Northern Coast Salish Marine Resource Management

by

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Abstract

This dissertation explores the traditional marine management systems of the Northern Coast Salish in British Columbia, Canada. Combining traditional knowledge with archaeological data, this dissertation seeks to understand the long-term history of ancestral Northern Coast Salish marine resource use and management. The substantive chapters present, respectively: a review of traditional marine management systems of the Northwest Coast; a typology of intertidal marine management features in Northern Coast Salish territory; and, an evaluation of ancestral Northern Coast Salish marine resource management by integrating data from intertidal features and zooarchaeological remains using a series of nested analytical scales. Overall, this dissertation shows that the ancestral Northern Coast Salish had an expansive, integrated system of marine management that allowed for sustained use of a key suite of taxa over several millennia.

Preface

The research presented in this dissertation was undertaken as part of the Tla'amin-Simon Fraser University Archaeology and Heritage Stewardship project led by Dr. Dana Lepofsky (Department of Archaeology, SFU) and Dr. John Welch (Department of Archaeology and School for Resource and Environmental Management, SFU), with Michelle Washington as the main liaison with Tla'amin First Nation. The fieldwork to gather data for this dissertation could not have been possible without the contributions of Lepofsky, Welch, and Washington, as well as additional members of the research team: Nyra Chalmer, Julia Jackley, Sarah Johnson, Bob Mui, Chris Springer, and Craig Turner.

Chapter 2 of this dissertation has been published as: Lepofsky, D. and M. Caldwell. 2013. Indigenous marine resource management on the Northwest Coast of North America. *Ecological Processes* 2:12. D. Lepofsky and W. Caldwell are credited with equal authorship on the article, with D. Lepofsky responsible for the concept of the paper and writing, and M. Caldwell responsible for data gathering and compilation and writing.

Chapter 3 of this dissertation has been published as: Caldwell, M.E., D. Lepofsky, G. Combes, M. Washington, J.R. Welch and J.R. Harper. 2012. A Bird's Eye View of Northern Coast Salish Intertidal Resource Management Features, Southern British Columbia, Canada. *Journal of Island and Coastal Archaeology* 7(2): 219-233. M. Caldwell and D. Lepofsky are the main authors, with additional manuscript composition and review/edits provided by G. Combes, M. Washington, J. Welch, and J. Harper. All authors participated in collection and interpretation of preliminary data; M. Caldwell undertook the main data compilation and analysis.

Chapter 4 of this dissertation remains unpublished but will be submitted as: Caldwell, M., D. Lepofsky, and R. Losey. Ancient Marine Management in Northern Coast Salish Territory. M. Caldwell and D. Lepofsky are responsible for the concept of the paper. M. Caldwell is the main author, with key contributions of composition and edits from D. Lepofsky and R. Losey. M. Caldwell is responsible for the data collection, compilation, and analysis.

Appendix A of this dissertation is included in the unpublished field report for this project: Caldwell, M. (2014) Appendix E: Intertidal Subsistence Features. In C. Springer, M. Caldwell, N. Chalmer, J. Jackley, and D. Lepofsky (2014) *Final Report on Archaeological Investigations (2009-0132) by the Simon Fraser University – Tla'amin First Nation Archaeology and Heritage Stewardship Project, Powell River Regional District, British Columbia*. Report on file at the Ministry of Forests, Lands and Natural Resource Operations, Victoria, British Columbia, pp. 605-671. M. Caldwell is the sole author, and is responsible for the data collection, compilation, and presentation. C Crawford produced the location maps.

Chapter 1, Chapter 5, and Appendix B are original work by M. Caldwell. Ethics approval from the University of Alberta Research Ethics Board, Project Name "Intertidal Resource Management on the Northwest Coast", No. 14542, was received on May 9, 2011, for interviews undertaken as part of this research.

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Chapter 1: Introduction

The indigenous cultures of the Northwest Coast of North America at the time of European contact were extensive modifiers and managers of the environments around them. While large-scale agriculture and animal husbandry (except for the dog) were not practiced in this region until well after European colonization, Northwest Coast peoples modified a variety of resources and ecosystems (e.g., Turner 2014; Lepofsky et al. 2015). This management extended in a continuum from subtidal to high elevation ecosystems. This dissertation documents the traditional marine management systems of Northwest Coast peoples (Chapter 2), specifically within Northern Coast Salish territory in British Columbia, Canada (Chapters 3 and 4).

The research presented is one aspect of a multi-year collaborative research program – the Tla'amin-Simon Fraser University Archaeology and Heritage Stewardship project led by Dr. Dana Lepofsky (Department of Archaeology, SFU) and Dr. John Welch (Department of Archaeology and School for Resource and Environmental Management, SFU), with Michelle Washington as the main liaison with Tla'amin First Nation. The project began in 2008, with a five-year agreement to conduct archaeological and heritage research with the Tla'amin First Nation throughout their traditional territory. This project seeks, among other things, to establish a culture history for the territory and the greater Northern Coast Salish region, to understand settlement and resource use, and to delve into broader anthropological questions about resource management, social complexity, and social interaction (Caldwell et al. 2011; Chalmer et al. 2011; Lepofsky et al. 2008, 2009; Welch et al. 2011).

This dissertation is presented in article format. Two of the articles (Chapter 2 and Chapter 3) have been published. Additionally, this introduction and a concluding chapter (Chapter 5) provide context for the substantive chapters. Two appendices are also provided; one on the intertidal features recorded during this research, and a second detailing the zooarchaeological data presented in Chapter 4. This introduction gives an overview of the study area, an introduction to previous archaeological studies on marine resource management on the Northwest Coast, a brief summary of the research undertaken, and the goals of the research, to which I will return in the concluding chapter.

The Northern Coast Salish Region and Tla'amin Traditional Territory

The research presented in this dissertation is situated within Tla'amin traditional territory, located near Powell River, British Columbia. The Tla'amin (Sliammon) First Nation is one of six Northern Coast Salish groups (Kennedy and Bouchard 1990:441). The other five groups are the Klahoose and Homalco, who live directly to the north of the Tla'amin and are closely related and share the Ahayajuthem language; the K'omoks and Pentlatch, who live on the eastern side of Vancouver Island, across the Strait of Georgia from the Tla'amin; and the shíshálh (Sechelt), who live immediately south of Tla'amin traditional territory (Kennedy and Bouchard 1990).

