % Ubiquity). It is interpretively significant that the relative abundance of fish specimens so closely corresponds to the sequence of ubiquity as this demonstrates that the most abundant taxa (%NISP) also occur very regularly in the deposit as a whole. Conversely, less numerous taxa occur very infrequently. There are some notable exceptions that indicate that some taxa are present in high numbers in only a few contexts (e.g., hake) while others are consistently present in low numbers (e.g., rockfish). These similarities and differences provide vital insight into the spatial and temporal variability of these taxa in the examined assemblage and are discussed in more detail below. The overall similarity between these two measures provides a level of confidence that the taxonomic composition of the total assemblage is broadly representative and that the numerically dominant species are also likely to be the most abundant in small portions of the assemblage.

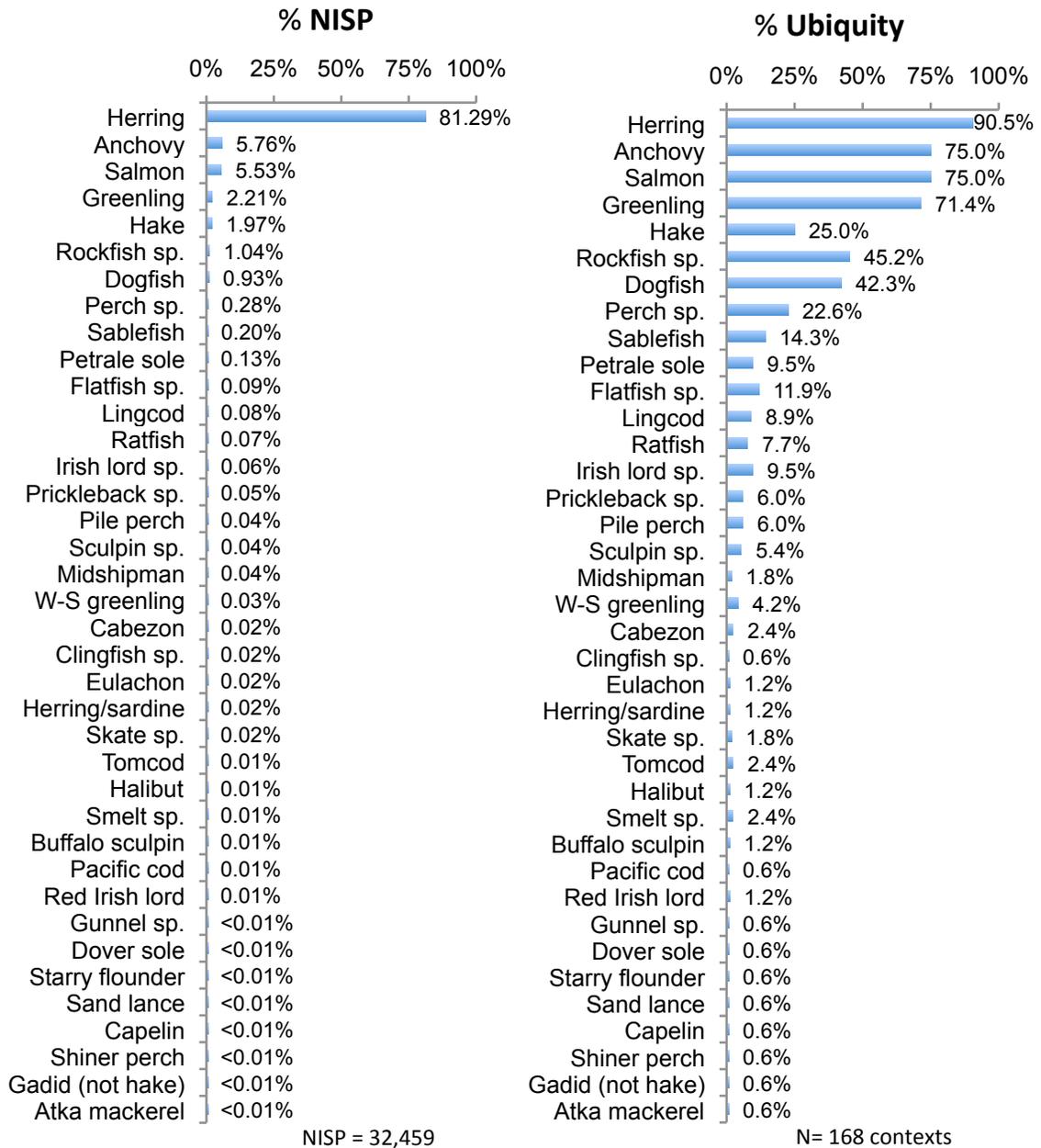


Figure 5.7. Taxonomic composition of the entire column sample fish assemblage according to two measures of abundance; 1) the relative percent of the number of identified specimens (%NISP) and 2) ubiquity (% occurrence in individual column levels). Taxa are shown in descending frequency according to %NISP with sample sizes indicated below bar charts.

Taxonomic Composition

While a large number of fish taxa are present in the examined deposits (n=32), the ten most numerous taxa represent more than 99% of the identified specimens while the remaining 20 taxa represent less than 1% of the combined total. This indicates that the bulk of the fishing activity focused on a limited number of species. In the following section, I discuss the ten most abundant and ubiquitous fish as shown in Figure 5.7. To more fully document the temporal and spatial changes, I also employ MNI measures as well as density measures (e.g., NISP per m³) to further distinguish the relative differences in abundance (Figure 5.8 and Figure 5.9).

Herring

The column sample vertebrate faunal assemblage from Huu7ii is dominated by herring, which represents 81.3% (NISP) of the total column sample fish assemblage (Figure 5.7). Similarly, herring is the most ubiquitously occurring species in each of the 168 column sample levels (90.5%). Herring is also the most numerous taxon as indicated by MNI calculations (Figure 5.8). The numerical abundance and consistent ubiquity of herring suggest this species dominates the indigenous fishery at Huu7ii throughout the archaeologically examined period of human occupation.

Herring is most dominant in the back terrace deposits (ca. 5,000-3,000 years ago), where herring represents 94.9% of NISP and 60% of MNI (Figure 5.8). Herring is less abundant but still dominates the House 1 assemblage in both the sub-floor and house-floor deposits (65% NISP and 25-28% MNI). Herring from the back terrace also exhibits a much higher NISP and MNI per m³ than in the later House 1 deposits (Figure 5.9), strongly indicating that herring use and as a consequence, fish utilization was more intense than in the

House 1 deposits. Despite these differences, the consistency of herring utilization (as most strongly indicated by ubiquity) indicates continuity in cultural practice relating to herring throughout the examined history of occupation.

Anchovy

Anchovy are the second-most numerically abundant fish species recovered from the column sample assemblage (%NISP), but still only represent 5.8% of all identified specimens (Figure 5.7). Nevertheless, anchovy are tied with salmon as the second-most ubiquitous fish, occurring in 75% of all examined contexts (Figure 5.7). This indicates that even though anchovy (and salmon) are considerably less abundant than herring, they occur almost as regularly in the column sample assemblage. As estimated by MNI, anchovy represents over (10 %) of the assemblage but its rank-order abundance drops from second to third using this measure (Figure 5.8).

Anchovy are sequentially more abundant over the three temporal periods rising from 2% of NISP in the in the back terrace assemblage to 6.8% in the sub-floor assemblage, to a high of 11.6% in house floor assemblage (Figure 5.8). Comparing the number of anchovy specimens (NISP) per cubic metre and individuals (MNI) per cubic metre indicates there is a progressive increase anchovy over time (Figure 5.9). As shown in Figure 5.8b, the ubiquity value of anchovy remains virtually the same over time, suggesting that this species was harvested consistently but was increasingly utilized relative to other fish.

Salmon

Salmon are the third-most numerically abundant taxon in the assemblage, representing 5.5% of the total NISP (Figure 5.7) and 8.8% of the total MNI (Figure 5.8). Salmon are also relatively ubiquitous in the examined assemblage indicating consistent use

throughout the site deposits (70%). However, salmon are considerably more abundant in the House 1 deposits than in the back terrace based on NISP, ubiquity, and MNI, as well as NISP per m³ and MNI per m³. Within the House 1 deposits, salmon increase in abundance between the sub-floor and House floor deposits, reaching their highest abundance in the period just prior to site abandonment.

Greenling

The next most numerically abundant taxa is greenling which represents only 2.2% of the total NISP but has a ubiquity value of 70% indicating it is found in low quantities but is regularly utilized (consistently present in most examined contexts). This circumstance appears to impact the estimate of MNI for greenling, which shifts it to the second-most abundant fish in the assemblage (Figure 5.8). There is not a discernable difference in the relative abundance and ubiquity of greenling over the three temporal periods represented at the site, suggesting this taxon remained consistently important throughout the occupation of Huu7ii.

Hake

While hake is the fifth most numerically abundant fish in the column sample assemblage, it is significantly less ubiquitous than other abundant taxa. This indicates hake is not as consistently harvested over the 5,000-year period of occupation, but rather occurs much more frequently within a particular context or time frame (i.e., a portion of the House 1 deposits). This is strongly supported by the temporal trends in abundance where hake very rarely occur in the back terrace deposits but spike in abundance and ubiquity in the sub-floor deposits only to drop in abundance during the house floor deposits (Figure 5.8 and Figure 5.10).

As discussed for the excavation unit assemblage (Frederick 2012), there is an extremely high density of hake remains present the lower portion of column N18-20/E6-8 from House 1 that disproportionately increases the calculated abundance for the total unit assemblage. In contrast to the very high abundance estimates for hake in the excavation unit assemblage, the column sample data indicate that this species represents not much more than 10% of the assemblage in the sub-floor deposits. Hake MNI estimates range from a low of 0.2% to a high of 9% in the sub-floor deposits (Figure 5.8).

Rockfish

Rockfish represent only slightly more than 1% of the total assemblage but are found in 45% of the examined column level samples (Figure 5.7) and comprise nearly 8% of the estimated MNI (Figure 5.12). Rockfish are considerably more abundant and ubiquitous in the sub-floor deposits than in either the back terrace or house-floor deposits indicating this taxon was used most intensively during this period (Figure 5.8).

It is noteworthy that rockfish are slightly less abundant than greenling in the column assemblage (Figure 5.6) but strongly outnumber greenling in the excavation unit assemblage (Frederick 2012). This likely reflects a screen size bias favoring larger fish where greenlings have a smaller size-range than rockfish (McKechnie 2005a:217). Similarly, greenling has a slightly smaller size range than rockfish in this assemblage (Figure 5.13).

Dogfish

Dogfish are not particularly abundant in the column assemblage, representing less than 1% of total NISP (Figure 5.7). However, they do occur regularly throughout the examined occupational history as indicated by their consistent ubiquity (Figure 5.7b).

Dogfish do not appear to change over time but do have slightly higher frequencies in the House 1 deposits relative to the back terrace (Figure 5.9).

It is notable that dogfish are among the ten most abundant fish in the assemblage as these cartilaginous sharks have significantly fewer skeletal structures than bony fish, which would further diminish the potential importance of this taxon relative to others (Rick, et al. 2002). However, dogfish do have highly distinctive and numerous vertebrae (ca. 100-110) (Last, et al. 2007), which in comparison with many other fish, may help offset an otherwise sparse skeletal anatomy.

Perch

Perch is a taxonomic family level designation referring to several species (e.g., pile perch, surf perch, shiner perch) that occur moderately frequently in the overall assemblage but represent small abundance values (Figure 5.7 and Figure 5.12). Interestingly, perch progressively decrease in abundance over the three time periods among all relative abundance measures (%NISP, Ubiquity, %MNI) as well as absolute abundances as estimated by NISP and MNI per cubic metre (Figure 5.9). Thus, perch appear to be most regularly used in the back terrace deposits and progressively decrease over time.

Sablefish

Sablefish are long-lived fish that inhabit deep pelagic waters along the continental shelf edge (King, et al. 2000). Sablefish occur moderately regularly in the column sample assemblage (14% ubiquity) but represent only 0.2% of the total assemblage (NISP). Sablefish is nearly absent in the back terrace but increases in the later sub-floor and house-floor deposits (Figure 5.8).

Based on visual comparison to mature fish in the UVic comparative collection, it appears the majority of the archaeological specimens are from small, juvenile-sized fish, which inhabit shallow inshore waters before maturation. The moderately frequent occurrence of juvenile-sized sablefish in the House 1 assemblage is consistent with the use of the nearshore water in the vicinity of site. However, additional measurements and metric comparison to known age specimens might improve understanding of where in the environment these fish were harvested.

Petrale Sole

In contrast to the noted ethnographic importance of halibut (Arima 1983; Sproat 1868:225), the most numerous ‘flatfish’ in the column assemblage is Petrale sole, a plate-sized flatfish that inhabits relatively deep-waters between 80 and 500 metres (Department of Fisheries and Oceans Canada 1999). Petrale sole represent a small portion of the overall assemblage and exhibit a moderate ubiquity in the House 1 deposits but are absent from the back terrace column deposits (Figure 5.8). Petrale sole are also the most numerous flatfish identified in the excavation unit assemblage (Frederick 2012), considerably out-numbering all other flatfish including halibut.

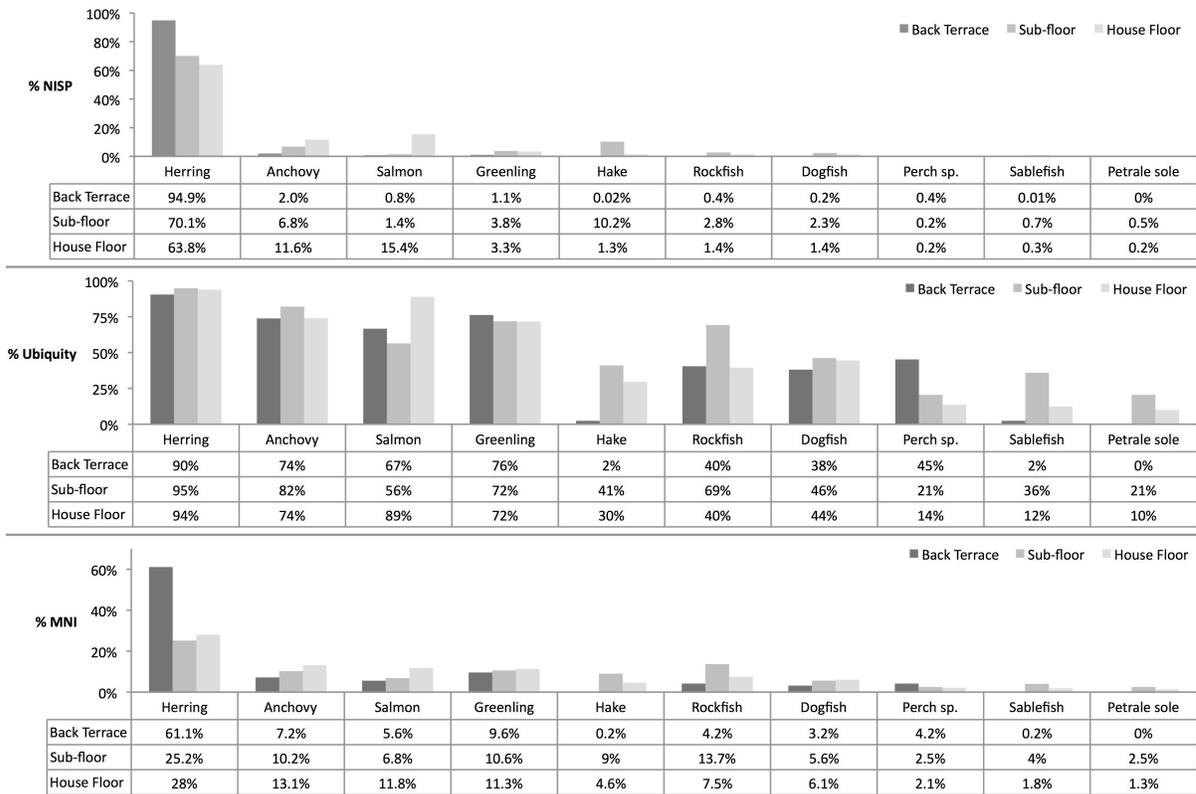


Figure 5.8. Relative abundance over time for the ten most numerous fish taxa shown as percent of identified specimens (top), ubiquity (middle), and the estimated minimum number of individuals (bottom). Grouped bars represent fauna from the three temporally distinct deposits; the back terrace, sub-floor deposits, and the House 1 floor deposits.

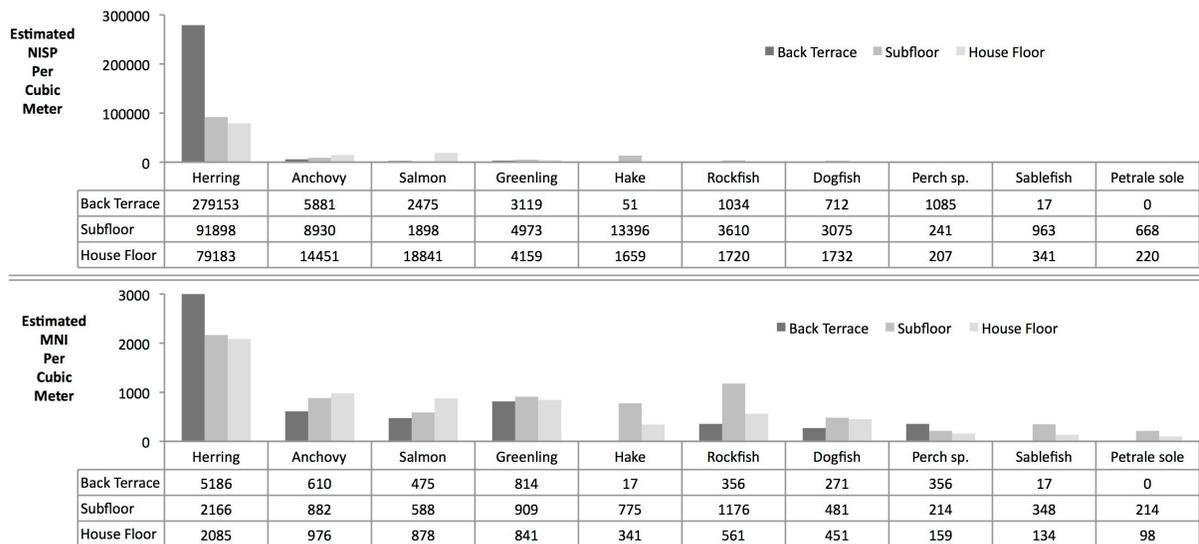


Figure 5.9. The number of specimens (NISP) and individuals (MNI) per cubic metre based on sampled volume from the back terrace (59 litres), the subfloor (37.4 litres) and house floor assemblages (82 litres). Note: estimates are overly precise (extrapolations) but nevertheless give a comparative basis for assessing change over time and differences between species and that are not limited to relative percentages.

Other Fish

As shown in Table 5.2 and Figure 5.7, a host of other fish taxa are present in the assemblage but occur in very low quantities relative to the ten most numerous taxa. It is important to consider that even though these taxa are not abundant in this assemblage, this may be not be warranted given the fact that this assemblage comes from 1) a small portion of what is a much larger site 2) may be present in greater quantities in unsampled areas; 3) represents several thousand years of human occupation, and 4) is only one of number of large shell midden sites whose occupants likely harvested similar species over extended time periods. Nevertheless, these small numbers of comparatively 'rare' taxa preclude a justifiable assessment of their abundance and history of use within this assemblage.

Notably however, there is a relative paucity of halibut in the column and unit assemblages (Frederick 2012), a circumstance that is not uncommon in archaeological contexts on the Northwest Coast (Orchard and Wigen 2008). The relative lack of halibut appears to reflect differential processing of halibut (butchery on the beach and public distribution of meat) as well as the taphonomic effects of a lower bone density value for halibut relative to other fish (Smith, RE, et al. 2011a). Culinary processing such as the use of halibut for soup is a common practice that likely contributes further to the relative paucity of halibut in the assemblage (Blackman 1990; de Laguna 1972:392-400).

There are some unique and relatively unexpected occurrences of taxa such as eulachon, a small oily smelt known to spawn in large rivers, as well as possible sardine in the back terrace and the House 1 deposits that indicates the potential presence of this southerly species that rarely occur at this latitude (*see* Wright et al. 2005) (Wright, et al. 2005). However, it is notable that that some of these 'rare' taxa occur much more frequently in the

excavation assemblage than would be expected based on screen size alone. For example, rockfish, lingcod, cabezon, and Irish lords are recovered in considerably larger numbers in the unit assemblage (Frederick 2012). While this is likely due in part to a strategy that preferentially recovers large distinctive bones, it also potentially reflects the spatially restricted sample of fish remains in the column sample assemblage relative to the spatially and volumetrically larger sample from the excavation units. For instance, at the completely sampled house floor at Ozette, there are patterned concentrations of fish species in certain parts of the housefloor (Huelsbeck 1981) which might be less likely to be captured in column sample deposits (*see* discussion in Gray 2008) (Gray 2008). Thus, it remains possible that those taxa that are rare in the column assemblage might appear comparatively more abundant if a larger spatial area was sampled but cannot be resolved until more samples are examined at some future date.

Temporal Trends

House 1 (ca. 1,500-400 yr BP)

To assess the temporal trends in fish use within the House 1 deposits, I plotted the relative abundance of three important fish taxa by individual column sample level (Figure 5.10). I compared trends across the four column samples spanning the full depositional sequence of House 1 and calculated both %NISP and NISP per litre in order to evaluate if an increase in the relative abundance might simply be a consequence of an increase in another taxa. This analysis also includes four additional column samples spanning the upper layers of the house floor deposits.

Overall, there is strong similarity between %NISP and NISP per litre for the House 1 column samples providing greater confidence that the observed trends are not spuriously caused by fluctuations in other taxa, but reflect actual changes in abundance. In some cases however, the two sets of data (%NISP and NISP per litre) diverge which allows further clarification for specific temporal periods. For example, the increasing NISP per litre for salmon in column sample N10-12/W2-4 does not match the decrease in salmon %NISP due to a particularly large increase in herring per litre (left column of Figure 5.10).

Secondly, there are distinct similarities in the temporal trends for specific taxa throughout the depositional sequence, suggesting that coherent change occurred in resource harvesting practices with the most striking trends noted for hake and salmon. In particular, hake do not occur in either the lowest levels or in the highest column sample levels from House 1 but exhibit a dramatic spike in abundance in the middle portion of each of the examined column samples (both %NISP and NISP per litre, Figure 5.10). In the upper layers of the house floor deposit (later in time), there are dramatic increases in salmon abundance (relative percent and bones per litre), in contrast to the consistently low abundance values for salmon in the lower, earlier levels. The increase in salmon also occurs in the upper levels of the four column samples that span only the house floor portions of House 1 deposits.

The sudden and progressive increase in the relative abundance of salmon appears to follow the period of intense use of hake (Figure 5.10) suggesting a long-term and spatially coherent shift in the focus of resource harvesting practice at a household level. Thus, despite the potential for spatial variability in a house deposit, this aspect of resource use appears to have shifted throughout the house deposit sometime after approximately 800 years ago.

In contrast to the dramatic shifts in the abundance of hake and salmon, the most numerous taxa in the assemblage, herring, show progressive long-term fluctuations in abundance that range widely over time. For instance, there are broad similarities in the trends in abundance between the four columns, with high abundances in both the lower levels and the upper levels contrasted with a period of comparatively low abundance in the middle portion of the depositional sequence. Interestingly, this corresponds to the peak in hake abundance suggesting that number of herring per litre drops when hake reach their highest frequencies (Figure 5.10). Similar to herring, anchovy appears to exhibit broad temporal trends in the House 1 deposits with somewhat consistent increases in abundance when herring decrease in abundance.

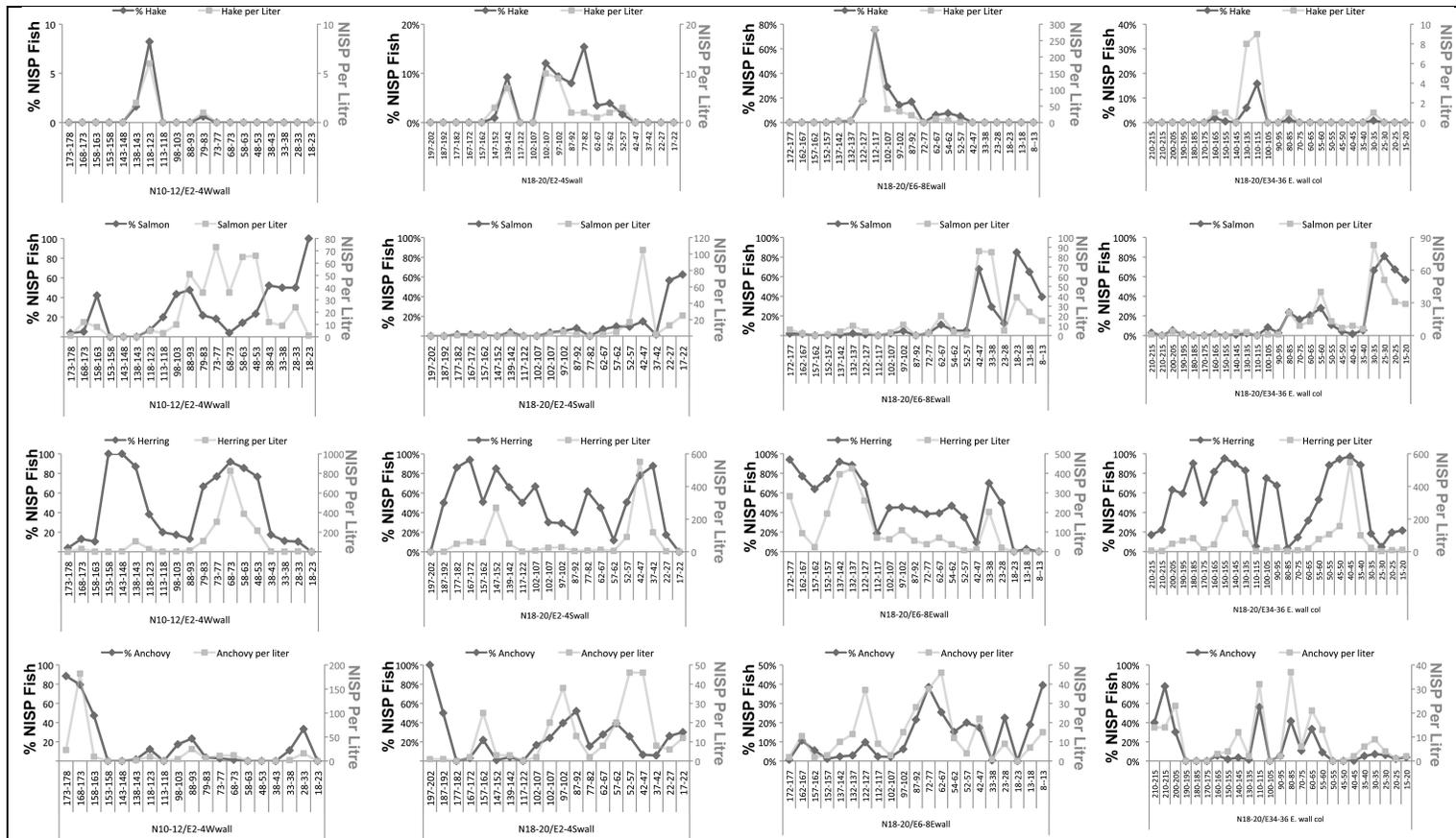


Figure 5.10. Temporal trends (left to right) in the abundance of four important fish taxa in four different areas of the House 1 deposits (top row–hake, middle row–salmon, bottom row–herring). Dark lines indicate the relative percent (%NISP) while the grey lines indicate absolute abundance (NISP/litre) and are plotted on a secondary vertical axis. The individual data points on horizontal axis are 5-cm increments in depths below ground surface. Interpretations of patterning provided in the right column. Note the difference ranges for scales

Interpretations
Hake suddenly occur in the middle portion of House 1 deposit but are then consistently absent.
Salmon exhibit dramatic increases in abundance in the upper levels of all column samples after Hake spike in abundance.
Herring exhibits broad fluctuations in abundance but is generally less abundant when hake is present.
Anchovy abundance broadly fluctuates but exhibits its highest abundances when hake spikes in abundance.

Back Terrace (ca. 5,000-3,000 yr BP)

Herring consistently dominates the fish assemblage in both of the back terrace column samples; representing more than 94% of total NISP and more than 70% of NISP in individual levels in all but three of the 38 examined levels from the two columns (Figure 5.11). This consistently high percentage is similarly reflected in the number of herring per litre, which vastly outnumbers all other taxa throughout the depositional sequence. These consistent trends occur in physically separate deposits (20+ metres apart) that have overlapping age ranges, and therefore likely represent a deposit-wide pattern over a broad 2,000-year period, between 5,000 and 3,000 years ago.

Notably, the highest herring frequencies occur in the upper half of the deposits between 125 and 90 cm below the surface in both column samples (both %NISP and NISP per litre). This spike in abundance therefore appears to represent a deposit-wide period of particularly intense herring use. The most extreme case is a series of contiguous levels in column N2-4/W18-20, which culminates in a single 1-litre level containing nearly 5,000 individual herring bones, representing a minimum of 98 individual herring (approximately 15% of the entire fish assemblage). Observations by excavators recount a “crazy herring” layer in both excavation units where dense concentrations of herring were present across horizontal levels. Such high fish numbers suggests an intense collective effort focused on herring harvesting and processing presumably over a number of seasons or over the course of a few human generations based on the presence of multiple 5cm levels containing particularly high numbers of herring.

Both preceding and following this period of particularly intense herring use, herring progressively rises and drops in abundance over successive levels (among both %NISP and

NISP per litre). This indicates progressive fluctuations in fishing effort that likely relates to a combination of 1) the abundance of herring in the environment, 2) local conditions conducive to herring spawning habitat, and most vitally 3) the collective social capacity and incentive to collect and process *that* many fish.

Anchovy are the second-most abundant fish species in the two back terrace column samples but are considerably less abundant than herring in all levels. Similar to herring, the back-terrace column sample N2-4/W18-20 contains many times more anchovy remains than in column N4-6/W0-2 reflecting the comparatively greater number of fish in this deposit. Both columns contain higher frequencies of anchovy in the levels preceding the dramatic spike in herring suggesting that inhabitants may increased their use of anchovy when herring harvests were lower. Combined with similar patterning observed in the House 1 deposits and considering that both fish are high in oil content and were likely caught using similar methods (e.g., rakes, nets).

Collectively, the temporal trends in the abundance of the most numerous and ubiquitous taxa reflect active shifts in fishing practices between the deposition in the back terrace deposits and the creators of the House 1 deposits. The cultural and paleoenvironmental significance of these changes are discussed further in the discussion section.

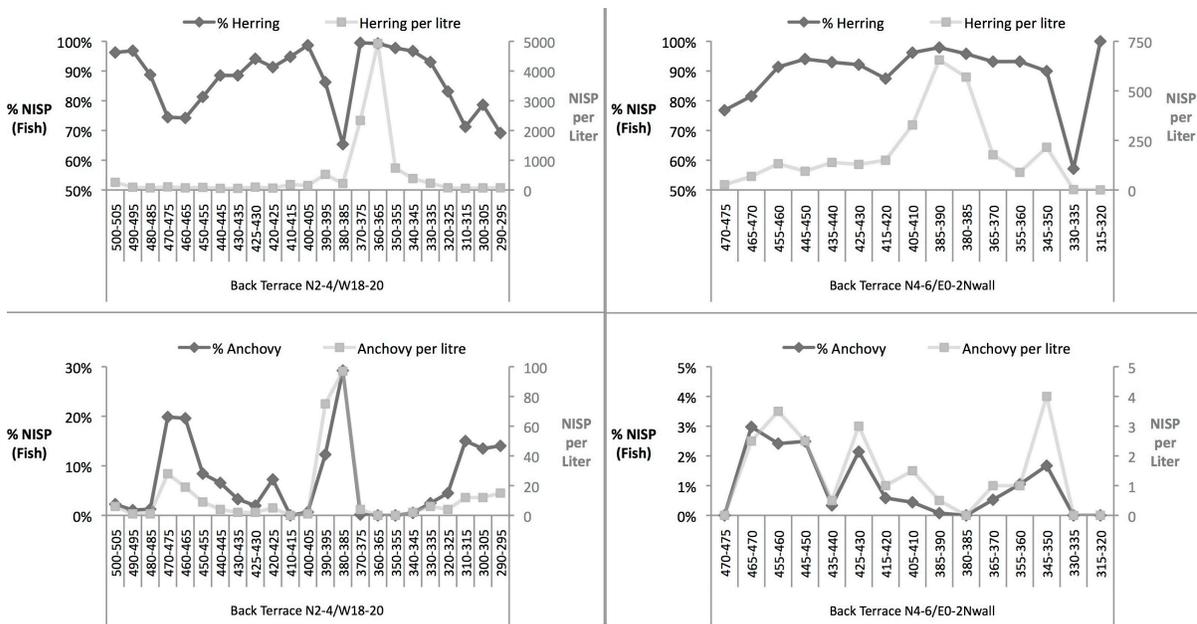


Figure 5.11. Herring and anchovy abundance in individual column sample levels from the two back terrace column samples. Dark lines indicate the relative percent (%NISP) while the grey lines indicate absolute abundance (NISP per litre) and are plotted on a secondary vertical axis. The individual data points on horizontal axis are 5-cm increments in depths below ground surface.

NISP and MNI

Figure 5.12 contrasts the NISP and MNI values for the ten most abundant taxa in the entire column assemblage. As previously discussed, MNI is a *minimum* estimate derived from the most numerous non-repetitive element in the individual column sample levels and is subject to numerous quantitative and thus interpretive uncertainties (Lyman 2008).

Nevertheless, this derived measure of abundance further details the relative and rank order abundance of the top ten fish taxa.

Interestingly, conversion to MNI for the entire assemblage roughly halves the relative abundance of herring (dropping from 81% to 39%). As a result, the percentages of all other taxa increase accordingly (Figure 5.12). This implies that these other fish have a consistently greater contribution relative to herring than indicated by NISP data alone. Conversion to MNI also shifts the rank order abundance for several of the 10 most abundant taxa. For example, greenling shifts from the fourth to the second most numerous fish (Figure 5.12).

Conversely, the contribution of hake drops from the fifth to seventh rank despite an increase in %NISP. Overall, rank order abundance generally corresponds with NISP data and no other taxa occur in the top ten, confirming the numerical importance of these ten taxa.

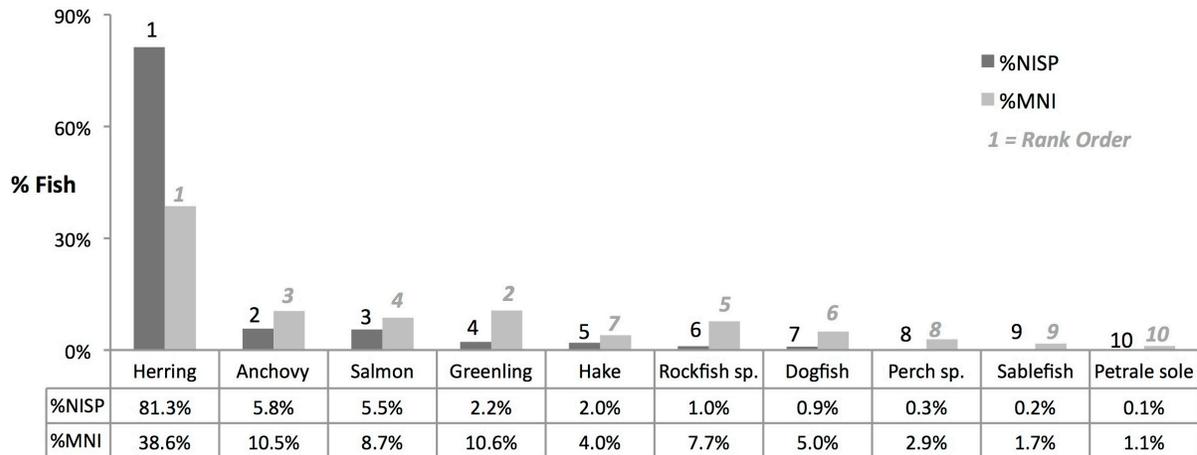


Figure 5.12. NISP and MNI data for the entire column sample assemblage. MNI represents the minimum number of individuals (%MNI) as derived from NISP data. Rank orders for NISP and MNI listed as numbers above bars.

Fish Length Estimates

Fish length estimations were conducted on hake, herring, rockfish, and greenling using linear regression introduced previously. I also measured the greatest transverse width of salmon vertebrae to estimate the range of salmon species present in the deposits following Cannon and Yang (2006). Fish length data are shown in Figure 5.13 and salmon vertebrae measurements in Figure 5.14. The sample was limited by the presence of measureable elements and therefore represents only a small percentage of all identified specimens. These data are combined from all time periods as small sample sizes preclude temporal comparisons.

The majority of herring are estimated to be between 20 and 27 cm in length, indicating adult-sized (spawning-age) fish were the focus of harvesting based on comparison with studies conducted during the late 20th century (Hourston 1958; Tanasichuk 1997:2784; Taylor 1969:45) (e.g., Hourston 1958; Tanasichuk 1997:2784; Taylor 1969:45). Visual

inspection of the histogram for herring length (indicates a normal distribution with a central tendency between 22.5-25.0 cm in length. This suggests that aboriginal harvesters targeted herring when they aggregated in large schools of mature adults. The absence of herring smaller than 18 cm (approximately 2+year old fish) suggests that juvenile schools were not targeted even though they are known to congregate in separate, smaller, more diffuse schools in bays and inlets (Hourston 1958).

As shown in Figure 5.13, the estimated size-range for hake is between 30 and 55 cm, indicating the exclusive presence of adult-sized fish that are well past spawning size (Benson, et al. 2002). This suggests that the hake targeted by site occupants were not part of a year-round resident population that inhabit parts of southern BC (ibid.) but are likely part of the California/Oregon migratory population whereby the largest individuals seasonally migrate north into southern British Columbia during the height of summer. As noted by several fishery researchers (Agostini, et al. 2006; Benson, et al. 2002; McFarlane, et al. 2000), hake migration is strongly related to oceanographic shifts in climate whereby larger hake migrate further north during years with warm ocean temperatures. Thus the abundant presence of hake in the sub-floor deposits may indicate warmer ocean conditions when they occur in abundance (ca. 1,500-800 years BP).

Rockfish and greenling length estimates suggest the majority of these two taxa are between 20 and 40 cm in length (Figure 5.13). The similar size distributions for both greenling and rockfish and the fact that they share rocky bottom kelp-bed associated habitats indicate they were harvested at the same time and likely using similar technologies. These size ranges are much smaller than fish caught in the modern sport fishery (McKechnie 2007a:218) but are identical to the lengths reported for the late-Holocene deposits at the

village of Ts'ishaa in the Broken Group Islands (ibid.). Considering these taxa are non-migratory and vulnerable to over-harvesting, this small size is conducive to a more sustainable harvest strategy (Birkeland and Dayton 2005), wherein targeting younger, smaller animals that have less reproductive capacity is preferable to targeting older, larger fish that exert a disproportionate effect on the survivorship of larval offspring (Berkeley, et al. 2004).

Salmon vertebrae measurements indicate a range of species present in the modest sample of whole vertebrae (Figure 5.14). The greatest proportion of vertebrae falls within the size-range of smaller species such as pink, sockeye, and coho indicating a possible concentration on these taxa. However, this contrasts slightly with measurements taken on a slightly a larger sample from the excavation units in 2004 (Frederick, et al. 2006b). A larger sample is needed to more fully document the salmon species represented and recent papers (Grier, et al. 2013; Huber, et al. 2011; Orchard and Szpak 2011) suggest that new metric and imaging approaches will yield useful insights.

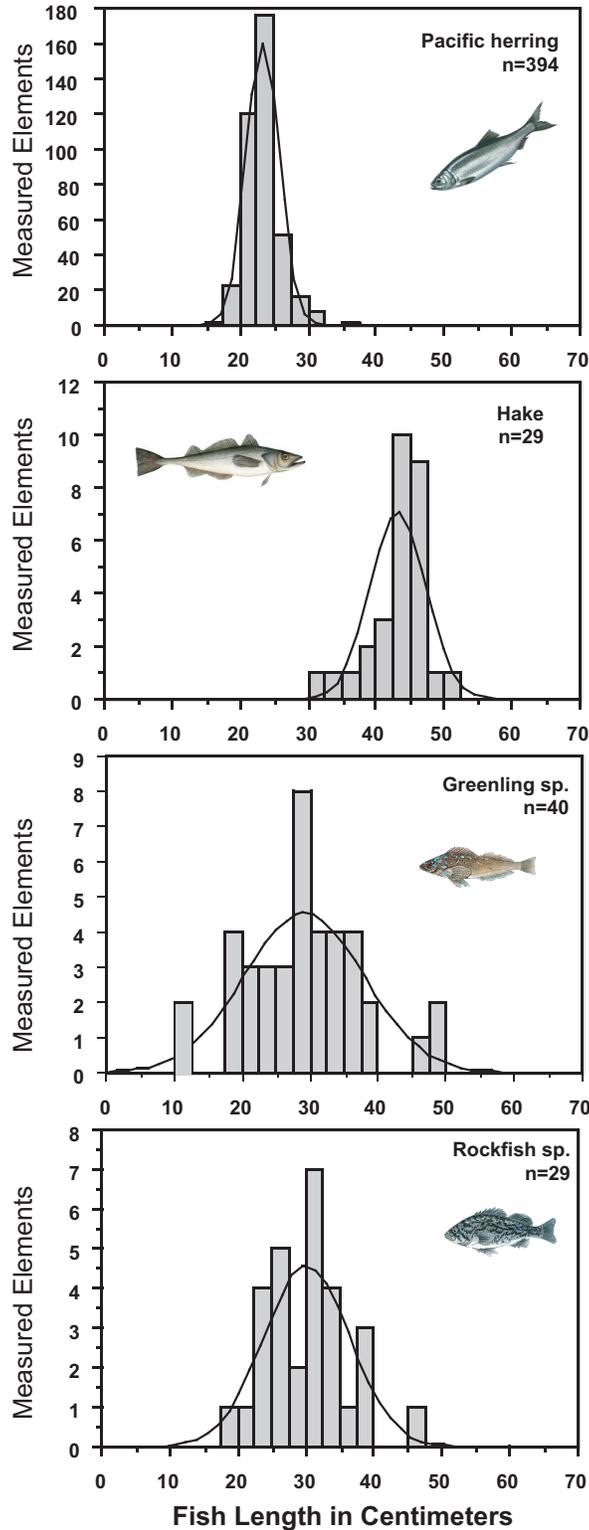


Figure 5.13. Histograms showing fish lengths measured elements of herring, hake, rockfish, and greenling. Herring is a fork length while the remaining are total lengths. Normal distribution curves shown over histograms. Note the large size of hake relative to other fish.

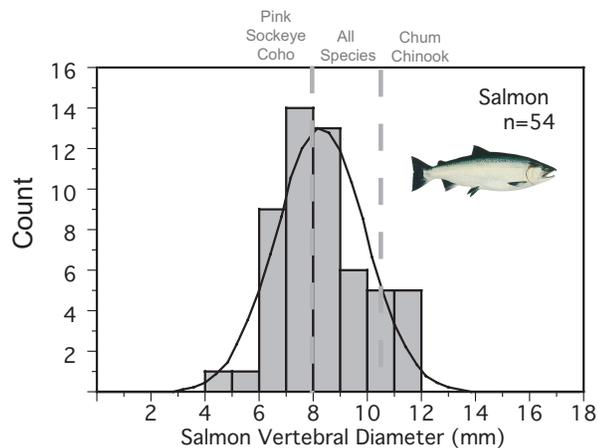


Figure 5.14. Measured salmon vertebrae from the column sample assemblage showing the size range for individual taxa as indicated using the criteria of Cannon and Yang (2006:132).

Taphonomy, Formation Processes, and Sampling

Taphonomy “the study of processes of preservation and how they affect information in the fossil record” (Behrensmeier and Kidwell 1985:105) is a fundamental process that underlies the archaeological record (Schiffer 1987), and the archaeology of animal remains in particular (Gifford 1981; Lyman 1994). Researchers have noted that faunal assemblages may be altered, transformed, and/or contributed-to by non-human agents such as burrowing and scavenging animals and microbes (Erlandson and Moss 2001), as well as a host of physical processes such as soil chemistry and sea-level change (e.g., Linse 1992; Moss 1985; Stein 1984). Cultural practices such as butchery, transport, consumption, deposition, and re-deposition can also strongly condition the types and proportions of animal bones recovered in archaeological contexts (e.g., Monks 2003). In addition, it is critical to be aware that the results observed in a zooarchaeological analysis may reflect limitations of the sampling strategy rather than a purported observation of historical significance (Gray 2008; Thomas 1978).

To assess how factors other than past human agency may have conditioned the skeletal assemblage and to consider how this may constrain the interpretive possibilities of

the assemblage, this section conducts analyses that explore how taphonomic and sampling factors may affect the assemblage and the strengths of the assemblage.