Northern Coast Salish territory is located in the northern reaches of the broader Coast Salish region, covering the upper half of the Strait of Georgia, the southern portion of Johnstone Strait, and the surrounding parts of the mainland and Vancouver Island, on the coast of southern British Columbia (Figure 1.1). The core of Tla'amin territory stretches from the mouth of Jervis Inlet in the south, and Comox Harbour to the west, to the eastern half of Homfray Channel in the north, including all of Powell Lake (Michelle Washington pers. comm. to M Caldwell 2009). This region includes numerous small islands, some larger islands, and expanses of mountainous mainland, all set within an extensive network of inlets, rivers, streams, and lakes. At the divide between the northern Strait of Georgia and southern Johnstone Strait, Tla'amin territory encompasses a unique marine ecosystem. In this region, tidal currents are relatively weak, especially when compared with those to the immediate north and south (Thomson 1981:157; Thomson 2014). Such weak currents, combined with the presence of wide intertidal benches, provided an ideal setting for the modification and management of the foreshore zone. In the past, Tla'amin people also would have travelled beyond their traditional territory to trade, procure resources, and establish and maintain social relations (Barnett 1955; Kennedy and Bouchard 1983; Paul 2014).

Few ethnographers and archaeologists have worked in Northern Coast Salish territory, including that of the Tla'amin. Some information about the Northern Coast Salish at the time of contact can be drawn from the journals of European explorers (Kendrick 1991; Menzies 1932; Vancouver 1984). However, most explorers appear to have spent little time in the area, and it is often difficult to determine if they are describing places within the Tla'amin traditional territory or that of their close neighbours. More formal ethnographies of the region are also scarce, and were conducted in the 20^{th} century, after the Northern Coast Salish culture had seen many changes as the result of European contact, settlement, and development of their territory (Barnett 1955; Kennedy and Bouchard 1974, 1983; Paul 2014; Peterson 1990).

Archaeological investigations in the Northern Strait of Georgia are dominated by a few extensive cultural resource management projects (Acheson and Riley 1976, 1977;

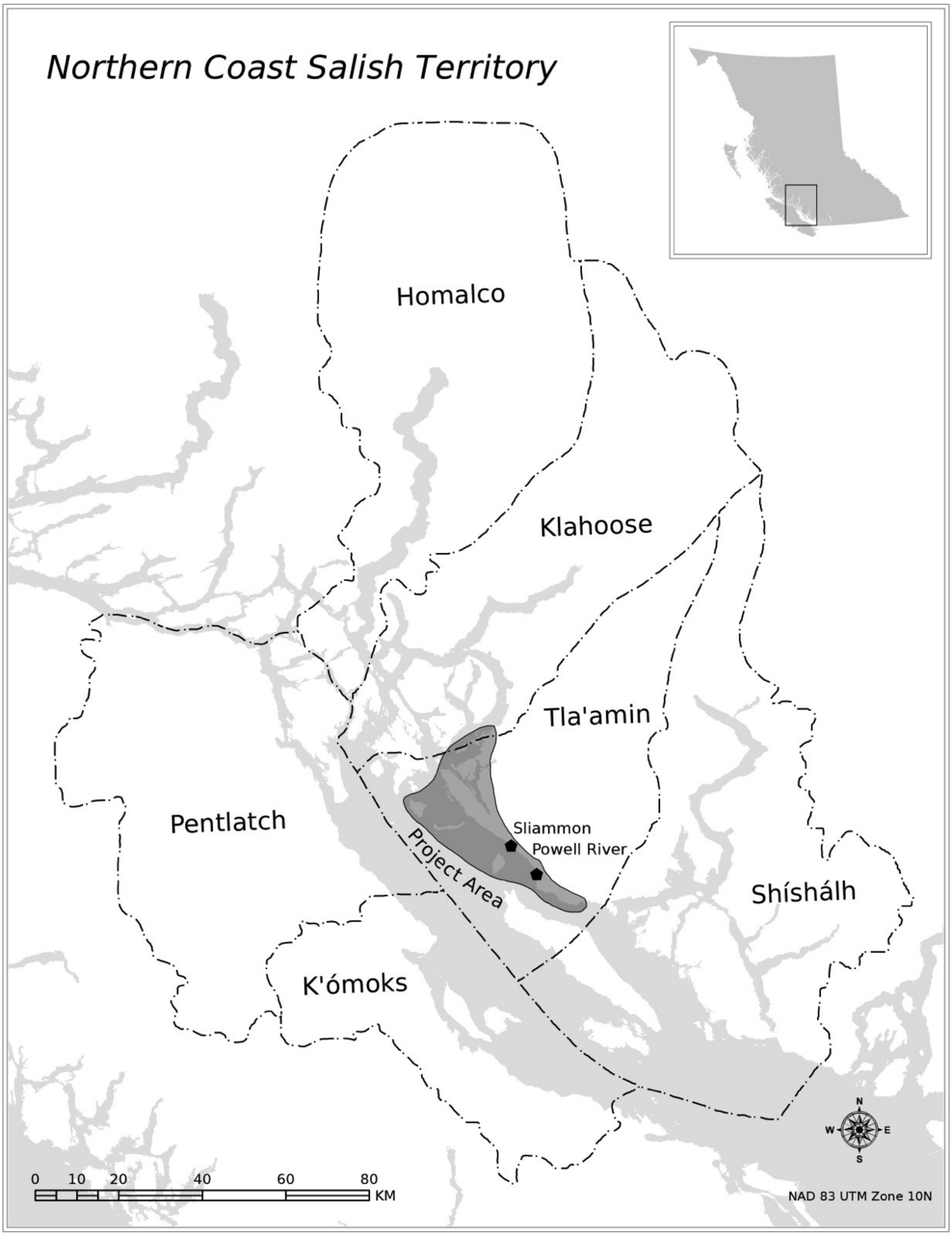

Figure 1.1*. Northern Coast Salish territory, showing the location of Tla'amin Traditional Territory and the project area (Map by Clayton Crawford).*

Mathews 2002; Pegg 2007). Academic archaeological investigations in this area also have been limited, but have contributed much of what is known about the pre-contact history here (Bernick 1983; Caldwell 2008; Letham 2011; Mitchell 1969; Monks 1987, 1980). Both the Tla'amin-SFU project, and an ongoing project in shíshálh territory (led by Dr. Gary

Coupland, Department of Anthropology, University of Toronto; e.g., Bilton 2014), will contribute much to our understanding of this region.

Prior to the Tla'amin-SFU project, more than 300 archaeological sites were recorded in Tla'amin traditional territory (British Columbia Ministry of Culture, Tourism and the Arts 2008), only 19 of which were intertidal features. The bulk of these were recorded in the 1970s as part of two regional surveys (Acheson and Riley 1976, 1977). Prior to the initiation of the Tla'amin-SFU project, there was little controlled excavation in this region, and most of this research was associated with development-driven investigations. The Tla'amin-SFU project has combined regional survey and mapping, site testing, and extensive excavation at more than 60 archaeological sites in the region (Springer et al. 2014). This dissertation contributes to a rapidly growing body of literature on Northern Coast Salish archaeology.

Traditional Resource and Environmental Management

In this dissertation, intertidal features and faunal remains from Northern Coast Salish traditional territory are viewed and interpreted through the lens of traditional resource and environmental management. Traditional ecological knowledge, as defined by Berkes (2012:7) is "a cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment". Following this definition, traditional resource and environmental management is "the application of traditional ecological knowledge (TEK) to maintain or enhance the productivity, diversity, availability, or other desired qualities of natural resources or ecosystems" (Lepofsky 2009:161; see also Fowler and Lepofsky 2011).

The term 'management', in reference to traditional (and modern) resource use, can be defined as "a set of actions taken to guide a system towards achieving desired goals and objectives" (Lertzman 2009:342). Specifically, in regard to resource and environmental management (including intertidal resource management), 'management' does not always refer to "direct manipulation of the environment" but also to "the regulation of human behaviour in relation to the environment" (Lertzman 2009:342). Furthermore, Lertzman (2009:342) defines a 'management system' as "the sum of these actions, the goals and objectives, the process through which they are legitimized by social norms, values, and institutions, and the actors [managers] involved in carrying them out". However, as Berkes (2012:19) points out, 'resource management' is largely a Western scientific concept, and what is actually under consideration are the relationships between humans and the environment. Further to this point, Lertzman (2009:346) states that "We need a conception of "management" wherein the managers and the system being managed are seen as interacting elements of the same larger system", that is, that people are part of the environment they are modifying, and cannot be separated from our considerations of resource and environmental management.

Northwest Coast Intertidal Features and Resource Management

Intertidal resource management features are found throughout the Northwest Coast region, and include fish traps, constructed of both stone and wood, and modified clam beds, including clam gardens (e.g., Byram 2002; Groesbeck et al. 2014; Harper et al. 1995; Langdon 2006, 2007; Lepofsky et al. 2015; Losey 2010; Puckett et al. 2014; White 2011). As presented in Chapter 3, intertidal features used for the management of both fish and shellfish are abundant in the Northern Coast Salish region. A summary of intertidal resource management features found on the Northwest Coast is provided here to provide context for the remainder of the dissertation.

Fish traps appear around the world beginning in the early Holocene and have been recorded on all continents in both marine and freshwater environments (Connaway 2007). An increasing number of traps through time is suggestive of a growing focus on more intensive fishing practices, and their initial appearance has been associated with stabilizing sea levels and marine ecosystems during the early to middle Holocene. Worldwide, fish traps take many forms, but can generally be categorized as either 'flowing stream weirs', 'tidal weirs', or 'longshore weirs' (Connaway 2007).

Moss (2013) reports that more than 1,300 weirs and traps are recorded on the Northwest Coast as of 2010. These structures include weirs, traps, pounds, basket trap and latticework remains, and other structures for trapping and holding fish. They are located in both intertidal and riverine settings, and are constructed from basketry, wood, stone, or some combination of the three. Ethnohistoric fish trap use has been documented along the Northwest Coast from Northern California to Southeast Alaska (Connaway 2007). Ethnographic sources are not often specific enough about location of stationary fishing structures to allow them to be relocated today. Instead, fish trap structures are identified during archaeological coastal and riverine surveys, often targeted towards locating these structures.

Archaeological fish traps have been found throughout the Northwest Coast from Southern Oregon through Southeast Alaska. The body of research is small but growing (e.g., Ackerman and Shaw 1981; Byram 2002; Caldwell 2008, 2011; Elder et al. 2014; Eldridge and Acheson 1992; Greene 2010; Langdon 2006, 2007; Losey 2010; Mobley and McCallum 2001; Monks 1987; Moss and Erlandson 1998; Moss et al. 1990; Moss 2013; Pomeroy 1976; Prince 2005; Smethurst 2014; Smith 2011; Tvsekov and Erlandson 2003), but most of these studies do little more than report form and age. Only a few studies have included details on location, types, structural components, and estimations of cultural affiliation. However, a growing number of detailed analyses and interpretations, including research that considers traditional environmental and resource management knowledge (Menzies and Butler 2007; White 2006, 2011), conceptions of salmon-human relationships (Langdon 2006, 2007; Losey 2010), and the role of fish traps in everyday food economies (Byram 2002), go beyond simple recording to consider the function of these traps and their relationships to other cultural and historical processes. Other work, including Monks (1987), Caldwell (2008, 2011), and Smethurst (2014), examines faunal remains associated with the use of such structures to assess the species targeted by these features.