Identification Rates

The ratio between ‘identified’ (NISP) and ‘unidentified’ (NSP)²¹ specimens in a faunal assemblage reflects variability in the degree of identifiability and fragmentation as well as an analyst’s confidence in identification. To assess the potential relationship between identification and fragmentation, I examined the ratio of unidentifiable to identifiable remains for fish within the 12 column samples (Figure 5.16).

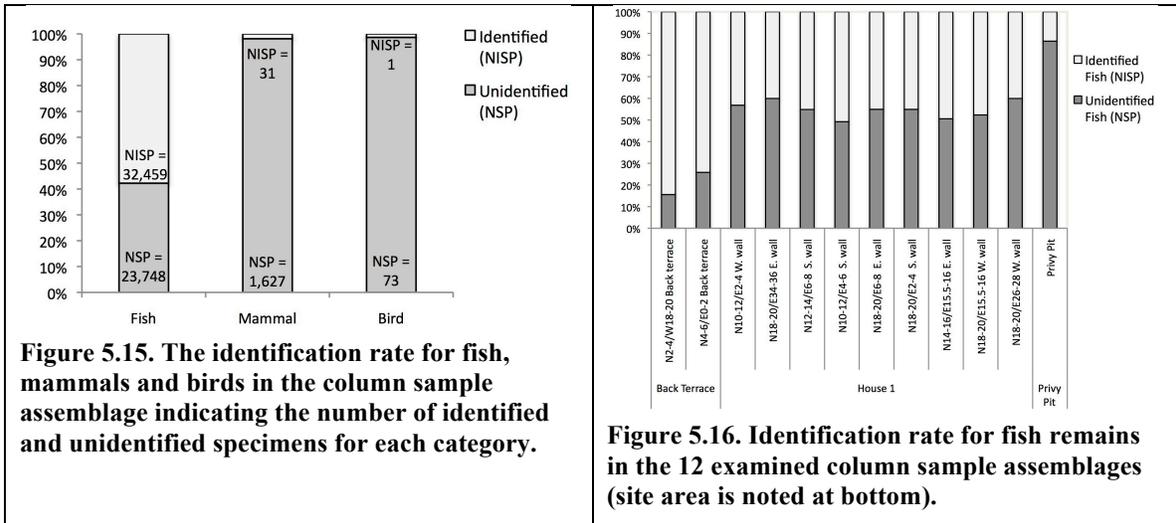
Each of the nine column samples from the House 1 deposits has a similar rate of fish identification (ranging between 40-50% of all fish specimens). This consistency in identification suggests fragmentation is similar within the House 1 deposits despite the potential for variability in a house floor.

In contrast, the two older back terrace column samples have much greater rates of identification (75–85%). This is a counterintuitive result as one might expect a much higher degree of fragmentation and lower identifiability in such an older deposit (ca. 5,000–3,000 yrs ago). However, in this case, the pattern of high identifiability is likely driven by the large numbers of identifiable herring remains in these two deposits (Figure 5.15 and Figure 5.16). Regardless, the fact that larger numbers of small herring are abundantly present in these older deposits indicates excellent preservation conditions during that time.

The single column from the privy pit has a notably low rate of identification (15%) but also has the smallest assemblage size and examined volume of the 12 column samples.

²¹ ‘Identified’ refers to specimens that can be assigned to taxonomic family, genus, or species whereas ‘unidentified’ refers to specimens that are only recognizable as fish (i.e., usually ribs, branchials, and/or fragmented bones).

This undated sample is close to the modern shoreline, and in the context of regional sea level history and site formation processes, it likely dates to within the past 500 years.



Density of Recovered Fish Remains

Based on the total number of fish remains present in the column sample assemblage, there is an estimated density of 175,000 identifiable (NISP) fish bones per cubic metre (from 2mm mesh). The identified assemblage from the temporally older and spatially distinct back terrace deposits (ca. 5,000-3,000 yr BP) has an even greater estimated density of 294 identifiable fish remains per litre while the younger House 1 deposits have an estimated 123 bones per litre. While these estimates do not incorporate the considerable variability among individual column sample levels, they nevertheless, indicate the considerable scale and intensity of the fishery as archaeologically represented in the examined deposits.

The greater number of bones per cubic metre present in the older deposits demonstrates the excellent preservation conditions and indicates a comparatively more intensive fishery at the site during that time (Figure 5.17). Conversely, this may also indicate that house-floor deposits are not as conducive to the preservation of bone and/or are subject to differing depositional conditions (e.g., trampling and house cleaning).

To further investigate the absolute abundance of fish remains in the examined assemblage, I developed estimates for the number of individual fish per litre in the three temporally distinct deposits. Figure 5.17 indicates that the older back terrace deposits have the highest number of fish per litre which is predominantly due to a greater number of herring overall as there are fewer other fish per litre in this deposit. Conversely, later in time in the sub-floor and house-floor deposits, there is a substantial reduction in the number of herring per litre but an increase in the number of other fish, which appears stable during both periods.

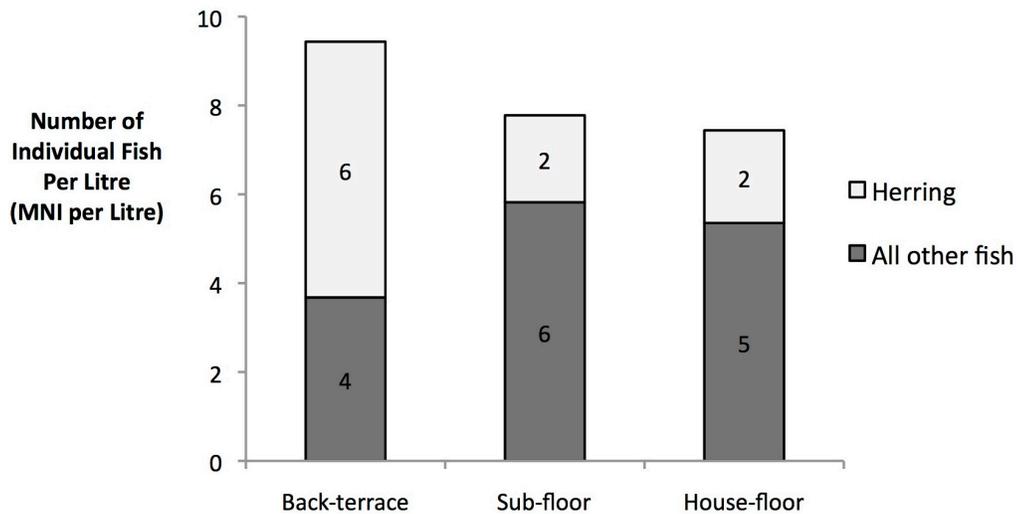


Figure 5.17. Estimated number of individual fish per litre (numbers have been rounded up) in the three temporally distinct deposits at Huu7ii. Numbers of herring and all other fish are based on the total number of individual fish divided by the total examined volume for each deposit.

Sampling Effort

To assess the relationship between taxonomic richness and sampling effort within the column sample assemblage (cf., Lepofsky and Lertzman 2005; Lyman and Ames 2004, 2007; Monks 2000), I created ‘collectors curves’ depicting the stepwise relationship between taxonomic richness and sampling intensity (Figure 5.18 and Figure 5.19). These figures show

the ‘rate’ at which new fish taxa are identified as new column levels are cumulatively added together (i.e., new taxa found in individual column levels).

Unsurprisingly, this analysis reveals that the greater number of identified specimens, the more fish taxa were identified. Importantly however, the ‘rate’ of novel identifications slows dramatically as sample size increases. For instance, Figure 5.18 illustrates that 30 fish species were identified when the sample size reached 15,000 specimens but an additional 15,000 specimens needed to be examined before two additional fish species were identified. Overall, this ‘slowing’ in the rate of identification indicates that the analysis passed a threshold whereby a larger sample size does not dramatically increase the number of new taxa.

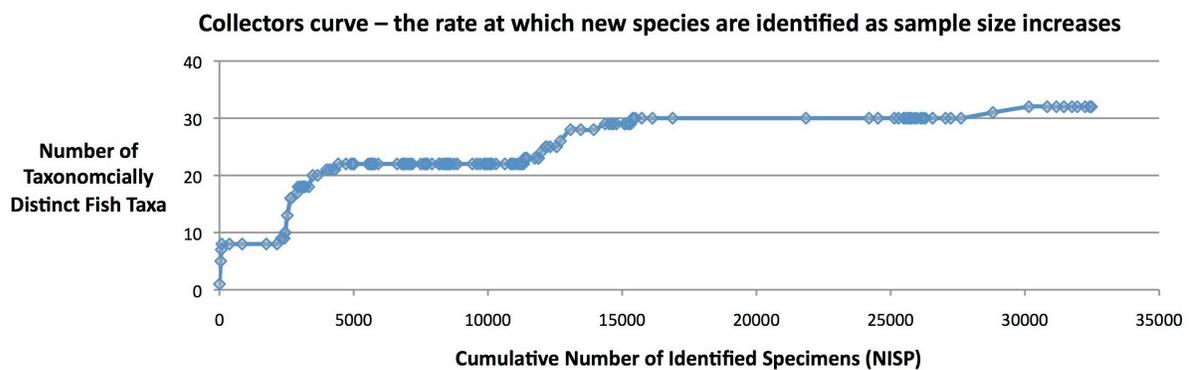


Figure 5.18. Collectors curve for taxonomic richness in the column sample assemblage depicting the linear relationship between the cumulative number of identified specimens and the number of new taxa present.

Figure 5.19 compares the collector’s curves for from House 1 and the back terrace. This comparison reveals the similar level of sampling intensity in the two temporally distinct deposits. Both assemblages contain similar sample sizes and have reached relatively ‘level’ portions on the ‘curve’. Interestingly, this comparison also indicates that a greater number of fish taxa are present in the House 1 assemblage (n=29) assemblage than in the back terrace (n=19), even though the back terrace has a moderately larger sample size. The differences in the shape of these curve is likely due to the high number of herring present in the back

terrace but the overall differences in the number of taxa appears to indicate substantial differences in the use of fish in these different periods in time (an issue discussed elsewhere).

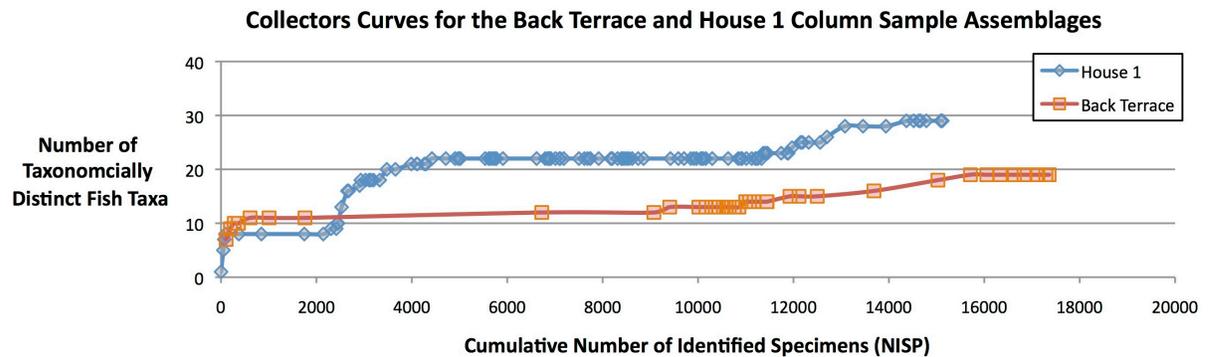


Figure 5.19. Collector’s curve comparing the taxonomic richness of the House 1 and the back terrace assemblages.

The observation that both assemblages appear to have passed the ‘steepest’ portion of the curve indicates that the level of sampling effort adequately encompasses the taxonomic richness of these deposits. That said, neither collector’s curve appears to ‘level out’ indicating that new fish species will likely be identified if additional samples are examined. Thus, the assemblage has by no means been sampled to complete “redundancy” (Lyman and Ames 2004) but appears adequate for evaluating differences between them due to similar sample sizes and similarly shaped collector’s curves.

Shellfish and the Preservation of Bone

There is a widely held observation in shell midden archaeology of an association between the presence of shellfish and the preservation of bones (Erlandson 2001; Linse 1992) whereby the deposition of shell creates alkaline conditions conducive to the preservation of bone. To assess whether this relationship has influenced the amount of bone present in the examined assemblage, I evaluated the strength of this relationship by using correlation between ¼” shell and 2mm bone for 256 samples processed samples (weights in grams per litre). However, I found no correlation between these variables for the assemblage

as a whole but rather observe a very insignificant relationship with wildly varying amounts of bone and shell in individual column samples (Figure 5.20). I further examined this relationship within the back terrace, as these older deposits (ca. 3,000-5,000 BP) presumably might be more affected by such a relationship but again found no correlation. These results suggest that the presence of shell does not have a direct influence on the amount of bone present in individual levels and provides support for the interpretation that the deposition of bone is a function of cultural practices rather than an artifact of bone diagenesis.

However, this analysis does provide some support for a taphonomic distinction between the main village and the back terrace in that both shell and bone are found in a wider range of quantities per sample in the House 1 deposits relative to the back terrace (Figure 5.21). In particular, the maximum weight of ¼-inch shell per litre and the bone weight in grams per litre have lower values in the back terrace than House 1. This suggests that either the amount of shell and bone is less abundant in these older deposits or is subject to greater rates of fragmentation. However, this does not appear to be positively correlated with the preservation of bone.

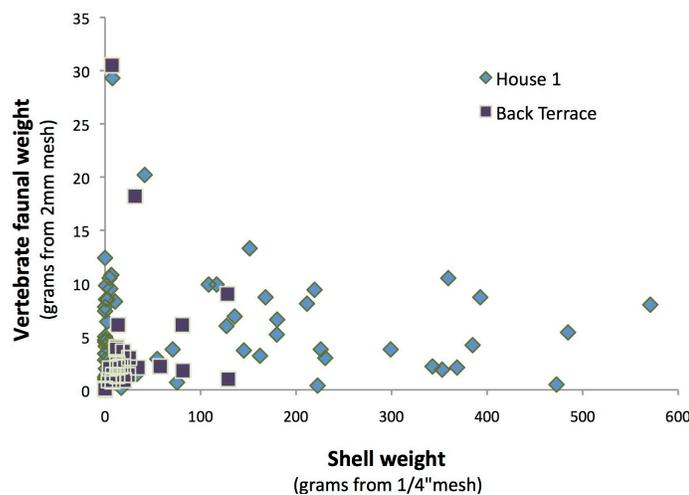


Figure 5.20. Scatterplot showing the non-linear relationship between the weight of bone and the weight of shell in individual column sample levels within the back terrace and the House 1 deposits (n=256). Note the lack of a strong correlation overall but the comparatively higher range for shell and bone weight in the House 1 deposits.

Condition of Bone Assemblage

Numerous skeletal specimens from the examined column sample assemblage show evidence of burning, erosion, cutmarks, and/or digestion. The frequencies of these alterations have implications for the preservation of the bone assemblage and for interpreting food preparation and bone disposal practices in the site as a whole.

Mammal bone specimens are the most frequently altered with a total of 45% of bone fragments from House 1 deposits and 8% of back terrace mammals being affected by either burning, erosion, cutmarks, and/or digestion (Figure 5.21). Bird bones are the second most frequently altered specimens with 8.1% from House 1 being affected while none of the bird from the back terrace appear altered. In contrast, very few fish remains show any evidence for burning, digestion, and no cutmarks were observed on fishbone.

The majority of burned and mammal and bird bones consist primarily of unidentifiable fragments of what were much larger skeletal elements and so appear disproportionately frequent relative to the much more numerous fish remains. The low frequency of taphonomic alterations on fish remains may be masked by their vulnerability to burning and digestion, as such bones might be much less likely to survive the digestive process (Jordan 1997). However, the assemblage does not lack fish bones and thus, such processes do not account for the exponentially more abundant fish in the assemblage.

Among the two examined areas of the site, the House 1 deposits contain considerably higher percentages of taphonomically altered bones as might be expected for deposition in a household context (e.g., cooking and consuming food). The large number of digested and eroded mammal bones indicate the influence of carnivore modification, most likely domestic dogs (*Canis familiaris*) that are abundant in the excavation units in both the back terrace and

the House 1 assemblages (Frederick 2012). Gnawing and consumption of bone fragments (for grease and marrow), is a common canine activity and one that might have been conducive to temporarily removing some mammal bones from a floor surface. Comparatively few fish bones show evidence for digestion with the greatest frequencies for digestion occurring on salmon (0.6%) and then greenling (0.1%).

Bird and fish bones also show higher percentages of burning and calcification in the House 1 deposits, which likely reflects culinary processing and/or bone disposal practices. Notably, the highest rate of calcification was observed for birds in the House 1 deposits suggesting high-temperature burning may have been a preferred culinary method or bone disposal method. Among the fish, Ratfish had the highest incidence of burning (34%) and this cartilaginous species lacks all skeletal structures except six teeth. Petrale sole was the second most frequently burnt and calcined fish (12%) followed by lingcod (10%), Irish lord (5%), greenling (3.5%), salmon (3.1%), and herring (0.8%). These frequencies suggest that roasting was a more common method of preparation among these taxa.

Cut marks are noted on a few mammal bone shaft fragments, all of which are too fragmentary to identify to a specific skeletal element let alone to species. These nevertheless indicate the use of sharp-edged tools in the butchery process. ‘Chop marks’ are noted on several mammal bones indicating direct percussion by a blunt object. In addition, several thin and warped ‘chips of mammal bone may reflect bone artifact production or carving detritus.

Collectively, this patterning suggests that the fish assemblage appears to be the least subject to destructive taphonomic factors and therefore most closely reflective of harvesting practices. In contrast, the highly fragmentary and rarely identifiable mammal remains from the column assemblage provide a much narrower view of the species utilized, but add

considerable detail to the taphonomic dimension of mammal bones present in the fine screen column sample mesh.

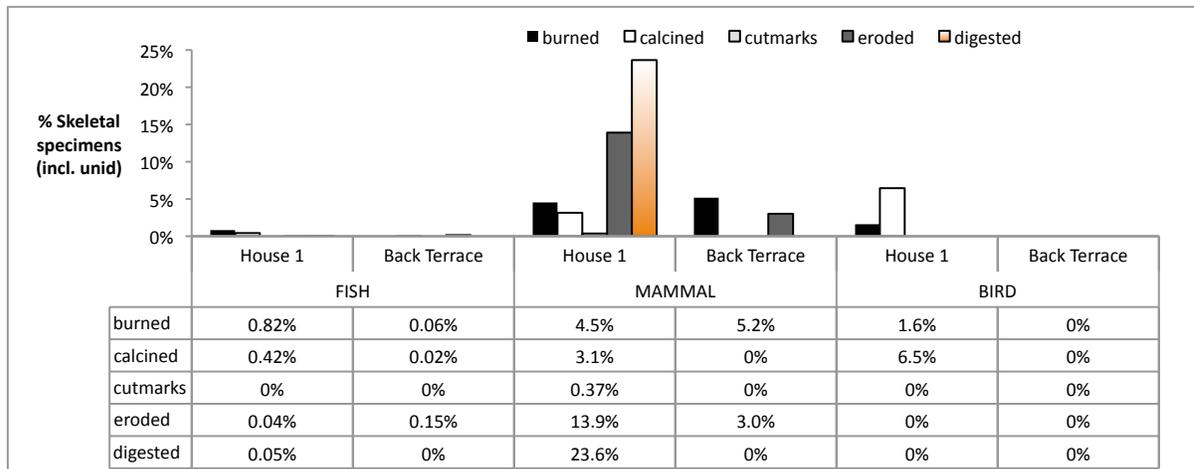


Figure 5.21. Burning and other modifications to bone specimens in the column sample assemblage by fish, mammal, and bird categories. Calcined refers to highly burnt ‘white’ bones.

Element Representation

The relative proportions of cranial, vertebral, and caudal elements for the ten most numerous fish taxa are depicted in Figure 5.22. There is broad consistency in that the greatest proportions of identified elements are vertebrae, followed by cranial and then caudal elements. Perch have the largest proportion of cranial elements but this is due in part to their numerous corn-kernel-like teeth that readily separate from the jaw structure, which over represents the proportion of cranial elements. However, this is not the case for hake, rockfish, and greenling, where over 25% of elements are from crania, which is disproportionate to their skeletal anatomy (see, Wigen 2005). These latter proportions may reflect the robusticity of these species’ cranial elements and/or high discard rate of head bones for these species as opposed to additional culinary processing.

In contrast, salmon have one of the lowest proportions of cranial elements among the ten most numerous fish as has been observed elsewhere in Barkley Sound (Frederick and Crockford 2005:192) and on the Northwest Coast (Matson 1992; Orchard 2007; Wigen and

Stucki 1988; Wigen, et al. 1990; Wigen 2005:92). It remains unclear whether this pattern is due to the differential transport or preservation, the fragility of salmon head bones, or the processing techniques such as boiling, smoking, or some taphonomic combination thereof (Butler and Chatters 1994). However, the persistence of this pattern in the H_uu7ii assemblage reaffirms this is as an intriguing and underexplored research question.

Notably however, fragmentary salmon vertebrae make up over 80% of all identified salmon remains in the assemblage whereas complete vertebrae only represent 5% of identified salmon. Salmon vertebrae are visually distinct from other fish remains due to their unique skeletal shape and texture that produces higher identification rates (Cannon 2000a; Orchard 2007; Wigen and Stucki 1988). Thus, while the ubiquity of salmon throughout assemblage demonstrates it was regularly used, the high proportion of fragmentary vertebrae disproportionately contributes to an apparent lack of cranial elements. Therefore, Figure 5.22 also includes a second element ratio for salmon that excludes fragmentary vertebrae and correspondingly increases the proportion of cranial remains to nearly 13%.

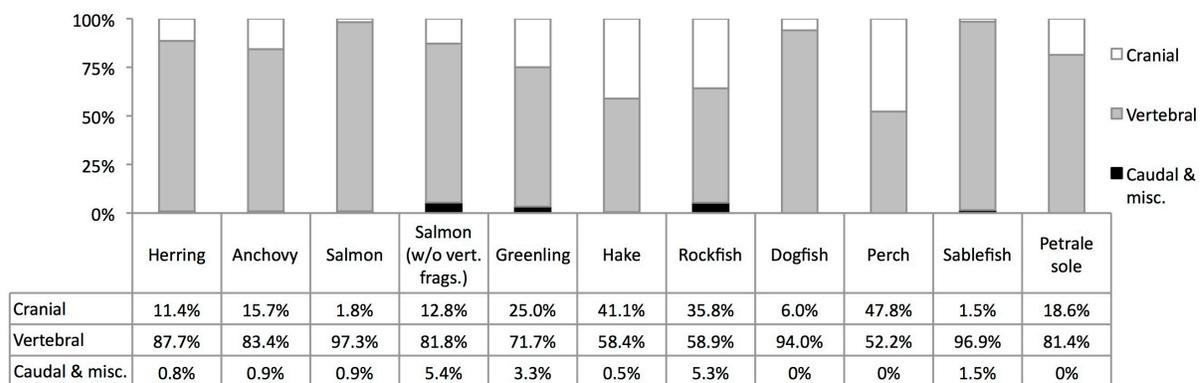


Figure 5.22. Relative percent of cranial vertebral and caudal elements for the 10-most numerous fish in the column sample assemblage. The cranial category includes the neurocranium, dermocranium, suspensorium, hyoid arch, and branchial arch. Vertebral category also includes the pectoral and pelvic girdle. Caudal includes tail elements and miscellaneous elements.

Discussion and Interpretation

Sampling Adequacy

The column sample assemblage contains over 32,000 identified fish remains from 32 taxa collected from a number of temporally and spatially distinct contexts in House 1 and the back terrace. The most abundant taxa are also the most commonly occurring, indicating that the most numerous species are also the most widely utilized and thus, of particular significance in interpreting the collective social and economic practices of the people who created the House 1 and back terrace deposits.

What is much more challenging to interpret in the column sample assemblage are those ‘rare’ taxa that represent food gathering and consumption activities that may be particularly socially valued but occur comparatively infrequently (e.g., whales and whaling). As noted by Sahlins (2010), the social construction of “value” is often related to culturally defined notions of rarity or “alterity” (i.e., exoticness). He argues, “scarcity is largely a function of exchange-value rather than the other way around” (Sahlins 2010:380). In an archaeological context, this implies that rarely occurring items in an assemblage can have particular cultural significance, but that scarcity will often frustrate attempts to adequately interpret their role in a given archaeological context (Gray 2008). Another interpretive hazard is that such archaeologically rare items may also reflect spontaneously random occurrences which may have less interpretive significance than they sometimes receive, especially in comparison to more common yet perhaps more mundane elements of everyday life that are nonetheless vital to social and economic relations.

Whichever the case, the series of analyses presented in this paper indicate the column sample faunal assemblage is a robust sample, representing common and widespread food harvesting practices present in small volumes of closely examined cultural deposit. I focused

on vertical ‘columns’ of sediment from multiple contexts to provide a strong basis for interpreting continuity and change over time, but recognize this approach is less conducive to understanding horizontal spatial patterning within a household context. However, in order to assess the more infrequent dimensions of social and cultural life an even larger sample size and a larger number of examined contexts is required. Fortunately, this is the case as the excavation unit assemblage (Frederick 2012) examined a much larger number of contexts and more rarely occurring taxa, revealing spatial patterning at a household scale.

Continuity in Resource Use

Although there is considerable dynamism in the composition and proportion of fish in individual column sample levels (Figure 5.10), there is also broad consistency and continuity across space and over time (Figure 5.7 and 5.8). The pervasiveness of fish remains in the site deposits reflects the importance of fish and fishing in the daily lives and social relations of the inhabitants of Huu7ii. Fishing targeted a wide range of species but intensively focused on a number of taxa. These are cultural patterns that indicate consistent and enduring connections between the site occupants and particular fish and the places from which they were harvested. Such information represents a vital and important aspect of how people created and sustained a community at this location for over five millennia.

The numerical dominance of herring, as indicated by multiple measures of zooarchaeological abundance over a 5,000-year period, is particularly significant to the interpretation of social and economic practices at Huu7ii. Herring represent an excellent winter and spring food, one that is rich in oil and could be mass harvested and stored, then consumed over extended periods (Arima 1983; Hart, et al. 1939; Jewitt 1807; McKechnie 2005b; Smylie 2004). Herring and herring roe were a form of wealth that could be traded and

distributed widely in a village setting, between households, within families, at feasts, and with other Nations in Barkley Sound and beyond (Drucker 1951:40; Jewitt 1807:37; Sproat 1868:224). Herring length estimates (Figure 5.13) indicate harvests concentrated on adult-sized fish that were likely caught in large schools prior to spawning. In summary, the dominance of herring in the column sample assemblage, both over time and consistently within small volumes of cultural deposit, reflects a particularly concentrated collective investment, focused on processing large numbers of fish for immediate consumption and long-term storage. Community members likely simultaneously harvested the other marine predators (birds and marine mammals) that also consume herring (Monks 1987) and thus the occurrence of herring likely was a highly anticipated and prepared for time of the year.

Of course, numerous other fish species are also regularly present in the assemblage and these additionally provide a basis for interpreting the persistent and everyday aspects of social, economic, and ecological relations at Huu7ii. In particular, anchovy and salmon are two taxa that represent similarly abundant contributions to the overall assemblage and are ubiquitously present, indicating highly regular use. Anchovy, as a small schooling fish, may have served as a supplement the comparatively more intensive harvest of herring. Salmon similarly occur in consistent but relatively low frequencies throughout the 5,000-year record but increase dramatically during the last 500 years of occupation (see discussion below). Greenling and rockfish are two non-migratory taxa that also consistently occur in the assemblage and could be readily obtained within the vicinity of the village at all times of the year. Numerous other fish species additionally played important roles in the daily lives of site inhabitants and further examination of these individual taxa is needed.

From a methodological standpoint, one of the intriguing consequences of calculating the minimum number of individual (MNI) fish in the fine-screened column sample assemblage is the considerable difference between the MNI and NISP values of herring. Herring are the most numerous fish according to both measures, but the NISP value for herring is more than twice as large as its MNI value (Figure 5.12). This suggests that even though herring represent more than 80% of total NISP, their nutritional contribution (according to MNI) may be equivalent to less numerous but individually larger fish such as salmon. However, this does not account for the uncertainty of MNI calculations (Lyman 2008) and the complexity of estimating ‘meat weight’, as well as how fish taxa (particularly salmon) change considerably in abundance over time. These estimates will remain under-resolved until additional analyses consider variability over time and space. However, the present analysis represents an important first step towards reconciling the difference between NISP and MNI data for small column sample assemblages.

Change in Resource Use

While there is a strongly expressed continuity in resource use within the Huu7ii fish assemblage, there are two particularly robust temporal changes in the abundance of fish in the House 1 deposits: 1) salmon increase dramatically during the last 500 years of occupation, reflecting a considerable shift from earlier periods and 2) hake occur in large numbers in the middle of the House 1 deposits (prior to ca. 700 BP) but are absent or have low frequencies during all other periods (Figure 5.10).

The shift towards increasing use of salmon indicates a broad cultural change in the social economy of House 1. This change may reflect an expansion of the political territory of the village, such as securing access to a productive salmon river from, or in cooperation with,

another polity. This also may be a product of a more intensive fishery in the immediate vicinity of the village, such as the large troll-based sport fishery for salmon that currently operates off Kirby Point on Diana Island (1 km from the village). Alternatively but not exclusively, the sharp increase in salmon may additionally reflect progressively more favorable oceanographic conditions conducive to the intensification of salmon fishing at a community scale. A similar and contemporaneous trend has been observed at other archaeological sites in Barkley Sound, such as at the Ts'ishaa village in Tseshah territory (McKechnie 2005b, 2007a; McMillan, et al. 2008) and at Ma'acoah in Toquaht territory (Monks 2006), as well as elsewhere on the northern (Orchard and Clark 2005) and southern (Wigen 2005) Northwest Coast. These local and regional patterns may relate to large-scale climatic changes in the North Pacific that occurred after AD 1200 (Anderson, et al. 2005b; Finney, et al. 2002; McKechnie, et al. 2008). Future research will help identify the cultural, historical, and climatic circumstance that may be driving these trends. Of particular importance will be identifying the particular salmon species targeted during this period of increased salmon utilization. Further examination of salmon specimens from Huu7ii is warranted and new morphometric techniques (Grier, et al. 2013; Huber, et al. 2011), as well as ancient DNA (Cannon and Yang 2006; Cannon, et al. 2011), have the potential to address this question of a period of dynamic change.

The second particularly notable change in the abundance of fish in the column sample assemblage is the sharp increase in the abundance of hake throughout the House 1 deposits (Figure 5.10). While this trend is moderately observed at other sites in Barkley Sound (McKechnie 2007a:214), it appears to be much more strongly expressed at Huu7ii. This increase may reflect a local specialization, such as community access to particularly

productive hake fishing locale. However, since hake are strongly influenced by marine climate (Agostini, et al. 2006; Benson, et al. 2002; McFarlane, et al. 2000) and the length measurements suggest that primarily large migratory adults were harvested (rather than a local population in which a range of sizes would be expected), the occurrence of hake provides support to the interpretation of a period of warmer ocean conditions prior to AD 1200. It is also significant that the sharp increase in hake occurs prior to the increase in salmon, further suggesting that climatic factors may be influencing this cultural change.

Within the back terrace, the most notable temporal change is the higher abundance and higher numbers of herring per litre relative to the House 1 deposits (Figure 5.8 and 5.9), indicating fisheries were comparatively more intensive during this mid-Holocene occupation (ca. 5000–3000 BP). The progressive increase in the middle levels of both deposits suggest a particularly intensive peak in the utilization of herring followed by a progressive decline in the upper levels (Figure 5.11). A possible factor that might have contributed to the higher abundance of herring in the back terrace is the beach sand present beneath these cultural deposits that represent a former intertidal zone. This may have been an ideal habitat for herring spawning and a reason for intensive human use and settlement. These fine beach sands were likely deposited when sea levels were 3–4 m higher during the mid-Holocene (Friele and Hutchinson 1993) and contrast with the steep rocky intertidal storm beach that dominates the shoreline today. It is therefore possible that during the back terrace occupation, the intertidal zone may have been a herring spawning location and may even have included a fishtrap. Additional paleo-topographic reconstruction of this raised beach landform will help add substance to this interpretation.

Seasonality

The dominance of herring in the back terrace deposits may indicate a comparatively more seasonal use of the site during the period between 5,000 and 3,000 years ago. However, a year-round use of the site is indicated by the continuous deposition of shell midden sediments (Figure 5.4) and the occurrence of mammalian, bird, and fish species that are summer and fall seasonal indicators abundantly present in the back terrace excavation unit assemblage (Frederick 2012). In addition, the back terrace column samples also consistently contain anchovy and salmon that may have been more readily obtained in summer and fall, as well as herring that may have been used more readily in winter and spring. Later in time, during the House 1 occupation, the column sample assemblage contains a comparatively more ‘even’ distribution of fish taxa (Figure 5.8) as well as a greater number of fish taxa (Figure 5.19), suggesting an even more substantial degree of year-round occupation. This is also supported by the excavation unit assemblage.

An important consideration in determining the seasonality of archaeological faunal assemblages is that the assessment of seasonality is often based on the presence of ‘indicator species’ in a given depositional context (e.g., Ford 1989). However, a key question is how consistently these species occur: are they ubiquitous and abundant, or are occurrences rare and thus a reflection of sampling intensity rather than site seasonality? This column sample assemblage provides important insight into this issue, as there are several fish taxa that are both abundant and ubiquitously occurring. Thus, their consistent presence across dozens of depositional contexts (i.e., multiple small temporal snapshots) may represent a more robust indication of seasonality than infrequently occurring but more seasonally diagnostic taxa.

Another key issue in the determination of seasonality is that species may occur over a broader range of seasons than is conventionally understood, especially considering the

impact of 20th century industrial commercial exploitation of the marine environment. For instance, the consistent occurrence of adult herring in archaeological deposits on the Northwest Coast is often interpreted to mean that herring were targeted exclusively during the spring spawning season. However, this does not often encompass the range of variability on the coast, particularly relating to the period prior to herring spawning. A series of historic observations suggest that herring were harvested during a much longer period of the year. For instance, John Jewitt's (1807) journal recounting his two and a half years of captivity among the Mowachaht in Friendly Cove (120 km north of Barkley Sound) documents the consumption of herring and herring roe multiple times in all months of the year except July and August (McKechnie 2005b:103). Modern industrial herring fisheries conventionally began fishing for herring in October, well prior to the winter and spring spawning periods (Mackinson 1999; Taylor 1955:111; Tester 1933:287). Department of Fishery and Oceans records going back to the 1940s (McCarter, et al. 2005) show herring spawn once regularly occurred as early as late January and early February on western Vancouver Island. These observations indicate that pre-industrial herring populations may be better characterized as a late fall and mid-winter food in addition to the spring spawning period. Moreover, the storability of herring would mean that it could be consumed for months afterwards and thus well into summer.

Similarly, anchovy is a species said to occur more frequently in summer as it is at the northern edge of its latitudinal range (Department of Fisheries and Oceans Canada 2002). However, paleoecological analysis of fish scales recovered from a geological sediment core in nearby Effingham Inlet (~15 km north of Huu7ii) indicates that anchovy were the dominant fish in that particular inlet over the past 4,000 years (Wright, et al. 2005:376),

implying that anchovy are a resident non-migratory population and were likely available throughout much the year. The occurrence of salmon from multiple size ranges and species (Figure 5.14) suggests that this taxon could also have been harvested at multiple times of the year (spring through fall). Thus, rather than seeking to identify seasonal indicators, it is additionally important to consider the consistent utilization of species that are present during multiple seasons as a proxy for year-round site occupation.

Comparisons to Other Assemblages

The examined column sample assemblage can be compared with available precontact archaeological faunal assemblages in Huu-ay-aht territory and elsewhere in Barkley Sound. However, there are only three other sites within Huu-ay-aht territory where fine-screen fish remains (smaller than ¼-inch mesh) have been used. The nearby Huu-ay-aht village of Kiiix7in (DeSh-1) contains a modest vertebrate assemblage (NISP = 700), in which herring are the most abundant fish (48% NISP fish), followed by salmon (22%) and greenling (16%) (Wigen 2003b). Herring is considerably less abundant (18% NISP) but still the second most frequent fish in the small assemblage (NISP = 171) from the adjacent defensive site at Kiiix7in (DeSh-2), which is dominated by greenling (49%) (Wigen 2003b). An additional fine-screen assemblage (NISP = 187) from the Klanawa Rivermouth (DeSf-6), 20 km south of Cape Beale (McKechnie 2007c:9), is dominated by salmon and greenling and only contains a small percentage of herring (6% NISP).

Northwest of Huu7ii in the Broken Group Islands, herring are also dominant among the fish at the large Tseshaht village of Ts'ishaa (DfSi-16&17), followed by anchovy, rockfish, greenling, and salmon (McKechnie 2005b; McMillan, et al. 2008). Herring is similarly the most abundant fish (58%) in a small (NISP = 151) column sample assemblage

from a defensive site on Clarke Island (DfSi-26) in close proximity to Ts'ishaa (McKechnie 2007b:29) and is overwhelmingly dominant (85%) in an assemblage from Dodd Island in a protected portion of the Broken Group Islands (Wigen 2009).

Two fine-screened assemblages from Ucluelet Harbour in western Barkley Sound, Little Beach (DfSj-100) (Weathers, et al. 2008; Wigen 2008a) and Ittatsoo North (Brolly and Pegg 1998:167), have identically high abundance values for herring (79% of NISP). The fish identified from Ma'acoah (Monks 2006), Tukw'aa and Ch'uumat'a (Monks 2011) in Toquaht territory as well as Shoemaker Bay at the head of Alberni Inlet (Calvert and Crockford 1982) are not directly comparable to the Huu7ii column assemblage as these excavations did not use column sample recovery methods. However, it is notable that these ¼-inch assemblages contain only a negligible number of hake specimens, which further indicates the uniqueness of the Huu7ii assemblage. However, all sites appear to have significant frequencies of rockfish, greenling, and salmon and a host of other taxa that speak to the common utilization of these fish in other archaeological contexts. Grasping the variability will require considerably more analysis to fully synthesize and assess the spatial and temporal variability.

Conclusions

This study has explored the archaeological expression of vertebrate faunal remains, particularly fish, from the ancestral village site of Huu7ii. I analyzed over 58,000 vertebrate specimens containing over 32,000 identified remains from 12 column samples representing 168 depositional contexts spanning 5,000 years of human occupation. Fish bones were the most numerous and commonly encountered vertebrate elements, followed distantly by mammals and birds. Herring was the most numerous and consistently present fish species,

followed distantly by anchovy, salmon, greenling and a host of other taxa. I analyzed these frequencies using multiple measures of abundance and argue they reflect cultural, social, and economic relations within the village.

Collectively, these site specific and regional patterns indicate the vital importance of herring in indigenous precontact fisheries in Barkley Sound and have broader significance for interpreting the archaeological history of fishing on the Northwest Coast. The column sample assemblage from H_{uu7ii} further confirms that small fish are grossly under-represented using conventional recovery techniques, which contributes to the under-recognized role of herring relative to the more well-known and disproportionately emphasized taxa such as salmon (cf., Coupland, et al. 2010; Monks 1987). A long-standing gap in understanding is the lack of column sample analysis, which is widely recognized to offer the most precise determination of the relative abundance of fish. A full-scale comparison of the temporal and spatial variability is ongoing and will yield more detailed insights into the regional character and intensity of ancient Nuu-chah-nulth fishing practices.

Chapter 6. Indigenous Oral History & Settlement Archaeology in the Broken Group Islands, Western Vancouver Island

This chapter examines both archaeological and Indigenous oral historical information specific to a precontact Nuu-chah-nulth local group territory on western Vancouver Island and asks whether these data reveal parallel sequences of human settlement. I draw on the past 2,500 years of archaeological records in the Broken Group Islands and the corpus of oral historical information specific to this area to help evaluate and inform the dynamic human settlement history in this region. The archaeological data have been compiled from previous surveys and excavations as well as from new field investigations and radiocarbon dating I coordinated in 2008, 2009, and 2011 while the oral historical and ethnohistorical observations have been translated and compiled by previous researchers over the past century.

Indigenous Oral History and the Archaeological Record

The historical accuracy of Indigenous accounts of history and its specific applicability to archaeological interpretation has faced numerous empirical and interpretive challenges. Archaeologists in North America and elsewhere have a long history of ignoring and/or regularly questioning the validity, specificity and historical accuracy of oral historical accounts, due in part to the pervasive critique that orally transmitted histories are qualitatively less robust than textually or archaeologically based accounts and/or are regularly contrived to suit practical political purposes and thus, are fundamentally ‘biased’ (Mason 2000; McGhee 2008). Oral histories are also considered to be subject to inherent degradation over time (Vansina 1985) a viewpoint often associated with the settler-colonial mentality that aboriginal culture has been similarly ‘degraded’ due to cultural ‘assimilation’.

Such pervasive skepticism(s) helps explain the continued privileging of colonial historical accounts over Indigenous historical experiences, exemplified by the treatment of Indigenous oral history in courts of law (Miller 1992, 2011). Yet, as much as orally performed histories may indeed reflect a strategically deployed emphasis crafted to suit particular circumstances and audiences (Cruikshank 1997), the narrative content in these histories retains an enduring historical structure that fundamentally transcends, collapses, and contextualizes the contemporary moment and can extend far beyond the colonial experience.

Archaeologists who seek to include Indigenous oral accounts in their interpretive practice are frequently charged with perpetuating a teleological (self-referenced) account of history (McGhee 2008). This skepticism similarly relates to a perception that oral historical accounts lack analytical rigor (Mason 2006) a critique somewhat akin to the ‘cultural historical’ approach dismissed by a generation of ‘processual’ archaeologists (Trigger 1991). However, one fundamental problem with this critique is that it effectively minimizes consideration of oral history as a legitimate source for archaeological insight and therefore further displaces the narration of Indigenous history from Indigenous voices (Atalay 2008). It also fails to acknowledge the pervasive influence that oral historical accounts have had on archaeological observations and in guiding interpretive processes and ethnographic and ethnoarchaeological analogues, particularly in North American anthropology and archaeology, which has been unmistakably shaped and influenced by the Indigenous societies they study (Darnell 2000; Valentine and Darnell 1999).

Recent commentators contend that a productive aim in evaluating Indigenous oral narrative and historiography in the context of archaeological interpretation is not to seek to empirically ‘verify’ the culturally embedded forms of place-based oral historical knowledge

(Crowell and Howell 2013; Cruikshank 2001; Green 2008; Martindale n.d.). Rather, it is to recognize that both Indigenous oral history *and* archaeological interpretation represent attempts to narrate and assign causality to human history, but that each perspective encompasses rich but incomplete sources of knowledge about the past, which can be made richer and stronger when examined in parallel (Martindale 2006). Such an approach avoids a dichotomous questioning of ‘Indigenous knowledge’ or its decontextualized incorporation into scientific and bureaucratic enterprises (Cruikshank 2005:256-257). Rather, it refocuses on how particular translations between oral historical and archaeological knowledge can advance and thus strengthen understanding of the human and environmental past.

Translating Between Archaeological and Oral Historical Information

A number of disciplines recognize Indigenous oral histories have a richness and sophistication that require detailed consideration of how they are performed, reflected upon, and persist over multiple generations (Basso 1996; Cruikshank 1997; Marsden 2001; Martindale 2006; Miller 2011). These factors do not necessarily detract from their utility in comparison to archaeological data. Rather, they require an anthropological engagement with historical and cultural setting and linguistic dimensions that strengthens understanding of how aspects of oral narratives can persist across generations in the absence of written texts. Such an engagement helps further refine and identify the embedded cross-linked event chronology in oral narrative and its links to geographically grounded place names and named actors. As stated by Fogelson (1989:141), oral historical *events* “do not generate the narrative, but events are selected to cohere to story lines, frameworks, or plots that result in intelligible narratives.”

Archaeologists and Indigenous scholars concerned with understanding human history on the Northwest Coast have increasingly identified the considerable potential for examining parallels between Indigenous oral histories and archaeological histories. A number of recent studies identify parallel alignments between oral historical accounts of places and archaeological evidence that stretch into the precontact past (Atleo 2004; Crowell and Howell 2013; de Laguna 1960; Ludwin, et al. 2005; Marsden 2001; Martindale and Marsden 2003; Martindale 2006; McLaren 2003; McMillan 1999; McMillan and Hutchinson 2002; McMillan 2009). Archaeological researchers have further observed a widespread correspondence between geological events, particularly earthquakes and tsunamis and Indigenous oral histories (Bornhold, et al. 2007; Budhwa 2002; Losey 2000, 2002, 2005; Ludwin, et al. 2005; Ludwin, et al. 2007). Others have identified intergroup conflict and political alliances and amalgamation as a significant event-scale temporal marker regularly recounted in Indigenous oral histories (Angelbeck and McLay 2011; Huu-ay-aht First Nations 2000; Martindale and Marsden 2003; Swadesh 1948).