Intertidal modifications on the Northwest Coast are not limited to fishing structures. Clam bed modifications are also common throughout some portions of the culture area, and are often referred to as 'clam gardens' (Lepofsky et al. 2015). Most of the research on these features is recent, and much of it has been done specifically from a resource management perspective, unlike the more descriptive work that has been done with most archaeological fish traps. First identified by western researchers in the Broughton archipelago of British Columbia, clam gardens consist of intertidal beaches that have been cleared of large cobbles (Harper et al. 1995). The cobbles are moved to the lower edge of the intertidal zone, creating a wall-like structure at the low tide line. Clam species targeted by these modifications, such as the common Pacific littleneck clam (*Leukoma staminea*) and the butter clam (*Saxidomus gigantean*), inhabit the mid to lower portion of the intertidal zone. The effect of these modifications is to increase the area of clam habitat on a given beach by increasing the amount of soft sediment in the lower portion of the intertidal zone. These alternations also improved the growing conditions for clams, and increased the productivity of the beaches (Deur et al. 2015; Lepofsky et al. 2015). The management activities recorded include adding gravel to beaches to increase water flow and thus increase the number of clams present, aerating beaches by moving rocks around, a procedure which reduces anoxic conditions that can kill clams, and returning crushed shells to beaches, a procedure which increases clam settlement.

Since their initial identification in the Broughton Archipelago in 1995, clam gardens have also been found from southeast Alaska through to Washington State (Lepofsky et al. 2015). Research in the Strait of Georgia south of this project's study area suggests that beaches were modified to enhance clam production starting around 1,000 years ago (Lepofsky et al. 2015). Lepofsky and colleagues (2015) bring together traditional knowledge on clam gardens from three disparate areas of the Northwest Coast. This research shows that clam management was part of larger systems of ownership, tenure, and management on the Northwest Coast; knowledge is embedded in stories and songs, as well as in the social activities associated with the labour of clam digging (Lepofsky et al. 2015).

Williams (2006) identified a number of potential clam gardens in Tla'amin traditional territory, but our subsequent field investigations have concluded that these places are either fish traps or cleared beaches that do not conform to Harper and colleagues' (1995) 'clam garden' type (i.e., they do not have a stone wall low in the intertidal zone). In fact, only one such feature has been identified by us in the study area (Chapter 3). In Chapter 3, my colleagues and I propose that cleared beaches are likely to have functioned in much the same manner as clam gardens. Formal clam gardens, however, are present in other areas of Northern Coast Salish territory (Lepofsky et al 2015). We propose that clam gardens are very rare in the study area because naturally productive clam beaches are plentiful. In contrast, some other areas of the coast are characterized by small beaches and limited clam habitat.

This dissertation seeks to further integrate the concept of traditional resource and environmental management with the archaeological study of intertidal features and the remains of marine fauna in nearby habitation sites. To accomplish this objective, I draw upon a suite of data, ranging from ethnohistoric descriptions of marine resource management in the Northern Coast Salish region, to archaeological data on intertidal features and their uses. Together, these data show both the time depth and complex nature of marine resource management practices in an emerging region of archaeological research on the Northwest Coast of North America.

Goals and Dissertation Outline

This dissertation has three specific goals. First, this research aims to summarize the main components of the marine management system on the Northwest Coast of North America by reviewing documentary sources on traditional resource and environmental management. The second goal is to document the specific characteristics of Northern Coast Salish marine resource management, with a focus on traditional knowledge and practice.

Finally, the third goal is to document the archaeological signatures of marine resource management in the Northern Coast Salish region by recording both the extent of intertidal features in the study area and the structure of the associated archaeological marine fish and shellfish assemblages.

To address these goals, this dissertation details the results of three main areas of research. First, a survey of ethnographic literature on marine resource management is presented in Chapter 2. Review of Northwest Coast ethnographic literature on marine resource management was undertaken at the University of Alberta between 2009 and 2013, and Tla'amin traditional use studies were reviewed at the Sliammon Treaty Society in 2009 and 2010. Additionally, a series of interviews with Tla’amin community members were undertaken as part of the Tla’amin-SFU project; these interviews yielded key information regarding marine resource management that is included in Chapters 2 and 3 of the dissertation.

Second, Chapter 3 summarizes the results of two aerial reconnaissance surveys for intertidal features. These surveys were focused on Tla’amin traditional territory and the southern portions of Klahoose and Homalco territory as part of the Tla’amin-SFU project. During two extreme low tides in June and July 2009, project member Georgia Combes took over 2,500 photos of the intertidal zone from a helicopter. These photos were used to identify 66 features at 51 locations in Northern Coast Salish territory. During the spring and summers of 2009-2011, pedestrian survey of the intertidal zone allowed for the detailed recording of some of these features, as well as the identification of 13 additional feature locations. Some data from the pedestrian surveys also are included in Chapter 4, with specific details regarding each recorded site provided in Appendix A. This appendix was initially drafted as part of a permit report submitted to the British Columbia Archaeology Branch for the archaeological work done for the Tla’amin-SFU project. It contains information about the location, ecological setting, size, and form of intertidal research features newly recorded as part of this project.

In Chapter 4, we combine zooarchaeological data with information about the form and function of intertidal resource management features to understand the social and ecological aspects of ancient marine management systems among the ancestral Northern Coast Salish. This study was undertaken to assess the potential uses of nearby intertidal features and to help to understand affects of their use, both upon the marine fauna and on ancestral Northern Coast Salish socio-economical practices. The faunal samples were obtained through excavations undertaken in 2009-2011 as part of the Tla’amin-SFU project, including three field schools run by the Department of Archaeology at SFU. Full details on the excavations undertaken between 2009 and 2013 are available in a report submitted to the BC Archaeology Branch (Springer et al. 2014). Laboratory analysis of zooarchaeological remains was undertaken between 2009 and 2013 at both the Department of Anthropology at the University of Alberta, and the Department of Archaeology at SFU. Further information on the six sites presented in this dissertation, including the full zooarchaeological data for each site sampled, are available in Appendix B. Chapter 5 provides a short conclusion of the previous chapters, and offers suggestions for future research.

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Chapter 2: Indigenous Marine Resource Management on the Northwest Coast of North America[1]

Abstract

There is increasing recognition among anthropologists that indigenous peoples of the Northwest Coast actively managed their terrestrial and marine resources and ecosystems. Such management practices ensured the ongoing productivity of valued resources and were embedded in a complex web of socio-economic interactions. Using ethnographic and archaeological data, this paper synthesizes the ecological and cultural aspects of marine management systems of coastal First Nations. We divide our discussion into four aspects of traditional management systems: harvesting methods, enhancement strategies, tenure systems, and worldview and social relations. The ethnographic data, including memories of living knowledge holders, tend to provide windows into daily actions and the more intangible aspects of management; the archaeological record provides insights into the more tangible aspects and how management systems developed through time and space. This review demonstrates not only the breadth of Northwest Coast marine management but also the value of integrating different kinds of knowledge and data to more fully document the whole of these ancient management systems.

Introduction

For decades, anthropologists, including archaeologists, have struggled to come up with classificatory schemes that would describe how subsistence-based peoples interact with their environments (e.g., Ford 1985; Harris 1989, 1996; Smith 2001). These discussions emerged out of the realization that traditional peoples worldwide rarely rely solely on truly wild or domesticated resources. Rather, there are continua of human-environmental interactions that encompass differing degrees of human management of their environment (Fowler and Lepofsky 2011).

With a few notable exceptions (e.g., Croes and Hackenberger 1989; Johannes 1981, 1982; Smith 2011a; Thornton and Scheer 2012; Turner 2005), most of the discussions about traditional management practices have revolved around human interactions with the plant world. On the Northwest Coast of North America, there have been significant strides in the

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last decade to firmly establish in the anthropological literature the central role of plant management in the ancient and traditional subsistence practices of coastal First Nations. Extensive research with traditional knowledge holders, and to a lesser extent with archaeological and paleoecological records, demonstrates the widespread management of plants at both individual and ecosystem levels (e.g., Deur and Turner 2005; Thornton 1999; Weiser and Lepofsky 2009).

In part spurred on by evidence of traditional plant management practices, regional ethnobiologists, working with traditional ecological knowledge holders, have documented parallel management practices in marine resources and ecosystems (Hunn et al. 2003; Langdon 2006a, 2006b; Thornton et al. 2010a, 2010b). That such practices were widespread in the past is not surprising given the fundamental importance of marine resources in the lives of Northwest Coast peoples (Newton and Moss 2005; Ellis and Swan 1981; Ellis and Wilson 1981; Moss 1993).

Archaeologists have been slower to embrace the idea of marine resource management on the Northwest Coast, and in particular that management systems played a role in ensuring ongoing access and availability of resources. In the case of salmon, for instance, many recognize the combined importance of mass capture and storage technologies but emphasize the role that social networks had on dampening spatial and temporal resource variability (Schalk 1977; Suttles 1987). In the case of shellfish, Croes and Hackenberger (1988, 1989) posit that overexploitation led to the development of harvest controls, but they do not recognize the possibility of enhancement strategies. The lack of recognition of the breadth of management strategies is in part due to the fact that the archaeological record, because it is largely an amalgamation of certain kinds of events, does not often provide evidence of the subtle management practices that may mimic natural processes (e.g., transplanting fish eggs) or that are conducted by individuals (Lepofsky and Kahn 2011).

The nature of archaeological discussions about marine resource management have changed in recent years, in part prompted by the growing body of literature on ancient plant management and also on the relatively recent recognition by archaeologists of ancient features that were undeniably used to manage clams (“clam gardens”, see below). These recent discussions are notable because they combine archaeological and traditional knowledge and because they seek to place traditional marine management within its larger socio-economic context (e.g., Caldwell et al. 2012; Campbell and Butler 2010; Groesbeck 2013; Powell 2012; White 2006).

Here, we synthesize the vast body of disparate archaeological and ethnographic information, including currently held knowledge, on marine management by Northwest Coast peoples to better situate these traditional practices within the larger continuum of Northwest Coast management systems. We include in our review the management of all marine resources and their ecosystems, including that of the anadromous salmon. We use the term management here to refer to any conscious choices made about plant and animal use that could influence the resource (Lertzman 2009) and include in our discussion both tangible and intangible aspects of this management. As with today's resource management, our definition makes no assumption about whether the management results in positive or negative outcomes (c.f. Lertzman 2009), although we recognize that many management practices resulted in sustained or increased diversity and/or yields. Following Turner and Berkes (2006), the discussion is organized around four aspects of traditional management systems: harvesting methods, enhancement strategies, tenure systems, and worldviews and social relations. This review demonstrates not only the breadth of Northwest Coast marine management but also the value of integrating different kinds of knowledge and data to more fully document the whole of these ancient management systems.

Social and Ecological Context of Northwest Coast Marine Management

The Northwest Coast region (Figure 2.1) is widely known for its abundant marine life. This abundance has been central to the lives of coastal peoples since the region was first colonized in the early Holocene (e.g., Cannon and Yang 2006; Wigen 2005; Ames and Maschner 1999). Archaeological and ethnographic literature document the wide range of marine animal taxa on which Northwest Coast peoples relied. In addition to a few focal taxa such as Pacific salmon (*Oncorhynchus* spp.), Pacific herring (*Clupea pallasii*), rockfish (*Sebastes* spp.), and halibut (*Hippoglossus stenolepis*), a wide variety of marine fish, shellfish, and sea mammals were eaten. Archaeological and ethnographic evidence suggests local availability influenced what species of fish and shellfish were used and preferred in any given place (Cannon et al. 2011; Lepofsky et al. 2007; Losey et al. 2004; McKechnie 2005; Monks 2011; Orchard 2007; Pierson 2011).