Objectives

Archaeological research that is attentive to Indigenous oral narrative addresses two important aspects of human history that are often poorly investigated in conventional archaeological research: 1) an Indigenous perspective and narration of the historical phenomena represented in archaeological data and 2) a focus on the intergenerational timescales spanning the lifetimes of individuals that fall between the broad millennial-scale of the *longue durée* (Ames 1991; Smith 1992) and the “event based” scale of conventional history (Fogelson 1989).

To date, Indigenous oral histories have not been broadly integrated with or evaluated alongside the conventional archaeological chronologies on the Northwest Coast (but see Martindale and Marsden 2003; McLaren 2003). Following the principle of relative sequential ordering (Martindale 2006), this chapter examines Indigenous oral histories, as well as the place names embedded within them, to evaluate Indigenous timelines of sequential and overlapping historical events alongside archaeological sequences of settlement. I specifically compare these distinct datasets to evaluate the ages of occupation between spatially and ethnographically affiliated settlements in close proximity to each other and within these large shell middens. I observe the oral historical sequences and the archaeological settlement chronology to show overlapping and complementary patterns that document the growth, expansion, and dynamically shifting residence patterns at multiple village sites over the past two and half millennia. I argue this comparison adds vital detail and an Indigenous perspective to archaeological settlement histories at an intergenerational scale and anthropologically enriches interpretation of the relationships between spatially associated archaeological sites. This research also addresses sources of archaeological settlement variability that have not been particularly well documented on the Northwest Coast (Cannon 2001; Moss 2012).

Analysis of Archaeological and Oral Historical Sequences

The analyses undertaken in this chapter compare and evaluate oral historical information alongside archaeological data at multiple spatial and temporal scales specific to the Broken Group Island archipelago. In the spatial domain, I use contact-era Indigenous territories and place names identified in oral historical narratives compiled by St. Claire (1991) to compare with archaeological site locations and site sizes compiled through

previous survey efforts (Haggarty and Inglis 1985). I compare these datasets by creating separate geospatial layers in ARCGIS with place names, territorial boundaries and archaeological settlement locations. To calculate archaeological site size, I geo-rectified images from the original hand-drawn survey maps onto a high resolution DEM and basemap²² to trace the outline of shell bearing site deposits indicated by the appropriately scaled site map to generate a polygon estimate of shell-bearing surface area (m²) using the calculate area function in *ARCGIS 10*.

On a temporal scale, I reviewed oral historical information specific to archaeological study sites for information specific to the sequence of occupation, growth and disruption of settlement to evaluate alongside chronological sequences of archaeological settlement. I focused this comparison on seven study sites within a local group territory on the outer Broken Group Islands (Figure 6.1) where I conducted fieldwork including radiocarbon dating, surface mapping and percussion coring.

Historical Background

Nuu-chah-nulth peoples were among the first Indigenous communities on the British Columbia coast to make contact with European explorers during the late 18th century. The trade and exchange that took place between Nuu-chah-nulth and visiting European explorer/traders initiated a geopolitically significant period of colonial expansion in the Pacific and the impact of this trade reverberated in communities throughout the coast (Harris 1997; McMillan 1999). This intensive period of trade sustained relationships between particular Nuu-chah-nulth chiefs and European and Eastern North American ship captains and merchants over a 30-year period but rapidly collapsed after sea otter pelts became scarce

²² Basemap generously provided by Ed Gregr (UBC Resource Management & Environmental Studies).

and trading ships such as the *Boston* and the *Tonquin* were attacked and ransacked by Nuuchahnulth groups in the early 19th century (Clayton 2000:143; McMillan 1999:188). Exchanged European goods were widely and rapidly circulated throughout coastal communities and overland through an elaborate set of intermediaries that built on existing social relations and exchange patterns (Galois 2004; Harris 1997). For Nuuchahnulth, this period marked an initial process of colonial expansion which was greatly diminished throughout the early 1800s but was then sharply amplified 50 years later during the mid 1850s and 1860s when colonial presence and settlement rapidly expanded amidst disease and violent military attacks from colonial presence combined to reduce and displace Indigenous peoples from much of their former territories (Gough 1984; Harris 1997; Sellers 2013).

Individual Nuuchahnulth Nations along the west coast differed in their participation in this period of trade and exchange (McMillan 1999). Some groups, particularly the *Mowachaht* at the village of Yuquot (i.e., Friendly Cove in 'Nootka' Sound) sustained exclusive control over favored anchorages and extracted tribute from or excluded others from direct access. Other Nuuchahnulth communities, whether through geographic circumstance or long-standing political conflict and/or alliances, participated indirectly in this exchange, often at a material disadvantage, particularly when guns were involved (Harris 1997). Such is inferred to have been the case in Barkley Sound and the Broken Group Islands where the *Tlaloquiaht* chief *Wickaninish* attempted to exert and maintain control over the distribution of sea otter pelts and direct access to trading ships but this control was tenuous and limited at best (Clayton 2000:143-148; McMillan 1999:188).

Nuuchahnulth First Nations on western Vancouver Island have persisted through significant political and cultural changes since the early maritime fur trade (ca. AD 1778-

1803). In the intervening decades between the maritime fur trade and the 1860s numerous Nuu-chah-nulth groups underwent a series of amalgamations through confederation or as a result of competitive conflict (Arima 1983; Atleo 2011; Clayton 2000; Drucker 1951; Golla 1987; Huu-ay-aht First Nations 2000; Inglis and Haggarty 2000; Kenyon 1980; Marshall 1993; McMillan 1999; St. Claire 1991). After the 1850s, groups were further subjected to devastating demographic changes due to introduced diseases. Thus, while 14 individual Nations are recognized today, this number was far greater during the early contact era and prior. However, this rich mosaic of individual autonomous groups has not been adequately recognized in the broader archaeological literature (McMillan 1999; McMillan, et al. 2008; McMillan 2009). For instance, two widely cited archaeological syntheses note that a limited number of individual groups controlled large territories and exhibited a pattern of seasonal movement between the ‘inside’ and ‘outside’ coasts (Dewhurst 1980; Mitchell 1990b). This synthetic impression is based largely on the interpretation of Nuu-chah-nulth territorial structure specific to central and Northern Vancouver Island influentially put forth by Philip Drucker (1951) who detailed patterns of settlement organization that neglected to take into account many of the demographic and political changes during the early contact era (McMillan 2009).

This influential viewpoint reflects a lack of engagement with an abundance of primary data pertaining to the early contact era: those recounted and detailed in oral historical accounts. However, many archaeologists reviewing ethnographic literature to provide insight into the archaeological past often project a less complicated and politically and territorially altered circumstance dating from the late 19th century into the more distant past (cf. Grier 2007). Aside from a problematic circumstance for archaeological interpretation, this

impression is not an accurate reflection of the rich historical content provided in oral accounts, which often speak of numerous titleholders and groups whose significance may appear diminished relative to the circumstances of the late 19th century and early 20th century, which are nevertheless, among those *most relevant* to archaeological interpretation of pre-contact history. For instance, on western Vancouver Island, Indigenous oral histories and place names describe a large number of Nuu-chah-nulth communities that occupied spatially distinct territories during the contact era (Golla 1987; Inglis and Haggarty 1986, 2000; Marshall 2000a, b; McMillan and St. Claire 2005; St. Claire 1991). Over the late 18th and 19th centuries, these communities subsequently amalgamated into larger groups as they endured large-scale population reductions from introduced diseases alongside dramatic increases in the colonial presence in the 1850s and 1860s. Archaeological support for larger populations and more numerous but smaller and circumscribed group territories during the precontact era has been observed across western Vancouver Island such as in Hesquiaht Harbour (Calvert 1980; Haggarty 1982) and Nootka Sound (Inglis and Haggarty 2000; Marshall 1993), and particularly in Barkley Sound and the Broken Group Islands where sizable clusters of large shell middens have been inferred to indicate much larger precontact populations (Haggarty and Inglis 1985; McMillan and St. Claire 1982). The archaeological importance of these Indigenous oral histories is that they detail the processes of post-contact political change and amalgamation and show how they unfolded uniquely for individual Nuu-chah-nulth groups at named places that have extensive archaeological deposits.

The Broken Group Study Area

The Broken Group Islands on the southwest coast of Vancouver Island (Figure 6.1) is an area of the Northwest Coast where there is both a detailed set of inter-generational

community knowledge described in Indigenous oral histories and encoded in Indigenous place names, as well as a thoroughly surveyed archaeological record (Haggarty and Inglis 1985) including two large-scale excavation projects at the major village site of Ts'ishaa (McMillan and St. Claire 2005) and ongoing research at Hiikwis (MacLean 2012; Sellers 2013)²³. I have conducted further research at a cluster of sites in the southern quadrant of the archipelago (McKechnie 2009, 2010b) (Figure 6.1), which is the pre-contact territory of the *Maktl7ii7ath* (a Nuu-chah-nulth polity) who amalgamated with *Ts'ishaa7ath*, the present-day Tseshaht First Nation, in the mid-to-late 18th century (McMillan and St. Claire 2005).

²³ This study area is further bounded by extensive research conducted in the adjacent but culturally distinct territories to the south (Mackie and Williamson 2003, n.d.) and North (Brolly and Pegg 1998; McMillan and St. Claire 1992, 1994, 1996; McMillan 1999; Monks 2006, 2011)

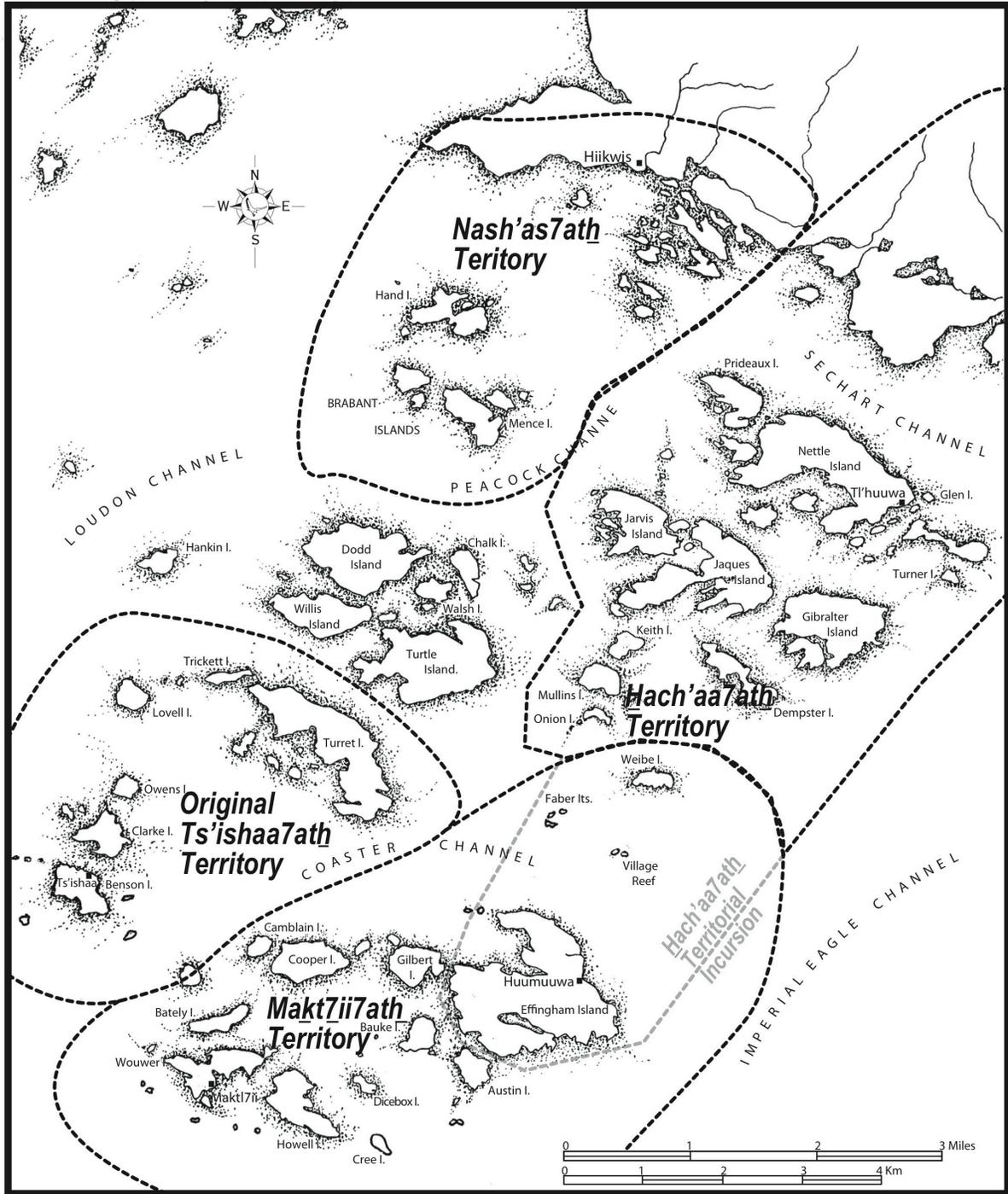


Figure 6.1 Territorially bounded local group areas in the Broken Group Islands during the 18th century as described in oral historical accounts synthesized by St. Claire (1991) and McMillan and St. Claire (2005). Map modified with permission of St. Claire.

Oral Histories

A large corpus of oral histories have been transcribed from Nuuchahnulth elders in the early 20th century by Edward Sapir and his Tseshaht collaborators Alex Thomas and Frank Williams (Figure 6.2) and subsequently edited and published by Morris Swadesh, and later by Eugene Arima, Denis St. Claire, Katherine Robinson, and others (Arima, et al. 1991; Arima, et al. 2000; Arima, et al. 2004, 2007; Arima, et al. 2009; Sapir and Swadesh 1939, 1955; Sapir n.d.-b, a). These narrative histories were transcribed in the original Barkley Sound dialect of the Nuuchahnulth language through a practical orthography collaboratively developed between Thomas, Williams, and Sapir and subsequently translated into English. This occurred in the first few decades of the 20th century when the majority of the Tseshaht First Nation concentrated year-round settlement in Port Alberni on the lower Somass River. This was also the location of the colonial residential school, which mandated attendance for all First Nation children and had a dramatic intergenerational cultural and social impact on Nuuchahnulth communities in Barkley Sound and elsewhere in British Columbia. Alexander Thomas and Frank Williams had both been pupils at the residential school and later worked with Sapir, who was then associated with the Anthropological Division of the Geological Survey of Canada. Similar to Franz Boas and George Hunt, after a period of initial fieldwork, Sapir regularly corresponded with Thomas and Williams who worked to further compile oral histories as dictated by elders for a period of over 30 years (Darnell 1990). These narrative histories primarily concern events in the Broken Group Islands and in outer Barkley Sound before and during the contact-era fur trade (ca. 1778-1805) and the 50-year period following its collapse when there were particularly striking changes in the political landscape of Barkley Sound albeit in the absence of extensive European colonial presence (ca. 1805-1860). Rather than detailing the periodic contacts with

explorers and colonists, these narratives are overwhelmingly concerned with conflicts, alliances, and ceremonies between Nuu-chah-nulth individuals and groups. This voluminous literature provides a wealth of historical details relevant to archaeological interpretation and have been considered in depth by Alan McMillan and Denis St. Claire in the course of decades of ethnohistorical and archaeological research.



Figure 6.2. Alex Thomas (left), Frank Williams and his daughter (centre) in Port Alberni in 1914. Edward Sapir (right) pictured in New Haven in 1934 (Images used with permission from the Canadian Museum of Civilization). CMC Historical Photo Archive numbers 26545, 26574, and 2006-00012 respectively.

Indigenous Place Names

Within the Broken Group archipelago and Sechart Channel (Figure 6.1), there are 134 documented Tshesht place names (Figure 6.3). The majority of these (73%) were transcribed and translated during the early 20th century. An additional 36 names were added through the research of Denis St. Claire (1991). Thirty-five of the 134 place names (26%) were not translated, leaving open the possibility for future linguistic analyses.

The density of Indigenous place names in the Broken Group and Sechart Channel study area is estimated to be 1.3 names per square kilometer (ca. 100 km²). This greatly

exceeds (by orders of magnitude) the density of Indigenous place names recorded in other studies elsewhere in North America (Hunn 1994) and complements other placename syntheses on the Northwest Coast (e.g., Boas 1934; Hilbert, et al. 2001; Richardson and Galloway 2011; Thornton 2012). This high density may be a reflection of the relatively small and tightly bounded study area but it is also an indication of the extensive and sustained research effort to systematize place names, thus making this dataset a significant research contribution as well as a valuable cultural archive. It is also a reflection of the detailed familiarity that generations of Tseshaht had with this landscape, its features, and its history as well as an indication of a high precontact settlement density indicated by archaeological data described below.

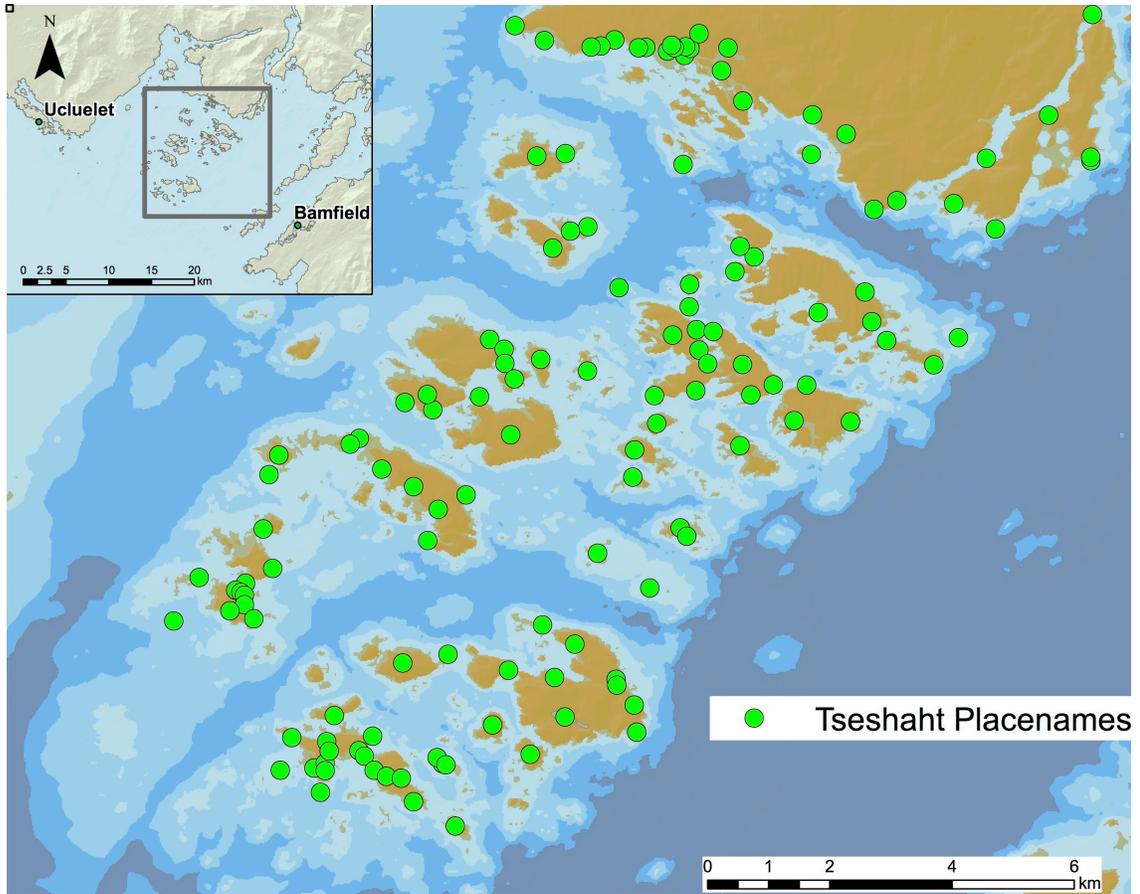


Figure 6.3. Tseshah place names as detailed in oral historical accounts shared by community knowledge holders transcribed and translated by Sapir, Thomas, and Williams and later synthesized by St. Claire (1991) who affirmed each translation through interviews with Tseshah elders in the 1970s and 1980s.

Archaeological Site Locations

The archaeological landscape of the Broken Group archipelago contains a minimum of 73 shell midden sites with a very broad geographic distribution throughout the archipelago (Figure 6.4). There are also a variety of intertidal sites including fish traps, garden features, and canoe runs. The ubiquitous distribution of shell middens and particularly their range of sizes and proximity to one another demonstrate a rich diversity of human occupation and use has occurred throughout the archipelago. The site sizes range from over 14,000 m² to less than 5 m². Collectively there are more than 114,000 m² of recorded shell midden deposits spread throughout the archipelago. It is significant that all of the 15 largest shell midden sites

have surficial evidence of houses, terraces, and/or constructed ridge landforms and all but one are directly associated with Indigenous place names described in oral histories and were noted to be villages occupied prior to and during the contact era (Table 6.1).

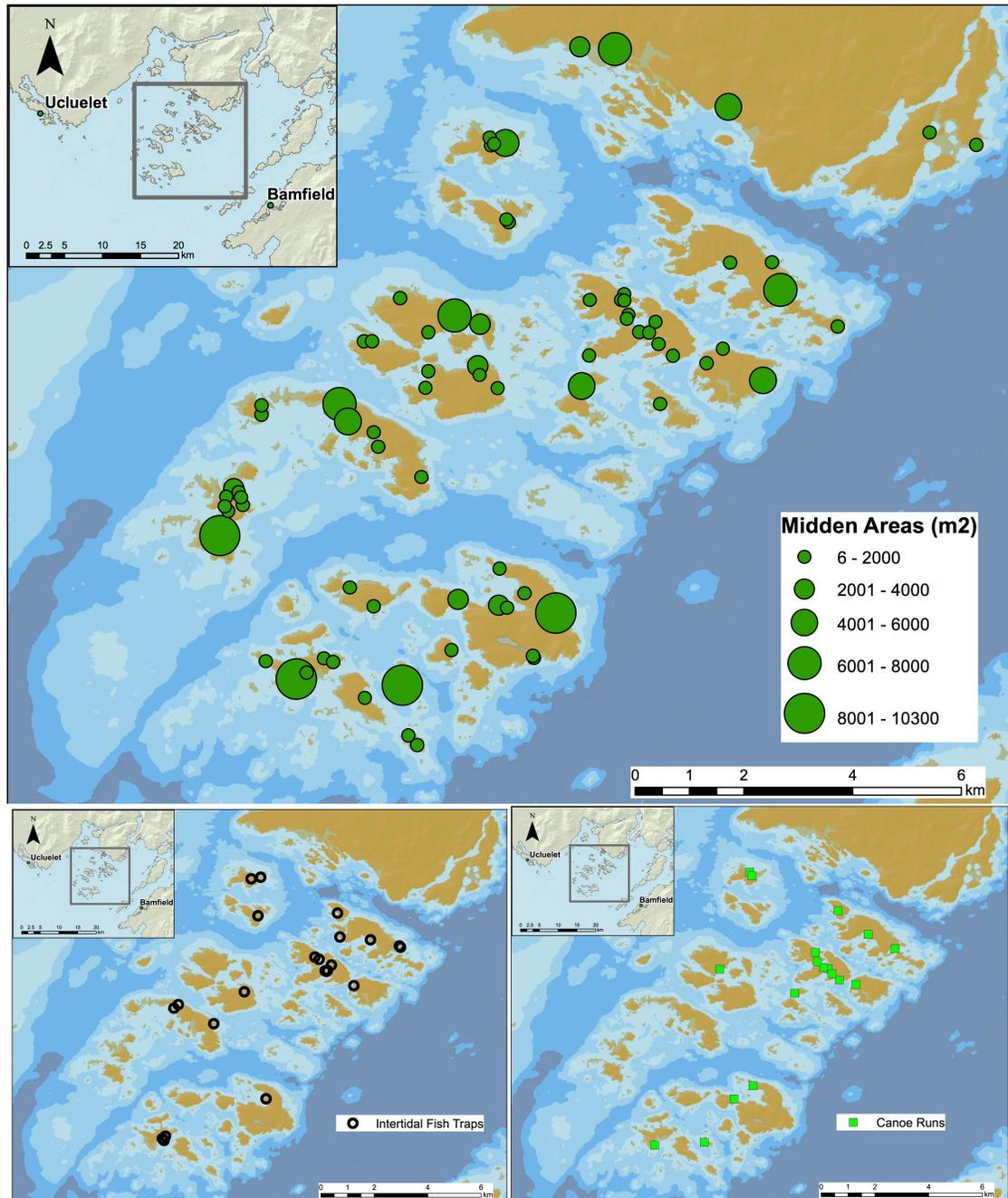


Figure 6.4 Recorded archaeological sites in the Broken Group Islands and Sechart Channel. The size of each circle represents the horizontal surface area of shell middens as determined by geo-rectifying original site maps in ARCGIS. Also shown are intertidal rock alignments interpreted to be fishtraps by Haggarty and Inglis (1985) (lower left) and sites with canoe runs representing canoe width channels cleared of rocks (right).

Table 6.1. The 15 largest shell midden sites in the Broken Group Islands and their associated place names. Bolded sites have been subject to fieldwork as part of this dissertation or previous research.

No.	Place name Location	Site Parks # & Borden #	Midden Area ^a (m ²)	House Platform	House Depression	Back- ridge	Radiocarbon data	Zooarch data
1	<i>Ts'ishaa</i> , Benson Island	204T&205T DfSi16&17	14,450	X	X	X	X	X
2	<i>Maktl'iji</i> Wouwer Island	206T&215T DfSi19& 30	10,040	5		X	X	X
3	<i>Huumuuwaa</i> Village Island	304T DfSh-4	9,110	15	X	X	X	X
X	N. Turret Island No place name	198T DfSi-10	6,660	X	X	X		
4	<i>Tl'ihuuw'a</i> Nettle Island	305T DfSh-5	6,630	X	X	X	X	X
5	<i>Aalhachmakis</i> Dodd Island	72T DfSh-19	6,150	X	X	X	X	X
6	<i>Muk'waa7a</i> Turret Island	195T DfSi-7	4,690	X	X	X		
7	<i>Huts'atswilh</i> Dicebox Is.	83T &129T DfSh31&79	4,520	32	X	X	X	X
8	<i>Kakmakimilh</i> Keith Island	306T DfSh-17	4,840	X	X	X	X	X
9	<i>Aasimilh</i> Hand Island	187T DfSh-101	4,030	X	?	?	X	
10	<i>T'um'aktli</i> Gibraltar Island	80T DfSh-47	3,560	X	X	X		
11	<i>Tl'akiyamilh</i> Chalk Island	73T DfSh-20	3,490	X	X	X		
12	<i>Hats'aat'iml</i> Turtle Island	156T DfSh-111	3,300	X	?	X		
13	<i>Shiwitis</i> Gilbert Island	82T DfSh-29	2,470	X	?	?	X	X
14	<i>Tl'at'l'inkuuwis</i> Effingham Bay	DfSh-28	2,060	NA	NA	NA		

a – Shell Midden surface area calculated using the polygon outline of a geo-rectified original site map in ARCGIS 10.

Archaeological Site Size Distribution

Within the archipelago, the four bounded autonomous local group territories described in oral histories shown in Figure 6.1 occur in physically distinct clusters of islands. A spatial comparison of the number of archaeological sites and the distribution of site sizes within these geographically distinct quadrants shows similar distributional patterning (Figure 6.5), with each quadrant of the archipelago having a similar number of sites and similar numbers of 'large' sites (> 2000 m²) in each cluster. This demonstrates the occurrence of repeating subunits of archaeological site distributions and site size distributions. Given the

assumptions that 1) larger sites reflect larger numbers of site occupants and 2) that a range of site sizes reflects a diversity of use and that 3) the sea level history chronologically constrains many of these shoreline proximal sites to within the past 2,000 years, this indicates the contemporaneous use of the archipelago by multiple communities and thus is consistent with the oral historical accounts describing the presence of multiple autonomous groups in this small region (Figure 6.1).

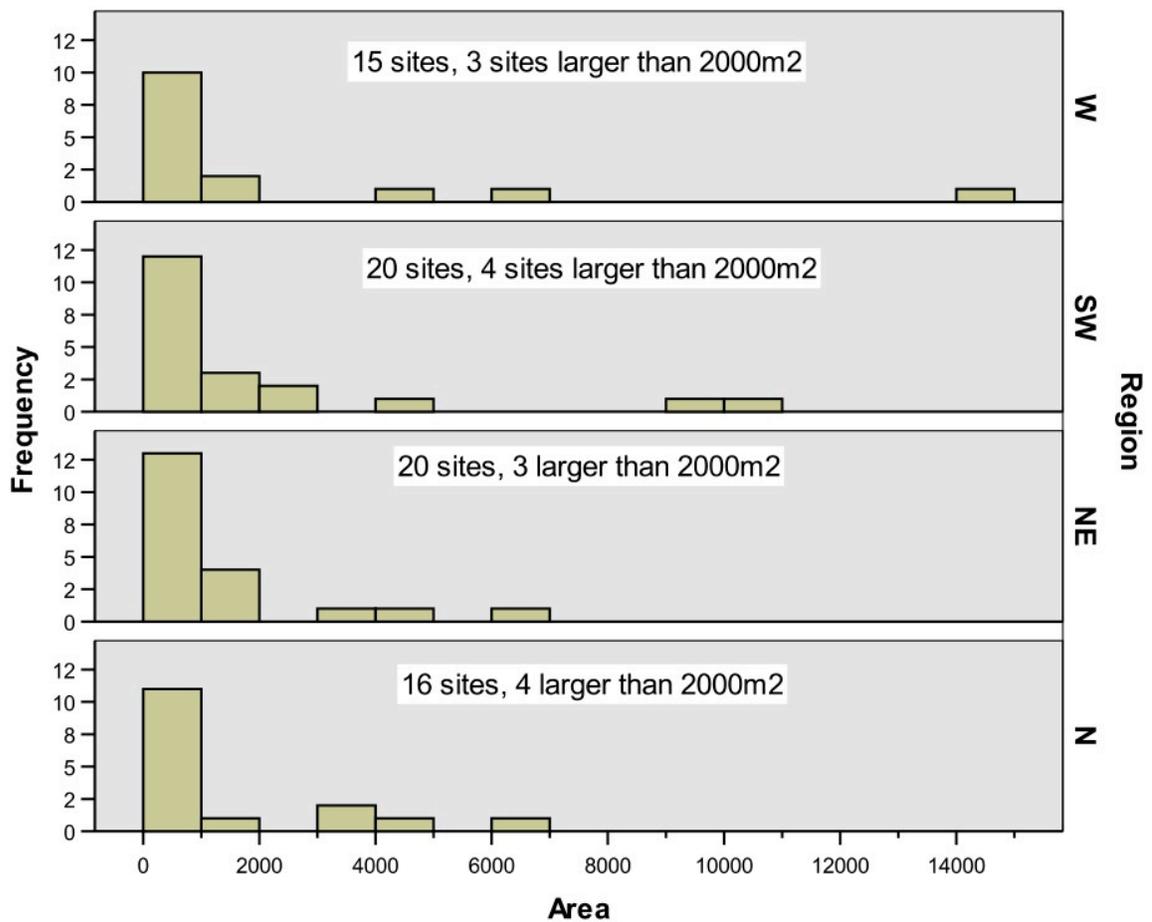


Figure 6.5. The size and number of shell midden sites in different quadrants of the Broken Group Islands. Data compiled from scaling and georectifying original site maps in *ARCGIS 10* and tracing shell midden site boundaries.

The Largest Sites

It is additionally significant that of the 73 shell midden sites in the archipelago, the two largest sites are also the oral historically named ‘origin’ locations for the Ts’ishaa and *Mak̓tl̓7ii7ath* local groups who shared mutual territorial boundaries in the outer Broken Group archipelago. The Indigenous names for these political groups literally translate as: ‘the people of *Ts’ishaa*’ and ‘the people of *Mak̓tl̓7ii*.’ The archaeological observation that the two largest sites represent politically foundational groups and are associated with numerous smaller sites in close proximity further supports the oral historical descriptions that these sites were villages occupied year-round and not simply used as seasonally migratory destinations (see also: McMillan and St. Claire 2005; McMillan, et al. 2008). This also indicates a potential relationship between site size and site antiquity of occupation, which is supported by the 5000 year-long record of occupation at the village of *Ts’ishaa* and the 2,500 year long record at *Mak̓tl̓7ii* described in the sections below as well as at the similarly named origin village of *Huu7ii* nearby in southeastern Barkley Sound (see also Chapter 5 and McMillan and St. Claire 2012).

Settlement History of *Ts’ishaa*, The *Ts’ishaa7ath* Origin Village

As mentioned, the archaeological site of *Ts’ishaa* is the oral historically named ‘origin place’ for the *Ts’ishaa7ath*, the present day Ts’ishaa First Nation, and has an archaeological settlement history that spans the past 5,000 years (McMillan and St. Claire 2005). The documented occupation from 5,000-3,000 BP is associated with higher mid-Holocene sea levels (McMillan 2003), and is small in comparison to the much more extensive late-Holocene midden deposits. The lower elevation late-Holocene (ca. 2,000-300 BP) deposits contain house platforms and midden terraces. A host of radiocarbon dates

provides strong evidence for a village-sized settlement since 1,800 BP (McKechnie 2007a:212; McMillan, et al. 2008:218-219).

Oral historical accounts provided by Sayach'apis to Sapir describe the first *Ts'ishaa7ath* woman and man being “created” at Ts'ishaa by the ‘Day Chief,’ a transformer/creator who also created a river and a channel for Tseshaht but then “scattered the river and the channel everywhere. That is why the islands are scattered about now” (Sapir and Swadesh 1955:52). Thereafter, the oral narratives describe that the population of Ts'ishaa expanded to the point where “the tribe became numerous, reaching to the other end of the village” (Sapir and Swadesh 1955:52). Additional recounted details about the village include the locations of four lineage households (*ushtakimilh*), their political rankings relative to one another, as well as the architectural details and descriptions of the figures painted on the housefront of the highest ranked *ushtakimilh*. The lineage-based households and the individuals who resided in them held various rights to select resources (*tuupati*) within the Tseshaht local group territory (*hahuulhi*) owned and managed by the head chief (*Taayii Hawilth*). The relative order in which the *ushtakimilh* were ranked reflects the sequence with which they were established; a ranking that was codified in the potlatch seating orders mentioned and detailed in several oral accounts (McMillan and St. Claire 2005:9-10). For instance, the lowest ranking *ushtakimilh* was located on the southern margins of the village (Figure 6.6) and various accounts mention this was the last to be established (McMillan and St. Claire 2005:9). This area was initially occupied by low-ranking members of the other *ushtakimilh* but acquired the status of an *ushtakimilh* after a high-ranking outsider mysteriously arrived after a flood event and was granted permission to establish a

lineage household that incorporated the low ranking individuals (Inglis and Haggarty 1986:126; McMillan and St. Claire 2005:9; St. Claire 1991).

As part of the Tsessaht Archaeological project, all four of these named *ushtakimilh* locations were subjected to archaeological excavation and radiocarbon dating down to basal beach sediments (McMillan, et al. 2008:218-219; McMillan 2009:628). Remarkably, this research demonstrated that the oral historically named sequence of village growth parallels the sequence of growth documented archaeologically (Figure 6.6). That is, archaeological excavations in these four named areas follow the oral historically recounted sequence of village expansion whereby the first-ranked and ‘oldest’ *ushtakimilh* contains the correspondingly oldest radiocarbon dated deposit (ca. 1,800 BP or AD 250), the second-ranked and second-oldest *ushtakimilh* contains the second oldest radiocarbon date and so on for the four identified areas. This parallel sequence indicates that this particular oral history, specific to multiple areas within one village site, is archaeologically supported and spans a period of at least 1,800 years. This complementary alignment of archaeological and Indigenous oral historical sequences indicates a chronological depth to the oral historical record that adds robusticity and detail to our understanding of human settlement history at this particular village site. These and related issues are discussed in depth below in the neighboring local group territory of the *Makl7ii7ath* where I move beyond an individual site to demonstrate how the oral historical record and archaeological investigations can complement each other within the broader traditional territory of a Nuuchahnulth local group.

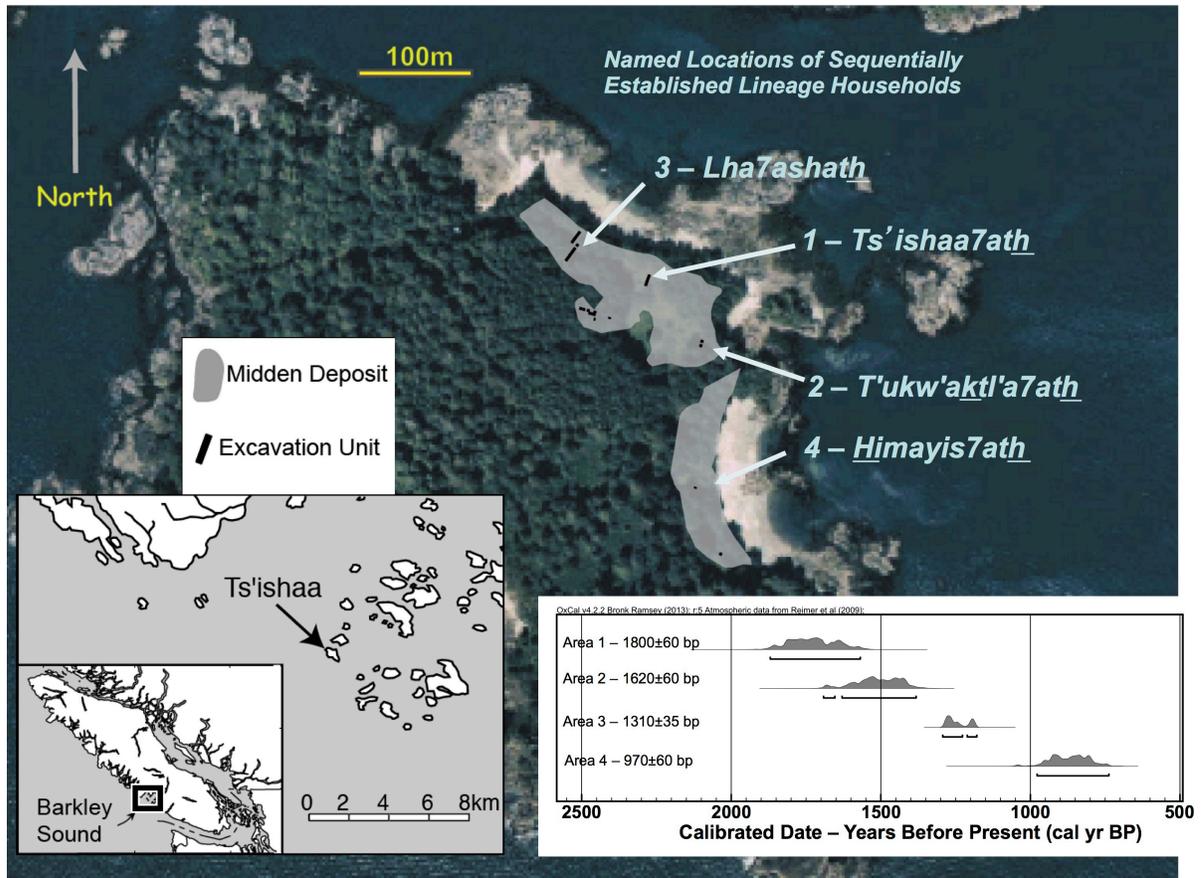


Figure 6.6. Site map of the village of Ts'ishaa (204 and 205T) showing oral historically named locations of household lineages (*ushtakimilh*) and their numbered sequence of occupation. Horizontal extent of midden deposits and the Tseshaht Archaeological project excavation areas are shown following (McMillan and St. Claire 2005). Inset on the lower right depicts the calibrated ages of the four oldest radiocarbon dates obtained from separate site areas indicating the sequential occupation that accords with oral historical accounts. Dates are presented in McKechnie (2007a:215).

Oral Historical Accounts of the *Mak̓tl̓ii7ath* Local Group Territory

The *Mak̓tl̓ii7ath* local group territory is the focus of the archaeological fieldwork described in the remainder of this chapter. Multiple oral historical accounts and ethnographic syntheses (Golla 1987; Inglis and Haggarty 1986; Sapir 1910-1914; n.d.-a:34; St. Claire 1991; William 2009) identify the *Mak̓tl̓ii7ath* as a formerly politically autonomous community whose territory encompassed the southwestern portion of the Broken Group Island archipelago (Figure 6.1 and Figure 6.7) during and prior to European contact. Like other 'local groups' on western Vancouver Island (e.g., Arima 1983; Curtis 1916; Drucker 1951), the *Mak̓tl̓ii7ath* are named for the village location from which they took their name:

Maktl7ii, which translates as ‘higher than others’ (St. Claire 1991:143) and is located on southwest Wouwer Island (Figure 6.7). This name refers to the high landform on which houses were located as well as the social standing of the founding and highest ranked lineage in the village. Across Imperial Eagle Channel to the southeast, the *Maktl7ii7ath* maintained a territorial boundary with the *Kiix7in7ath* and the *Huu7ii7ath* in the Deer Group islands and adjacent shoreline. Similarly to *Ts’ishaa7ath*, these groups later amalgamated to become the *Huu7ii7ath*, the contemporary Huu-ay-aht First Nations (Huu-ay-aht First Nations 2000; McMillan and St. Claire 2012; Nookmiis 2009).

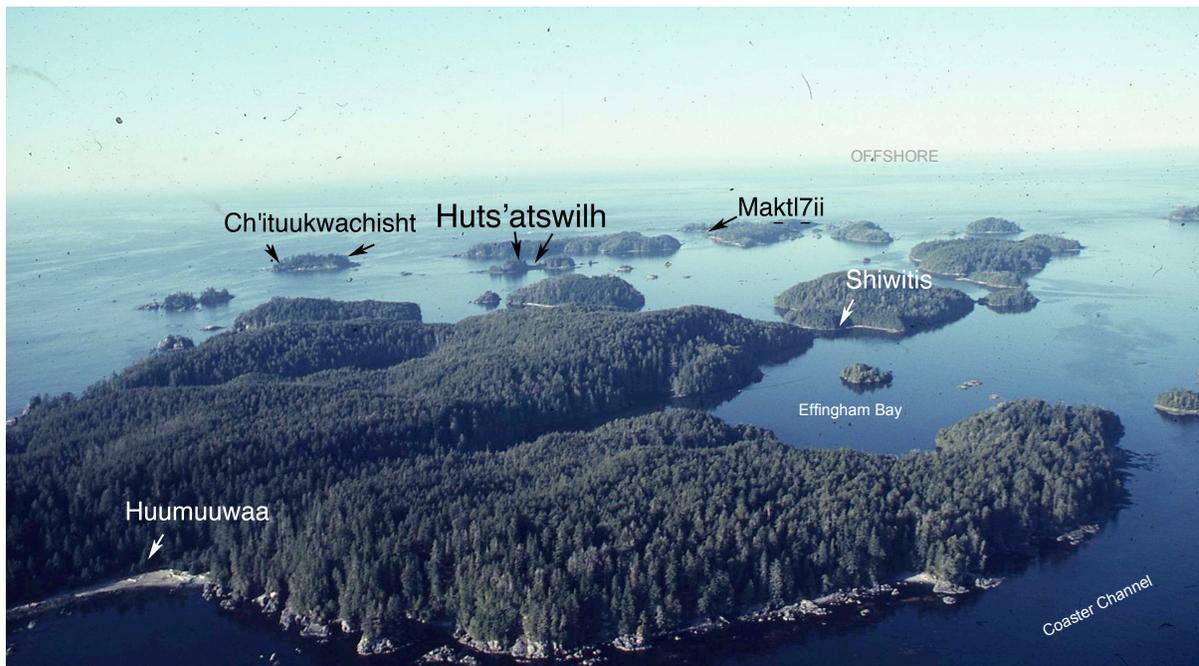


Figure 6.7. Overview of the *Maktl7ii7ath* study area with individual study sites (view looking west). Photo courtesy of the Royal BC Museum (West Coast Archaeological Project Files).

Sapir (n.d.-a:34) describes the *Maktl7ii7ath* as “one tribe with four bands” which refers to four named *ushtakimilh* locations within the village of *Maktl7ii* (Table 6.2). These households, their leaders and by extension, members, would have held rights (*tupaati*) to occupy and use resources associated with this territory with the permission of the *Taayii Hawilth* (head chief). Like at *Ts’ishaa*, these *ushtakimilh* have an internal ranking based on

their sequence of establishment (St. Claire 1991:38) with the *Maktl7ii7ath* holding the highest rank. The lowest ranking group of the *Maktl7ii7ath*, the *Ts'ap'is7ath*, was founded late after the daughter of the high ranking chief had a child with a low ranking man. Eventually when the *Ts'ap'is7ath* held a potlatch at which the flukes of 10 whales were distributed, the group was given a new name, the *Nach'imuuwas7ath*, and accorded a higher level of status within the *Maktl7ii7ath* (St. Claire 1991:38).

Table 6.2. Lineage household names (*ushtakimilh*) names at the village of *Maktl7ii* on Wouwer Island (206T) presented in St. Claire (1991:38-41 and 142-143).