Age, gender, and status influenced the ways in which individuals participated in the management and procurement of marine resources on the Northwest Coast. Although roles were not rigidly defined (Ellis and Swan 1981; Moss 1993), ethnographic sources suggest that men constructed fish traps and wove nets (e.g., Miller and Seaburg 1990), hunted sea mammals (e.g., Drucker 1951), and fished. Women and young children collected shellfish,

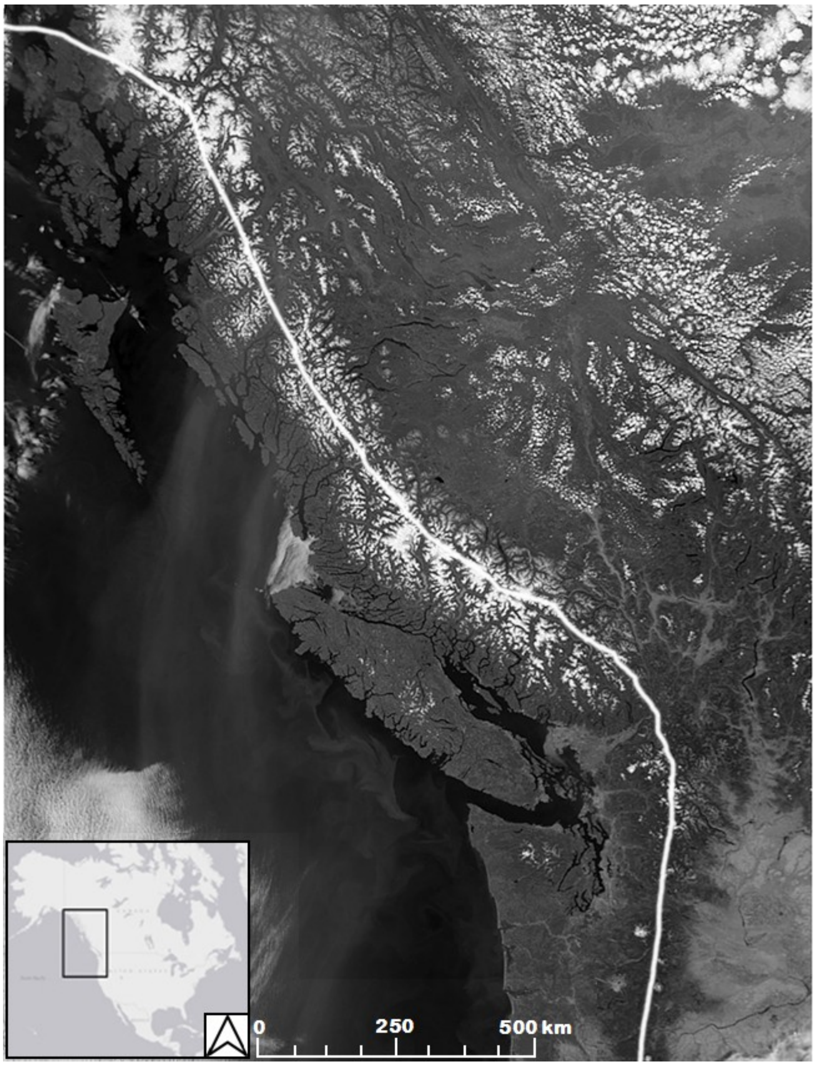

Figure 2.1. *Northwest Coast of North America (image adapted from NASA/Earth Observatory: http://eoimages.gsfc.nasa.gov/images/imagerecords/1000/1667/S2001221205452.L1A_HUAF_lrg.jpg). White line demarcates the height of land dividing the Northwest Coast from the drier Interior Plateau to the east.*

and processed fish and sea mammals procured by men (e.g., Drucker 1951). Slaves, who were considered genderless, could be called on to do any task (Donald 1997), such as when large numbers of fish had to be processed. Conversely, some tasks, such as the procurement of whales and other large sea mammals, were restricted to high status males (e.g., Drucker 1951), and the elite might control access to fish weirs (Gunther 1927), with rights of first harvest. Importantly, all of these tasks were embedded in community-specific cultural practices and beliefs, such as participation in First Salmon ceremonies (e.g., Amoss 1987; Gunther 1927; Kennedy and Bouchard 1983).

Marine Resource Management on the Northwest Coast

The following discussion of Northwest Coast marine management encompasses both ethnographic and archaeological information (Table 2.1). Ethnographic and ethnohistoric sources, although suffering from issues of bias (e.g., Moss 1993), provide good baseline information on management technologies and practices at and just after contact. The ethnographic data used in this review were written during vastly different times. Early ethnographic sources (i.e., prior to 1970) overwhelmingly consist of trait lists and descriptions of technologies. Although there is little consideration of tenure systems and aspects of worldviews and social relations in these early ethnographic sources, there are nuggets of information about management and tenure that reflect the time depth of these practices (e.g., Drucker 1951; Stern 1934). More recent ethnographic sources, and especially those that rely on first hand knowledge and experience (e.g., Turner et al. 2013; Ellis and Swan 1981; Ellis and Wilson 1981; White 2006, 2011), are more likely to contain descriptions about the various components of the whole resource management system. Archaeological data complement well the ethnographic sources. Although the archaeological record more reluctantly reveals details about some aspects of management systems, it does provide a deep time perspective on physical details such as the timing and location of specific harvesting methods and enhancement strategies. These data, when combined with data on settlement patterns, in turn allow inferences about aspects of land tenure and social relations of ancient resource management systems.

Although we divide our review into four aspects of management (harvesting methods, enhancement strategies, tenure, and worldview; Table 2.1), we recognize that these categories are simply heuristic devices, and actions in one category could easily be placed in another. For instance, some aspects of harvesting, such as size selection via nets, could be discussed with enhancement methods or with a discussion of harvesting restrictions and tenure. The very nature of traditional management systems is that they are an integrated whole which cannot be easily segmented into component parts.

Harvesting Methods

Various social and economic decisions are embedded within the choice to use different resource harvesting methods. Fish and sea mammals were harvested individually using a variety of methods, such as harpoons, gaff hooks, and hook and line. In addition, and of central importance to the development of the region’s large and complex societies,

Table 2.1. *Components of marine resource and environmental management systems on the Northwest Coast.*

Component	Goal/intent	Strategy	Archaeological evidence of goal/intent
Harvesting methods	• Selection for species and size	• Mesh size • Capture method • Timing • Location	• Relative abundance of zooarchaeological taxa; size of zooarchaeological taxa
	• Extending harvests	• Habitat creation	• Holding ponds
Enhancement strategies	• Increasing availability/ abundance	• Transplanting eggs	• None
		• Habitat manipulation & extension	• Beaches cleared of stone; intertidal walls
	• Selection for age/size of resource	• Return young/small bivalves to beach	• Age and size of zooarchaeological taxa
Tenure systems	• Limit/control access to resources and harvesting locations	• Rights to harvest specific species • Ownership of harvesting locales • Ownership and control of harvesting features	• Differences in zooarchaeological taxa between sites; rock art marking fishing locales; management features in proximity to settlements
	• Proscriptions on harvesting	• Restricted timing/season • Limits on catch size • Limits on who can harvest	• Relative abundance & size of zooarchaeological taxa
World view and social relations	• Respect for non-human kin	• Do not take more than is needed	• Sustained use over millennia
	• Ritual connections to animal world	• First food ceremonies (e.g., salmon)	• Differential abundances of salmon to other taxa
		• Return remains to water	• None
	• Maintenance of kinship ties	• Feasting, trading, social events	• Extra-local taxa in shell middens

Figure 2.2. *Approximately 200-year-old wooden riverine fish weir in South Bentick Arm, Central Coast, B.C. This was likely used to trap salmon by impeding their movement upstream. (Photo: courtesy of Alan Hobler).*

Northwest Coast peoples harvested fish en masse using a variety of weirs, traps, and nets (Figure 2.2). Clams were harvested with digging sticks.

Choice of net size and mesh regulated the overall size of the catch, the species caught, and the size and age of the individuals harvested. Detailed ethnographic accounts as well as waterlogged archaeological deposits (Figure 2.3) indicate a wide variety of net types were used on their own, and as parts of traps and weirs. Net meshes, which regulated the size and species of the fish caught, were standardized by using net gauges. Examples of net gauges have been recorded in both the ethnographic (e.g., Duff 1952; Haeberlin and Gunther 1930; Stewart 1977) and archaeological (e.g., Bernick 1989; Borden 1976; Croes 1995; Munsell 1976) records.

Figure 2.3. *Remains of an approximately 2,800-year-old gill net recovered from the Hoko River site (45CA213) in Washington. The net is made of mono-filament Sitka spruce limb splints and tied with non-slip square knots placed approximately 5 cm apart. The net was recovered with an attached anchor stone, indicating that it was likely used for fishing (Croes 1995). Prior to its recovery, Washington State Fish and Wildlife Department lawyers argued in American Indian fishing rights court that Europeans introduced net fishing to the Northwest Coast. (Photo: courtesy of Dale Croes).*

A variety of management decisions influenced the timing and length of harvests. Drucker (1951) writes that on the west coast of Vancouver Island, herring were known to spawn sequentially in neighboring coves, and so the timing of herring egg harvest was different for each cove. As well, a combination of archaeological and ethnographic information indicates that harvest times were extended through the construction of holding ponds built into intertidal fish traps (e.g., White 2011; Lepofsky 2005; Caldwell et al. 2012) (Figure 2.4). By keeping the fish alive through multiple tidal cycles, these ponds extended the period in which fish could be killed and processed. Decisions such as when to open or close weirs, and when to dismantle portions of traps likewise determined the timing of harvests (Figure 2.5) (c.f., Losey 2010). Decisions by downriver settlements about how many fish to harvest and when to open weirs would have had a significant impact on the nature and timing of the resource for upriver peoples (c.f., Swezey and Heizer 1977).

Figure 2.4 *Hook-shaped stone intertidal fish trap near Powell River, B.C. that functioned by funneling and then trapping fish, such as herring and perch, in through the wall openings during a receding tide. Water held by the walls through the tidal sequence may have extended harvesting times. (Photo: Megan Caldwell).*

Figure 2.5 *Wooden intertidal fish weir at Bear River, Willapa Bay, Washington. Note the absence of weir remains in the river channel, indicative of dismantled weirs. Also note footprints next to stakes for scale. (Photo: courtesy of Robert Losey).*

The ethnographic and archaeological records are somewhat divergent with regards to people's decisions about the number and kind of taxa harvested from weirs and traps. That is, most ethnographic sources describe the targeting of single fish species, especially salmon (e.g., White 2006, Drucker 1951), as well as attracting seals and other fish predators (Barnett 1955; Elmendorf 1992). In contrast, the zooarchaeological record recovered from middens suggests these features trapped a wide range of predator and prey species (e.g., Monks 1987). This discrepancy between the two records can in part be accounted for by the fact that ethnographic accounts tend to capture specific events, whereas archaeological records are palimpsests of events. On the flip side, our interviews with Tla'amin knowledge holders demonstrate that ethnographic information can sometimes provide information on the harvest of taxa that are rarely preserved in archaeological contexts (e.g., Pacific octopus [*Enteroctopus dofleini*] and sea cucumbers [*Parastichopus californicus*]).

Ethnographic information suggests a variety of other harvesting rules protected resources from being over-harvested. Harvesting rules include controlling the number and timing of seabird eggs harvested (Hunn et al. 2003), allowing some kelp fronds with herring eggs to remain unharvested so the eggs could hatch (Steven Carpenter, pers. comm. to D. Lepofsky), and delaying the harvest of herring until after spawning (Michelle Washington, pers. comm. to D. Lepofsky).

The archaeological record is less forthcoming about whether harvesting rules were designed to prevent overharvesting. For instance, although Lyman (2003) noted that the capture of predominantly adult male Steller sea lions in Oregon likely prevented depletion of the local sea lion population, he questions the intentionality of this behavior. We would suggest that whether such behaviors were initiated with conservation in mind is a moot point. Rather, a likely scenario is that the people who relied on these resources, and who closely watched animal behavior, understood the consequences of their actions. Furthermore, as demonstrated by the discussion of clam harvesting below, measurements of archaeological clams indicate intentional harvesting practices in the past.

Enhancement Strategies

Enhancing local environments to increase availability or productivity, or to make resources more reliable, is a well-established component of traditional management systems worldwide (Fowler and Lepofsky 2011). Recently, Smith (e.g., 2011a, 2011b) situated these behaviours within an evolutionary framework that views tangible management practices as aspects of niche construction (Smith 2011a). Some of the marine resource enhancement strategies discussed here can be viewed as examples of people creating niches that served to increase availability and productivity and in some instances to make resources more reliable.