Place name	Translation
<i>Maktl7ii7ath</i>	'higher than others' Also the name for the Entire Village
<i>Ts'ap'is7ath</i> later becoming the <i>Nach'imuuwas7ath</i>	NA "people who have whale fins all around" (St. Claire 1991:38)
<i>Ust'is7ath</i>	'down below (not high up on the beach)'
<i>T'imik'ak'is7ath</i>	'people of gooseberry bushes on beach'

Oral Historical Events in Relation to Settlement

Oral historical accounts of *Maktl7ii7ath* territory place primacy on the village of *Maktl7ii*, the namesake of the highest ranking household in the village and take the name of that place. However, oral historical accounts additionally mention two other village settlements in *Maktl7ii7ath* territory, including the village of *Huumuuwaa* (Inglis and Haggarty 1986:127; William 2009) the village and fortress of *Huts'atswilh* on Dicebox Island. Of particular archaeological significance, the large village of *Huumuuwaa* is identified as "not one of the old villages" but rather as one that "belongs to *Maktl7ii7ath*" (William 2009:370). Similarly, *Huts'atswilh* is identified as a village that was "inhabited by the *Huts'atswilhath*, a sept of the *Maktl7ii7ath*" (ibid.). The reference to 'sept' refers to a lineage group (*ushtakimilh*) of the *Maktl7ii7ath*. These accounts provide an indication that

villages of *Huts'atwilh* and *Huumuuwaa* were established after the village of *Maktl7ii* and provide a sequential model to evaluate in parallel with the archaeological dataset.

The *Maktl7ii7ath* local group was the first independent local group to politically amalgamate with the *Ts'ishaa7ath* just prior to or during the early contact-era (ca. late 18th century) (McMillan and St. Claire 2005:16). This amalgamation was one in a sequence of several for the *Ts'ishaa7ath*, the politically autonomous community that represent the present-day Tseshaht First Nation. Based on several oral historical records, this merger occurred “probably in the latter years of the eighteenth century” after a devastating battle with the *Hach'aa7ath* (McMillan and St. Claire 2005:17). The *Hach'aa7ath* were also a neighboring local group who occupied the northeastern portion of the archipelago at contact (Figure 6.1) and nearly devastated the *Maktl7ii7ath* in a particularly formative conflict, which reduced the population to such an extent “that only 15 adult men remained” (McMillan and St. Claire 2005:15). The survivors choose to merge politically with the *Ts'ishaa7ath* but the head chief retained rights to host potlatches and the drift whale rights in their former territory (ibid.). This merger greatly expanded the *Ts'ishaa7ath* territory and critically included the strategically defensive fortress of *Huts'atwilh* discussed at length later in this chapter.

Prior to and during the early years of contact with European trading ships, the *Maktl7ii7ath* local group maintained a defined territory encompassing the southwestern portion of the archipelago and shared a mutually recognized boundary with the *Ts'ishaa7ath* local group (Figure 6.1). The shared boundary was marked by a line of brush cleared across a small island that was visible from the water (*iitsmakiis*, St Claire 1991:142). The northern boundary of the *Maktl7ii7ath* was Coaster Channel encompassing ‘Village Reef,’ the ‘Faber

Islets' and Wiebe Island (Figure 6.1). This latter portion of *Makl7ii7ath* territory including the village of *Huumuuwaa* on Effingham [Village] Island (Figure 6.7) was violently obtained by *Hach'aa7ath* local group mentioned above. This conflict was precipitated by *Hach'aa7ath* 'striking' – *his7ukwt* – to obtain territory in the late 18th century (St. Claire 1991:28-31). Soon thereafter however, *Hach'aa7ath* were defeated as a fighting force and extinguished as a politically autonomous group by a regional alliance of Nuu-chah-nulth local groups in Barkley Sound and elsewhere (ibid.).

Archaeological Case Studies in *Makl7ii7ath* Local Group Territory

There are 20 recorded archaeological shell midden sites in the area bounded by *Makl7ii7ath* territory, including five large shell middens with surface areas greater than 2000 m² (Figure 6.5). I investigated seven sites in this study area (Figure 6.7) and obtained a total of 56 radiocarbon dates (Table 6.3)²⁴. Combined with detailed surface mapping and percussion coring, these radiocarbon chronologies provide a basis for inferring the long-term settlement history within this territory. Over 40 Indigenous place names are known for this portion of the Broken Group archipelago and each archaeological site is directly or indirectly associated with one or more place name(s) (Figure 6.3). Several oral histories pertaining to events in the territory offer a chance to further evaluate oral historical records and archaeological history prior to the mid-20th century. Below, I describe each of the seven

²⁴ To translate radiocarbon dates into calibrated age estimates, I use the OXCAL calibration program (Bronk Ramsey and Lee 2013) which both calibrates individual dates and provides a way to graphically depict the probability of the calibrated age range for a number of dates. I radiocarbon dated both terrestrial charcoal and marine shellfish, the latter requiring an estimate of the marine reservoir effect. I estimated the temporally variable local marine reservoir using shell-charcoal pairs (Fedje and Southon 2003; McMillan and St. Claire 2005; McKechnie et al. n.d.) and calculated Delta-R values (shown in Table 6.3) following personal communications with Paula Reimer & Maarten Blaauw in July 2013.

study sites, focusing first on the archaeological deposits and settlement chronology for the village site of *Makl7ii*.

***Makl7ii* – Wouwer Island**

As mentioned, *Makl7ii* is a large archaeological shell midden (206T, DfSi-19) that is the oral historically named origin village for the *Makl7ii7ath* local group (i.e., ‘the people of’ *Makl7ii*). The site is situated in a sheltered cove on the highly exposed southwestern fringe of Wouwer Island facing south towards the Pacific Ocean (Figure 6.7) and has extensive archaeological deposits consisting of five closely spaced shell middens separated by elevated bedrock promontories. These deposits lie shoreward of several pocket beaches that are sheltered from ocean swell by fringing reefs to the west and south (Figure 6.8). A detailed topographic map of the site created over 10 days with a total station provides spatial context for assessing the shell bearing components, which have a combined 2-D surface area of approximately 10,000 m² (Figure 6.8). This site includes four very deep ‘backridges’ (3-5.5 m), that are constructed midden ridges behind house platforms or gradually sloping terraces suitable for house locations. These ridge features are characteristically observed at other village-sized sites throughout Barkley Sound as well as across western Vancouver Island (Mackie and Williamson 2003; Marshall 1993, 2006; McMillan 1999).

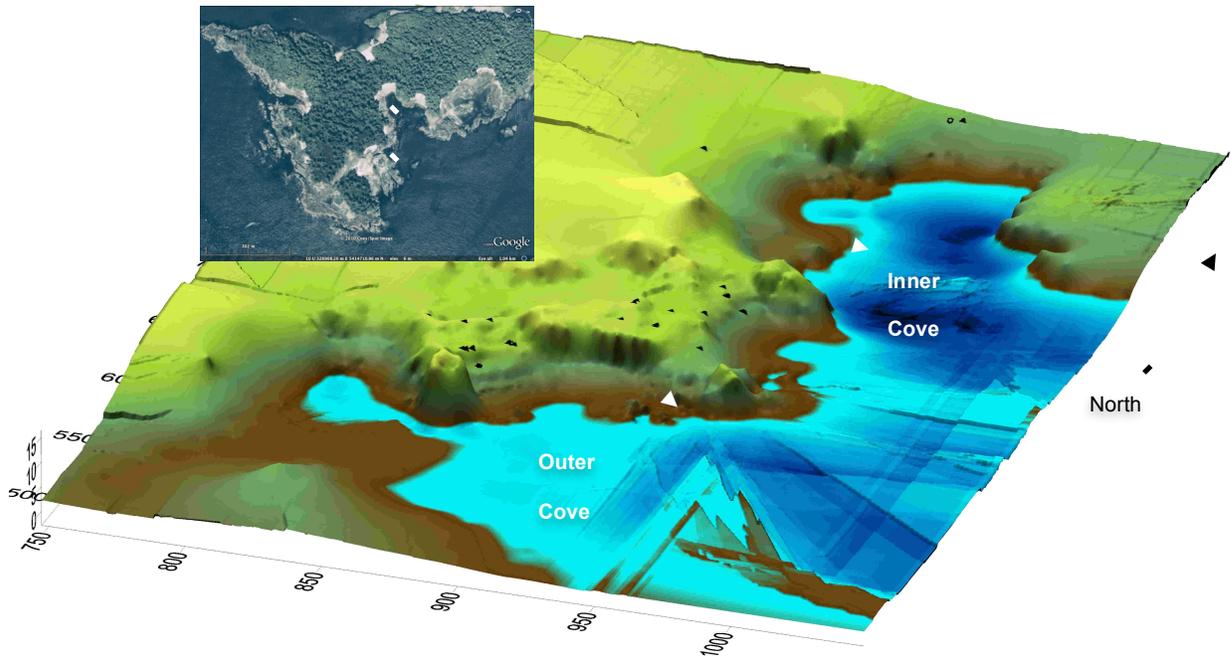


Figure 6.8. Oblique perspective view of *Makl7ii* looking north (with inset satellite image). Black dots represent core-tests locations in cultural deposits and brown- blue transition represents sea level (i.e., barnacle line). Scale in arbitrary metres shown on the bottom of the image. Angular lines on periphery of image represent lack of topographic data.

A series of 42 percussion cores, 10 auger samples, and 10 AMS dates, obtained from various locations at *Makl7ii*, provide a basis for interpreting the archaeological settlement history. The site can be interpreted to be a village as the three oldest radiocarbon dates are from the base of three separate deep midden ridges situated in the more sheltered northeastern portion of the site (the inner cove). These three dates statistically overlap in calibrated age (ca. 2340-2600 cal BP) and indicate the growth of these separate midden ridges began simultaneously around 2,400 years ago (Figure 6.9). Given the depth and extents of these massive midden features, this contemporaneous deposition represents strong evidence for the establishment of the site as a village location. Moreover, terminal dates from the midpoints and top of two these separate ridge deposits indicates they grew rapidly over the next 1,100 years but stopped accumulating between 1,400 and 1,300 years ago.

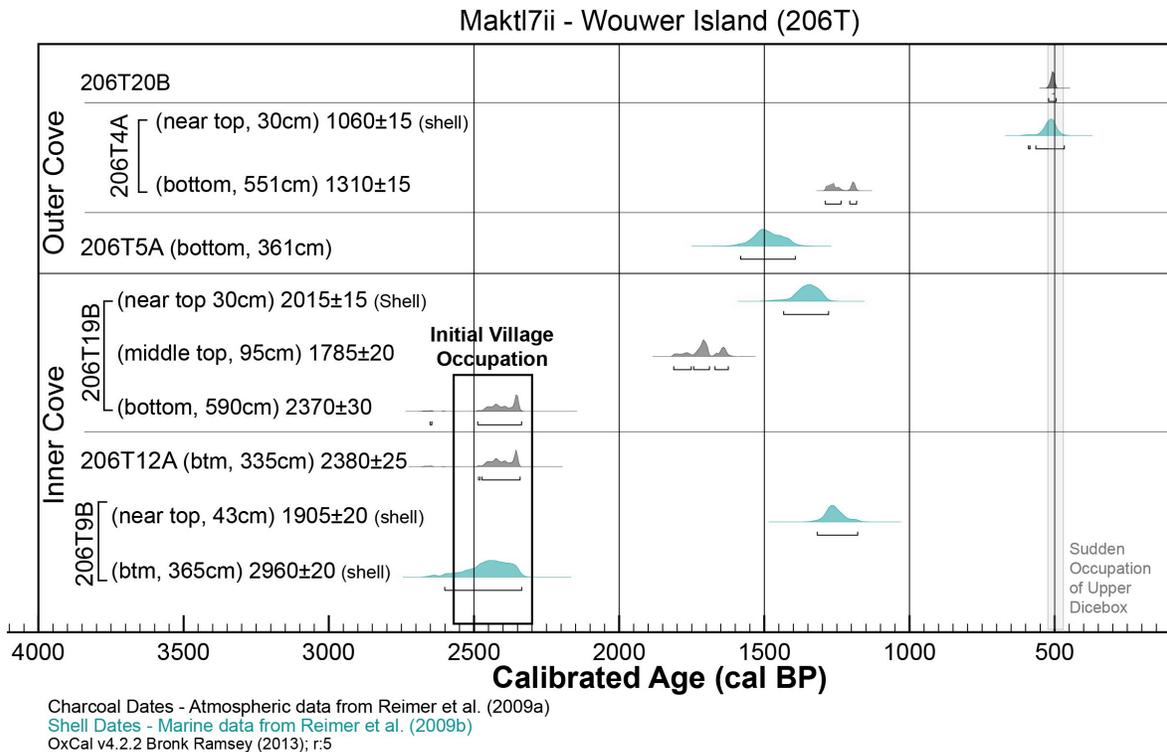


Figure 6.9. Calibrated Radiocarbon dates from *Maktl7ii* (site 206T) at Wouwer Island showing the calibrated age range and probability for individual dates. Dates on marine shell shown in turquoise and dates on charcoal are in grey calibrated on the atmospheric curve.

During this same temporal interval, extensive midden deposits began to accumulate in a separate ‘outer’ cove to the southwest representing a shift in community residence. This area of the site has surficial evidence of historic materials and sub-surface evidence for historic material to a depth of at least 1.8 m in one of four well-defined house platforms on a sharply sloping but terraced shellmidden (Figure 6.10). Here, dates from 3.5m beneath a house platform and at the base of a 5.5m deep backridge indicate rapid midden growth between approximately 1500 and 500 BP and continuing at a slower rate into the historic era (Figure 6.9). This stands in contrast to the older and more extensive site areas discussed above which contain much more heavily vegetated terrain with dense salal that does not contain historic materials on the surface or in the auger samples.

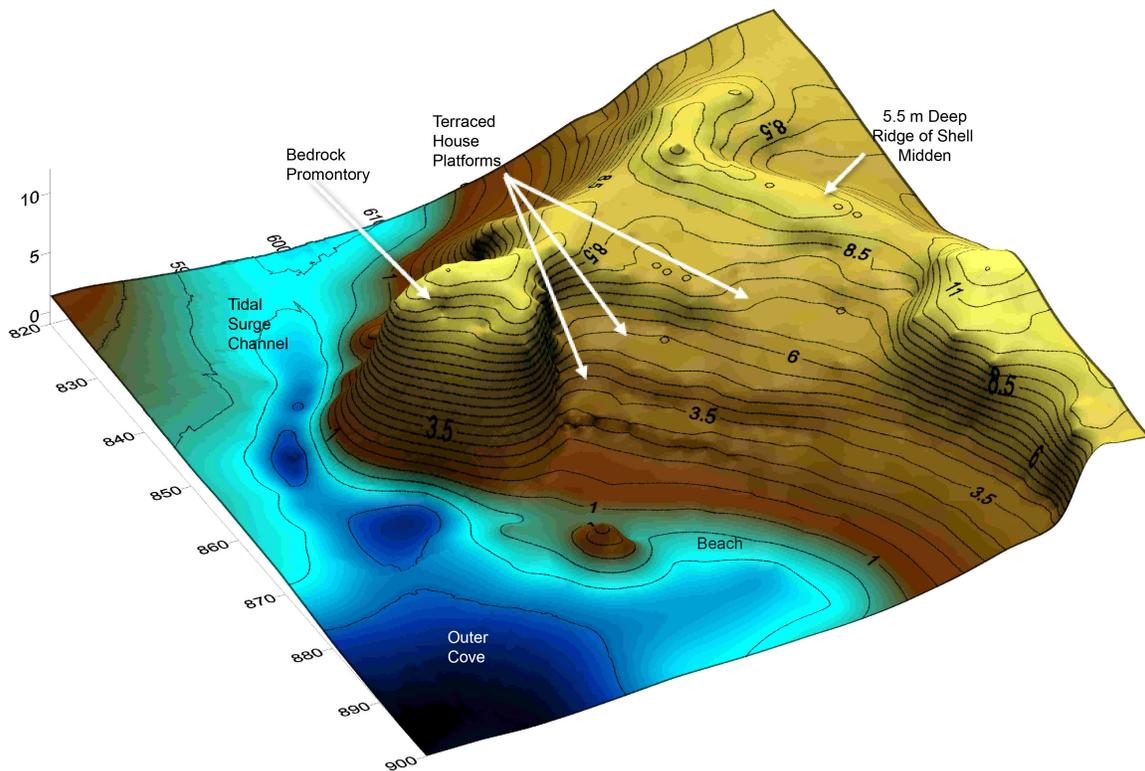


Figure 6.10. Terraced midden with house platforms and a 5.5 m deep backridge at site 206T, Outer cove, Wouwer Island.

A fourth portion of the site contains a date of approximately 500 BP. This represents a mid-depth estimate of a midden deposit at the head of a cove with ready trail access across to the north side of the island. This deposit lacks ridges or other features and is interpreted to reflect periodic resource use. It provides a constraining age on faunal remains recovered from an auger in this location (*see* Chapter 7).

Huumuwaa – Village Island

The large shell midden and historic village of *Huumuwaa* (306T, DfSh-4) is located along a semi-exposed rocky beach facing Imperial Eagle Channel on eastern Effingham [Village] Island (Figure 6.7). The village area was designated a reserve in 1882 and remains one of only three Tseshaht Reserves in the Broken Group Islands. The shell midden deposits at this site span approximately 275 metres of vegetated shoreline with an estimated surface

area of 9,100 m² (Table 6.1). The cultural topography of the site is remarkably intact with well-defined evidence for 14 rectangular house platforms with mean surface areas of 95.8 m² (1,060 ft²) and a combined housefloor area of 1379 m². A number of the house platforms additionally contain the partially preserved remains of 14 house posts and 6 house beams and provide further context inferring the structural dimensions of houses. These house platforms front the shoreward portion of a 90 m long ‘back-midden ridge’ that contains at least 7.08 m (23 ft) of cultural deposit at its greatest height (Figure 6.11). Shallower shell midden deposits occur at the periphery of this portion of the site and are bisected by two small drainages diverted by the massive shell midden landforms present at the middle of the site. A much more heavily vegetated site area to the south contains less distinct cultural topography overlain by a comparatively thick layer of humic material, and is accessed by canoe via a small south-facing pocket beach.

Percussion core tests were conducted in 12 different locations alongside 4 auger tests from multiple site areas (Figure 6.11). Seven radiocarbon dates were obtained from a variety of localities within *Huumuuwaa* and constrain the age of this large village site to within the past 1,800 years (Figure 6.12). As at *Makl7ii*, the three earliest dates come from three separate areas at the base of a very deep 90 m long ‘backridge’ of shell midden that parallels the shore and represents the inland extent of the massive shell-bearing components of the site. These dates indicate the middle of this massive ridge began to accumulate around 1,800 years ago, expanding 40m to the south over the following century and reaching its northern extent by approximately 1200 BP (Figure 6.12). Another date recovered from the base of a house platform shoreward of the northern extent of the ridge falls a century later (ca. 1070-

970 cal BP). As at *Makl7ii*, these dates represent good evidence for the initial establishment of this site as a village-sized community between approximately 1,800 and 1,200 BP.

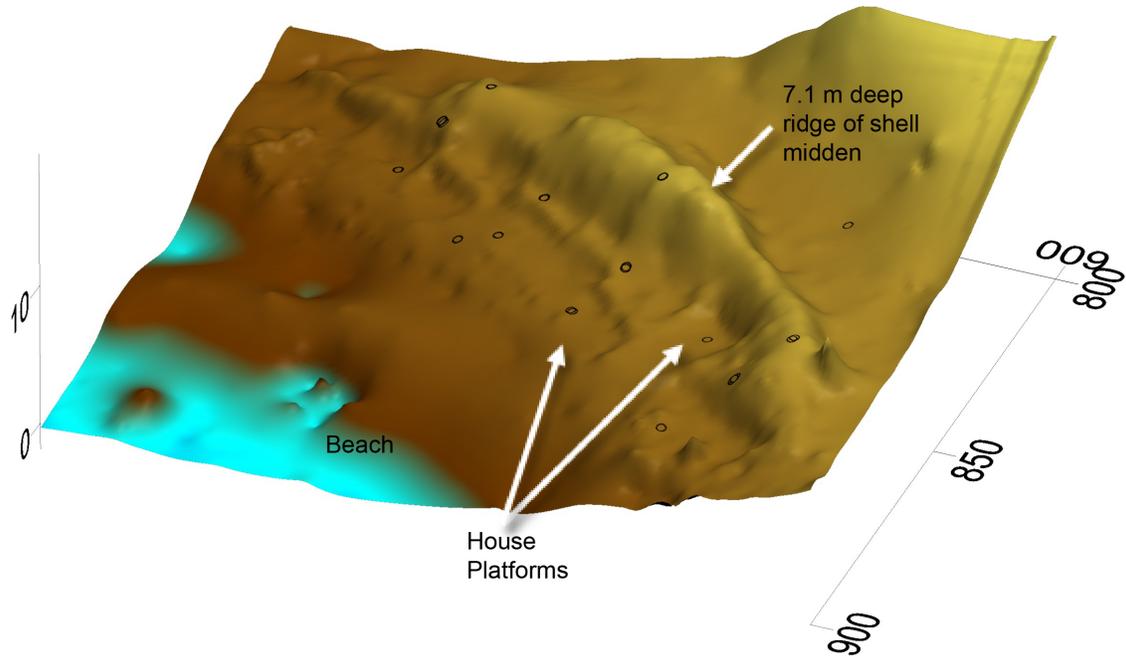


Figure 6.11. Oblique perspective view of *Huumuuwaa* showing the numerous house platforms and the large backridge feature. Small circles represent core test locations. Scale in arbitrary metres shown on the margin of the image.

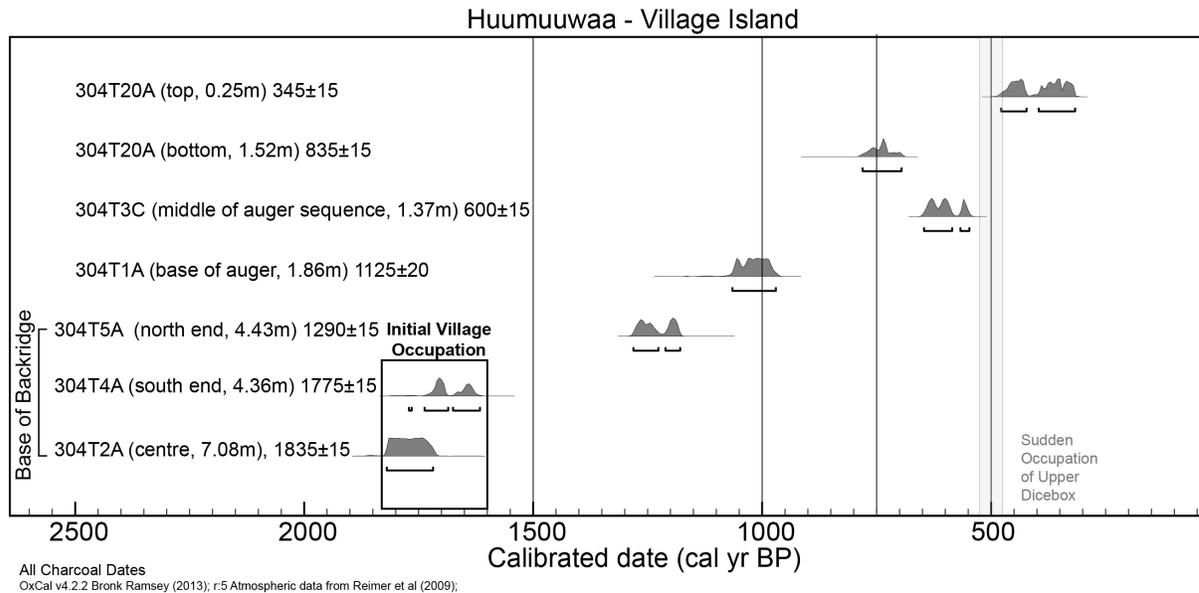


Figure 6.12. Calibrated radiocarbon dates from Huumuuwaa on Effingham Island (site 304T) showing the calibrated age range and probability for individual dates. All dates calibrated on the atmospheric curve.

Two additional dates from the bottom and top of cultural deposits at the far southern margin of the site (core 20A) indicate a horizontal expansion of the site between approximately 800 years ago (ca. AD 1170-1260) and ca. 400 years ago (ca. AD 1490-1630). If these basal and terminal dates adequately characterize the chronology for this area, it indicates that *Huumuuwaa* roughly doubled in length and then contracted to its former extent 400 years later (ca. AD 1500-1600). An additional date of approximately 600 years BP, obtained from midway down a small ridge behind a house platform.

***Shiwitis* – Gilbert Island**

The archaeological site of *Shiwitis* (82T, DfSh-29) is a medium-sized (2,400 m²) shell midden on southeastern Gilbert Island facing Effingham Bay, a protected bay overlooking Coaster Channel to the north and east (Figure 6.7). Shell midden deposits are situated on a tombolo landform amidst an elevated promontory to the south and north and parallel the shoreline for nearly 90 m. The deposits extend to a depth of approximately 2 m as determined by multiple percussion core tests. The shell midden deposit includes at least one house-platform associated with a small ‘backridge’ but cultural topography is generally lacking for much of the rest of the site. Visitors to Pacific Rim National Park Reserve currently use the site as a campground. Numerous bark-stripped culturally modified trees (CMTs) currently grow on the site amidst a series of older hand-logged cedar stumps and likely date to the early or mid-20th century (Sumpter and St. Claire 2007).

The Tseshaht placename for the site location translates as “whale oil on the beach” (St. Claire 1991:146). This location was used seasonally by *Ts’ishaa7ath* and *Maktl7ii7ath* families after the two groups amalgamated (Sumpter and St. Claire 2007). *Shiwitis* has been classified as one of the 15 village settlements in the Broken Group Islands following the

criteria of Haggarty and Inglis (1985:63), who define village sites as “generally exceeding 100 metres in length, with well-defined house platforms, and or house depressions, and a rounded, back midden ridge.” This site represents the smallest site in their ‘village’ category and provides an interesting contrast to the much larger village sites of *Ts’ishaa*, *Maktl7ii*, and *Huumuuwaa*.

The archaeological chronology of Shiwitis begins approximately 1,200 years ago as determined from three charcoal dates on basal cultural sediments from three separate areas along the centre of the midden landform. The two dates from the northern half of the midden landform strongly overlap in time (ca. 1260-1090 cal yr BP or AD 690-870). The third basal date at the south end of the midden began accumulating several decades thereafter around 1,100 years ago (ca. 1170-1060 cal yr BP or AD 780-890). A shell date from near the top of the deposits places the cessation of midden accumulation just after AD 1400 (Figure 6.14). Similar to *Huumuuwaa* and *Maktl7ii*, multiple radiocarbon dates from separate areas at the base of a midden ridge landform are closely spaced in time indicating relatively rapid simultaneous occupation of a large area within a 800-year period, from approximately AD 700 up until the mid 1400s (AD).

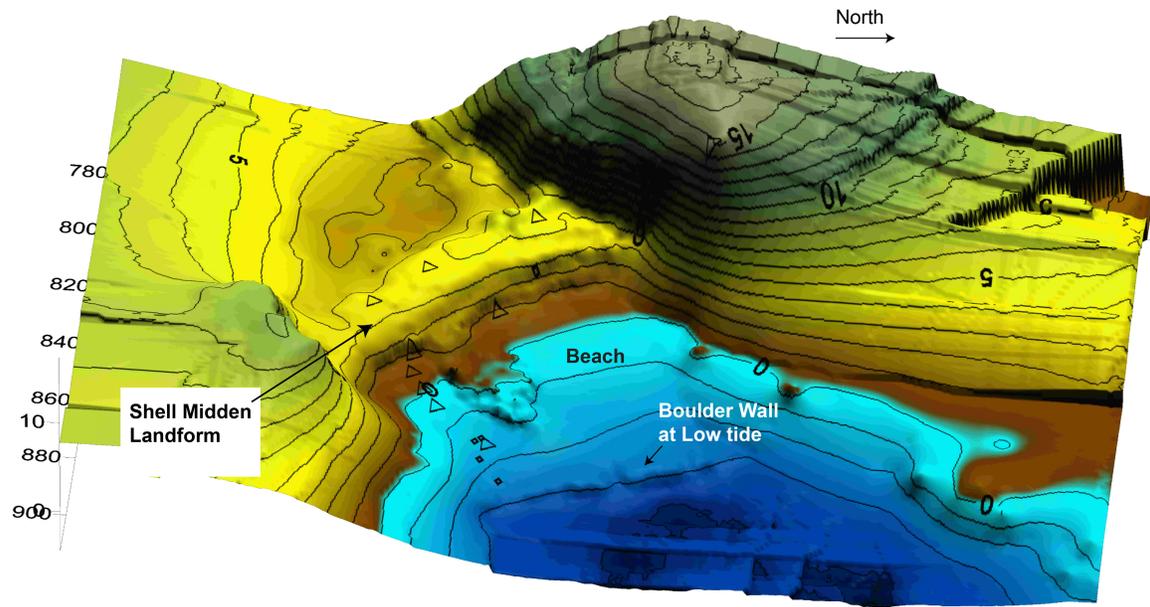


Figure 6.13. Oblique view of the archaeological deposits and landform setting at the site of Shiwitis (82T). Triangles depict auger tests. Contour lines are in metres and the brown- blue transition represents sea level (i.e., barnacle line). Scale in arbitrary metres shown on the margin of the image. Angular lines on periphery of image represent lack of topographic data.

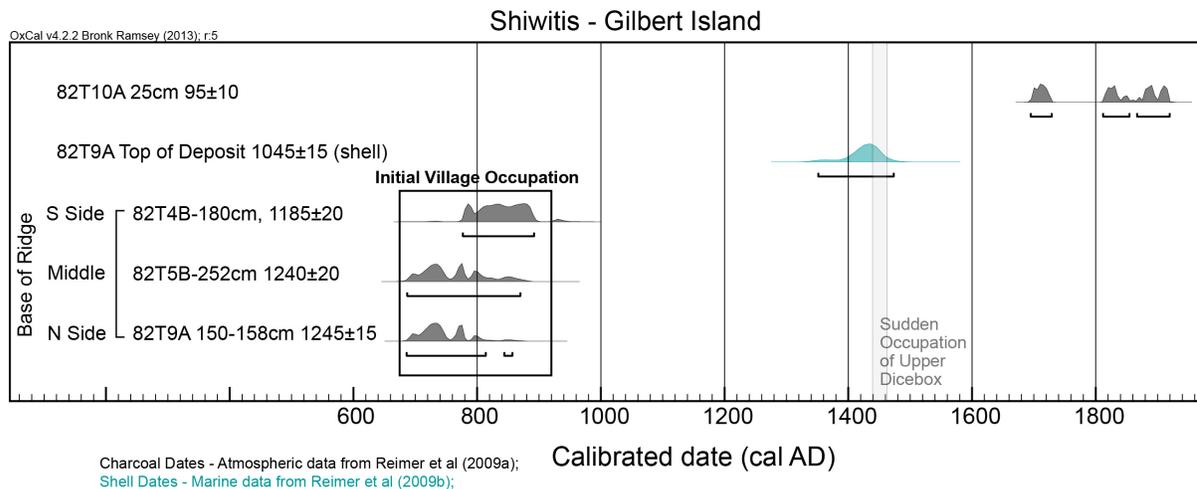


Figure 6.14. Calibrated radiocarbon dates for Shiwitis, 82T showing the calibrated age range in years AD and the probability for individual dates. Dates on marine shell shown in turquoise and dates on charcoal are in grey calibrated on the atmospheric curve.

Ch'ituukwachisht – Cree Island

Ch'ituukwachisht (Cree or Redonda Island as it is referred to on early marine charts) is a small (7.7-hectare) steeply-sided island in the southernmost periphery of the Broken Group (Figure 6.7 and Figure 6.15). Due to its exposure and lack of suitable landing spots,

predominant weather conditions make approaching this island by boat very hazardous except in a very calm wind and minimal ocean swell.



Figure 6.15. Southwest facing view of *Ch'ituukwachisht* from the upper fortress of *Huts'atswilh* showing the general location of sites 132T and 131T on the far left and far right portion of the island respectively. Photo by the author.

Ch'ituukwachisht contains two previously recorded archaeological sites (Figure 6.15), both of which are elevated and have expansive views of the open ocean.. Previous archaeological and ethnohistorical documentation of these sites (131T and 132T) has interpreted the south facing site (131T) as a ‘lookout’ and the north facing site (132T) as ‘defensive’ (Haggarty and Inglis 1985:85-86). The interpretation as a lookout for site 132T is supported by its 290-degree view from an elevation of 27 m (90ft), which would enable those with keen eyesight to view at least 18 km out to sea during ideal weather conditions²⁵. Also from this vantage point, one can also see elevated portions of Makah territory 60-90 km to the south (including the Islands off Ozette and Cape Flattery). This fits the Nuuchahnulth definition of a lookout, *nachowa7a*, translated by Sapir as “where one goes to look out to sea” (St. Claire 1991:143 citing [Sapir nd. field notebook I:57]). It is additionally worth

²⁵ <http://blogs.discovermagazine.com/badastronomy/2009/01/15/how-far-away-is-the-horizon/>

mentioning that there appear to be few other localities in the Broken Group archipelago which have such expansive elevated viewsapes of the offshore environment.

Archaeological mapping of the extent of shell-bearing cultural deposits indicate both sites 132T and 131T are relatively small (150 and 1100 m² respectively) and sub-surface investigation indicates both sites have relatively shallow deposits (less than 2 m) which accumulated over several millennia as determined by six radiocarbon dates (Figure 6.16). Unlike the larger sites discussed previously, the small horizontal extent and the prolonged period of occupation both at sites 131T and 132T are consistent with a small number of people periodically occupying a limited area over long periods time. These observations provide further support for the oral historically documented practice of whalers, sealers, and navigators occupying lookouts to watch for incoming weather and others travelling the coast.

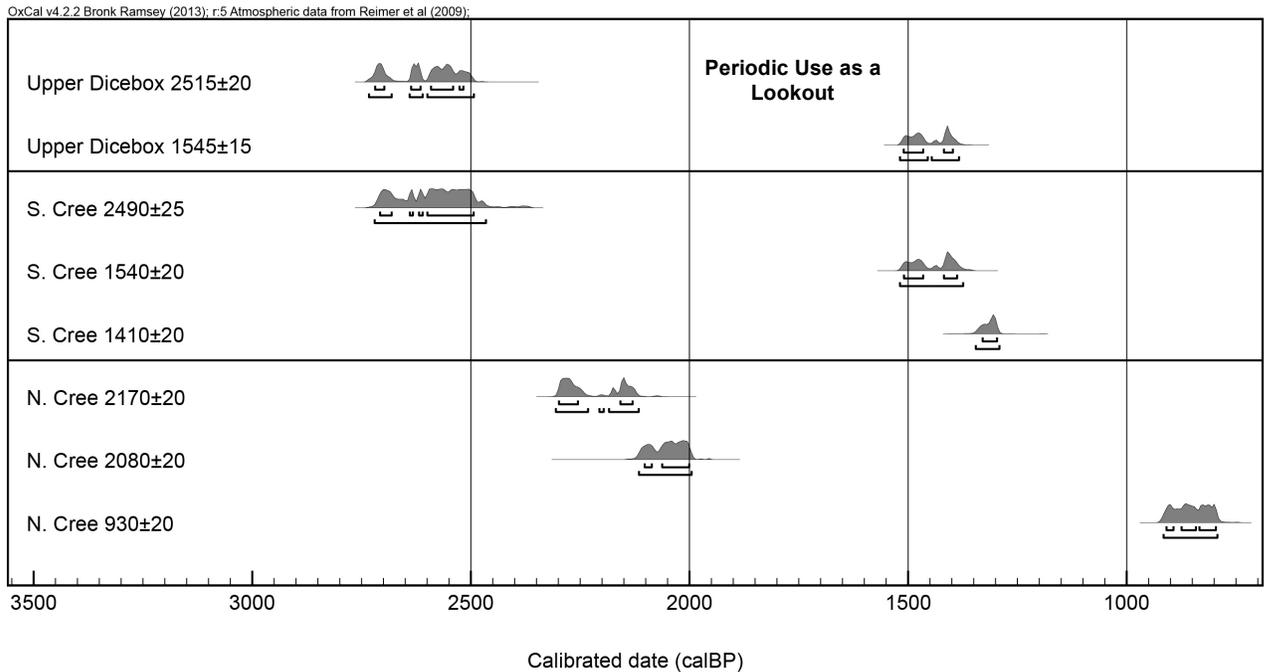


Figure 6.16. Calibrated radiocarbon dates on charcoal from deposits at upper Huts'atswilh (site 129T, top), Northern Cree Island (site 132T, middle), and Southern Cree (site 131T, bottom). These plots show the calibrated age range and probability for individual dates.

Huts'atwilh –Village and Fortress

The final two sites examined in this section are both on Dicebox Island and are named *Huts'atwilh*. This small 6-hectare island contains extensive archaeological deposits including well-defined house platforms, constructed with shell midden matrix, atop a steep, elevated bluff on the southern side of the island (site 129T, DfSh-79) and a lower elevation shell midden with house depressions covering a tombolo landform (site 83T, DfSh-31) with east and west facing beaches (Figure 6.17). There are three Indigenous place names for the Island. *Huts'atwilh* is specific to the village and fortress location and is derived from the word for 'drift back,' referring to winter waves which “splashed through a cave in the middle of the island” (St. Claire 1991:145). A beach on the western side of the island is named *7aats'aatsupshilh*, which means, “when you are there it is so beautiful that you don't want to leave”. A third placename, *Ch'iwaakhat*, translates as “somebody holds your hair while you are at it” (ibid.) likely indicating a sheer drop from the elevated site. The site is described in oral histories as a “village... on top of the hill inhabited by the Hots'atsswil?ath, a sept of the Ma:ktl?i:?ath” (Sapir 1910-1914; William 2009:370) indicating that the island was owned by the *Huts'atwilh7ath*, a sub-group of the *Maktl7ii7ath* (Inglis and Haggarty 1986:127; Sapir 1910-1914).

The occurrence of extensive archaeological deposits on the precipitous elevated location of upper *Huts'atwilh* supports the interpretation that the upper site area was used over a prolonged period that may have occurred during a period of political and/or territorial conflict.

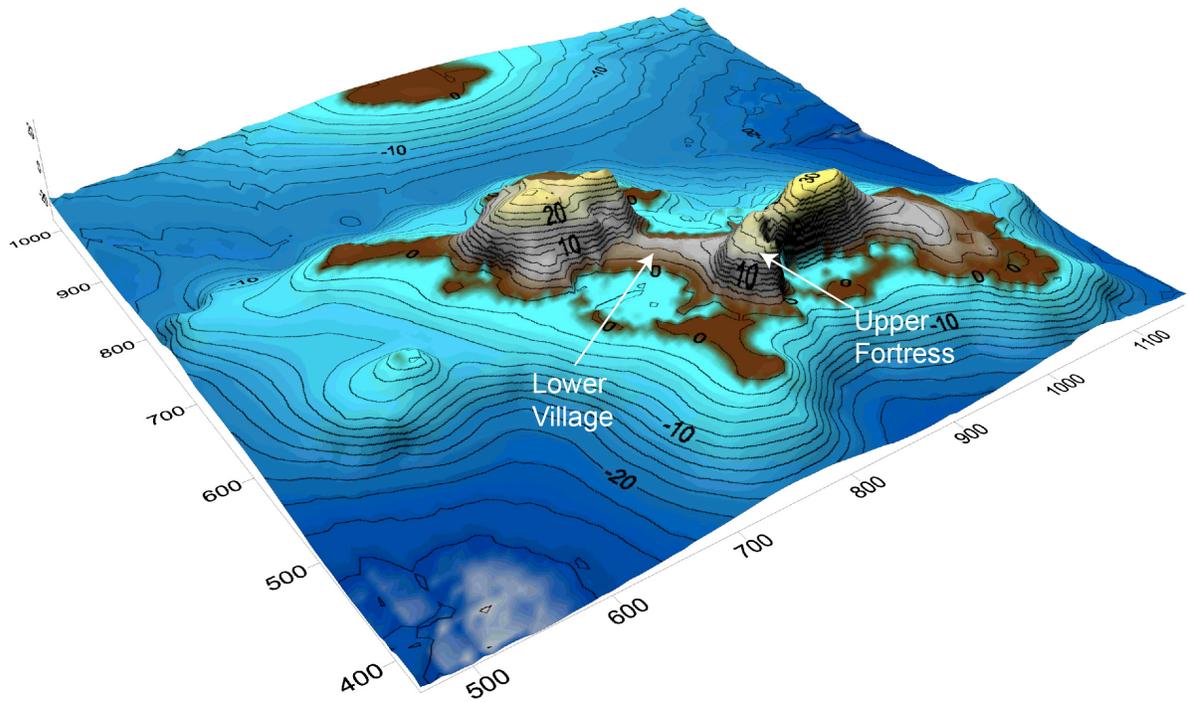


Figure 6.17. Perspective view of a topographic model of *Huts'atwilh* showing the lower village in between two elevated bluffs and the upper defensive site on the sheer-sided elevated area to the right.



Figure 6.18. View from upper Huts'atwilh (site 129T) looking west. Photo by Author.

Lower Huts'atwilh

Lower *Huts'atwilh* (site 83T, DfSh-31) contains nine surficially recognizable house depressions oriented to the west-facing beach on this tombolo landform (Figure 6.19). Seven radiocarbon dates from throughout this area (Figure 6.19) indicate the age of the cultural deposits falls between AD 1050 and 1620 (2-sigma calibrated range). Five of these dates are from the bottom of cultural sediments just above underlying beach sands and reveal a progressive sequence of horizontal site expansion from south to north over a period of approximately 400 years and spanning a distance of 70 metres. This south-to-north trend is also stratigraphically apparent in that the deepest archaeological deposits, indicating

relatively more sustained deposition in the southern portion of the site that has more direct access to the elevated upper defensive site. The timing of the construction of these house depressions is therefore likely sequential as indicated by the greater depth of deposits on the southern portion of the site versus the northern portion.

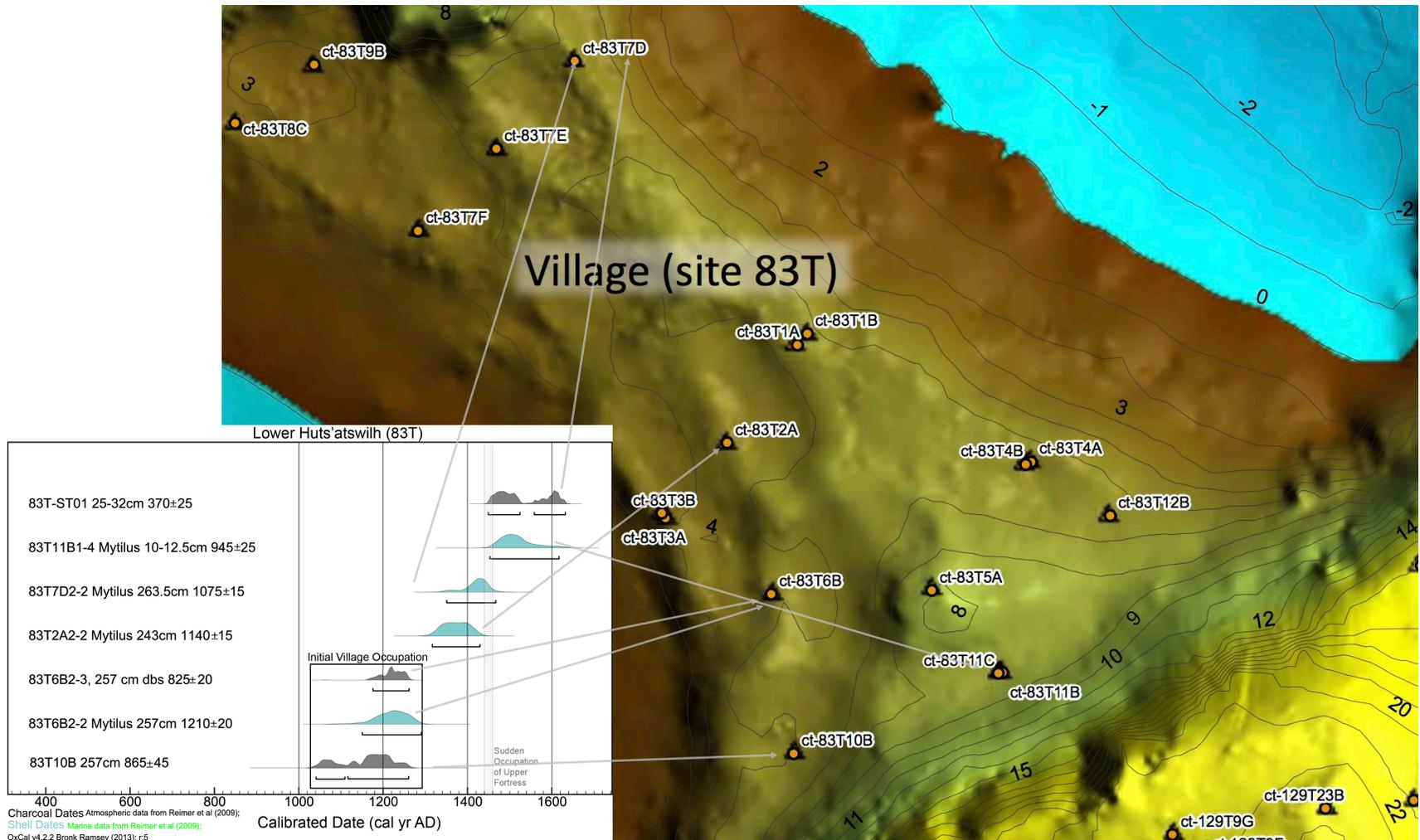


Figure 6.19. Dates from lower Huts'atswilh showing calibrated ages from basal percussion core samples. Note the progressive south to north trend in calibrated age reflecting horizontal growth of the site. Note the date from on lower right (83T11C) is a terminal date from the top of the cultural sediment rather than the other dates which are from basal layers. Dates on marine shell shown in turquoise and calibrated with a Delta-R of 150±21. Dates in grey are charcoal and calibrated on the atmospheric curve. Both sets calibrated using the program OxCal.

Upper Huts'atswilh

Radiocarbon dating was conducted on 19 samples from seven separate house platforms spread throughout upper *Huts'atswilh* (Figure 6.21). Two of the dates from upper *Huts'atswilh* are significantly older than the remaining 17, and indicate a highly intermittent sequence of human occupation between 2,500 and 500 calibrated years ago (Figure 6.16). These two dates are from two closely spaced cultural deposits in the western portion of elevated site area (Houses 6 and 3) that have particularly prominent views of the ocean to the west. They also closely overlap in age and are directly inter-visible with two similarly elevated small sites on Cree Island (131T and 132T), 1km to the southwest (Figure 6.15). I interpret the ages of these sites to indicate periodic use as inter-visible lookout locations (*nachowa7a*, St. Claire 1991:105).

As for the remaining occupational sequence on the elevated portion of *Huts'atswilh*, multiple dates from four separate house platforms (Figure 6.21) indicate that house construction occurred extremely tightly in time between approximately AD 1430 and 1450 (pooled 2-sigma [94.5%] probability). This very narrow temporal range indicates an effectively simultaneous occupation of several areas of the site by multiple household groups. This relatively precise calibrated age estimate representing a span of a few decades (± 20 years), is well within that of a human generation. This is consistent with a scenario of a relatively large-scale community effort to initiate construction and occupation of a defensive landform at a moment in history. A fifth dated house structure (House 2) situated in the midst of a cluster of these three dated houses appears to have been constructed slightly after this period (AD 1450-1620). Notably, this structure would have much less of a view and be buffered from approach by houses on its periphery. A sixth dated house structure on the

southern periphery of the site dates to well within the contact era (ca. 1774-1850) and indicates a later expansion of this portion of the site, as previously interpreted by the 1982 survey and mapping team (Inglis and Haggarty 1986:276).

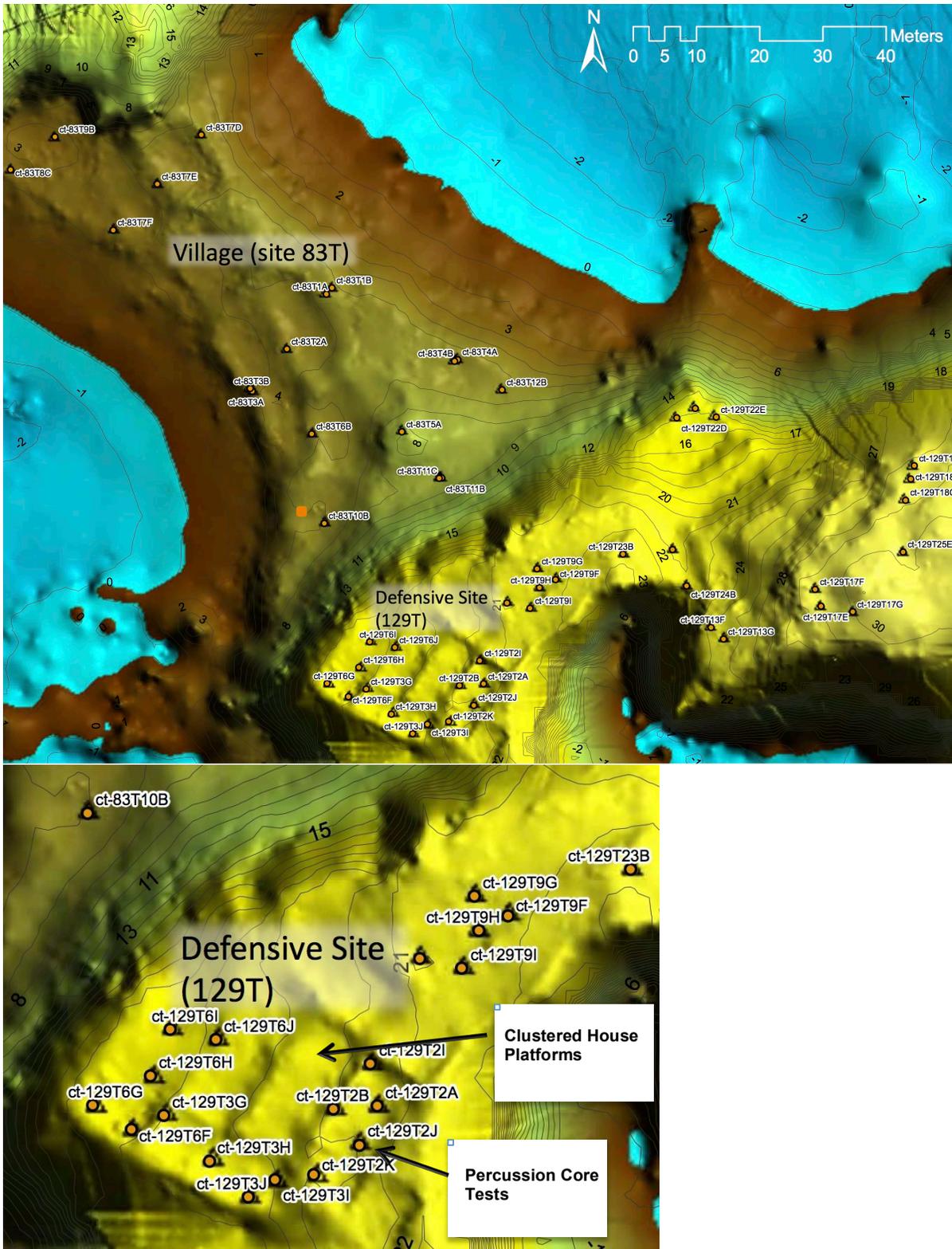


Figure 6.20 Map of the lower village (83T) and upper defensive site (129T) indicating locations of percussion core tests and showing the topography and cluster of house platforms. Numbers following '129T' indicate the house number while letters indicate the test number within that house. Core and auger tests are in the same locations.

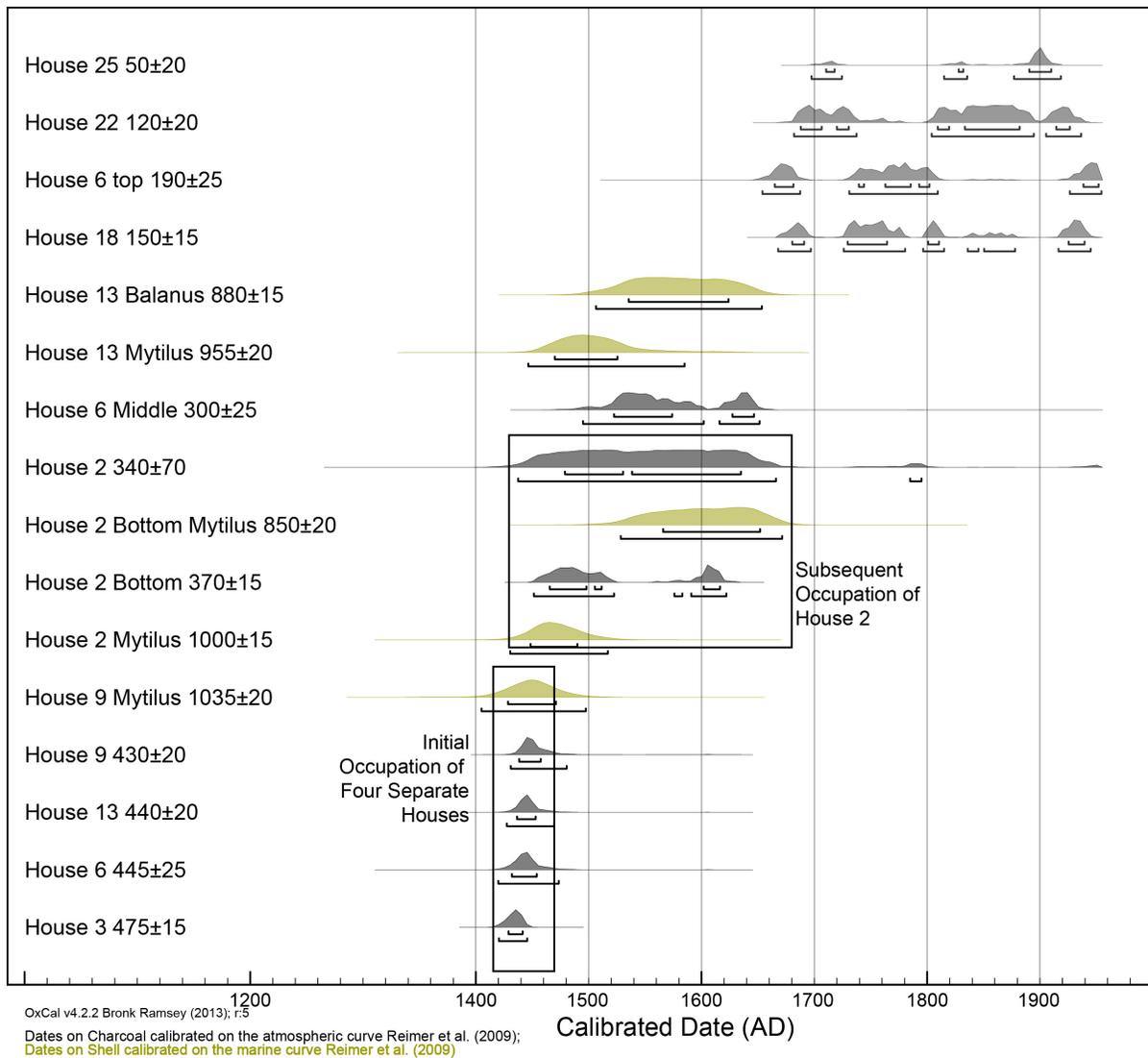


Figure 6.21 Dates on cultural deposits on upper Dicebox indicating the rapid construction of houses within the AD 1440-1460 interval and subsequent occupation up until the early 20th century.

Discussion

The preceding sections have examined archaeological evidence for settlement in seven of the 20 shell midden sites in *Makl7ii7ath* local group territory (Figure 6.7). A series of radiocarbon dates document the lateral and vertical growth of these varied archaeological sites, ranging from 150 to 10,400 m² in extent and from less than 0.5 to more than 7 m in depth (23 ft.). The earliest dates on cultural material from these sites are approximately 2700-2500 years old and come from two elevated sites the southern periphery of the archipelago

Ch'ituukwachisht (131T) and the lookout component of *Huts'atwilh* (129T). Use of both sites at this time and over the following two thousand years is interpreted to be periodic based on the limited surface extent and depths of archaeological deposits. These elevated and directly inter-visible sites likely served as lookouts, *nachowa7a*, or “where one goes to look out to sea” (St. Claire 1991:143 citing [Sapir nd. field notebook I:57]) and served a logistically vital role of watching for approaching people, animals, and weather. A century or so thereafter, deep midden deposits in three separate areas of the very large site of *Maktl7ii* began to accumulate simultaneously, which I interpret to be strong evidence for the rapid growth of a ‘village-sized’ community. Approximately 1,000 years later (ca. 1500-1200 BP), major portions of this site appear to have slowed or stopped accumulating. During this interval the also large site of *Huumuuwaa* began accumulating rapidly between 1800 and 1200 BP and reached nearly the same size of the *Maktl7ii* around 800 years ago. By 1200 BP a medium sized midden was established simultaneously at Shiwitis, while 800 years ago the lower village of *Huts'atwilh* grew rapidly followed by the upper fortress site abruptly 500 years ago.

The results of these ‘site based’ settlement analyses are significant in that the earliest documented evidence for a village-sized settlement in the territory occurs at the named origin place of *Maktl7ii*. Recall that this placename describes the local group whose territory is recognized in oral historical accounts. The criterion for inferring a ‘village-sized’ settlement is the rapid horizontal expansion of sites with large midden landforms as determined by multiple radiocarbon dates. At *Maktl7ii*, two deep midden deposits began to accumulate within the same 300 year period. This site is also the second largest shell midden in the Broken Group archipelago following Ts’ishaa and thus is consistent with a substantial

occupation over a long period of time. The use of this location as a village overlaps with the periodic use of three inter-visible sites situated on elevated landforms associated with lookouts (two sites on Cree Island, one on Dicebox). As indicated in the oral history, these were not village locations and the limited extents and depths archaeological deposits confirms their use as periodic.

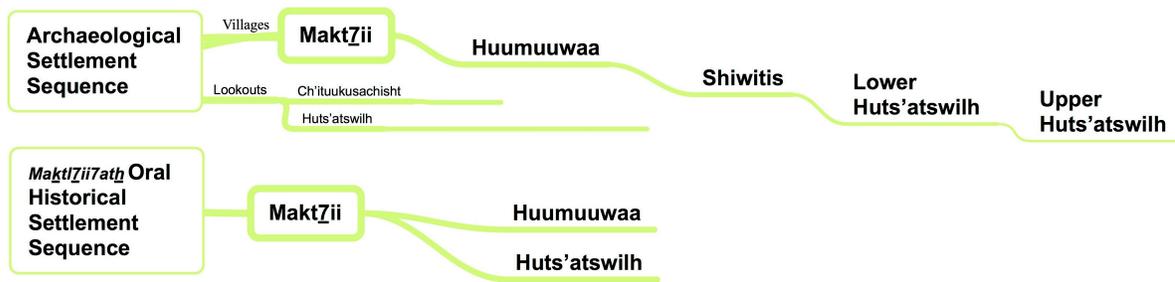


Figure 6.22. Settlement history in *Maktł̄ii7ath* Local Group territory comparing the archaeological settlement sequence and the oral historical sequence (from left to right).

Subsequent to this period, the village settlement of *Huuumuwaa* expands between 1800 and 1200 years ago. This significantly large site is the third largest shell midden in the entire archipelago (Table 6.1) and roughly doubles in size for a brief period of 300 years approximately 800 years ago (Figure 6.12) while the dates from upper *Huts'atswilh* provide strong evidence for the sudden need for constructing multiple households on a defensive landform suggesting conflict approximately 500 years ago and extended use into the 19th century. The dates at both *Huuumuwaa* and *Huts'atswilh* demonstrate these villages came into existence well after *Maktł̄ii*. These observations are sequentially consistent with oral historical accounts identifying these villages as semi-autonomous 'septs' or *ushtakimilh* within *Maktł̄ii7ath* territory. As indicated in Figure 6.22, when the archaeological chronology is evaluated alongside the oral historical accounts of village establishment, there is complementarity but it is not complete. Such a sequence however provides a chronological

architecture for deeper readings of both the archaeological and oral historical sequences of which only an initial sketch has been provided here.

Contact-era Political Change and Amalgamation

After this millennia-long history of village and fortress establishment within *Mak̓tl̓7ii7ath* territory, oral narratives additionally describe how the *Mak̓tl̓7ii7ath* became engaged in a devastating violent conflict with the *Hach'aa7ath* during the “latter years of the eighteenth century” and were reduced from a robust multi-village community to a small population with ‘less than 15 men’ (McMillan and St. Claire 2005:17). This fundamentally consequential event for the *Mak̓tl̓7ii7ath* occurred during the early European fur trade, a period of widespread political tension and inter-community conflict that persisted into the mid-19th century (Harris 1997; McMillan 1999; Swadesh 1948).

After regrouping at their origin village of *Mak̓tl̓7ii*, the remaining *Mak̓tl̓7ii7ath* members opted to politically amalgamate with their *Ts'ishaa7ath* neighbors to the north, retaining their potlatch seats and drift whale rights but ceding their territorial ownership to *Ts'ishaa7ath* (St. Claire 1991:41). Soon thereafter, a political alliance of Nuu-chah-nulth groups within and outside Barkley Sound collectively defeated the *Hach'aa7ath* (McMillan and St. Claire 2005:17). Regional tensions persisted however, and a series of conflicts unfolded over the next few decades (McMillan 2009; Swadesh 1948) culminating in the “Long War” in the 1840s which also extended beyond the Nuu-chah-nulth world (Sapir and Swadesh 1955:412–439). After this extended and large-scale conflict, the amalgamated *Ts'ishaa7ath* seasonally resumed settlement at the former *Mak̓tl̓7ii7ath* village of *Huumuuwaa* as recounted in 1921 by Tom Sayach'apis (ca. 1835-1927):

“after the herring finished spawning. We would go to Huumuwa (Village Island), the whole Tsishaa Tribe, staying together because the war had ended only recently. We did not want to get separated”

(Sapir and Swadesh 1955:39).

As this quote indicates, the amalgamated *Ts'ishaa7ath* remained vigilant and consolidated during the years following the Long War, practicing seasonal residential mobility. As time passed and regional conflict did not re-emerge, the formerly autonomous local groups within the amalgamated *Ts'ishaa7ath* polity, began to seasonally reoccupy their former village sites within *Maktl7ii7ath* territory (Sapir and Swadesh 1955:45). Thus, approximately a decade later, when Sayach'apis “grew up to be a young man” [ca. 1850], he describes a time when:

“War was not in season. So the Tsishaa moved apart. The Maktlii Tribe went to Maktlii (Storm [Wouwer] Island). The Tsishaa Band was with the Nachimwas at Tsishaa [Benson Island]. The Himayis people went to Himayis. The Wanin people went to Wanin. The Nashas people went to Dutch Harbor [*Hiikwis*]. The Tlasimiyis people went to Tlasimiyis. The Hachaa people lived on Village Island [*Huumuwwaa*], for that was their land. The Hikuuthl people went to Shaahuwis. I used to live at Mokwa'a [Turrett Island]. We would troll when autumn was coming and when the coho started going thru the passage in schools.”

(Sapir and Swadesh 1955:45).

This account describes patterns in seasonal residential settlement that emerged after the Long War, wherein families within the now amalgamated *Ts'ishaa7ath* returned to their ancestral villages within their former territories. This reversion to pre-amalgamation territorial and residential affiliations, but only on a seasonal basis, indicates an enduring persistence for long-standing cultural identities and place-based lineage affiliations. Yet, it is during this period of a rapidly expanding colonial presence in the 1860s and 1870s (Sellers 2013) amidst the spread of virulent introduced diseases (Harris 1997), on which influential ethnographic observations are based (Grant 1857; Sproat 1868; Swan 1870) and form the foundation for

later syntheses (Curtis 1916; Drucker 1951) that can gloss over oral historical sequences and result in the application of less than appropriate archaeological analogues (McMillan 2009).

Conclusion

This chapter has examined oral historical information and archaeological data specific to the Broken Group Islands to determine whether these distinct ways of understanding the past reveal parallel or comparable sequences of human settlement. I first considered the Broken Group Islands as a whole and examined place names and accounts of local group territories as summarized in the oral historical literature alongside the archaeological survey information for the archipelago. By considering these data for the larger region, I narrowed my focus on the southern cluster of islands within the archipelago as both culturally and archaeologically relevant units of analysis. This island cluster is recognized oral historically as the traditional territory of the *Maktl7ii7ath* and contains a similar range of archaeological site types, densities, sizes, and size-distributions as is found in other geographically distinct island clusters within the Broken Group associated with other politically autonomous local groups.

I then presented a range of archaeological data within the local group territory with a focus on chronological indicators of village growth, expansion, and settlement reorganization. I observed several consistencies between archaeological and oral historical sequences. Specifically, *Makt7ii*, the named origin site of the *Maktl7ii7ath*, is the oldest and largest village while *Huumuuwaa* and *Huts'atswilh* are respectively more recent.

Huumuuwaa exhibits periods of rapid changes in site size, both increasing and decreases over time, which may also correspond with a previous history of conflict between the *Maktl7ii7ath* and another group. *Huts'atswilh* expanded rapidly in size during two periods,

the latter of which is an indication of the archaeologically simultaneous occupation of multiple houses at a fortress or defensive location (ca. AD 1440-1460).

This historical dynamism and complex correspondence between archaeological and oral historical information support the observations of Crowell and Howell (2013), Cruikshank (2001), Green (2008), and Martindale (2006, n.d.), which demonstrate narrative oral accounts of human settlement maintain an enduring historical structure that compliments, and are complemented by, archaeological data. As demonstrated here, archaeological interpretation is not needed to verify the oral historical knowledge but rather, both forms of knowledge offer views of the past, and are made stronger and richer when examined in parallel.

Table 6.3 Radiocarbon dates and calibrated age estimates (at 2-sigma) from archaeological sites in the *Makd7ii7ath* study area.

Site	Test Location/Depth	Elevation (m abl)*	Material	¹⁴ C Lab number	¹⁴ C age	±	Delta R **	Cal yr BP Upper	Cal yr BP Lower
131T	131T1A-64-66cm	11.22	Charcoal	UCIAMS-75885	930	20		915	793
131T	131T1A5-87-89cm	10.99	Charcoal	UCIAMS-73347	2170	20		2305	2116
131T	131T2A4-98-100cm	11.73	Charcoal	UCIAMS-73345	2080	20		2116	1995
132T	132T2A-82-84cm	25.94	Charcoal	UCIAMS-73346	2490	25		2719	2467
132T	132T3B-55-60	25.565	Charcoal	UCIAMS-75886	1410	20		1344	1292
132T	132T3B-55-60	25.26	Charcoal	UCIAMS-73344	1540	20		1518	1374
82T	82T9A14 150-158cm	1.852	Charcoal	UCIAMS-105976	1245	15		1161	1093
82T	82T9A2 15-30cm	3.477	Mytilus sp.	UCIAMS-105987	1045	15	Delta R=150±21	549	463
82T	82T4B 180cm	1.51	Charcoal	UCIAMS-73351	1185	20		1173	1059
82T	82T10A-25cm	14.51	Charcoal	UCIAMS-73350	95	10		255	32
82T	82T5B-252cm	1.83	Charcoal	UCIAMS-73352	1240	20		1263	1083
304T	304T2A-708cm	3.74	Charcoal	UCIAMS-72229	1835	15		1819	1720
304T	304T4A-436cm	3.74	Charcoal	UCIAMS-72231	1775	15		1771	1616
304T	304T5A-443cm	5.45	Charcoal	UCIAMS-72228	1290	15		1281	1179
304T	304T20A 150-153cm	2.985	Charcoal	UCIAMS-105974	835	15		779	696
304T	304T20A 25cm	4.25	Charcoal	UCIAMS-105975	345	15		396	317
304T	304T3C 135-139cm	5.204	Charcoal	UCIAMS-105973	600	15		646	548
304T	304T1A11 183-86cm		Charcoal	UCIAMS-105979	1125	20		1064	971
206T	206T20B-117-20cm	3.724	Charcoal	UCIAMS-105978	470	15		528	504
206T	206T4A-30cm	9.13	Mytilus sp.	UCIAMS-72246	1060	15	Delta R=150±21	565	467
206T	206T4A-551cm	3.77	Charcoal	UCIAMS-72233	1310	15		1290	1183
206T	206T9B-43cm	7.24	Mytilus sp.	UCIAMS-72248	1905	15	Delta R=202±26	1317	1179
206T	206T19B2-20-40cm	1.976	Mytilus sp.	UCIAMS-105977	2015	15	Delta R=202±26	1433	1279
206T	206T5A-361cm	1.74	Mytilus sp.	UCIAMS-72245	2145	15	Delta R=202±26	1581	1394
206T	206T19B-94-96cm	2.702	Charcoal	UCIAMS-105977	1785	20		1812	1623
206T	206T12A-335cm	3.65	Charcoal	UCIAMS-73348	2380	25		2483	2342
206T	206T9B-365cm	4.02	Mytilus sp.	UCIAMS-72247	2960	20	Delta R=220±24	2599	2336
206T	206T19A-590cm	2.23	Charcoal	UCIAMS- 73349	2370	30		2650	2337

Site	Test Location/Depth	Elevation (m abl)*	Material	¹⁴ C Lab number	¹⁴ C age	±	Delta R **	Cal yr BP Upper	Cal yr BP Lower
129T	129T13F1-3	22.958	Charcoal	UCIAMS-58619	440	20		522	483
129T	129T18F1	28.1	Charcoal	UCIAMS-72235	150	15		281	0
129T	129T22D-1	13.741	Charcoal	UCIAMS-62195	120	20		268	0
129T	129T2B1-5	19.115	Charcoal	UCIAMS-61763	340	70		513	155
129T	129T2B1-3	18.255	Charcoal	UCIAMS-61762	370	15		498	329
129T	129T3J	17.653	Charcoal	UCIAM-75887	2515	20		2732	2494
129T	eu129T6J16A	16.8	Charcoal	UCIAMS-73410	300	25		455	299
129T	eu129T6J16B	16.791	Charcoal	UCIAMS-73411	445	25		529	479
129T	eu129T6J12C	16.961	Charcoal	UCIAMS-73412	190	25		296	-2
129T	129T6G	16.5	Charcoal	UCIAMS-72234	1545	15		1517	1384
129T	129T9Z1-3 34cm	20.89	Charcoal	UCIAMS-61761	430	20		519	474
129T	129T13F1-5	24.01	Mytilus sp.	UCIAMS-58365	955	20	Delta R=150±21	503	368
129T	129T13F1-2	22.958	Balanus sp.	UCIAMS-58361	880	15	Delta R=150±21	443	298
129T	129T25E	29.14	charred seed	UCIAMS-72236	50	20		251	0
129T	129T3H 75-80cm	16.528	Charcoal	UCIAMS-105980	475	15		530	505
129T	129T2B1-4	19.115	Mytilus sp.	UCIAMS-58362	850	20	Delta R=150±21	422	279
129T	129T2B1-2	18.255	Mytilus sp.	UCIAMS-58363	1000	15	Delta R=150±21	520	434
129T	129T9Z1-2	20.89	Mytilus sp.	UCIAMS-58364	1035	20	Delta R=150±21	545	454
83T	83T11B1-4	7.067	Mytilus sp.	UCIAMS-58366	945	25	Delta R=150±21	497	333
83T	83T2A2-2	2.189	Mytilus sp.	UCIAMS-58368	1140	15	Delta R=150±21	633	522
83T	83T6B2-2	2.242	Mytilus sp.	UCIAMS-58367	1210	20	Delta R=20±21	800	660
83T	83T7D2-2 263.5cm	2.28	Mytilus sp.	UCIAMS-58369	1075	15	Delta R=150±21	599	484
83T	ct-83T6B2-3, 257cm	2.242	Charcoal	UCIAMS-61760	825	20		775	689
83T	ST83T-ST1 25-32cm	1.51	Charcoal	UCIAMS-73413	370	25		501	319
83T	ct-83T10B 257cm	2.34	charred seed	UCIAMS-72237	865	45		908	691
131T	<u>131T1A97-99cm</u>	10.89	Charcoal	UCIAMS-75889	6240	20		7253	7028
131T	<u>131T1A6108-116cm</u>	10.75	Charcoal	UCIAMS-75888	8210	35		9282	9031
129T	<u>129T6F-2 58cm</u>	15.961	Charcoal	UCIAMS-62196	10765	35		12760	12570

* meters above barnacle line, ** Delta-R values derived from shell-wood pairs following personal communications with Paula Reimer and Maarten Blaauw (July 2013). *** Calibrated upper and lower age estimates shown are at the 2-sigma range and were calibrated using Calib 6.10 (Reimer, et al. 2009). Underlined dates at bottom are from dated landforms and not from definitely cultural deposits.

Chapter 7. Zooarchaeological Scales of Variability on the Northwest Coast: A Barkley Sound Case Study

Introduction

Evaluating difference and similarity between cultural practices and their relationship to ecological factors across space and time is a fundamental challenge in archaeological interpretation. In this chapter, I outline a multi-scalar approach to identifying the most commonly consumed foods at five archaeological sites in the southern Broken Group Islands, falling within the contact-era territory of an autonomous Nuu-chah-nulth local group (Figure 7.1). Rather than seeking to detail the full spectrum of subsistence, I identify the most commonly represented fish and shellfish at the five study sites by examining patterning at multiple scales using several abundance measures applied across numerous depositional contexts spanning a period of 2,500 years (*see* previous chapter for site context and dates, Table 6.3). The foundation for this analysis are basic units of archaeologically recovered data: a small quantity of cultural sediment (0.5-2 litres) from a series of individual auger sample levels. I argue that attentiveness to such small-scale deposition most closely resembles everyday practices (i.e., regularly disposed or deposited refuse) and provides an enhanced basis for evaluating “how contemporaneous sites within settlement systems functioned in relation to resource variability” (Moss 2012:6). Using these data, I identify small-scale environmental variation between culturally affiliated settlements through patterning in the consistency of resource use within sites as well as between sites that spans the last several millennia up until the late 19th century.

Theoretical and Methodological Context

Archaeological research on the Northwest Coast has overwhelmingly been conducted in relation to the compelling and pervasive narrative concerning the ‘origin’ and development of ‘intensive’ and/or ‘complex’ subsistence economies²⁶. The structure of this narrative is progressive, linear, and invariably predicts a series of increasingly complex forms of social and political interaction developing over time (Mackie 2001; Martindale and Letham 2011; Moss 2011a). A host of economic and paleoenvironmental drivers (e.g., storage, trade and exchange, stabilization of sea levels, environmental productivity, population pressure, hereditary inequality, and control over labour) have been proposed to explain the ‘origins’ of social and political ‘complexity’ on the Northwest Coast (reviewed in Ames and Maschner 1999; Matson and Coupland 1995). However, archaeological evidence to support this narrative, particularly regionally and temporally coherent socio-economic data on subsistence, remains poorly demonstrated and lacks consensus despite decades of research (Butler and Campbell 2004; Moss 2012). In a recent review, Moss (2012:1) concluded that the “single narrative of increasing Northwest Coast cultural complexity is no longer tenable” as an analytical construct and argued for an increased attentiveness and engagement with regional cultural and ecological variability on a smaller scale. This imperative to confront and explain smaller-scale variability builds on Cannon’s insight from a decade previous, who similarly advocated for “the pressing need to expand research strategies beyond the individual site to encompass a variety of site locations within specific regions” thereby allowing archaeologists to “gain a better appreciation of the extent of regional, seasonal, and longer-term temporal variability” (Cannon 2001:185).

²⁶ Even studies that have argued against such a viewpoint have been discursively engaged in a critique of it. This is really the true measure of its pervasiveness and influence.

Moss and Cannon's advocacy for confronting variability is a recognition that the large spatial and temporal scales prevalent in Northwest Coast archaeological interpretation must be refined with stronger datasets that better resolve archaeological patterning and variability and better account for the social processes they represent. They identify the need for studies at an intermediate, sub-regional scale that allow for multiple perspectives on the differences and similarities among spatially and temporally associated sites *and* at multiple scales of analysis. Such an approach holds the possibility for identifying scales at which archaeological data are most strongly patterned and thus may have the greatest interpretive relevance. It is also a recognition that patterning may be recognizable at certain scales but obscured and/or lost at other scales (cf. Ames 1991; Levin 1992).

Fortunately, there have been many sub-regional studies that have investigated spatially and temporally associated sites with the aim to detail such small-scale variability (Acheson 1998; Calvert 1980; Friedman 1976; Maschner 1992; McLay 1999a; Moss 1989; Orchard 2007). More recently, a number of researchers have built on the work of Cannon (2000a, b) to combine percussion coring, auger sampling, and limited excavation at multiple sites to investigate sub-regional patterning in settlement and resource use at coastal shell midden sites (Brewster and Martindale 2011; Cannon, et al. 2008; Cannon, et al. 2011; Letham 2011; Martindale, et al. 2009; Martindale, et al. 2010). Such studies help refine understanding of patterns of indigenous subsistence and settlement by sampling a number of locations within and between coastal shell midden deposits²⁷.

²⁷ Fundamental research is still being conducted on relative sea level change during the Holocene which has immense consequence for where sites dating to certain time periods are located and why sites dating to other time periods are absent from current records (e.g., Dallimore, et al. 2008; Fedje, et al. 2009; Grier, et al. 2009; Mackie, et al. 2011; McLaren, et al. 2011). Stratigraphy, accumulation rates and the temporal resolution of these deposits also remain poorly understood (Taylor, et al. 2011). Even within relatively well known time periods

Although this considerable research effort has greatly expanded the basis for interpreting variation, examination of such patterning remains focused on archaeofaunal data from singular sites, thereby collapsing centuries or millennia of subsistence into a singular analytical unit, and if available, a few coarse-scale temporal divisions. An additional limitation is that the spatial scale of comparison rarely examines several sites within a small ecologically similar and ethnographically defined local group territory, which makes it difficult to distinguish between cultural and environmental variability (Moss 2012). Combined, these factors mask understanding of spatial and temporal variation in resource use within individual sites and over time and at the scale that most closely reflects everyday depositional practice. This widespread tendency to ‘lump rather than split’ is driven by the legitimate concern for adequate sample size, a cautionary awareness of the temporal coarseness of calibrated radiocarbon dates, and a recognition of the complexity of shell midden formation processes. However, these same factors have the corresponding effect of flattening generations of human subsistence and history into singular site-based observations. Here, I use a multitude of small (0.5 - 2 litres) but broadly distributed sediment samples obtained from multiple sites and site areas to examine patterning in depositional practices as a proxy for interpreting the everyday over millennia in a small territory on the Northwest Coast.

and regions, there remains a surprising lack of temporal resolution which further limits identification of even the most coarse-scale cultural historical units (Morin 2013).

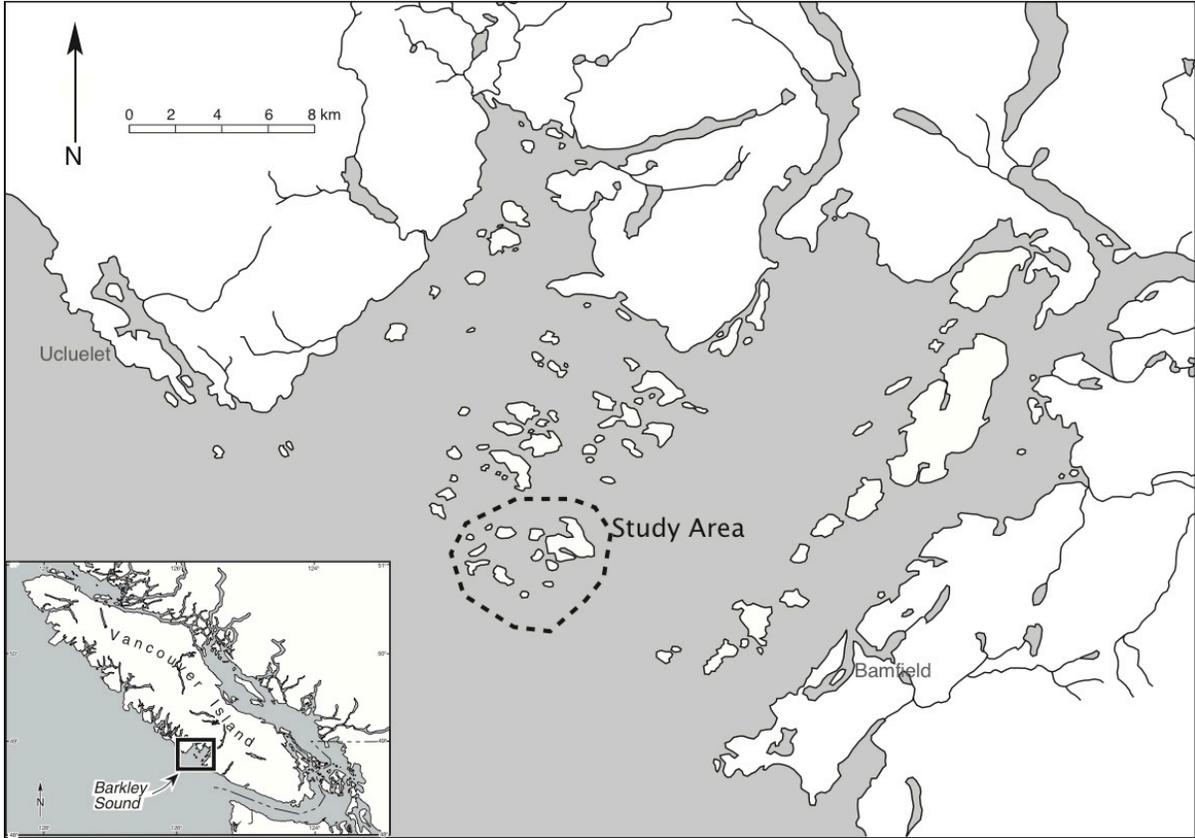


Figure 7.1. Map of the *Makl7ii7ath* study area in the Broken Group Islands in Barkley Sound.

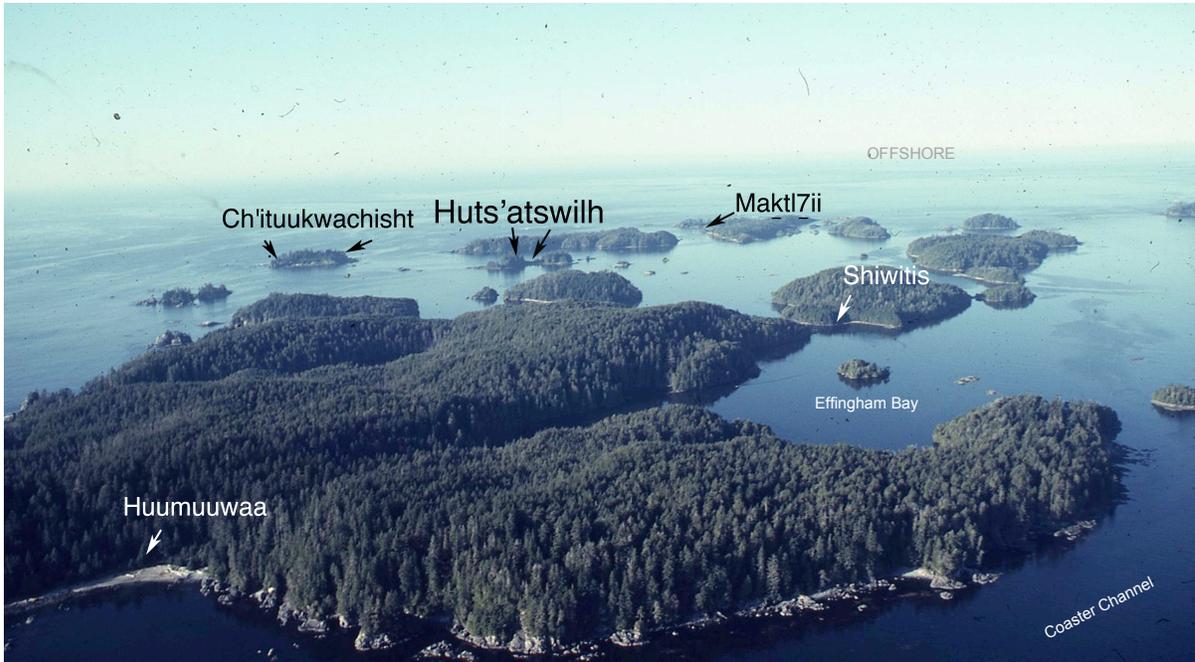


Figure 7.2. Aerial overview of the *Makl7ii7ath* study area with individual study sites looking west towards the Pacific Ocean. Photo courtesy of the Royal BC Museum (West Coast Archaeological Project Files).

Analysis of Scale and Variability

To establish the taxonomic composition of fish and shellfish in my study area and explore spatial and temporal variability in resource use, I apply four measures of abundance.

The measures of abundance include:

- 1) *Relative abundance*: the percentage of a particular item (e.g., herring) relative to all other specimens within the same category (e.g., identified fish remains).
- 2) *Density per litre*: the number of specimens per litre of excavated volume.²⁸ This measure can be calculated by dividing the frequency of a taxa by the examined volume of cultural sediment (e.g., 40 herring bones per litre). Accordingly, this measure is not subject to the relative abundance of other taxa (e.g., if anchovy abundance goes up, then herring abundance does not necessarily go down).
- 3) *Ubiquity*: percentage of contexts in which a certain item is present or absent (frequency of occurrence). For example, herring would have a ‘ubiquity’ value of 100% if it were present in every level of every excavation unit in a site.
- 4) *Rank order and rank order abundance*: Rank order is the numeric rank of taxa based on their relative abundance within a given context (e.g., the most abundant taxa, or that with the highest percentage, receives the rank order of one; the second-most abundant receives a rank of two, etc.). *Rank Order Abundance* is the calculated average rank order across many examined contexts (e.g., all the individual auger sample levels within a site). Rank order abundance is expressed as a percentage reflecting how frequently a taxon receives a specific ranking (e.g., herring is the highest ranked taxon in 95% of contexts).

The first measure, *relative abundance*, is by far the most common quantitative measure of abundance used in zooarchaeological analysis. Measure 2, *density per litre*, is much less common but reported with increasing frequency on the Northwest Coast (Brewster and

²⁸ This term is not the same ‘bone density’ which is an entirely separate form of zooarchaeological analysis that examines the physical properties of bone from a taphonomic perspective (Butler and Chatters 1994).

Martindale 2011; Cannon 2000a). Measure 3, *ubiquity*, has long been a central abundance measure in paleoethnobotany (Lepofsky and Lyons 2003; Popper 1988) but “has seldom been used” in zooarchaeological datasets (Lyman 2008:84)²⁹. Measure 4, *rank order abundance*, as a proportion of relative rank order for taxa across the multiple depositional contexts within a site has, to my knowledge, not been applied to the analysis of zooarchaeological datasets.

While the use of these multiple measures may initially seem redundant, I employ them here because they have an analytical importance that dramatically expands the archaeological interpretation of variability at different scales. For instance, the first and most widely used measure of *relative abundance* is commonly the only measure that summarizes the composition of taxa for an entire site and/or stratigraphic/temporal components within a site. This is entirely legitimate and appropriate but has the consequence of limiting the archaeological perspective on variability to a small number of observations. Moreover, such relative percentage data are further influenced by other taxa (e.g., if something goes up, something else has to go down) (Grayson 1984). In contrast, the three other abundance measures are not as limited and collectively offer a greatly-expanded perspective on variability. For instance, *density per litre* is a measure that can be evaluated alongside *relative abundance*. Thus, if both measures similarly indicate that one particular taxon has the highest value, this doubly strengthens the observation of abundance as these two measures are quantitatively independent.

While such a correspondence is important, it still leaves open the question of depositional variability within a site. Thus, an even more expansive perspective on variability

²⁹ The calculation of ubiquity is not even discussed in two recent syntheses of zooarchaeological methodology (Reitz and Wing 2008; Russell 2012).

is provided through the abundance measures of *ubiquity* and *rank order abundance*. These measures dramatically expand the archaeological basis on which abundance is evaluated because they give equal weight to the numerous archaeological contexts in which items are found. As a measure of the frequency of occurrence, *ubiquity* has the virtue (Kowalewski, et al. 1998) of being both spatially averaged across different areas of site and temporally averaged over the time a site has been occupied (e.g., individual auger sample levels from throughout a site). As such, *ubiquity* is a more direct measure of how frequently a particular taxon is present in an archaeological context and thus, a reflection of how regularly a class of item or animal taxa is used relative to others. It particularly well suited to quantification across small quantities of sediment (0.5-2 litres), and is akin to small scale deposition expected for routinized refuse disposal. As such, *ubiquity* can be used to evaluate how deposition is structured across a variety of archaeological contexts and thus how such repetitive patterning is relevant to the interpretation of ‘everyday’ social practices (cf. Garrow 2012).

Such a spatially and temporally expanded basis for measuring abundance is appropriate to the Northwest Coast given the many different depositional circumstances with which shell midden deposits accumulate (e.g., as house floors, as dump events, as storage features, etc.). This equal weighting (spatial and temporal averaging) of a large number of distinct depositional contexts (Kowalewski, et al. 1998) provides a significantly more well-rounded basis for assuming the regularity of occurrence, and hence, cultural use within a settlement relative to singularly lumped relative abundance values. It is further applicable to auger sampling which vertically penetrates cultural sediment but often lacks a clear indication of depositional context (housefloor, posthole, hearth feature, etc.). Thus, whereas

relative abundance represents a totalized and singular value for a site or temporal component (Lyman 2003a), *ubiquity* is a proxy for how regularly certain items are used across the many examined contexts within a site and can similarly be scaled up to examine variation among several sites.

Here, I use these four measures of abundance to identify the most regularly used taxa in a series of sites within a small ethnographically identified territory. I examine both inter-site and intra-site variation at three scales of analysis. The first scale of analysis applies these multiple abundance measures to all examined contexts in the study area as a single unit representing ‘resource use in *Maktl7ii7ath* territory.’ This multi-sited assessment of compositional patterning is legitimate because archaeological sampling was undertaken in multiple areas of each site using similar methods (auger sampling) and the analysis of fauna resulted in relatively similar sample sizes (NISP and shell weights, Table 7.1 Table 7.2). The second and most conventional scale of analysis is *site-based*, in that I simply compare lumped compositional data between individual sites focusing on the most abundant and most commonly used taxa in the territory as a whole. The third scale examines *within-site compositional patterning* for individual sites using four abundance measures.

Applying the measures outlined above to two different sets of subsistence data (shellfish and fish) allows me to examine the robusticity of archaeological patterning for these regularly deposited foods. Collectively this focus on identifying patterning among those mundane and everyday foods (cf. Garrow 2012) allows for more detailed interpretations of the cultural, environmental, and historical factors that underlie differences in their proportionality.

Methods

Faunal Identification

To explore the archaeological expression of everyday foodways as represented over millennia, I identified animal bones and shellfish from auger samples at seven sites in the southwest Broken Group Islands study area (Table 7.1 and Table 7.2). I examined multiple auger samples collected from separate areas within each site and identified bones systematically collected from 2 mm water screened mesh and shellfish collected from 6.35 mm mesh (¼-inch). The greatest auger sampling intensity and examined volume was at two sites on upper and lower Dicebox Island (129T and 83T) while the smallest examined volumes and sample sizes are from two small sites on Cree Island (131T and 132T). Relatively similar numbers of specimens and taxa were identified from five of the seven sites ensuring that comparisons can be made.

Vertebrate skeletal identification procedures and quantification protocols followed the methods used in a number of other studies in the region (Frederick and Crockford 2005; Frederick 2012; Wigen 2003b, 2009, 2013) (*see also* Chapter 5). To further ensure analytical comparability, identifications were conducted using the same comprehensive comparative collection at the University of Victoria. Independent verification of a limited number of morphological identifications was provided by ancient DNA analysis focused on herring, *Clupea pallasii* (Speller, et al. 2012), and rockfish, *Sebastes spp.* (Rodrigues, et al. 2013), and indicates that more than 95% of specimens were accurately identified to genus or species.

Invertebrate identification was conducted using the comparative shellfish collection housed at the Laboratory of Archaeology facilities at UBC, including a comparative

collection donated from Parks Canada Archaeological Services³⁰. Specimens were morphologically identified to the lowest possible taxonomic level and the number of hinges were counted and weighed to generate estimates of the minimum number of individual valves. While there are a variety of approaches to quantifying shellfish (e.g., Giovas 2009; Glassow 2000), the methods employed here are internally consistent and are thus internally comparable for the purposes of evaluating variability within the study sites.

Size-at-Harvest Data

To provide an additional level of insight into the taxonomic variability of fish within my study area, I examined the size-at-harvest profile for three of the five most abundant fish taxa (herring, rockfish, and greenling) using available skeletal regression formulae (McKechnie and Tollit n.d.; Orchard 2003). This methodology is based on the predictable relationship between the dimensions of particular bones and the known size and weight of modern fish which can then be applied to archaeological specimens to reconstruct size-at-harvest profiles (Casteel 1974).

Results

Bone and Shell Assemblages

The combined vertebrate assemblage from the seven study sites contains 8,307 identified bone specimens representing 25 fish taxa, 6 mammal taxa and 3 bird taxa (Table 7.1). This represents 272 litres of recovered sediment from 58 spatially discrete auger samples containing 366 vertically discrete auger sample levels spanning the past 2,500 years. A total of 22.9 kilograms of shellfish from the 6.35 mm fraction was identified from the

³⁰ Collection formerly managed by Cultural Resource Services staff at the now defunct Parks Canada Northern and Western Centre Victoria office.

seven study sites representing 277 litres of recovered sediment from 66 spatially discrete auger samples containing 343 vertically discrete auger sample levels (Table 7.2). Examined volumes and number of examined contexts for vertebrates and invertebrates differ slightly due to identification effort but are based on the same set of samples. For five of the seven study sites, there are relatively similar sample sizes (examined volumes and identified shellfish weights) to provide sufficient basis for inter-site comparisons for both fish and shellfish – and therefore these five will be analyzed in more detail below.

Vertebrate remains are present in the overwhelming majority of all examined auger sample levels from the seven study sites (99.4%). Similarly, the overwhelming majority of the bone that is taxonomically identifiable to species genus or family is fish (Figure 7.3) whereas mammal bones make up only 0.6% of the identified assemblage (NISP=48). Identifiable bird bones are exceedingly rare in comparison, being 12 times less numerous than mammals and roughly 2,000 times less numerous than fish (Table 7.1). This vast difference in the proportionality of vertebrate fauna is commonly observed in other shell midden deposits in Barkley Sound that were screened with fine-screen ($\leq 3.2\text{mm}$) mesh (Wigen 2003b, 2008a, 2009) and the Northwest Coast more generally (Moss and Cannon 2011) (*see* also Chapters 2 and 5).

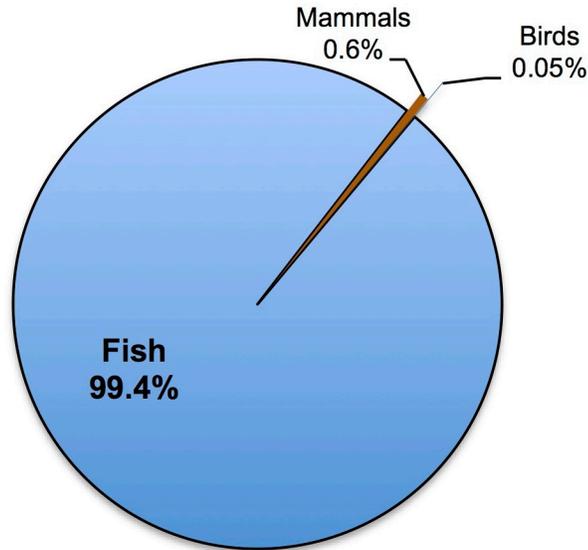


Figure 7.3 Proportion of fish, birds and mammals identified in the examined assemblage from the five study sites.

Table 7.1 Examined vertebrate remains from the seven study sites (2 mm fraction); *Makt7ii*, *Huumuwaa* (304T), *Shiwitis* (82T), lower (83T) and upper (129T) *Hutsatswilh*, and sites on the south (132T) and north (131T) sides of Cree Island (*Ch'ituukwachisht*).

Site Name	NISP Fish	NISP Mammals	NISP Birds	N Auger Samples	N Auger Levels	Volume (Litres) ¹	Fish per Litre	N Fish Taxa
<i>Makt7ii</i> 206T	1939	8	2	6	99	61.8	31	17
<i>Huumuwaa</i> 304T	1167	8	1	5	62	33.4	35	14
<i>Shiwitis</i> 82T	1374	7		4	37	27.3	50	16
Lwr <i>Hutsatswilh</i> 83T	1999	15	1	12	77	64.1	31	17
Uppr <i>Hutsatswilh</i> 129T	1738	10		27	77	74.0	24	17
N. Cree 131T	27			2	6	4.9	6	6
S. Cree 132T	11			2	8	6.9	2	3
Total	8255	48	4	58	366	272.4	30	25

¹ Displaced volume as measured by placing bag of excavated sediment in a bucket with water.

Table 7.2 Examined invertebrate remains from the seven study sites (6.35 mm fraction).

Site	Shell wt. (g)	Volume (Litres) ¹²	Mussel (g.)	Clam	Barnacle	All other shell-fish	Shell (g.) per litre	N Auger Smpls	N Auger Levels
<i>Maktl7ii</i> 206T	2456.0	40.8	1588.9	319.8	504.2	57.0	60.2	8	62
<i>Huumuuwaa</i> 304T	2048.0	15.9	935.9	676.1	391.3	33.7	129.2	5	33
<i>Shiwitis</i> 82T	1742.7	21.5	775.4	685.5	196.9	61.3	81.1	3	29
<i>Lwr Hutsatswilh</i> 83T	10844.4	77.7	5770.4	2410.7	2331.6	177.7	139.6	13	90
<i>Uppr Hutsatswilh</i> 129T	5082.7	104.5	2485.4	1323.9	1120.1	72.8	48.7	32	109
<i>N. Cree</i> 131T	15.4	3.6	20.68	0	0	0	4.3	2	4
<i>S. Cree</i> 132T	709.0	13.5	636.5	0.27	66.84	3.62	52.5	3	16
Total	22898.3	277.4	12213.2	5416.2	4610.8	406.1	82.6	66	343

¹Displaced volume as measured by placing bag of excavated sediment in a bucket with water.

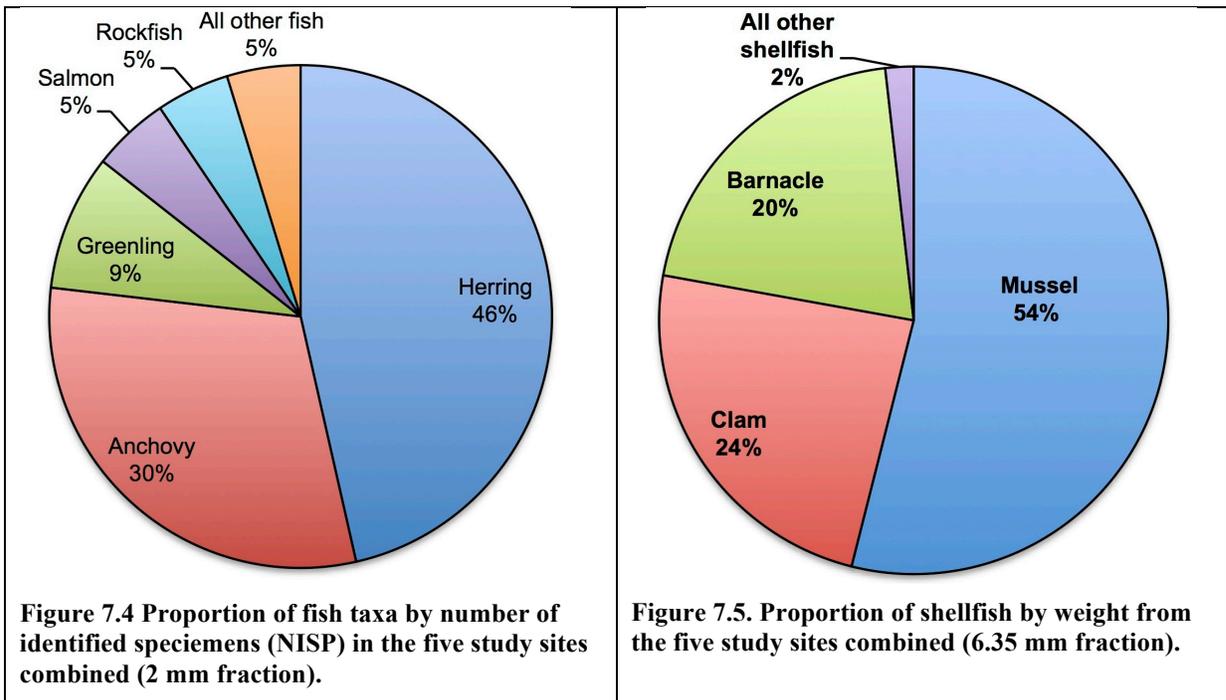
²Examined volumes differ from vertebrate assemblage presented in table above as I examined more contexts for shellfish.

Shellfish are present in over 95% of the examined auger sample levels from the seven study sites, a figure that would undoubtedly increase if specimens smaller than the 6.35 mm fraction (¼-inch) were included in this ubiquity measure. This demonstrates that shellfish are a pervasive feature of the depositional practices in the study sites and comprise an average of 82 g per litre in the 6.35 mm fraction. The assemblage is overwhelmingly dominated by mussel, clam, and barnacles. The combination of all remaining species amounts to less than 2% of the assemblage by weight (Figure 7.5).

Scale 1 – Multi-sited Assessment of Taxonomic Composition

The identified fish assemblage from the seven study sites is numerically dominated by five taxa: herring, anchovy, greenling, rockfish, and salmon (Figure 7.3), followed distantly by a number of other species and genera. As discussed in further detail in the analyses of scales 2 and 3 (below), these same five taxa are also the five most abundant within each of the study sites for which there is sufficient sample size (Figure 7.7) and the five most ubiquitous in the 366 discrete auger sample levels examined from the

investigations at each site and spanning all time periods for the study area. These multiple measures, representing a sub-regional, site-specific, and within site variation indicate that an intensive and broadly consistent use of *these particular taxa* occurred over the 2,500 years in the study area³¹.



As with the fish remains, the taxonomic proportionality of shellfish reveals that a limited range of taxa dominate the invertebrate assemblage (Figure 7.5). The single-most dominant shellfish species is mussel (likely *Mytilus californianus*), which is also the most frequently occurring and abundant (by weight) shellfish genus within and throughout the five assemblages (Figure 7.8). Secondly, various clam species (butter, littleneck, horse, and cockle) are consistently present in the multiple assemblages. Medium-sized barnacles (predominantly *Balanus balanus*) are another omnipresent invertebrate taxa. Comparatively

³¹ The remaining taxa are difficult to assess with the same degree of confidence due to the lack of sample size but more intensive sampling in the future will likely provide more on these rarer taxa.

rare invertebrate taxa are also present at all five sites including abalone, urchin, and chiton, and turban snails but none are present in sufficient quantities to be evaluated in detail in the scales of analysis described previously.

Given that these shellfish remains are from the 6.35 mm fraction, they under-represent smaller and more fragmentary shellfish remains such as mussel and likely over-represent larger and more durable shell taxa such as clam (Muckle 1994; Sumpter 2005:154). The exclusive use of specimens from the 6.35 mm fraction accounts for the lower observed abundance of mussel in the study sites in comparison to the nearby and similarly exposed sites of *Ts'ishaa* (Sumpter 2005) and *HuuZii* (Sumpter 2012). Likewise, the taxonomic representation of shellfish is further skewed against the small, fragmentary, and disproportionately lightweight species such as urchin as well as species such as abalone (e.g., Menzies 2010) which tend to preserve poorly in wet shell midden sediments relative to other taxa. These methodological limitations therefore constrain the taxonomic representation and hence the recognition and resolution of the most regularly harvested shellfish. However, this methodology remains internally comparable for the purposes of this analysis and can be supplemented in future analyses.

Size-at-Harvest Data for Fish

Using estimates for a total of 214 elements with a relatively even sample size between sites (Table 7.3), I observed similar mean lengths and length distributions for the three fish taxa: rockfish (*Sebastes* spp.), greenling (*Hexagrammos* spp.) and herring (*Clupea pallasii*). Although each taxa exhibits different length variations, the majority of harvested fish are between 20 and 30 cm in length (Figure 7.6). The size-range does not appear to significantly differ between sites (Table 7.3) although a greater sample size would likely reveal a broader

size distribution and potentially subtle differences over time or between sites. These observations are consistent with size-at-harvest data for rockfish, greenling, and herring at other sites in Barkley Sound (McKechnie 2007a, b) (*see also* Chapter 5). This similar size-range observed between sites (Table 7.3) further supports the previously described patterns of taxonomically focused and intensive fish harvesting practices over the past 2,500 years.

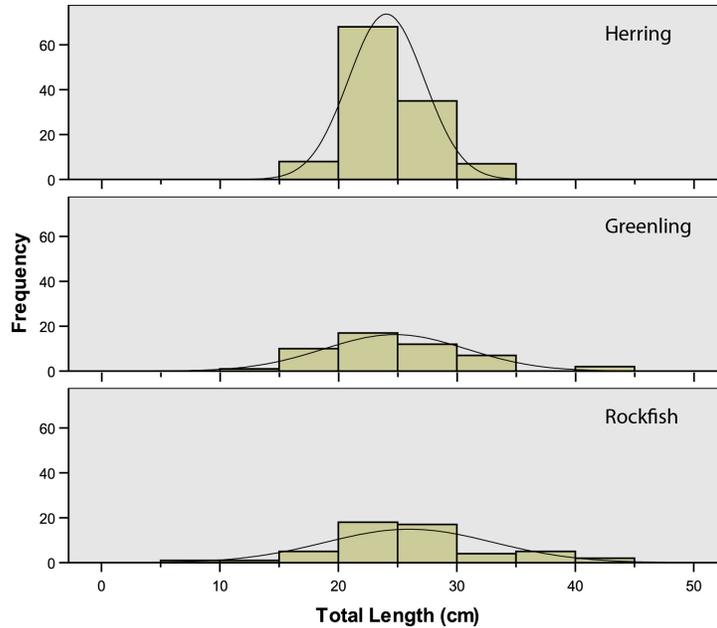


Figure 7.6. Distribution of fish lengths for three of the five ubiquitous and abundant fish taxa in the study sites showing broadly similar size ranges clustering between 20 and 30 cm, with fewer specimens in the smaller and larger size categories. The faint curved line represents a normal distribution curve applied to each dataset.

Table 7.3. Mean lengths and standard deviations in cm for herring (fork length), greenling (total length), rockfish (total length), and all measured fish combined from the five study sites. N indicates sample sizes.

Site	Herring	SD	n	Greenling	SD	n	Rockfish	SD	n	Combined Mean	Combined SD	Combined n
129T	24.1	2.7	34	24.4	5.8	14	26.9	5.6	10	24.6	4.2	58
83T	26.1	3.4	23	27.2	7.4	13	25.0	4.6	13	26.1	5.0	49
82T	22.7	3.0	15	24.8	6.4	5	26.1	7.1	5	23.8	4.8	25
304T	22.3	3.2	14	24.8	1.8	2	23.8	7.1	5	22.9	4.2	21
206T	24.2	3.1	27	23.1	5.3	14	26.7	9.3	20	24.8	6.3	61
Total	24.1	3.2	113	24.8	6.1	48	26.0	7.1	53	24.7	5.2	214

Scale 2 – Site-Based Compositional Differences

Site specific spatial variation in use of the most abundant and ubiquitous shellfish and fish taxa across the five study sites indicates a broad similarity among sites in the proportion of species represented (Figure 7.7 and Figure 7.8). This indicates that similar fishing practices were undertaken by the residents of the sites and thus similar items were used as foods over the sites' histories. Even so, a moderate degree of spatial variation is apparent in the use of the five most abundant and ubiquitous fish and shellfish within this small territory as indicated by differences in the relative and rank order abundance between sites.

Among the identified fish (Figure 7.7), anchovy are slightly more abundant than herring in the two sites near Coaster Channel (sites 82T and 304T), while herring are the single-most abundant taxa in the three other sites with a peak at site 129T (the elevated defensive site on Dicebox Island). Other notable differences include a higher proportion of rockfish from site 206T and a high proportion of salmon in site 129T relative to the other study sites (Figure 7.7).

The spatial patterning in fish is similarly represented in the shellfish data (Figure 7.8). There is a higher percentage of clams within the two sites in Coaster Channel (82T and 304T) and a higher percentage of mussels and barnacles in the three other sites (206T, 83T, and 129T). A notable difference between the two datasets is evident at site 129T which has a specialized focus on herring but an even use of shellfish taxa. These broadly complementary patterns indicate subtle spatial variation specific to place.

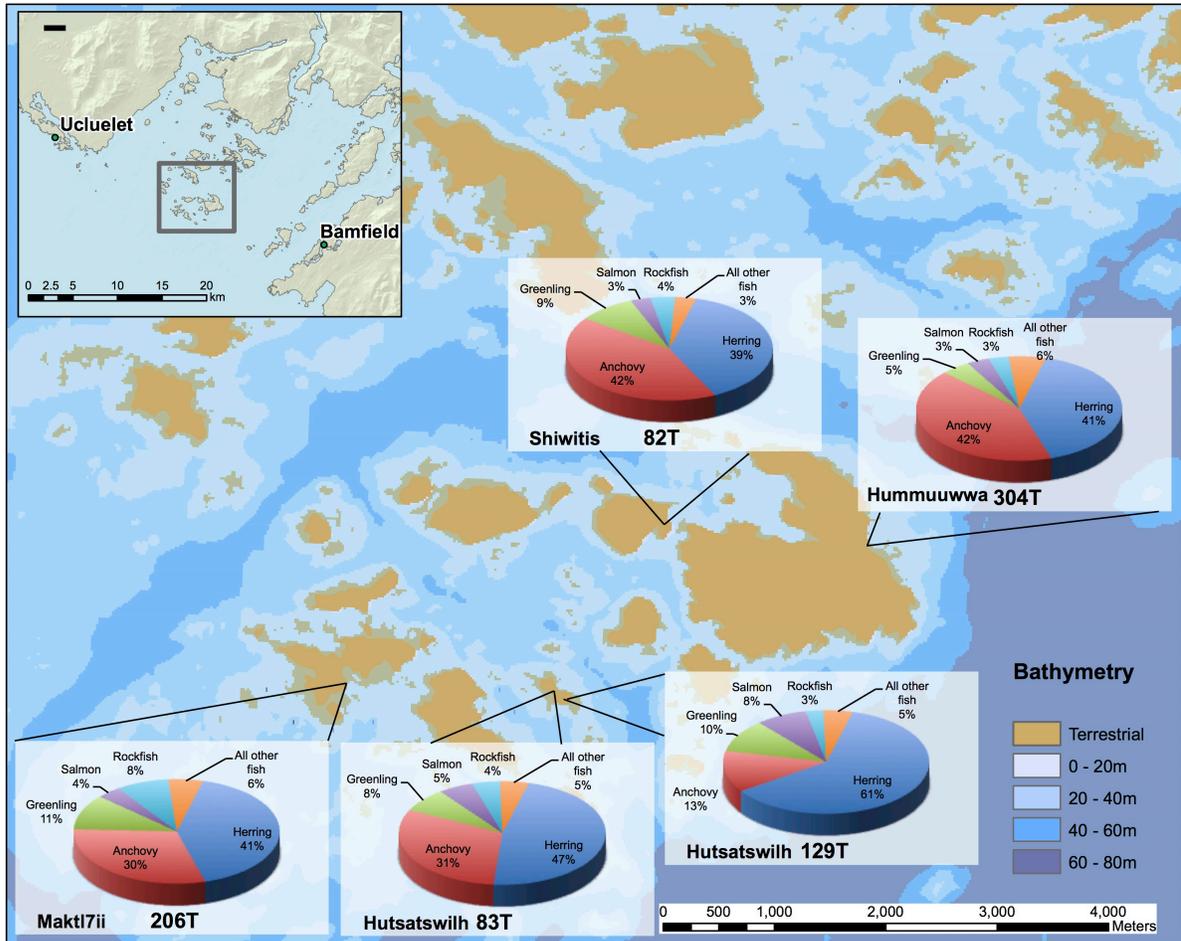


Figure 7.7. Identified fish remains from the five study sites representing ca. 2,500 years of history.

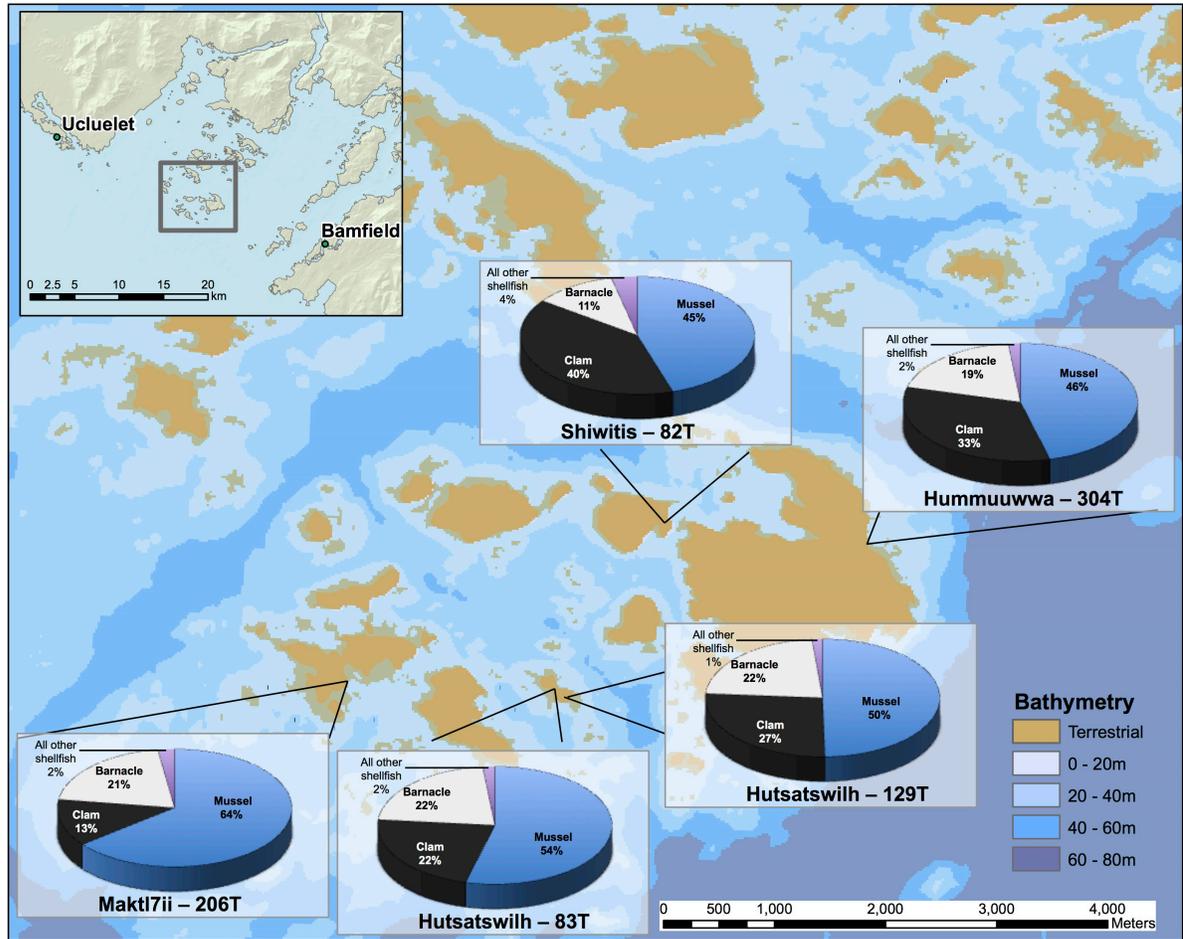


Figure 7.8. Proportion of shellfish from the five study sites representing ca. 2,500 years of history.

Scale 3 –Within-site Patterning

To further evaluate the spatial comparison presented above, I examined whether these patterns are present at finer depositional scales and thus, whether there is similarly consistent patterning within a site over the duration of occupation. I focus on anchovy and clams as they demonstrate the greatest variation in abundance at the site-specific scale. Across all four measures of abundance (relative abundance, density per litre, ubiquity, and rank order abundance), both anchovy and clam have their highest values in sites 82T and 304T (Figure 7.9). For clams, which are dominated by butter and littleneck, have their greatest abundance at sites 82T and 304T (Figure 7.9). The significantly greater number of grams per litre of butter clam versus littleneck likely reflects its greater robusticity and weight rather than a

differential use between the species as they have such consistent differences across all five study sites. These within-site patterns confirm the spatial differences observed at the site-based spatial scale (Figure 7.7). Anchovy and clams were not present in every sample, but there is a consistently higher ubiquity, density per litre, and relative rank order as well as relative abundance in the samples from 82T and 304T than at the other sites.

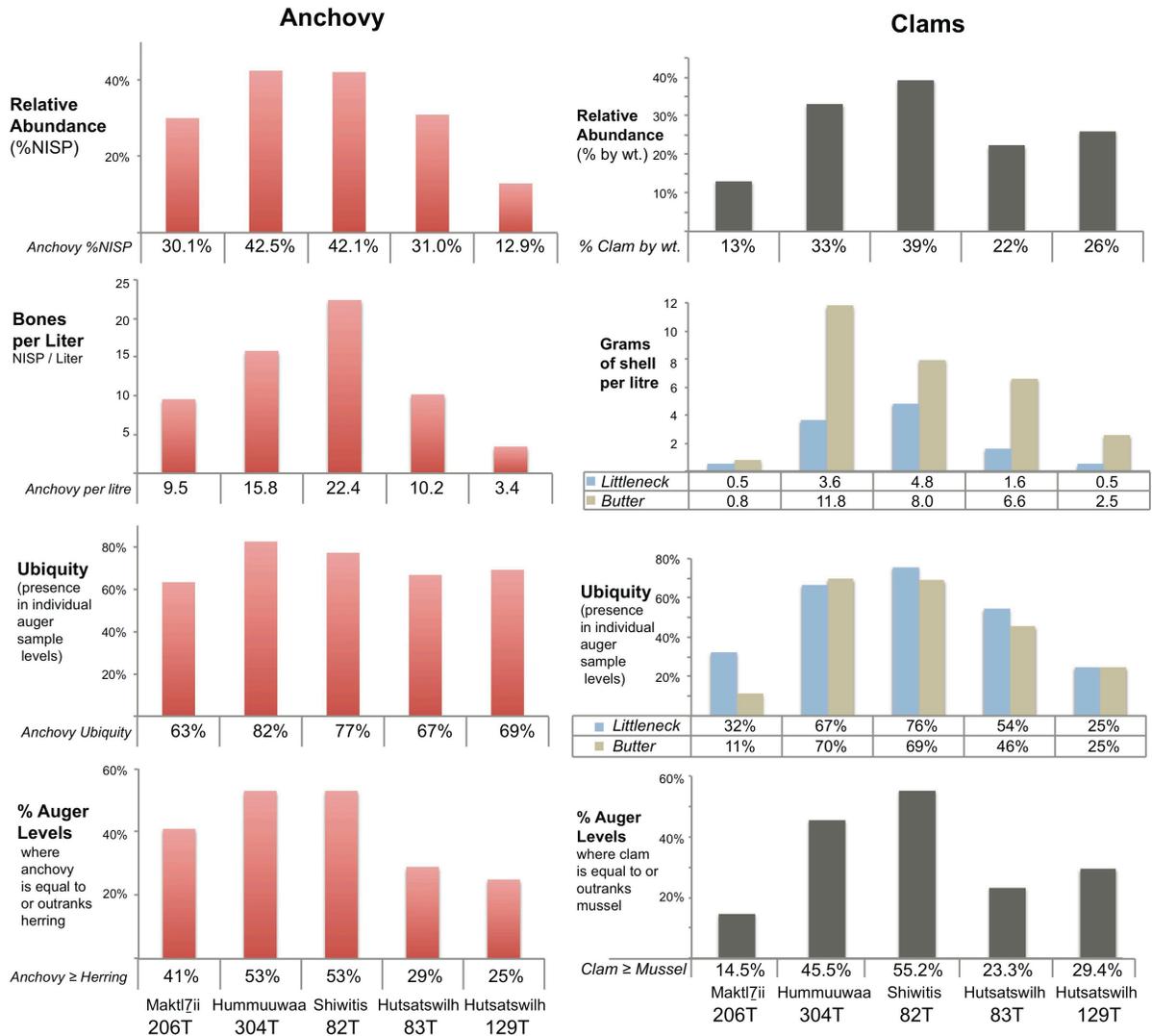


Figure 7.9. Four measures of abundance (relative abundance, density per litre, ubiquity, and rank order abundance) applied across the five study sites for anchovy (left) and clam (right). Note the consistently higher values for sites 82T and 304T indicate the greater anchovy and clam use throughout the occupation of these sites. Clams are further distinguished by butter and littleneck for two of the four measures.

Discussion

The previous analyses have shown that particular fish and shellfish resources were consistently and abundantly present in all five study sites among multiple abundance measures and at multiple scales of analysis spanning over two and a half millennia. This provides further support for the interpretation that fishing and shellfishing were vital and regular components of Indigenous subsistence practices in this coastal setting and constitutes strong evidence for regularly practiced aspects of everyday food harvesting and deposition. It further indicates a robusticity and resilience in the social and ecological dimensions of Indigenous foodways in this portion of the archipelago and suggests these particular animals played important economic and nutritional roles in these communities.

While the analyses presented here document an enduring continuity in the intensive use of certain archaeologically abundant taxa, they reveal subtle spatial variation between individual sites that is strongly expressed across four measures of abundance. These differences are similarly observed across the multiple scales of analysis, which gives further confidence that these results are long-term reflections of ‘everyday’ depositional practices. Among the most striking spatial differences in compositional patterning are those evident in the two settlements in the eastern portion of the study area (82T and 304T) relative to the three to the west (206T, 129T and 83T). These two sites contain a consistently higher abundance of anchovy as well as littleneck, and butter clams (Figure 7.9). They are located along relatively protected, lower energy, and sediment-dominated shorelines of Coaster Channel and Effingham Bay – habitats that are more suitable for clam harvesting and sheltered waters that are more suitable to anchovy schools (Figure 7.2). Conversely, higher percentages of mussel, barnacle, rockfish, and greenling are present on the exposed margin of

the archipelago, which provides more suitable habitat for these taxa (Holmes and Tomascik 2003; Lee and Bourne 1977; Markel 2011; Schmidt 1999; Seed and Suchanek 1992).

Such strong and persistent spatial differences in a small area and their relation to ecological characteristics near each settlement, indicates that the most abundant and regularly utilized fish and shellfish were likely harvested in close proximity to individual sites (± 1 km). Moreover, the comparatively greater abundance of rockfish and greenling present in site 206T (Figure 7.7) is consistent with the more exposed offshore environment noted to be a preferred habitat for these genera (Holmes and Tomascik 2003; Markel 2011:27). A sample of rockfish bones identified to species using ancient DNA techniques from the five study sites (Rodrigues, et al. 2013) further substantiates this spatial variation (Figure 7.10). In particular, specimens from site 206T are predominantly composed of widow rockfish (*Sebastes entomelas*), a deeper-water species (Love, et al. 2002:172) that was not identified at any of the other tested sites.

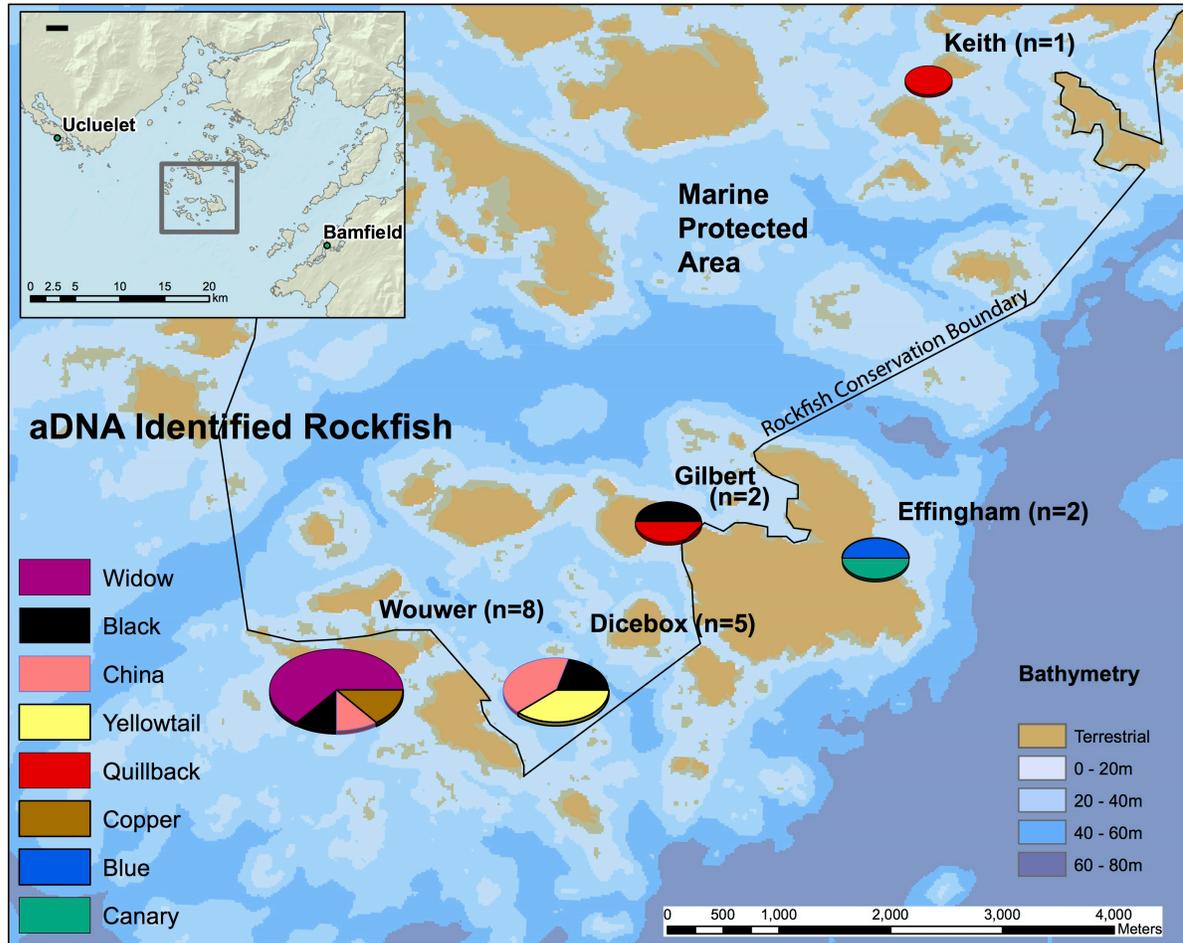


Figure 7.10. Ancient DNA identifications of rockfish in the study area (from Rodrigues, McKechnie, and Yang 2013). Size of pie chart is scaled to sample size.

Collectively, these differences indicate that residents of the five study sites regularly used relatively small localized resource gathering areas. Of course, such an observation does not preclude the likelihood that resources from these sites were regularly exchanged and/or shared between site residents or well beyond the Broken Group archipelago, but it suggests that evidence for such practices appears to have been overwhelmed by what was caught and collected locally. It also indicates these small resource harvesting areas were highly productive as they could withstand the intensive use of large village-sized settlements over long periods of time (cf. Campbell and Butler 2010; Cannon, et al. 2008; Reitz 2014; Suttles 1968).

This ‘hyper-localized’ pattern is consistent with the pervasive optimality notion that hunter-gatherers harvest resources in close proximity to their residences, or conversely, situate their residences in close proximity to resources in order to maximize the caloric return for their efforts (Maschner and Stein 1995; Monks 2011). However, this structured approach to resource use also suggests a process whereby intensive, sustained, and community-based use of localized harvesting areas provides an intergenerational incentive to maintain and enhance (where possible) productive resource gathering areas and/or to restrain and coordinate harvests in certain areas for future use, particularly those in close proximity to long-term settlements (Cannon and Burchell 2009; Lepofsky and Caldwell 2013). Such localized patterning in resource use also supports the interpretation that community residents at these sites exhibited territorial control over productive resource gathering areas near their settlements. Considered in relation to the large number of other large settlements elsewhere in the Broken Group archipelago indicating the presence of other autonomous local groups (*see* Chapter 6), it is reasonable to infer that residents in *Maktl̓ii7ath* territory would be excluded from or have limited access rights to resources in other local group territories, further encouraging cultivation and maintenance of their established harvesting areas.

This scenario is supported archaeologically by the spatially patterned use of shellfish and fish in the study area generally. It is particularly illustrated in the intensive use of clams from site 82T, which has the consistently highest clam abundance values across the four abundance measures (see tabular data presented within Figure 7.9) and where the beach fronting this settlement has an 80-m long clam garden feature (Figure 7.11). The feature consists of a boulder alignment paralleling the shore exposed only during the low-low tide (below 0.5m). This boulder alignment is bisected by four canoe runs and fronts an

anthropogenically cleared beach containing moderately productive clam habitat. The attributes of this feature are consistent with clam garden features observed elsewhere on the coast (Caldwell, et al. 2012; Cardinal, et al. 2011; Harper, et al. 1995; Harper, et al. 2005) although the boulder wall and finer sediments on the shoreward side of the wall appear to have been dispersed by wave action in the 400 years since the site was intensively occupied (*see* 82T site chronology in Chapter 6). Combined with the proximity to this feature and the specialized focus on clams at this site over an extended period of time, this pattern indicates that generations of people who inhabited this place created this feature to expand and sustain use of this important resource.



Figure 7.11. Anthropogenically altered beach at Shiwitis (Site 82T). View looking south. Note canoe run in foreground. Picture taken at a 0.5m low tide (Photo by author).

Such focused, sustained, and patterned use, in combination with physical modifications to habitat, reflects a form of purposeful cultivation and is conducive to long-term resource stewardship and traditional environmental resource management (Cannon and Burchell 2009; Lepofsky and Caldwell 2013; Lertzman 2009; Moss 2011a). For intertidal areas, ecologically consequential management actions could be readily practiced through the periodic removal of shellfish predators such as sea stars (e.g., Paine 1974), the hunting and/or spatial exclusion of sea otters (e.g., Szpak, et al. 2012) as well as the physical alteration and expansion of habitat in order to maximize ecological productivity for specific preferred food items (e.g., Deur 2005; Groesbeck 2013). Thus, rather than a pattern of *exploitation*, such practices could serve to *facilitate* and sustain certain ecological interactions (cf. Bruno, et al. 2003; Haggan 2012; Menzies 2012; Smith 2011; Trospen 2009; Turner and Berkes 2006; Whitaker 2008).

Numerous ethnographic and oral historical references to Nuu-chah-nulth territorial tenure systems identify that lineage-based households held the rights to resources (*tuupati*) within local group territories (*hahuulhi*). Descriptions of Nuu-chah-nulth resource management emphasizes permission to access to resources (excluding others), distributing harvested resources according to long-standing community protocols, and maintaining respectful relations with animals through ritual observances (Arima 1983; Atleo 2004; Curtis 1916; Drucker 1951; Ellis and Swan 1981; George 2003; Inglis and Haggarty 1986; Sapir 1922).

The archaeological observations made here suggest a remarkable stability and continuity in Nuu-chah-nulth resource use for a range of regularly utilized fish and shellfish within a small local group territory. Archaeological evidence of resource use at this scale and

taxonomic focus does not exhibit clear evidence for a directionality that can be encompassed within “a single narrative of increasing Northwest Coast cultural complexity” (Moss 2012:1). In contrast, this record of resource harvesting and use provides an indication of the archaeological difficulty of distinguishing subtle cultural and ecological variability within and between sites. However, now that multi-scalar patterning in elements of resource use has been established for this study area, future research can build on these insights to better account for the long-term social, historical, and evolutionary processes they may represent.

Conclusion

This chapter has explored multiple scales of analysis and abundance measures in zooarchaeological patterning in order to provide more confidence in the archaeological observation of difference and similarity in resource use within a Nuu-chah-nulth local group territory. I have evaluated variation in resource use among several spatially, temporally, and culturally associated sites following Moss’s (2012) advocacy to engage with small-scale cultural and ecological variability in order to better interpret patterning within zooarchaeological datasets. Following Cannon (2001), this research moves beyond generalizing from an ecologically isolated individual site to examine variation in multiple sites that share ecological characteristics.

I focused on the most abundant and ubiquitous foods within the politically defined territory of the *Mak̓tl̓ii̓7ath̓* local group, spanning 20 km² with seven study sites in close proximity to each other (± 2 km), all maintaining broadly contemporaneous occupation sequences dating to within the last 2,500 years. From each of these sites I examined faunal remains from multiple auger sample levels and from multiple site areas and observe that herring, anchovy, greenling, rockfish, salmon, mussel, clam and barnacle are the most

abundant and ubiquitous species in all sites comprising over 350 depositional contexts. The strength of these observations derives in part from the spatially and temporally averaged sampling strategy, with a focus on the most regularly consumed foods using multiple abundance measures and scales of analysis. This analysis would have been much less representative if samples were taken from a single site area representing a narrow time frame. Future research will seek to broaden the basis for understanding variation and coherence with the goal of including more taxa, such as the important but relatively less regularly practiced activities such as whaling (Cavanagh 1983) and examining such patterning over more refined temporal scales.

While the cumulative outcomes of human food harvesting practices in the study sites are clearly influenced by ecological characteristics, they are more accurately a direct outcome of human agency in an ecological domain in that they reflect the structured and regularized use of resources in a small territory. The pervasive notion that Indigenous peoples on the Northwest Coast were simply subject to local and environmental availability (Cannon 2011b), masks the culturally situated and historically grounded knowledge about how the territories people maintained and the habitats people managed may be significantly enhanced relative to what was there ‘naturally’ (Ames 1991:942). As this case study has shown, an increased archaeological attentiveness to structured depositional practices (Garrow 2012) at multiple temporal scales ranging from the everyday to the *longue durée* (Braudel 1970; 1980) indicates that Indigenous peoples did not simply catch the species ‘that were there’ but did so within a “specifically cultural and historical consciousness” (Ortner 2005:34) that reflects a deep knowledge and history of use in this particular marine environment. This is illustrated by the persistent abundance of clams at site 82T across

multiple abundance measures and its proximity to a clam garden feature. With further exploration in relation to ecological dimensions of the study area (mussel beds, herring spawning habitats) and durable structures such fish traps and other intertidal rock alignment features recorded in this portion of the Broken Group archipelago, such associations have the possibility of being extended to a variety of other harvesting practices, cultural particularities and social conventions, as well as use of technologies and protocols of collecting food in this environment. Thus, while these patterns are ecologically influenced, they also inescapably cultural and this is an archaeological indication of “how contemporaneous sites within settlement systems functioned in relation to resource variability” (Moss 2012:6).

Chapter 8. Conclusion: Significance, Limitations, and Future Directions

This dissertation makes an original contribution by identifying several scales at which two fundamentally important domains of everyday life, **food and settlement**, are archaeologically patterned and persist and change over millennia on the Northwest Coast. Following the advocacy of Cannon (2001:185), I sought “to expand research strategies beyond individual sites to encompass a variety of site locations within specific regions.” I examined settlement and subsistence at a variety of scales, including the much of the Northwest Coast (Chapter 2), multiple linguistically and culturally distinct regions in southern British Columbia (Chapter 3), multiple sites in Barkley Sound and Prince Rupert Harbour (Chapter 4, 6, and 7), and between and within individual sites in Nuu-chah-nulth local group territories in Barkley Sound (Chapters 5-7). Collectively, this multi-scalar perspective offers a range of new insights into the temporal and spatial scales of archaeological variation on the Northwest Coast.

In contrast to a singular narrative of increasing cultural complexity involving the unidirectional growth, elaboration, and specialization of subsistence economies (Moss 2012), data presented in this dissertation indicate that several aspects of Northwest Coast subsistence and settlement demonstrate remarkable continuity over millennial and centennial time scales and across a large variety of coastal landscapes. This identification of spatially and temporally coherent archaeological patterning is anthropologically significant as it provides a basis for interpreting key dimensions of human lifeways on the Northwest Coast over the ‘long-term,’ especially since the actions that generated these observed patterns can be reliably assumed to have unfolded within the domain of the ‘everyday.’ This patterning is

an indication of how the culturally embedded practices (the *habitus* or system of *dispositions* [Bourdieu 1977]) of dwelling and eating durably persist over the *longue durée*, or ‘beyond the history of events’ (Braudel 1970). The archaeological identification of such repetitively enacted practices within settlements demonstrates “continuities of cultural categories” (Sahlins 1981:8) and further affirms the interpretive utility of focusing on “the little things one hardly notices in time and space” (Braudel 1981:29) such as the secular rituals of food and settlement.

This focus on “the material signatures of everyday practice” (cf. Garrow 2012) allows for the exploration of patterning at a fine scale but also the integration of these data across larger scales of history. It also provides a productive point of departure for contrasting the equally important, but more infrequently occurring archaeological examples of symbolically laden ritual and ceremonial events that purposefully represent a dramatic departure from everyday practice (cf. Klokler 2008; Luby and Gruber 1999; McNiven 2013). Considering the richness and multi-dimensionality of human history in relation to certain foods, certain land/seascapes, and certain ecological histories (Anderson 2002; Bolster 2012; Mintz and Bois 2002; Wilk and Barbosa 2012), archaeological research refining understanding of long-term foodways is likely to remain a productive avenue for considering how food harvesting has influenced the environments we inhabit and the everyday practices we often take for granted.

This dissertation has also demonstrated a simultaneous historical dynamism amidst longer-term patterning in settlement and subsistence (particularly in Chapters 4, 5, and 6). These are historical processes that unfold across an intermediate temporal scale, one that spans the lifetime of individuals and persists in social memory and is passed on through oral

history. This intermediate temporal scale provides a fundamentally vital link between Bourdieu's (1977) concept of *practice*, as an iterative unfolding of culturally constructed subjectivities and dispositions (Ortner 2005), and the regularized everyday practices of the *longue durée*.

Food

Four chapters in this dissertation demonstrate a regional and temporal coherence in the archaeological patterning specific to certain animal food remains in coastal settlements (Chapters 2, 3, 5, and 7). These patterns are strongly represented both at centennial and millennial time scales as well as at fine depositional scales that approximate 'structured use' within individual sites (cf. Garrow 2012). This patterning is evident across a large variety of coastal settings and at different archaeological site 'types,' and collectively represents a multitude of linguistically, culturally, and historically distinct Indigenous communities.

In chapter 2, I show that coastal settlements spanning the Northwest Coast, from Puget Sound in Washington to southeast Alaska, share a widespread pattern in the intensive and sustained use of Pacific herring, a small and ecologically important forage fish that is a foundation for marine foodwebs on which many other species depend. This contribution provides new insight into a coast-wide focus on this oil-rich fish, which also prolifically spawns on kelp and other substrates. This analysis significantly revises archaeological understanding of Northwest Coast fisheries and appropriately broadens the anthropological and archaeological focus beyond salmon. It further demonstrates regional variation, with particularly intensive use of herring in the northern and western portions of the Salish Sea (northern strait of Georgia) and in Barkley Sound. Temporal analyses of herring abundance data from 50 sites throughout the coast also illustrate a relative lack of chronological

variability in herring use and secondarily provide insight into settlement variability with respect to fisheries. Future research on this considerable dataset, integrating a host of recent and neglected primary and grey literature, has the potential to further refine archaeological patterning for other species and also has relevance for fisheries management, historical ecology, and the zooarchaeology of human-animal relationships.

Additional fisheries data from Nuu-chah-nulth territories in Barkley Sound presented in Chapters 5 and 7 provide further indication of the importance of herring and can be linked to the earliest documented European observation of a Nuu-chah-nulth village. Upon visiting the village of Yuquot in ‘Friendly Cove’ in March of 1778, Captain James Cook described herring eggs (herring roe) as the “winter bread of these people” and recounted the Mowachaht method for preserving herring in the rafters of houses:

“They hang them on small rods at first about a foot from the fire, afterwards they remove them higher and higher to make room for others till they get to the roof of the house; when dried they are made up into bales and covered with Mats; thus they are kept till wanting and eat very well, but there is but little meat upon them. In the same manner they cure Cod and other large fish, and some are cured in the air without fire.”

(Beaglehole 1967:303-304)

This description of herring processing and storage is fulsomely illustrated by the expedition’s artist, John Webber, who sketched the interior of chief Maquinna’s house, including approximately 2,600 small herring-sized fish hanging from the rafters or being smoked or stored along with 26 fish of other species (Figure 8.1). This image provides further insight into daily practices within a Nuu-chah-nulth house and village at contact and can be related to an archaeological history spanning millennia. While it remains to be confirmed whether the small fish depicted are indeed herring, it is notable that the month of the visit, March, is a peak time for herring spawning.

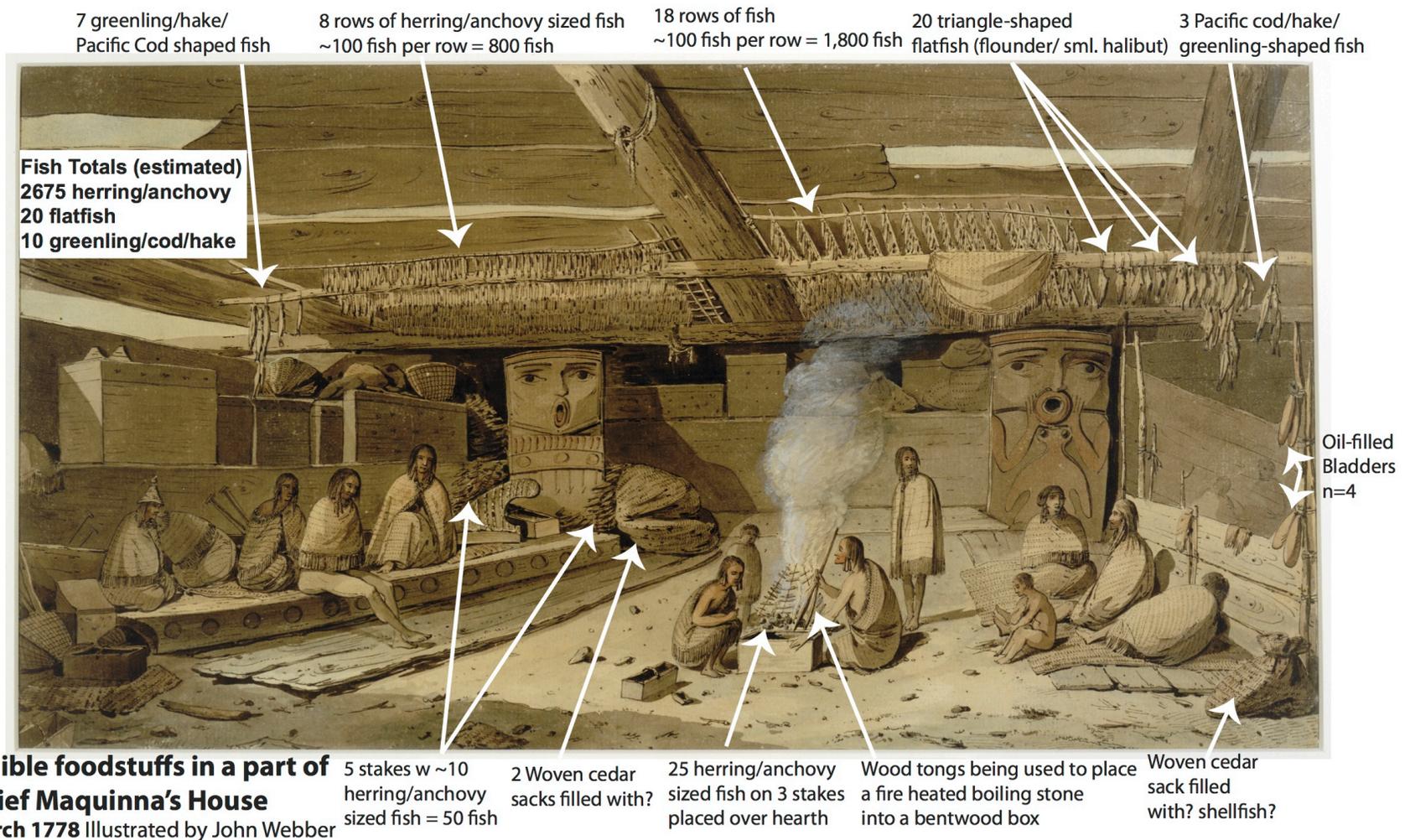


Figure 8.1 Illustration by John Webber depicting the inside a portion of the house of Mowachaht Muchalaht Chief Maquinna. Annotations estimate the number and type of fish species (98.8% herring or anchovy). Image courtesy of the Peabody Museum of Archaeology and Ethnology, Harvard University (Peabody ID: 41-72-10/499).

In chapter 3, I identified long-term stability in marine and terrestrial hunting practice that overlaps with linguistically distinct culture areas (Nuu-chah-nulth and Coast Salish). While this patterning does correlate with environmental factors, it is more directly a reflection of purposeful action undertaken by generations of people who maintained a technologically sophisticated and culturally embedded hunting practice, without which human relations with these particular animals could not be sustained (e.g., pelagic fur seal hunting). These regionally coherent patterns persisted not simply because animals were ‘out there’ but because of the intergenerational transference of particular skills, ritual magic, and place-based knowledge as well as the long-term resilience of these animals in the face of culturally specialized human harvesting. This analysis provides further insight into the complex regional expression of social and economic relations within and between Nuu-chah-nulth and Coast Salish cultural histories. It also illustrates consistency between archaeological and Indigenous perspectives on food types as exemplified in this quote from Edward Sapir describing Tom Sayach’apis’ unfamiliarity with certain foods:

“Tom ate very little meat of land mammals in his early days. Indeed, like most of the [west] Coast people, he had a prejudice against deer meat and it was not until as a middle-aged man, he had come into contact with some of the deer hunting tribes of the interior of the island, that he learned to prize it, though to this day, venison has not for him the toothsome appeal of a chunk of whale meat” (Sapir 1922:304).

Together, these observations represent continuity in patterning in subsistence over millennia but also exhibit differences in the relative proportionality of commonly used animals at regional, sub-regional, and micro-environmental scales. The identification of such large-scale patterning, as well as the compilation of a diffuse and often obscurely published primary literature that underlies it, provides an opportunity for future researchers to investigate patterning on a spatially and temporally expansive scale as well as on smaller spatial and

temporal scales. For example, examining sub-regional patterning in marine mammal hunting can be further evaluated with other datasets (e.g., stable isotopes), provides a basis to infer the differential emphasis on particular mammal species in Indigenous ritual life (e.g., Sapir 1922; Suttles 1952), and provides better estimates of the long-term ecological baselines in relation to recent conditions and management regimes (e.g., Jackson, et al. 2001).

This dissertation offers some specific examples of how certain forms of regularly practiced subsistence activities are expressed in the archaeological record on the Northwest Coast. At a coarse scale, I have identified strong evidence for widely shared aspects of everyday cultural practices, stretching across large regions of the coast and emerging from a deep engagement with specific animals and places, over thousands of years. At a finer spatial scale, the observed differences in food remains among sites located close to one another affirms the persistence of ‘routines of habit’ specific to and influenced by particular places (Mackie 2001). It also indicates that some elements in Indigenous conceptions of ‘food’ are very broadly understood while others exhibit subtle differences between regions, sites. This continuity suggests this strong repetition underlies the patterning of the *longue durée* as it emerges from culturally situated everyday subsistence practices. This similarity further affirms the practice-based perspective that food is not simply a basis for survival but rather a culturally organized process (Sahlins 1976) that expresses a “specifically cultural and historical consciousness” (Bourdieu 1984; Ortner 2005:34).

Settlement

I have examined the broad-scale patterns and historical dynamics of settlement and place using radiocarbon dates (Chapters 4 and 6) and subsistence in coastal shell midden sites (i.e., Chapters 2, 3, 5, and 7). In Chapter 4, I focused on an area that has been extensively

researched with a rich archaeological chronology (Prince Rupert Harbour). In this analysis Eldridge and I applied available marine reservoir correction data to recalibrate two previously disparate archaeological datasets (burial dates and village abandonment dates), allowing us to place them on a single calibrated timescale. This revised analysis makes more explicit the archaeological basis for inferring a large-scale change in the settlement history for the Northern Northwest Coast and established a foundation for further research involving dates on marine or marine influenced organisms. As Ames (2005), Archer (2001), and Martindale and Marsden (2003) have argued, this change resulted from a disruption in settlement as a result of large-scale conflict between the Tsimshian people and culturally distinct groups from the north – an event recorded in Tsimshian oral history. Despite the relatively sudden abandonment of this dense aggregation of settlements, we observe the chronology of human interments to persist and even peak centuries after the period of ‘abandonment.’ This contrast in patterning indicates a centuries-long continuation of ancestral, lineage-based affiliations with particular former village locations and suggests a cultural emphasis on maintaining connections with ancestors. The chapter also is methodologically relevant for calibration of marine radiocarbon dates and the integration of regional radiocarbon datasets more broadly.

In Chapter 6, I examined the spatial and temporal sequence of archaeological settlement alongside Indigenous oral historical sequences recorded in the early 20th century and observed a complementarity stretching back more than 2,000 years. I show there is enduring consistency in Nuu-chah-nulth occupation and use of landscapes at a site scale and household scale (also evident in Chapter 5) as well as within several broadly contemporaneous sites in a small territory (Chapters 6 and 7). These aspects of settlement

and subsistence are consistent with the Nuu-chah-nulth concepts of territory (*hahuulhi*) in which local resources were used and managed intensively while others were excluded. This is further apparent in the asserted protection of their territory through the sudden construction and large-scale occupation of an elevated, difficult-to-access defensive fortress. This site in particular is a physical manifestation of the assertion of political and territorial autonomy in the face of conflict and contested control of a resource-rich archipelago.

Chapter 6 also demonstrates that sequences of oral narratives can describe archaeologically observable construction sequences within a single village (*Ts'ishaa*) as well as the relative sequences of the establishment of separate village sites nearby (*Matkl7ii*, *Huumuwaa*, and *Huts'atswilh*). This complementarity is observed in the context of a small named oral historically identified territory (*Makl7ii7ath*) in a portion of the Broken Group Islands. This identification of parallel lines of archaeological and oral historical evidence strengthens and enriches archaeological inference (Wylie 1989, 2009). It simultaneously reveals a historical dynamism as well as continuity in the place-based familiarity that Nuuchah-nulth communities had with their villages and the cultural landscapes surrounding them.

This chapter explored how Indigenous oral narratives provide culturally situated insights into the events and causal factors of history and how Indigenous place names provide a spatial architecture for understanding the locations and landscapes in which that history unfolded. This subjective frame on the events of history helps to inform not only 'the past' but the how the past was 'understood.' Although this latter point is beyond my ability to fully explore, this effort to connect this information with archaeological settlement data provides a further indication of the interpretive potential of combining archaeological and Indigenous histories, particularly in the context of place names.

Attentiveness to these oral historical accounts additionally details the Indigenous perspective on disruptions to settlement that occurred before and after contact with Europeans in the late 18th century. During the initial contact era, differential access to trading vessels and simmering tensions between politically autonomous local groups resulted in a number of amalgamations and conflicts as detailed in Indigenous oral histories. This latter insight importantly complicates the historical perspective on the events during maritime fur trade on western Vancouver Island (ca. 1778-1805) as a period of undifferentiated ‘enrichment’ for Nuu-chah-nulth communities participating in the trade (Fisher 1977). Rather, this research has contributed to further contextualizing the varied consequences of the colonial encounter in the late 18th century (Clayton 2000; Martindale 2009; McMillan 2009; Salmond and Salmond 2010; Sellers 2013). The contact-era shifts in territories and political amalgamations further demonstrate how ‘enrichment’ is an overly simplified perspective that “ignores too much of what was going on along the Northwest Coast during the contact years” (Harris 1997:81).

Collectively, these settlement-related case studies illustrate the interpretive utility of considering Indigenous oral history alongside the evaluation of archaeological data. It also highlights the importance of applying a temporally refined ‘medium-term’ scale of historical analysis to archaeological data to track the dynamism represented over the lived experiences of individuals. Such ‘medium-term changes’ that span beyond the event-centered history such as Braudel’s (1970) *conjunctures*, comprise an interpretively rich scale of historical analysis, which, although clearly represented in Indigenous oral traditions, is commonly lacking or rarely specified in many archaeological sequences. Here, I have added chronological resolution to the previously identified phenomena of a peak in the

abandonment of 22 village sites in a highly populated locality of Prince Rupert Harbour (Archer 2001; Martindale and Marsden 2003) amidst a more extended history of burial practices. In Barkley Sound, I explored the implications of a sudden reorganization of settlement during the contact era, the outcome of which was historically formative for the persistence of contemporary Tseshaht and Huu-ay-aht First Nations.

The archaeological research presented in this dissertation further demonstrates the value of engaging with Indigenous oral narrative on the Northwest Coast. It provides an example of how a detailed consideration of such information can be “translated across cultural epistemologies” (Martindale 2006:160) to strengthen what is often a necessarily more tenuous set of inferences had they rested solely on archaeological observations. It also shifts the evaluation of oral history from a role in ethnographic analogizing towards a more holistic effort to rigorously interrogate human history on the Northwest Coast, one in which archaeology is a part (Atalay 2008; Martindale 2006; Wylie 2009).

Data Sources

This research has drawn on a wealth of previously existing data compiled by dozens of researchers over several decades as well as my own primary field and laboratory research, which is also set within a long-standing research effort in Barkley Sound. I focused on compiling two types of data (morphologically identified animal bones and shells and radiocarbon dates) across a large range of archaeological scales. These two archaeological datasets comprise a robust basis for archaeological interpretation relative to other common forms of archaeological observation (e.g., artifacts types, architectural features, cultural historical phases). These data are quantitatively comparable, which has made it possible to simultaneously expand the scale of analysis and incorporate a range of data beyond my

personal capacity to collect. Such forms of directly comparable data, increasingly synthesized by individual researchers (e.g., appendices in Angelbeck 2009 and Morin 2012) and compiled in interactive data repositories (e.g., Blake, et al. 2012; Gajewski, et al. 2011) allow for a richer collaborative synthesis in Northwest Coast archaeological knowledge.

Limitations

A fundamental drawback to the interpretation of archaeological data are the challenges of sampling and the problem of time. This dissertation has examined ubiquitous aspects of the archaeological record of food and settlement but has done so without giving equal attention to the issues and data presented in each individual chapter. This logistically necessary constraint can also be considered a virtue in part as it provides a clarity of focus on a limited number of variables at large scales or alternatively, and at the same time, a larger set of variables examined at a smaller spatial and temporal scale. Such a ‘tradeoff’ is present throughout the dissertation and leaves unexplored gaps in evaluation. For instance, the zooarchaeological analysis of Indigenous fisheries undertaken in Chapter 2 took a broad scale approach to much of the Northwest Coast but was limited to the analysis of a single (albeit numerically dominant) species – herring. Similarly, the sequences explored in Chapter 5 do not match the level of detail provided in Chapter 7, either in terms of size of the identified assemblage, the temporal resolution, or the quantitative metrics (MNI, MNI per m³, etc.). In spite of this potential shortcoming, Chapter 7 presents data from multiple areas within five separate study sites and includes shellfish in addition to fish remains. Other chapters examined a more wide ranging suite of data, including contextualizing patterning in relation to present day variation and change and identifying a number of important contrasts

(Chapters 2 and 3). However, further exploration is warranted, such as a more thorough integration of ecological and archaeologically observed patterning (Moss 2012).

It is significant that those food items focused on in this dissertation are only those that were relatively most abundant in zooarchaeological deposits. However, this only represents a small fraction of the total representation of harvested items. In order to assess the abundance of comparatively infrequently occurring (rare) items (e.g., birds, land mammals), it will be necessary to conduct a much more intensive and targeted approach to sampling (Gray 2008). Another limitation is the difficulty of assessing the cryptic influence of cultural and non-cultural taphonomy in structuring the way in which archaeofaunal patterning is expressed. The approach taken in this dissertation has been to identify those elements of the archaeological record that are most abundant and ubiquitous, which reveals key aspects of pervasively used Indigenous foods and does not require as large of a sample to assess patterning.

While this dissertation has provided detail on the enduring continuity of a range of cultural practices, it also reveals a historical dynamism at finer temporal and spatial scales. These insights provide a productive reference point for further scrutinizing increasingly refined scales of variability in future research. For instance, at the most refined temporal and spatial scale examined (Chapter 5), I observed spatially and temporally coherent changes in the proportionality of fish taxa within multiple areas of a large household at a single site. This relatively highly resolved record reveals fluctuations in the abundance of regularly consumed taxa that are not as apparent at the coarser scales explored in chapters 2, 3, and 7. Thus, patterning at a coarser scales may mask the patterns we might observe at a finer scale and by extension, obscure the social histories that produced them .

Variation and Scale into the Future

The challenge of these results is both simple and profound. I have argued that the archaeological data in this thesis is evidence of continuity in Indigenous history over millennia, but that it emerges from cultural conventions in which the volatility of individual agency is contained within what we might think of as tradition. This allows Indigenous history to be both dynamic and patterned, adaptive and responsive, and ultimately to be the history of both purposeful negotiation and under-acknowledged convention. It is this dynamic that links the *longue durée* to the everyday, that allows us to see the constancy of intergenerational transference of convention in routinized momentary acts. The challenge is twofold, empirical and theoretical. The first is to test this consistency by evaluating archaeological patterning in greater detail and at finer scales to query whether the broad patterns of history that I have outlined here are upheld. The second is to consider how the *longue durée*, and thus the long-term patterns of archaeological data, can be reconciled with the everyday moments that make up human history.

One key domain explored in this dissertation is the complex ecological influence that human foodways have both exerted on and been shaped by marine environments over multiple human generations. I have sought to explore the small-scale spatial variability in the use of regularly used foods within contemporaneous sites in a small area or region and shown it to be influenced by ecological habitats in proximity to human settlements. This has been observed in patterns of shellfish and rockfish (Chapter 7) and herring and herring spawning areas (Chapter 2) and more broadly with marine and terrestrial mammals (Chapter 3). However, these patterns are also influenced by modification and expansion of habitat such as in the construction and use of clam gardens or the long established practice of burning oak scrubland to facilitate growth of camas and forage for deer. Thus, while the exploration of

such patterning presented here, has provided a way to distinguish how “contemporaneous sites within settlement systems functioned in relation to resource variability” (Moss 2012:6), we still have a long way to go in our explorations of people’s relationships with everyday food.

A final challenge facing future research is grasping the vast scale of the archaeological history on the Northwest Coast that has yet-to-be investigated. A hint of the magnitude of this under-explored historical complexity is suggested Figure 8.2 which depicts over 5,300 recorded coastal shell midden sites on the coast of British Columbia as filed in the provincial archaeological database collectively representing more than 50 years of survey observations by archaeologists and First Nations heritage managers. This map vastly eclipses the number of Indigenous communities on the coast today and yet only represents those shell midden sites located on the shoreline of tidally influenced waterways. However, it is an indication of the richness archaeologists have yet to address as less than 1% of these sites have been subject to sustained excavation let alone zooarchaeological analysis and radiocarbon dating. It also does not reflect the numerous regions which have yet to be surveyed such as those now-underwater or inland sites that were once situated on a former shoreline (Mackie, et al. 2011). Future research into such a large and complex archaeological history will, in the words of Joan Gero (2007), undoubtedly require that “honoring ambiguity” and “problematizing certitude” remains a vitally important part of the interpretive process in the present and into the future.

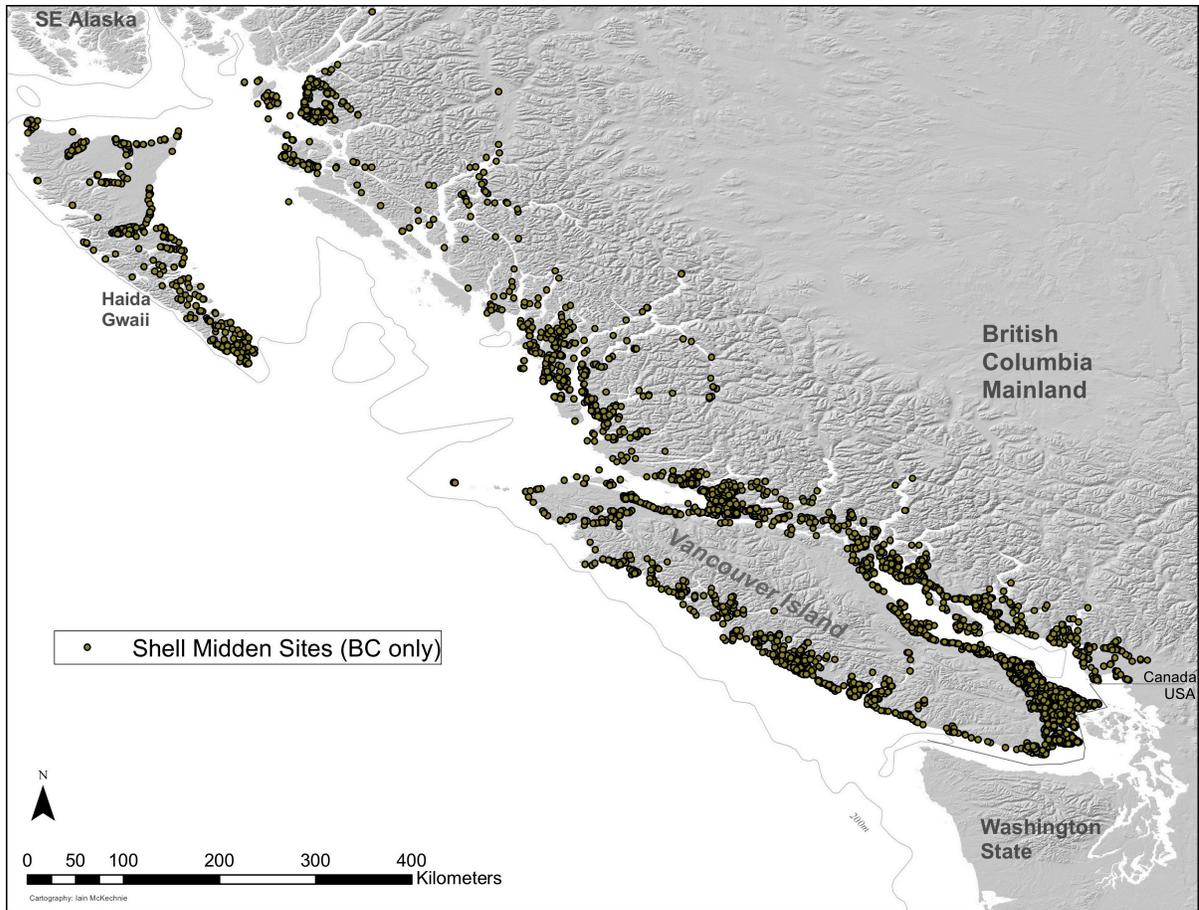


Figure 8.2 Archaeologically recorded shell middens on the British Columbia Coast as represented in the provincial archaeological database (N=5,383, data current as of May 2010). Least well-surveyed area indicated by the lack of green dots along eastern Hecate Strait, south of Prince Rupert, and east of Haida Gwaii.

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Appendices For Chapter 2

Table 2.1 Archaeological data for Pacific herring and associated chronological information for all sites (N = 171). Relative abundance and rank order data based on number of identified skeletal specimens (NISP).

Table 2.2 Individual assemblage data for the 50 sites with within site-variability presented in Figure 2.6 Numbers on left correspond with sites listed in in Table 2.1.

Table 2.3 Distance between archaeological sites dating to within the last 2,500 years and documented spawning localities mapped by federal fisheries monitoring efforts (ca. 1930-2012) and available data Traditional and Local Ecological Knowledge (TEK/LEK) datasets. Numbers on left column correspond with sites listed in Table 2.1.

Table 2.1 Archaeological data for Pacific herring and associated chronological information for all sites (N = 171). Relative abundance and rank order data based on number of identified skeletal specimens (NISP).

No.	Region ^a	Sub-region ^b	Arch. Site No.	Zooarchaeological Reference	NISP ^c	N Taxa	% NISP	Rank ^d	Time Interval Years BP ^e	Reference for ¹⁴ C Date & stratigraphic context
1	SS	SVI	DcRu-75	(Wilson, et al. 2003:85, Table 32)	682	13	42%	2	300-1200	(Wilson, et al. 2003:93)
2	SS	SVI	DcRu-78	(Wigen 2009:3, Tables 2 & 3)	61	4	90%	1	Historic/300-1200*	(Mitchell 1981)
3	SS	SVI	DcRu-4	(Stewart and Wigen 2003:29, Table 1)	903	13	64%	1	300-1200	Gajewski et al. 2011 (Gajewski, et al. 2011)
4	SS	SVI	DcRt-16	(Wilson, et al. 2004a:114, Table 45)	746	13	79%	1	300-1200	Wilson et al. 2004:121 (Wilson, et al. 2004a)
5	SS	SVI	DcRt-10	(Willerton 2009:150, Table 12.4)	3167	13	77%	1	300-1200/1200-2400	Willerton 2009:36 (Willerton 2009)
6	SS	SVI	DcRu-71	(Wigen 2000:11, Table 5)	78	6	81%	1	1200-2400/2400-5000*	Eldridge 2000:33 (Eldridge 2000)
7	SS	SVI	DcRw-57	(Bowie and Wigen 2010:42, Table 2)	205	10	0.5%	7	300-1200*	Bowie & Wigen 2010a:48 (Bowie and Wigen 2010)
8	SS	SVI	DcRv-21	(O'Neill 2007:40, Table 3)	57	5	77%	1	300-1200*	O'Neil 2007:28 (O'Neill 2007)
9	SS	SVI	DdRu-81	(Bowie, et al. 2010:164, Table 29)	1815	20	75%	1	300-1200	Bowie et al. 2010:184 (Bowie, et al. 2010)
10	SS	SVI	DdRu-4	(Wilson 2005:154, Table 67)	638	14	62%	1	300-1200	Cooper 2008 (Cooper 2008); Wilson 2005 (Wilson 2005)
11	SS	SVI	DeRu-1	(Hewer 1999:26, Table 4)	1589	17	86%	1	1200-2400	Hewer 1999:52 (Hewer 1999)
12	SS	SVI	DdRu-5	(Kanipe, et al. 2007:Appendix E, Table 11)	316	7	89%	1	300-1200	Kanipe et al. 2007:283-284 (Kanipe, et al. 2007)
13	SS	SVI	DdRu-18	Weathers et al. (Weathers, et al. 2007:31, Table 8)	57	10	21%	2	300-1200*	Weathers et al. 2007:36 (Weathers, et al. 2007)
14	SS	GI-BC	DdRt-6	(O'Neill and Wilson 2005:47, Table 6)	597	12	93%	1	300-1200/1200-2400/2400-5000*	O'Neil & Wilson 2005:52 (O'Neill and Wilson 2005)
15	SS	GI-BC	DeRu-44	(Wilson 1988:Appendix 1)	93	4	90%	1	1200-2400	Wilson 1988:44 (Wilson 1988)
16	SS	GI-BC	DfRu-3	(Brolly, et al. 1993:71, Table 7)	1155	9	88%	1	300-1200/1200-2400	Brolly et al. 1993:91-92 (Brolly, et al. 1993)
17	SS	GI-BC	DeRt-1	(Hanson 1995:36 & 39)	473	12	75%	1	300-1200	Hanson 1995:32 (Hanson 1995)
18	SS	GI-BC	DeRt-109	Wigen 2007(Wigen 2007a:103, Table 12)	521	13	85%	1	300-1200	Sumpter & Fedje 2007:62 (Sumpter and Fedje 2007)
19	SS	GI-BC	DgRu-3	(Ewonus 2011:77-78, Table 1)	12675	29	70%	1	1200-2400	Grier 2006:102 (Grier 2006)

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20	SS	GI-BC	DgRv-4	(McLay 1999b: Appendix 5)	1681	9	96%	1	300-1200*	McLay 1999:67 (McLay 1999b)
21	SS	GI-BC	DgRv-1	(McLay 1999b: Appendix 5)	246	9	86%	1	300-1200*	McLay 1999:67 (McLay 1999b)
22	SS	GI-BC	DgRv-2	(McLay 1999b: Appendix 5)	404	6	93%	1	300-1200*	McLay 1999:67 (McLay 1999b)
23	SS	GI-BC	DgRv-2	(Matson, et al. 1999:61-71)	2039	14	74%	1	300-1200	Matson 2003:85 (Matson 2003)
24	SS	GI-BC	DgRw-78	(McLay 1999b: Appendix 5)	59	6	39%	1	300-1200*	McLay 1999:67 (McLay 1999b)
25	SS	GI-BC	DgRw-73	(McLay 1999b: Appendix 5)	646	7	89%	1	300-1200*	McLay 1999:67 (McLay 1999b)
26	SS	GI-BC	DgRw-32	(McLay 1999b: Appendix 5)	80	8	55%	1	300-1200*	McLay 1999:67 (McLay 1999b)
27	SS	GI-BC	DgRw-4	(Oliver and Park 1997:Appendix 3)	552	8	86%	1	300-1200/1200-2400	Burley 1989:33 (Burley 1989)
28	SS	GI-BC	DgRw-204	(van Gaalen 1991:Table 3)	631	8	72%	1	1200-2400	Curtin 1991:38 (Curtin 1991)
29	SS	GI-BC	DiSe-10	(Eldridge 1987:5-63-65, Table 5-13-15)	166	8	71%	1	2400-5000*	Eldridge 1987:5-14 (Eldridge 1987)
30	SS	EVI	DjSf-13	(Mason and Hoffmann 1998:AIV-9, Table AIV-8)	221	7	92%	1	300-1200/1200-2400	Mason and Hoffmann 1998:Appendix V & VI (Mason and Hoffmann 1998) and Mitchell 1974 (Mitchell 1974)
31	SS	EVI	DkSf-26	(Mitchell 1988:17, Table 6)	4577	17	78%	1	1200-2400/2400-5000	Mitchell 1988:16 (Mitchell 1988)
32	SS	EVI	DkSf-40	(Wilson and Clark 2003:40, Table 10)	83	5	83%	1	300-1200	Wilson & Clark 2003:47-48 (Wilson and Clark 2003)
33	SS	EVI	DkSf-4	(Simonsen 1991:Appendix tables, pg 53 of 59)	2612	10	89%	1	1200-2400	Simonsen 1991:27 (Simonsen 1991)
34	SS	EVI	DkSf-19	(Caldwell 2008:120, Table 5.39)	2721	8	96%	1	1200-2400	Caldwell 2008:175 (Caldwell 2008)
35	SS	EVI	DkSf-29	(Hall, et al. 2003:83-93)	909	10	88%	1	300-1200/1200-2400	Hall et al. 2003:33 (Hall, et al. 2003)
36	SS	EVI	DiSc-26	(Wilson 2003:42 Table 13)	215	6	86%	1	300-1200	Wilson 2003:52-53 (Wilson 2003)
37	SS	EVI	DiSe-7	(Wilson, et al. 2004b:44, Table 5)	5638	14	94%	1	300-1200/1200-2400/2400-5000	Wilson et al. 2004:48-50 (Wilson, et al. 2004b)
38	SS	EVI	DhSb-3	(Wilson, et al. 2006:60, Table 18)	661	9	97%	1	1200-2400	Wilson et al. 2006:83-84 (Wilson, et al. 2006)

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39	SS	EVI	DhSb-11	(Bowie and Wigen 2010:41, Table 3)	2464	10	97%	1	300-1200	Kristensen et al. 2009:87, (Kristensen, et al. 2009)
40	SS	EVI	DhRx-16	(Wilson and Crockford 1994:105, Table 38)	2870	10	97%	1	1200-2400	Wilson & Crockford 1994:v (Wilson and Crockford 1994)
41	SS	EVI	DhRx-66	(Stryd, et al. 1993:70)	2578	9	97%	1	300-1200	Stryd et al. 1993:81 (Stryd, et al. 1993)
171	SS	EVI	DhRx-101	(Eldridge, et al. 2007:101-102, Table 8)	430	8	90%	1	300-1200/1200-2400	Eldridge et al. 2007:54 (Eldridge, et al. 2007)
42	SS	EVI	DhRx-104	Pawlowski 2008(Pawlowski 2008:16, Table 4)	195	3	89%	1	300-1200*	Pawlowski 2008:17 (Pawlowski 2008)
43	SS	EVI	DgRw-46	(Storey 2010:44, Table 6)	65	3	97%	1	300-1200	Storey 2010:37 (Storey 2010)
44	SS	EVI	DgRw-34	(Willows 2009:39, Table 3; Willows, et al. 2012:118-119, Tables 14&15)	1668	17	87%	1	300-1200/1200-2400	Willows et al. 2012:138 (Willows, et al. 2012)
45	SS	EVI	DeRv-68	(Brunsden and Cooper 2008:17, Tables 2 & 3 combined)	456	5	64%	1	300-1200*	Brunsden and Cooper 2008:10 (Brunsden and Cooper 2008)
46	SS	ESG	EaSe-18	(Caldwell 2013)	5715	10	85%	1	300-1200	Caldwell 2013 (Caldwell 2013).
47	SS	ESG	EaSe-11	(Caldwell 2013)	409	7	74%	1	300-1200	Caldwell 2013 (Caldwell 2013).
48	SS	ESG	EaSe-76	(Caldwell 2013)	705	9	37%	2	1200-2400	Caldwell 2013 (Caldwell 2013).
49	SS	ESG	DISd-3	(Caldwell 2013)	595	10	93%	1	300-1200	Caldwell 2013 (Caldwell 2013).
50	SS	ESG	DISd-6	(Caldwell 2013)	1410	8	93%	1	300-1200	Caldwell 2013 (Caldwell 2013).
51	SS	ESG	DISe-10	(Caldwell 2013)	64	6	9%	4	300-1200	Caldwell 2013 (Caldwell 2013).
52	SS	ESG	DISd-17	(Caldwell 2013)	680	9	93%	1	Historic/300-1200	Caldwell 2013 (Caldwell 2013).
53	SS	ESG	DjRw-1	(Caldwell 2013)	1791	10	97%	1	300-1200	Coupland et al. in prep.
54	SS	FD	DhRr-18	(Coupland 1991:88, Table 3)	5429	11	82%	1	1200-2400	Coupland 1989:71 (Coupland 1991) Coupland 1991:89 (Coupland 1989)
55	SS	FD	DhRt-6	(Brolly and Muir 1993:51, Table 11)	897	11	42%	1	2400-5000	Brolly & Muir 1993:31, (Brolly and Muir 1993)
56	SS	FD	DhRr-6	(Pierson 2011:77-78, Appendix 1)		28			300-1200/1200-2400/2400-5000	Pierson 2011:27 (Pierson 2011)

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57	SS	FD	DhRr-18	(Trost 2005:111, Appendix C)	4640	19	57%	1	300-1200*	Lepofsky et al. 2007:196 (Lepofsky, et al. 2007)
58	SS	FD	DhRq-1	(Pierson 2011:83-84, Appendix 1)	2098	22	40%	1	300-1200/1200-2400	Pierson 2011:31 (Pierson 2011)
59	SS	FD	DgRr-6	(Casteel 1976b:85, Table 5-2)	304	8	1%	4	1200-2400/2400-5000/5000-10000	Matson 1976 (Matson 1976)
60	SS	FD	DgRs-14	(Wigen 2002:1)	221	9	32%	1	1200-2400	Hammon 1986:97 (Hammon 1986)
61	SS	FD	DgRs-2	(Kusmer 1994b:133, Table 5-12; 1994a:197, Table 4)	1244	9	25%	3	300-1200/1200-2400/2400-5000	Kusmer 1994a (Kusmer 1994a) and Stryd et al 1994: volume 2:120 (Stryd, et al. 1994)
62	SS	FD	DgRs-1	(Brolly, et al. 1996:162 Table 13)	4589	10	22%	2	300-1200/1200-2400/2400-5000	Brolly et al. 1996:156, 180, & 209 (Brolly, et al. 1996)
63	SS	FD	DgRr-1	(Butler and Campbell 2004:349; Matson 1992: cited in Campbell and Butler 2004)	25659	12	6%	3	1200-2400/2400-5000	Matson 2010:1-2 (Matson 2010)
64	SS	PSnd	45-KI-23	(Butler 1987:Table 10-1, pg. 10-2)	3999	16	0.1%	13	300-1200	Blunkis Onat 1987:5-7 (Blunkis Onat 1987)
65	SS	PSnd	45-KP-115	(Butler and Baker 2002:11, Table 2 cited in Campbell & Butler 2004:349; Butler and Campbell 2004)	806	8	43%	1	300-1200	Lewarch et al. 2002:48 (Lewarch, et al. 2002)
66	SS	PSnd	45SK43	(Nelson, et al. 2010a:53, Table 7.5)	14800	11	25%	2	300-1200/1200-2400/2400-5000	Nelson et al. 2010a:33 (Nelson, et al. 2010a)
67	SS	PSnd	45-KI-437	(Kopperl and Butler 2002:107, Table 10.1)	5321	16	80%	1	Historic/300-1200	Stein & Phillips 2002:58 (Stein and Phillips 2002) see also Kopperl 2001:3 (Kopperl 2001)
68	SS	GI-WA	45SJ24	(Pegg 1999:67, Table 3.1)	18654	11	68%	1	300-1200	Pegg 1999:19 (Pegg 1999) and Stein et al. 2003:303 (Stein, et al. 2003)
69	SS	GI-WA	45-SJ-169	(Wigen 2003a:283, Table D.7)	3223	24	52%	1	300-1200/1200-2400/2400-5000	Walker 2003:76, Table 6.4 (Walker 2003)
70	SS	GI-WA	45-SJ-280	(Kopperl 2007:16, Table 1)	2450	14	6%	3	300-1200/1200-2400/2400-5000	Bovy et al. 2007:20 (Bovy and Kopperl 2007)
71	SS	PSnd	45IS2	(Trost, et al. 2010:B8, Table B.10)	16154	31	3.80%	6	300-1200	Shalk and Nelson 2010:102, (Shalk and Nelson 2010)
72	SS	PSnd	45IS263	(Smith, RE, et al. 2011b:23, Table 13)	401	15	6%	5	300-1200	Smith et al. 2011:l (Smith, RE, et al. 2011b)
73	SS	PSnd	45-IS-119	(Nelson, et al. 2010b:30, Table 6.2)	160	10	1%	7	300-1200	Nelson et al. 2010b:41

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										(Nelson, et al. 2010b)
74	SS	GI-WA	45SJ200	(Kopperl 2000:27 Table 1)	126	11	25%	1	300-1200*	NA
75	SS	GI-WA	45JS252	(Kenady 2000:11, Table 9)	373	6	19%	2	300-1200	Kenady 2000:Appdx. A (Kenady 2000)
76	SS	PSnd	45KI428 & 29	(Wigen 1995:A5-66, A5-70, Table A5-13)	8057	29	2%	8	300-1200/1200-2400/2400-5000	Larson & Lewarch 1995: Table 6.1, pg 6-4-6-5 (Larson and Lewarch 1995)
77	SS	PSnd	45PI974	(Shantry, et al. 2010:54, Table 13)	1226	12	43%	1	300-1200	Shantry et al. 2010 (Shantry, et al. 2010)
78	SS	PSnd	45MS50	(Wessen 2004:46-47, Tables 14 & 15)	1248	7	2%	7	300-1200/1200-2400	Wessen 2004:Appendix B (Wessen 2004)
79	WCVI	WCVI	EdSv-4	(Wigen 1999b:Table 3)	183	14	38.80 %	1	Historic/300-1200/1200-2400*	NA
80	WCVI	WCVI	DiSo-9	(Calvert 1980:298 & 302, Tables 45 & 49)	19426	22	48%	1	1200-2400	Calvert 1980:123, Table 9 (Calvert 1980)
81	WCVI	WCVI	DgSl-67	(Wilson 1994:18, Table 2)	68	10	57%	1	300-1200	Wilson 1994:27 (Wilson 1994)
82	WCVI	BS	DfSj-40	(Brolly and Pegg 1998:167)	757	12	79%	1	300-1200/1200-2400	Brolly & Pegg 1998:156 (Brolly and Pegg 1998)
83	WCVI	BS	DfSj-100	(Weathers, et al. 2008; Wigen 2008b:16, Table 6)	1021	15	79%	1	2400-5000	Stryd et al. 1991:37 (Stryd, et al. 1991)
84	WCVI	BS	DfSj-57	(Spady and Wigen 2008:49, Table 8)	1852	14	84%	1	300-1200	Spady & Wigen 2008:60 (Spady and Wigen 2008)
85	WCVI	BS	DfSi-16 & 17	(McKechnie 2005b:125, Appendix B1)	6979	21	53%	1	300-1200/1200-2400/2400-5000	McMillan & St. Claire 2005:45&77 (McMillan and St. Claire 2005)
86	WCVI	BS	DfSi-26	(McKechnie 2007b:29, Table 12)	157	7	58%	1	300-1200	(McKechnie 2007b:24)
87	WCVI	BS	129T	This Study	1738	17	61%	1	Historic/300-1200	Sumpter and St. Claire 2009:112 (Sumpter and St. Claire 2009)
88	WCVI	BS	83T	This Study	1997	16	47%	1	Historic/300-1200	McKechnie 2010:44 (McKechnie 2010b)
89	WCVI	BS	82T	This Study	1374	16	39%	2	300-1200	McKechnie 2010:20 (McKechnie 2010b)
90	WCVI	BS	306T	(Wigen 2013:7, Table 3 and This Study)	482	10	72%	1	Historic/300-1200	Smith et al. 2012 (Smith, et al. 2012) and McKechnie 2010:44 (McKechnie 2010b)
91	WCVI	BS	304T	This Study	1155	14	41%	2	Historic/300-1200	McKechnie 2010:28

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										(McKechnie 2010b)
92	WCVI	BS	206T	This Study	1939	17	41%	1	Historic/300-1200/1200-2400	McKechnie 2010:20 (McKechnie 2010b)
93	WCVI	BS	72T	(Wigen 2009:132, Table 6)	3725	18	85%	1	300-1200	McKechnie 2010:44 (McKechnie 2010b)
94	WCVI	BS	DeSh-1	(Wigen 2003b:Table 6)	700	17	48%	1	Historic/300-1200	Sumpter 2003:18 (Sumpter 2003)
95	WCVI	BS	DeSh-2	(Wigen 2003b:Table 9)	169	6	18%	2	Historic/300-1200	Sumpter 2003:18 (Sumpter 2003)
96	WCVI	BS	DfSh-7	(McKechnie 2012: Table 2, or Chapter 5)	32401	33	81%	1	300-1200/1200-2400/2400-5000	McMillan & St. Claire 2012:33&93 (McMillan and St. Claire 2012)
97	WCVI	WCVI	DeSf-6	(McKechnie 2007c:7)	258	10	11%	3	300-1200	McKechnie & Fedje 2010 (McKechnie and Fedje 2010)
98	CC	NVI	EeSu-13	(Wilson, et al. 1993:32, Table 6)	1121	15	67%	1	2400-5000	Wilson et al. 1993:69 (Wilson, et al. 1993)
99	CC	Namu	EISx-3	(Cannon, et al. 2011:62, Table 5.1)	3356	14	48%	2	300-1200/1200-2400	Cannon 1997:15 (Cannon 1997)
100	CC	Namu	EISx-5	(Cannon, et al. 2011:62, Table 5.1)	989	8	61%	1	300-1200/1200-2400/2400-5000	Cannon 2000:74 (Cannon 2000b); Cannon 1998:40 (Cannon 1998)
101	CC	Namu	EISx-18	(Cannon, et al. 2011:62, Table 5.1)	567	9	48%	2	300-1200/1200-2400/2400-5000	Cannon 1998:37 (Cannon 1998)
102	CC	Namu	EISx-10	(Cannon, et al. 2011:62, Table 5.1)	1433	9	62%	1	300-1200/1200-2400/2400-5000	Cannon 1997:45 (Cannon 1997) and Cannon 2000:72 (Cannon 2000b)
103	CC	Namu	EITa-25	(Cannon, et al. 2011:62, Table 5.1)	105	6	35%	2	Historic/300-1200/1200-2400/2400-5000	Cannon 1997:45 (Cannon 1997) and Cannon 2000:72 (Cannon 2000b)
104	CC	Namu	EISx-1	(Cannon, et al. 2011:62, Table 5.1)	5870	15	41%	2	300-1200/1200-2400/2400-5000/5000-10000	Carlson 1991 (Carlson 1991)
105	CC	Namu	EkSx-12	(Cannon, et al. 2011:62, Table 5.1)	1992	18	9.94%	2	300-1200/1200-2400	Cannon 1997:45 (Cannon 1997)
106	CC	Namu	EITa-3	(Cannon, et al. 2011:62, Table 5.1)	137	5	12%	3	Historic/300-1200	Cannon 2000:72 (Cannon 2000b); Cannon 1997:45 (Cannon 1997)
107	CC	Namu	EITb-1	(Cannon, et al. 2011:62, Table 5.1)	4802	13	86%	1	Historic/300-1200/1200-2400	Cannon 1998:22 (Cannon 1998) Cannon 2000:72 (Cannon 2000)

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										2000b);
108	CC	Namu	EITb-2	(Cannon, et al. 2011:62, Table 5.1)	97	8	38%	2	300-1200/1200-2400	Cannon 1998:26 (Cannon 1998)
109	CC	Rinit	EkSt-1	(Cannon, et al. 2011:62, Table 5.1)	2535	5	29%	2	N/A	MacDonald et al. 2011:3623 (MacDonald, et al. 2011)
110	CC	Rinit	EjSw-1	(Cannon, et al. 2011:62, Table 5.1)	3113	7	47%	1	N/A	MacDonald et al. 2011:3623 (MacDonald, et al. 2011)
111	CC	Rinit	EjSv-1	(Cannon, et al. 2011:62, Table 5.1)	122	3	35%	1	N/A	MacDonald 2008:26 (MacDonald 2008)
112	CC	Rinit	EjSv-2	(Cannon, et al. 2011:62, Table 5.1)	374	6	56%	1	N/A	MacDonald 2008:26 (MacDonald 2008)
113	CC	Rinit	EjSv-3	(Cannon, et al. 2011:62, Table 5.1)	140	3	40%	1	N/A	MacDonald et al. 2011:3623 (MacDonald, et al. 2011)
114	CC	Rinit	EjSv-4	(Cannon, et al. 2011:62, Table 5.1)	64	5	56%	1	N/A	MacDonald 2008:26 (MacDonald 2008)
115	CC	Rinit	EjSv-5	(Cannon, et al. 2011:62, Table 5.1)	328	4	66%	1	N/A	MacDonald et al. 2011:3623 (MacDonald, et al. 2011)
116	CC	Rinit	EjSv-8	(Cannon, et al. 2011:62, Table 5.1)	222	4	48%	1	N/A	MacDonald 2008:26 (MacDonald 2008)
117	CC	Rinit	EjSv-9	(Cannon, et al. 2011:62, Table 5.1)	551	5	42%	1	N/A	MacDonald 2008:26 (MacDonald 2008)
118	CC	Rinit	EjSv-10	(Cannon, et al. 2011:62, Table 5.1)	905	7	52%	1	N/A	MacDonald 2008:26 (MacDonald 2008)
119	CC	Rinit	EjSv-11	(Cannon, et al. 2011:62, Table 5.1)	127	5	42%	2	N/A	MacDonald 2008:26 (MacDonald 2008)
120	HG	S. HG	FaTt-9	(Acheson 1998; Wigen 1990)	23469	15	16%	2	300-1200	Acheson 1998 (Acheson 1998)
121	HG	S. HG	1325T	(Fedje, et al. 2005a:195, Table 11.2)	751	11	0.10%	7	5000-10000	Fedje et al. 2001 (Fedje, et al. 2001), 2005 (Fedje, et al. 2005a)
122	HG	S. HG	2008T	(Orchard 2011a:23, Table 12)	254	9	1.60%	5	300-1200*	Orchard 2011:22 (Orchard 2011a)
123	HG	S. HG	699T	(Orchard 2007:236, Table 7.10)	11651	12	28%	2	Historic/300-1200	Orchard 2007:223-227 (Orchard 2007)
124	HG	S. HG	740T	(Orchard 2007:236, Table 7.10)	112	10	13%	3	300-1200	Orchard 2007:223-227 (Orchard 2007)
125	HG	S. HG	717T	(Orchard 2007:236, Table 7.10)	6877	10	43%	2	300-1200	Orchard 2007:223-227 (Orchard 2007)
126	HG	S. HG	924T	(Orchard 2011a:9-10, Table 3&4 and th	35631	13	64.50	1	Historic/300-	Fedje et al. 2011:37 (Fedje,

No.	Region ^a	Sub-region ^b	Arch. Site No.	Zooarchaeological Reference	NISP ^c	N Taxa	% NISP	Rank ^d	Time Interval Years BP ^e	Reference for ¹⁴ C Date & stratigraphic context
				study)			%		1200/1200-2400/2400-5000	et al. 2011a) and Orchard 2007:258, Table 7.16 (Orchard 2007)
127	HG	S. HG	1370T	(Orchard 2011a:17, Table 8)	149	8	24.20 %	2	300-1200	Fedje & Smith 2009:5 (Fedje and Smith 2009)
128	HG	S. HG	781T	(Orchard 2007:236, Table 7.10; 2008:51-67, Tables D1-D10 & C1-C9)	3736	13	80%	1	Historic/300-1200	Orchard 2008:27, Table 3 (Orchard 2007)
129	HG	S. HG	922T	(Sumpter 1999; Wigen 1999a)	1927	13	2%	6	300-1200/1200-2400	Sumpter 1999:1 (Sumpter 1999)
130	HG	S. HG	785T	(Orchard 2007:236, Table 7.10)	6317	14	3%	4	Historic/300-1200/1200-2400	Orchard 2007:223-227 (Orchard 2007)
131	HG	S. HG	1134T	(Orchard 2007:237, Table 7.10)	904	5	0.00%	absent	Historic	Orchard 2007:223-227 (Orchard 2007)
132	HG	S. HG	1127T	(Steffen 2006:65, Table 3.6)	1615	11	0.43%	8	5000-10000	Fedje et al. 2005:209 (Fedje, et al. 2005b)
133	HG	N. HG	FjUb 10	(Christensen and Stafford 2005)	1731	9	2%	6	2400-5000/5000-10000	Christensen & Stafford 2005:251 (Christensen and Stafford 2005)
134	HG	N. HG	GaUa 18	(Christensen, et al. 2010:69, Table 11)	1020	14	6%	5	300-1200/1200-2400	Christensen et al. 2010:54 (Christensen, et al. 2010)
135	NC	Dundas	GdTq-1	(Brewster and Martindale 2011:258, Table 15.4)	379	4	4%	3	2400-5000/5000-10000	Brewster and Martindale 2011:256-7 (Brewster and Martindale 2011)
136	NC	Dundas	GcTr-5	(Brewster and Martindale 2011:258, Table 15.4)	671	4	7%	3	1200-2400/2400-5000	Brewster and Martindale 2011:256-7 (Brewster and Martindale 2011)
137	NC	Dundas	GcTq-5	(Brewster and Martindale 2011:258, Table 15.4)	896	4	11%	2	1200-2400/2400-5000/5000-10000	Brewster and Martindale 2011:256-7 (Brewster and Martindale 2011)
138	NC	Dundas	GcTq-7	(Brewster and Martindale 2011:258, Table 15.4)	204	4	12%	3	300-1200/1200-2400/2400-5000*	Martindale et al. 2010:73 (Martindale, et al. 2010)
139	NC	Dundas	GcTr-10	(Brewster and Martindale 2011:258, Table 15.4)	500	4	5%	3	300-1200/1200-2400/2400-5000*	Martindale et al. 2010:73 (Martindale, et al. 2010)
140	NC	Dundas	GcTr-8	(Brewster and Martindale 2011:258, Table 15.4)	347	4	26%	2	1200-2400/2400-5000/5000-10000	Brewster and Martindale 2011:256-7, Table 15.3
141	NC	Dundas	GcTr-9	(Brewster and Martindale 2011:258, Table 15.4)	75	4	19%	2	300-1200/1200-2400/2400-5000*	Martindale and Letham 2008:Figure 14
142	NC	Dundas	GcTq-1	(Brewster and Martindale 2011:258, Table 15.4)	382	4	13%	3	2400-5000/5000-10000	Brewster and Martindale 2011:256-7 (Brewster and

No.	Region ^a	Sub-region ^b	Arch. Site No.	Zooarchaeological Reference	NISP ^c	N Taxa	% NISP	Rank ^d	Time Interval Years BP ^e	Reference for ¹⁴ C Date & stratigraphic context
										Martindale 2011)
143	NC	Dundas	GcTq-6	(Brewster and Martindale 2011:258, Table 15.4)	82	4	16%	2	2400-5000/5000-10000	Brewster and Martindale 2011:256-7 (Brewster and Martindale 2011)
144	NC	Dundas	GcTq-4	(Brewster and Martindale 2011:258, Table 15.4)	64	4	36%	2	2400-5000/5000-10000	Brewster and Martindale 2011:256-7 (Brewster and Martindale 2011)
145	NC	PRupert	GbTo-24	This Study	142	7	4%	4	no dates just yet	Martindale in prep.
146	NC	PRupert	GcTo-6	This Study	155	5	10.30%	2	1200-2400	Coupland et al. 1993 (Coupland, et al. 1993)
147	NC	PRupert	GbTo-77	(Coupland, et al. 2010:199, Table 12)	83		24.10%	2	1200-2400/2400-5000	Coupland et al. 2010:193 (Coupland, et al. 2010)
148	NC	PRupert	GbTo-28	(Coupland, et al. 2010:198, Table 8)	742		21.20%	2	1200-2400	Coupland et al. 2010:193 (Coupland, et al. 2010)
149	NC	PRupert	GbTo-46	(Coupland, et al. 2010:198, Table 8)	419		11.00%	2	1200-2400	Coupland et al. 2010:193 (Coupland, et al. 2010)
150	NC	PRupert	GbTo-31	(Coupland, et al. 2010:197, Table 6)	374		3.20%	2	300-1200/1200-2400	Stewart et al. 2009 (Stewart, et al. 2009)
151	NC	PRupert	GbTo-13	(Eldridge, et al. 2008:117, Table 111)	284	7	16%	2	1200-2400	Eldridge et al. 2008:241 (Eldridge, et al. 2008)
152	NC	PRupert	GbTo-37	(Eldridge, et al. 2008:117, Table 111)	58	4	12%	2	2400-5000	Eldridge et al. 2008:241
153	SEAK	Angoon	49-SIT-124	(Moss 1989:242-260; 2007b:8-10, Unit 1)	1655	14	12%	2	300-1200/1200-2400	Moss 1989:249 (Moss 1989)
154	SEAK	Angoon	49-SIT-130	(Moss 1989:299-309)	1042	2	0%	absent	300-1200	Moss 1989:299 (Moss 1989)
155	SEAK	Angoon	49-SIT-132	(Moss 1989:203:Table 5.12)	356	6	41%	2	300-1200	Moss 1989:197 (Moss 1989)
156	SEAK	Angoon	49-SIT-171	(Moss 1989: 214-224)	384	3	4%	2	300-1200	Moss 1989:217 (Moss 1989)
157	SEAK	Angoon	49-SIT-244	(Moss 1989:175-177)	1730	9	55%	1	300-1200	Moss 1989:169 (Moss 1989)
158	SEAK	Angoon	49-SIT-259	(Moss 1989:267-269)	63	5	3%	4	300-1200/1200-2400	Moss 1989:227 (Moss 1989)
159	SEAK	Angoon	49-SIT-299	(Moss 1989: 326-334)	1109	9	1%	2	300-1200/1200-2400	Moss 1989:324 (Moss 1989)
160	SEAK	Angoon	49-SIT-304	(Moss 1989: 273-282)	920	2	99.70%	1	300-1200	Moss 1989:277 (Moss 1989)

No.	Region ^a	Sub-region ^b	Arch. Site No.	Zooarchaeological Reference	NISP ^c	N Taxa	% NISP	Rank ^d	Time Interval Years BP ^e	Reference for ¹⁴ C Date & stratigraphic context
161	SEAK	Noyes	49-CRG-188	(Moss 2011b:160)	112	8	36.60%	1	300-1200/1200-2400	Moss 2004 (Moss 2004)
162	SEAK	Sumez	49CRG-88	(Moss and Erlandson 2001:36-37, 40-41)	144	9	1%	7	300-1200	Moss & Erlandson 2001:35 (Moss and Erlandson 2001)
163	SEAK	Dall	49-DIX-46	(Moss 2008:50, Table 5)	194	12	5%	4	1200-2400/2400-5000	Moss 2008:49 (Moss 2008)
164	SEAK	Annette	49-KET-229	(Minor, et al. 1986)	618	8	17%	3	1200-2400	Minor et al. 1986 (Minor, et al. 1986)
165	SEAK	PWales	49-PET-67	(Moss 2011b:160)	391	6	23%	2	2400-5000	Moss 2011b:160 (Moss 2011b)
166	SEAK	PWales	49-PET-556	(Moss 2011b:160)	224	9	67%	1	1200-2400/2400-5000	Moss 2011b:160 (Moss 2011b)
167	SEAK	Kuiu	49-XPA-29	(Maschner 1992:318-320)	10912	9	32%	2	300-1200/1200-2400	Maschner 1992:178 (Maschner 1992)
168	SEAK	Kuiu	49-XPA-39	(Maschner 1992:318-320)	11726	7	66%	1	300-1200/1200-2400/2400-5000	Maschner 1992:178 (Maschner 1992)
169	SEAK	Kuiu	49-XPA-106	(Maschner 1992:318-320)	515	4	3%	3	300-1200	Maschner 1992:178 (Maschner 1992)
170	SEAK	Kuiu	49-XPA-112	(Maschner 1992:318-320)	548	4	1%	2	300-1200	Maschner 1992:178 (Maschner 1992)

a -Regions: SS = Salish Sea, Including Puget Sound, Strait of Georgia, & the Strait of Juan de Fuca; WCVI = Western Vancouver Island; CC = Central BC Coast; HG = Haida Gwaii; NC = Northern BC Coast; SEAK = Southeast Alaska.

b - Sub-Regions: PSnd = Puget Sound; GI-WA = Washington State Gulf Islands; GI-BC = BC Gulf Islands; SVI = Southern Vancouver Island; EVI = Eastern Vancouver Island; ESG = Eastern Strait of Georgia; FD = Fraser Delta; BS = Barkley Sound; WCVI = Western Vancouver Island; NVI = Northern Vancouver Island; Namu = Namu Area; Rinlt = Rivers Inlet Area; S. HG = Southern Haida Gwaii; N. HG = Northern Haida Gwaii; Dundas = Dundas Archipelago; PRupert = Prince Rupert Harbour; Angoon= Angoon Area; Noyes = Noyes Island; Sumez = Sumez Island; Dall = Dall Island; Pwales = Prince of Wales Island; Kuiu = Kuiu Island

c - NISP = Number of identified specimens.

d - Rank = Rank order of herring based on numbers of identified specimens.

e - Dates fall within these broad temporal intervals. Asterisk indicates no available ¹⁴C dates estimated from presence/absence of historic artifacts and /or relative sea level.

Table 2.2 Individual assemblage data for the 50 sites with within site-variability presented in Figure 2.6 Numbers on left correspond with sites listed in in Table 2.1.

No.	Reg- ion	Sub- region	Site	N levels	N Taxa	Mean %	SD %	Varian- ce	Mean rank	SD	Reference
168	NC	Kuiu	Step Island, AK	4	7	58%	24%	5.9%	1.5	0.58	Maschner 1992:318-320 (Maschner 1992)
156	NC	Angoon	Yaay Shaanoow, AK	7	6	40%	11%	1.1%	1.7	0.49	Moss 1989:203:Table 5.12 (Moss 1989)
150	NC	PR	Boardwalk, PRH	3	27	3%	4%	0.1%	2.0	0.00	Coupland et al. 2010:197, Table 6 (Coupland, et al. 2010)
131	HG	SHG	Lyell Bay	5	14	4%	4%	0.2%	4.3	2.22	Orchard 2007:257, Table 7.16 (Orchard 2007)
128	HG	SHG	Kaidso	3	13	74%	11%	1.1%	1.0	0.00	Orchard 2007:257, Table 7.16 (Orchard 2007)
126	HG	SHG	Burnaby Nrrws	16	11	51%	36%	12.7%	1.4	0.67	Orchard 2011:9, 39, Table 3 and B1-7 & this study (Orchard 2011a)
123	HG	SHG	Benjamin Pt.	5	12	20%	18%	3.4%	2.6	0.89	Orchard 2007:236, Table 7.10 (Orchard 2007)
104	CC	Namu	Namu	5	15	40%	4%	0.2%	2.0	0.00	Canon et al. 2011:62, Table 5.1 (Cannon, et al. 2011)
107	CC	Namu	Nulu	43	na	85%	11%	1.2%	1.0	0.00	Cannon n.d., Cannon 2002:320 (Cannon 2002) (Cannon, et al. 2011)
98	CC	NVI	Port Hardy	7	15	67%	11%	1.3%	1.0	0.00	Wilson 1993:32, Table 6 (Wilson, et al. 1993)
84	WCVI	BS	Spring Cove	5	14	70%	33%	11.1%	1.2	0.45	Spady and Wigen 2008:49, Table 8 (Spady and Wigen 2008)
83	WCVI	BS	Little Beach	8	15	69%	17%	2.9%	1.0	0.00	Weathers et al. 2008:46, Tables 7-8 (Weathers, et al. 2008)
82	WCVI	BS	Itasoo North	5	12	81%	7%	0.5%	1.0	0.00	Brolly and Pegg 1998:167, Table 40 (Brolly and Pegg 1998)
85	WCVI	BS	Ts'ishaa	38	21	54%	27%	7.2%	1.4	0.64	McKechnie 2005:125, Appendix B1 (McKechnie 2005b)
92	WCVI	BS	Wouwer	20	17	39%	21%	4.5%	1.6	0.88	this study
88	WCVI	BS	Lwr Dicebox	8	16	45%	21%	4.3%	1.6	0.74	this study
87	WCVI	BS	Upper Dicebox	6	17	62%	19%	3.7%	1.2	0.41	this study
91	WCVI	BS	Huumuwaa	15	14	43%	20%	3.9%	1.7	0.50	this study
89	WCVI	BS	Shiwitis	12	16	45%	28%	8.0%	1.5	0.52	this study
93	WCVI	BS	Dodd	3	19	85%	11%	1.2%	1.0	0.00	Wigen 2009:Table 6 (Wigen 2009)
90	WCVI	BS	Keith	4	8	72%	12%	1.4%	1.0	0.00	Wigen 2013:7, Table 3 and this Study (Wigen 2013)
94	WCVI	BS	Kiix7in	6	17	58%	7%	0.5%	1.0	0.00	Wigen 2003:Table 6 (Wigen 2003b)

No.	Region	Sub-region	Site	N levels	N Taxa	Mean %	SD %	Variance	Mean rank	SD	Reference
96	WCVI	BS	Huu7ii	115	33	67%	29%	8.2%	1.3	0.74	this study
35	SS	EVI	Kye Bay, Comox	8	10	87%	12%	1.4%	1.0	0.00	Hall et al. 2003:84-93, Tables 14-23 (Hall, et al. 2003)
34	SS	EVI	Q'umu?xs, Comox	10	8	96%	4%	0.1%	1.0	0.00	Caldwell 2008:120, Table 5.39 (Caldwell 2008)
33	SS	EVI	DkSf-4, Comox	7	10	89%	4%	0.1%	1.0	0.00	Simonsen 1991:Appendix tables (pg 53 of 59) (Simonsen 1991)
37	SS	EVI	Deep Bay	10	14	86%	20%	4.1%	1.1	0.32	Wilson et al. 2004:44, Table 5 (Wilson, et al. 2004b)
40	SS	EVI	Departure Bay	7	10	94%	4%	0.2%	1.0	0.00	Howe et al. 1994:90, Table 16 (Howe, et al. 1994) & Wilson & Crockford 1994:105, Table 38 (Wilson and Crockford 1994)
171	SS	EVI	Cypress St. Nanaimo	14	9	97%	3%	0.1%	1.0	0.00	Stryd et al. 1993:70 (Stryd, et al. 1993)
44	SS	EVI	Murdoch Rd., Cedar	17	17	89%	8%	0.7%	1.0	0.00	Willows et al. 2012:118-119, Tables 14&15 combined (Willows, et al. 2012)
11	SS	SVI	Blue Heron Rd., Sidney	13	17	85%	6%	0.3%	1.0	0.00	Hewer 1999:26, Table 4 (Hewer 1999)
12	SS	SVI	Patricia Bay	3	7	87%	9%	0.8%	1.0	0.00	Kanipe et al. 2007:Appendix E, Table 11 (Kanipe, et al. 2007)
5	SS	SVI	Willows Beach	14	13	82%	16%	2.5%	1.1	0.27	Willerton 2009:129, Table 11.4 (Willerton 2009)
52	SS	ESG	EaSe-18	12	10	78%	21%	4.2%	1.1	0.29	this study
47	SS	ESG	DISd-17	4	9	90%	7%	0.5%	1.0	0.00	this study
46	SS	ESG	DISd-3	8	10	94%	2%	0.0%	1.0	0.00	this study
27	SS	GI-BC	False Narrows	7	8	85%	8%	0.6%	1.0	0.00	Oliver and Park 1997:Appendix 3 (Oliver and Park 1997)
14	SS	GI-BC	Sidney Island	3	12	87%	12%	1.3%	1.0	0.00	O'Neil and Wilson 2005:47, Table 6 (O'Neill and Wilson 2005)
68	SS	GI-WA	British Camp	13	11	60%	17%	2.9%	1.1	0.28	Pegg 1999:67, Table 3.1 (Pegg 1999)
69	SS	GI-WA	Decatur Island	16	24	50%	23%	5.1%	1.3	0.58	Wigen 2003:287, Table D.11 (Wigen 2003a)
54	SS	FD	Point Grey	9	11	91%	10%	1.0%	1.0	0.00	Coupland 1989:72, Table 4 (Coupland 1989)
56	SS	FD	Tum-tumay-whuteon	9	23	26%	13%	1.8%	2.0	0.87	Pierson 2011:74-76, Appendix 1 (Pierson 2011)
58	SS	FD	Noons Creek	12	22	43%	15%	2.3%	1.3	0.45	Pierson 2011:81-84, Appendix 1 (Pierson 2011)
61	SS	FD	Tsawwassen	4	9	28%	26%	6.6%	2.5	1.29	Kusmer 1994a:197, (Kusmer 1994a), Kusmer 1994b:133, Tbl 5-12 (Kusmer 1994b)

No.	Region	Sub-region	Site	N levels	N Taxa	Mean %	SD %	Variance	Mean rank	SD	Reference
62	SS	FD	Beach Grove	4	10	18%	8%	0.7%	2.8	0.50	Brolly et al. 1996:162 Table 13 (Brolly, et al. 1996)
63	SS	FD	Crescent Beach	3	12	5%	2%	0.0%	3.3	0.58	Matson 1992 (Matson 1992) cited in Campbell & Butler 2004:349 (Butler and Campbell 2004)
66	SS	PSnd	Weaverling Spit	4	11	32%	26%	6.7%	2.0	0.82	Nelson et al. 2010:53, Table 7.5 (Nelson, et al. 2010a)
71	SS	PSnd	Cama Beach	6	31	3%	2%	0.0%	6.0	4.15	Trost et al. 2010:B8, Table B.10 (Trost, et al. 2010)
76	SS	PSnd	West Point 28&29	5	28	1%	1%	0.0%	5.4	4.42	Wigen 1995:A5-62-70, A5-62, Tables A5-2 and A5-13 (Wigen 1995)
67	SS	PSnd	Burton Acres	7	16	73%	18%	3.4%	1.0	0.00	Kopperl 2001:7, Table 2 (Kopperl 2001)

a - Regions: SS = Salish Sea, Including Puget Sound, Strait of Georgia, & the Strait of Juan de Fuca; WCVI = Western Vancouver Island; CC = Central BC Coast; HG = Haida Gwaii; NC = Northern BC Coast; SEAK = Southeast Alaska.

b - Sub-Regions: PSnd = Puget Sound; GI-WA = Washington State Gulf Islands; GI-BC = BC Gulf Islands; SVI = Southern Vancouver Island; EVI = Eastern Vancouver Island; ESG = Eastern Strait of Georgia; FD = Fraser Delta; BS = Barkley Sound; WCVI = Western Vancouver Island; NVI = Northern Vancouver Island; Namu = Namu Area; Rinlt = Rivers Inlet Area; S. HG = Southern Haida Gwaii; N. HG = Northern Haida Gwaii; Dundas = Dundas Archipelago; PRupert = Prince Rupert Harbour; Angoon= Angoon Area; Noyes = Noyes Island; Sumez = Sumez Island; Dall = Dall Island; Pwales = Prince of Wales Island; Kuiu = Kuiu Island

Table 2.3 Distance between archaeological sites dating to within the last 2,500 years and documented spawning localities mapped by federal fisheries monitoring efforts (ca. 1930-2012) and available data Traditional and Local Ecological Knowledge (TEK/LEK) datasets. Numbers on left column correspond with sites listed in Table 2.1.

No.	Reg-ion ^a	Sub-region ^b	Arch. Site No.	Distance to Documented Spawning Locality (± 0.5 km) ^c	Monitoring Status	Distance to monitored shoreline	DFO Monitoring Section (Department of Fisheries and Oceans Canada 2012a)	TEK/LEK Distance to Spawning Locality (± 0.5 km) ^c	TEK/LEK Reference
1	SS	SVI	DcRu-75	0.5			Sec. 193 V. Harbour		
2	SS	SVI	DcRu-78	0.5			Sec. 193 V. Harbour		
3	SS	SVI	DcRu-4	1			Sec. 193 V. Harbour		
4	SS	SVI	DcRt-16		unmonitored	2	Sec. 193 V. Harbour		
5	SS	SVI	DcRt-10		unmonitored	5.8	Sec. 193 V. Harbour		
6	SS	SVI	DcRu-71		unmonitored	7	Sec. 193 V. Harbour		
7	SS	SVI	DcRw-57		unmonitored	3.9	Sec. 202 Sooke Inlet		
8	SS	SVI	DcRv-21	1			Sec. 202 Sooke Inlet		
9	SS	SVI	DdRu-81		unmonitored	6.4	Sec. 191-192 Saanich Pen.		
10	SS	SVI	DdRu-4		unmonitored	1.5	Sec. 191-192 Saanich Pen.		
11	SS	SVI	DeRu-1	0.5			Sec. 191-192 Saanich Pen.		
12	SS	SVI	DdRu-5	0.5			Sec. 191-192 Saanich Pen.		
13	SS	SVI	DdRu-18	0.5			Sec. 191-192 Saanich Pen.		
14	SS	GI-BC	DdRt-6	3			Sec. 191-192 Saanich Pen.		
15	SS	GI-BC	DeRu-44	0.5			Sec. 181 Swanson Ch.		
16	SS	GI-BC	DfRu-3	0.5			Sec. 181 Swanson Ch.		
17	SS	GI-BC	DeRt-1	0.5			Sec. 182 Plumper Snd.		
18	SS	GI-BC	DeRt-109		unmonitored	4.3	Sec. 182 Plumper Snd.		
19	SS	GI-BC	DgRu-3		unmonitored	1.6	Sec 173s S Yellow Pt.		
20	SS	GI-BC	DgRv-4	0.5			Sec 173s S Yellow Pt.		
21	SS	GI-BC	DgRv-1	0.5			Sec 173s S Yellow Pt.		

No.	Reg-ion ^a	Sub-region ^b	Arch. Site No.	Distance to Documented Spawning Locality (± 0.5 km) ^c	Monitoring Status	Distance to monitored shoreline	DFO Monitoring Section (Department of Fisheries and Oceans Canada 2012a)	TEK/LEK Distance to Spawning Locality (±0.5 km) ^c	TEK/LEK Reference
22	SS	GI-BC	DgRv-2	0.5			Sec 173n N Yellow Pt.		
23	SS	GI-BC	DgRv-2	0.5			Sec 173n N Yellow Pt.		
24	SS	GI-BC	DgRw-78	0.5			Sec 173n N Yellow Pt.		
25	SS	GI-BC	DgRw-73	0.5			Sec 173n N Yellow Pt.		
26	SS	GI-BC	DgRw-32	0.5			Sec 173n N Yellow Pt.		
27	SS	GI-BC	DgRw-4	0.5			Sec 173n N Yellow Pt.		
28	SS	GI-BC	DgRw-204	1			Sec 173n N Yellow Pt.		
30	SS	EVI	DjSf-13	0.5			Sec. 142 Baynes Snd.		
31	SS	EVI	DkSf-26	4			Sec. 142 Baynes Snd.		
32	SS	EVI	DkSf-40	3.5			Sec. 142 Baynes Snd.		
33	SS	EVI	DkSf-4	0.5			Sec. 142 Baynes Snd.		
34	SS	EVI	DkSf-19	0.5			Sec. 142 Baynes Snd.		
35	SS	EVI	DkSf-29	0.5			Sec. 142 Baynes Snd.		
36	SS	EVI	DiSc-26	0.5			Sec. 143 Qualicum		
38	SS	EVI	DhSb-3	0.5			Sec. 143 Qualicum		
39	SS	EVI	DhSb-11	0.5			Sec. 143 Qualicum		
40	SS	EVI	DhRx-16	0.5			Sec 142 Nanoose		
171	SS	EVI	DhRx-66	0.5			Sec 142 Nanoose		
41	SS	EVI	DhRx-101	0.5			Sec 142 Nanoose		
42	SS	EVI	DhRx-104	0.5			Sec 142 Nanoose		
43	SS	EVI	DgRw-46	0.5			Sec 173n N Yellow Pt.		
44	SS	EVI	DgRw-34	0.5			Sec 173n N Yellow Pt.		
45	SS	EVI	DeRv-68	1			Sec. 181 Swanson Ch.		

No.	Reg-ion ^a	Sub-region ^b	Arch. Site No.	Distance to Documented Spawning Locality (± 0.5 km) ^c	Monitoring Status	Distance to monitored shoreline	DFO Monitoring Section (Department of Fisheries and Oceans Canada 2012a)	TEK/LEK Distance to Spawning Locality (± 0.5 km) ^c	TEK/LEK Reference
52	SS	ESG	EaSe-18		unmonitored	5.8	Sec. 152a N Powell R.		
51	SS	ESG	EaSe-11		unmonitored	1	Sec. 152a N Powell R.		
50	SS	ESG	EaSe-76	2			Sec. 152a N Powell R.		
46	SS	ESG	DISd-3	0.5			Sec. 152b S Powell R.		
49	SS	ESG	DISd-6		unmonitored	2.25	Sec. 152b S Powell R.		
48	SS	ESG	DISe-10	0.5			Sec. 152b S Powell R.		
47	SS	ESG	DISd-17	0.5			Sec. 152b S Powell R.		
53	SS	ESG	DjRw-1	0.5			Sec. 165 Sechelt		
54	SS	FD	DhRr-18		unmonitored	5.5	Sec. 280 Howe Snd.		
56	SS	FD	DhRr-6		unmonitored	22	Sec. 280 Howe Snd.		
57	SS	FD	DhRr-18		unmonitored	22	Sec. 280 Howe Snd.		
58	SS	FD	DhRq-1		unmonitored	28	Sec. 280 Howe Snd.		
60	SS	FD	DgRs-14	0.5			Sec. 291& 293 Boundary Bay		
61	SS	FD	DgRs-2	3			Sec. 291& 293 Boundary Bay		
62	SS	FD	DgRs-1	0.5			Sec. 291& 293 Boundary Bay		
63	SS	FD	DgRr-1	0.5			Sec. 291& 293 Boundary Bay		
79	WC VI	WCVI	EdSv-4		unmonitored	6.6	Sec. 271 Quatsino Snd.		
80	WC VI	WCVI	DiSo-9	0.5			Sec. 242 Hesquiat Hrbr.		
81	WC VI	WCVI	DgSI-67		unmonitored	2	Sec 245. Vargas Is.		
82	WC VI	WCVI	DfSj-40	0.5			Sec 232 W Barkley Snd.		
84	WC VI	BS	DfSj-57	0.5			Sec 232 W Barkley Snd.		
85	WC VI	BS	DfSi-16+17	0.5			Sec 232 W Barkley Snd.		

No.	Reg-ion ^a	Sub-region ^b	Arch. Site No.	Distance to Documented Spawning Locality (± 0.5 km) ^c	Monitoring Status	Distance to monitored shoreline	DFO Monitoring Section (Department of Fisheries and Oceans Canada 2012a)	TEK/LEK Distance to Spawning Locality (± 0.5 km) ^c	TEK/LEK Reference
86	WC VI	BS	DfSi-26	0.5			Sec 232 W Barkley Snd.		
87	WC VI	BS	129T	2			Sec 232 W Barkley Snd.		
88	WC VI	BS	83T	2			Sec 232 W Barkley Snd.		
89	WC VI	BS	82T	2			Sec 232 W Barkley Snd.		
90	WC VI	BS	306T	1.5			Sec 232 W Barkley Snd.		
91	WC VI	BS	304T	3.5			Sec 232 W Barkley Snd.		
92	WC VI	BS	206T	2.5			Sec 232 W Barkley Snd.		
93	WC VI	BS	DfSh-19 (72T)	0.5			Sec 232 W Barkley Snd.		
94	WC VI	BS	DeSh-1	1			Sec 231 Trevor Chnl.		
95	WC VI	BS	DeSh-2	1			Sec 231 Trevor Chnl.		
96	WC VI	BS	DfSh-7		unmonitored	3.6	Sec 231 Trevor Chnl.		
97	WC VI	WCVI	DeSf-6		unmonitored	27.3	No records		
99	CC	Namu	EISx-3		unmonitored	5.9	Sec. 086 Fitzhugh Snd.	0.5	Gerrard et al. n.d. (Gerrard, et al. n.d.)
104	CC	Namu	EISx-1	0.5			Sec. 086 Fitzhugh Snd.	0.5	Gerrard et al. n.d. (Gerrard, et al. n.d.)
105	CC	Namu	EkSx-12	2			Sec. 085 Kwakshua Ch.	2.5	Gerrard et al. n.d. (Gerrard, et al. n.d.)
106	CC	Namu	EITa-3	0.5			Sec.076 Kildidt Snd.	0.5	Gerrard et al. n.d. (Gerrard, et al. n.d.)
107	CC	Namu	EITb-1	0.5			Sec.076 Kildidt Snd.	0.5	Gerrard et al. n.d. (Gerrard, et al. n.d.)
108	CC	Namu	EITb-2	0.5			Sec.076 Kildidt Snd.	0.5	Gerrard et al. n.d. (Gerrard, et al. n.d.)
109	CC	Rinit	EkSt-1		unmonitored	4	Sec. 093 Rivers Inlt Head		
110	CC	Rinit	EjSw-1	2			Sec. 092 Rivers Inlt.		

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111	CC	Rintl	EjSv-1	4			Sec. 092 Rivers Inlt.		
112	CC	Rintl	EjSv-2		unmonitored	0.9	Sec. 092 Rivers Inlt.		
113	CC	Rintl	EjSv-3		unmonitored	1.8	Sec. 092 Rivers Inlt.		
114	CC	Rintl	EjSv-4		unmonitored	1.3	Sec. 093 Rivers Inlt Head		
115	CC	Rintl	EjSv-5	6			Sec. 093 Rivers Inlt Head		
116	CC	Rintl	EjSv-8		unmonitored	4.5	Sec. 092 Rivers Inlt.		
117	CC	Rintl	EjSv-9		unmonitored	4.6	Sec. 092 Rivers Inlt.		
118	CC	Rintl	EjSv-10		unmonitored	4.7	Sec. 092 Rivers Inlt.		
119	CC	Rintl	EjSv-11		unmonitored	5.2	Sec. 092 Rivers Inlt.		
120	HG	S. HG	FaTt-9	2.2			Sec. 006 Louscoone Inlt.	4.4	Haida TEK/LTK Vol 3, pg 67 (Haida Marine Traditional Knowledge Study Participants, et al. 2011)
122	HG	S. HG	2008T		unmonitored	9	Sec. 006 Louscoone Inlt.	13.2	Haida TEK/LTK Vol 3, pg 67 (Haida Marine TKS Participants, et al. 2011)
123	HG	S. HG	699T		unmonitored	15.9	Sec. 006 Louscoone Inlt.	11	Haida TEK/LTK Vol 3, pg 67 (Haida Marine TKS Participants, et al. 2011)
124	HG	S. HG	740T		unmonitored	1.7	Sec. 025 Skincuttle Inlt.	0.5	Haida TEK/LTK Vol 3, pg 67 (Haida Marine TKS Participants, et al. 2011)
125	HG	S. HG	717T	0.5			Sec. 025 Skincuttle Inlt.	0.5	Haida TEK/LTK Vol 3, pg 67 (Haida Marine TKS Participants, et al. 2011)
126	HG	S. HG	924T	0.5			Sec. 021s S. Juan Perez Snd.	0.5	Haida TEK/LTK Vol 3, pg 67 (Haida Marine TKS Participants, et al. 2011)
127	HG	S. HG	1370T	0.5			Sec. 021s S. Juan Perez Snd.	0.5	Haida TEK/LTK Vol 3, pg 67 (Haida Marine Traditional Knowledge Study Participants, et al. 2011)
128	HG	S. HG	781T	2.5			Sec. 021s S. Juan Perez Snd.	0.5	Haida TEK/LTK Vol 3, pg 67 (Haida Marine TKS Participants, et

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									al. 2011)
129	HG	S. HG	922T		unmonitored	7.5	Sec. 021n N Juan Perez Snd.	7.5	Haida TEK/LTK Vol 3, pg 67 (Haida Marine Traditional Knowledge Study Participants, et al. 2011)
131	HG	S. HG	785T		unmonitored	10.4	Sec. 024 Laskeek Bay	4.5	Haida TEK/LTK Vol 3, pg 67 (Haida Marine TKS Participants, et al. 2011)
132	HG	S. HG	1134T		unmonitored	3.1	Sec. 024 Laskeek Bay	3	Haida TEK/LTK Vol 3, pg 67 (Haida Marine TKS Participants, et al. 2011)
135	HG	N. HG	GaUa-18		unmonitored	26	Sec. 011 Masset Int.	23	Haida TEK/LTK Vol 3, pg 67 (Haida Marine Traditional Knowledge Study Participants, et al. 2011)
153	NC	PRupert	GbTo-24	0.5			Sec. 042 P. Rupert		
146	NC	PRupert	GcTo-6	0.5			Sec. 042 P. Rupert		
147	NC	PRupert	GbTo-77	0.5			Sec. 042 P. Rupert		
148	NC	PRupert	GbTo-28	2			Sec. 042 P. Rupert		
149	NC	PRupert	GbTo-46	2.5			Sec. 042 P. Rupert		
150	NC	PRupert	GbTo-31	0.5			Sec. 042 P. Rupert		
151	NC	PRupert	GbTo-13	1.5			Sec. 042 P. Rupert		

a – Regions: SS = Salish Sea, Including Puget Sound, Strait of Georgia, & the Strait of Juan de Fuca; WCVI = Western Vancouver Island; CC = Central BC Coast; HG = Haida Gwaii; NC = Northern BC Coast; SEAK = Southeast Alaska.

b – Sub-Regions: PSnd = Puget Sound; GI-WA = Washington State Gulf Islands; GI-BC = BC Gulf Islands; SVI = Southern Vancouver Island; EVI = Eastern Vancouver Island; ESG = Eastern Strait of Georgia; FD = Fraser Delta; BS = Barkley Sound; WCVI = Western Vancouver Island; NVI = Northern Vancouver Island; Namu = Namu Area; Rinlt = Rivers Inlet Area; S. HG = Southern Haida Gwaii; N. HG = Northern Haida Gwaii; Dundas = Dundas Archipelago; PRupert = Prince Rupert Harbour; Angoon= Angoon Area; Noyes = Noyes Island; Sumez = Sumez Island; Dall = Dall Island; Pwales = Prince of Wales Island; Kuiu = Kuiu Island

c – measured using georectified map of cumulative spawning location and distance by water in Google Earth. (see materials and methods).