The ethnographic literature provides numerous examples of Northwest Coast peoples applying management techniques to sustain and/or enhance the availability of salmon and herring. For instance, people transplanted herring and salmon eggs and created spawning populations in areas where the original population was decimated or where there was no prior spawning population (Carpenter et al. 2000; Jones 2002; Kennedy and Bouchard 1983; Langdon 2006b; Sproat 1868; Thornton et al. 2010b). In southeastern Alaska, the Tlingit took care to remove beaver dams on rivers as these dams would block access of sockeye (*Oncorhynchus nerka*) and coho (*Oncorhynchus kisutch*) salmon to their spawning grounds further upriver (Langdon 2006b). Additionally, the Tlingit would rearrange rocks to improve stream flow and increase salmon spawning habitat; these same "streamscaping" actions would also improve visibility for salmon gaffing (Langdon 2006b). Notably, none of these behaviors will be detectable in the archaeological record.

Both the ethnographic and archaeological records demonstrate that Northwest Coast peoples used a variety of techniques to enhance clam production. In addition to the ecological benefits of aerating the beach sediments while harvesting clams, people harvesting clams recognize the benefits of returning broken shells and gravels to the beach to keep the sediments productive (Nathan Cardinal and Nicole Smith, pers. comm. to M. Caldwell). Measurements of archaeological clam shells suggest that in some cases only clams of a certain size (age) were collected and that it is possible that clam beds were left fallow to allow populations to reach the harvestable size (Cannon and Burchell 2009). This proposition is supported by traditional knowledge which states that selective harvesting left behind small clams "to keep the populations productive" (Turner 2005). In the archaeological context, we cannot know whether this size selection was a personal decision to enhance clam production because it was the "right way to behave," because of more formal harvesting and tenure rules, or simply because of a desire to eat large clams. Finally, quantification of clam size, age, and number in archaeological sites in Washington state suggests that management was occurring at the level of habitat manipulation, rather than through harvesting rules per se (Daniels 2009).

Clam gardens are a concrete archaeological example of deliberate manipulation of clam habitat to enhance production (Figure 2.6). These features, which are found in abundance throughout the Northwest Coast archaeological record (e.g., Harper et al. 1995, 2003), are composed of rock walls constructed in the lowest intertidal zone and tidal flats which have been cleared of boulders (Harper et al. 1995, 2003; Williams 2006; Woods and Woods 2005). Stern (1934) posited that these features increased clam harvests because it was easier to dig clams in less rocky substrates. More recent researchers have hypothesized that the stone walls trap beach sediments, thus increasing clam habitat at a specific tidal height (Harper et al. 1995). This supposition is supported by controlled ecological experiments and surveys which demonstrate higher growth rates, survivorship, densities, and biomass of clams in clam gardens than in non-walled beaches, and the connection of tidal height and slope modification to increased productivity (Groesbeck 2013).

Figure 2.6. *Clam gardens on Quadra Island, B.C. The garden is composed of a rock wall placed at the zero tide line (see wall foreground of left image, and left side of right image), which creates a flat expanse of clam habitat at an ideal tidal height. In these photos, marine ecologist Amy Groesbeck and crew are sampling clams to understand how clam garden modifications affect clam growth and development. (Photos: courtesy of Amy Groesbeck).*

Determining the antiquity of these rock features has been elusive. Limited archaeological research indicates that these features may be hundreds of years old (Lepofsky and Deur 2011). Across the region, it is likely that these features follow the same temporal and spatial trajectory of intertidal fish traps. That is, they have been present in some form for many millennia but have increased in abundance in the last 2,000 to 3,000 years.

In addition to these "classic clam gardens," local knowledge and the archaeological record indicate that people cleared portions of beaches to enhance production but did not necessarily build walls (Caldwell et al. 2012). Based on field observations, whether a wall was built depends on the size and slope of the beach, and the location of the sea shelf, and possibly local ecological factors. Furthermore, we note that some fish traps/holding ponds are cleared of rocks at particular tidal heights, possibly to enhance clam production. Clearing beaches of large cobbles may increase spat recruitment but determining this requires ecological experiments. Finally, we have noted that the very building of a clam garden wall, or any intertidal or sub-tidal rock feature (e.g., the stone piles used to anchor reef nets) creates habitat for a variety of valued species, such as sea cucumbers, crabs, and small fish. Although archaeologists have largely missed these subtle manipulations of marine ecosystems, they represent an important part of ancient management systems.

Tenure Systems

On the Northwest Coast, as elsewhere, traditional tenure systems are fundamental to sustained marine resource management (e.g., Johannes 1981, 1982; Haggan et al. 2006; Turner and Jones 2000; Turner 2005). Such systems of ownership were embedded in larger hereditary kin- and status-based social networks (e.g., Powell 2012; Turner et al. 2000; Turner 2005) and regulated the timing and amount of resources extracted. Tenure associated with marine resources was asserted through the ownership of fish harvesting locations (e.g. streams, dip netting rocks, fish traps/weirs, coves), the rights to catch fish from specific locations (Turner and Jones 2000), when people could harvest, and who could harvest (Ramos and Mason 2004).

Claims to marine resources and ecosystems were made in a variety of ways (cf. Turner and Jones 2000). Ownership markers on the landscape, such as permanent harvesting features (fish traps, clam garden walls), cleared beaches, or now more elusive signals, such as pictographs, stories, and place names, would be known and recognized by people both within and outside of a community (Turner and Jones 2000). Access to resources could also be controlled through the use of specialized equipment (e.g., basket traps; Turner and Jones 2000) or by paying for the use of a resource by sharing the harvest with the resource's owner (Drucker

1951). At the Hoko Rockshelter in northwestern Washington, Croes (1992) suggests that a tight standard deviation around the mean age of harvested California mussels and increased use of other taxa to reduce pressure when mussel populations are stressed indicates management of the resource, possibly through territorial ownership and control over harvesting. However, Daniels (2009) argues that expanding diet breadth when high-ranked resources are stressed is an optimal foraging strategy that would not necessarily indicate active management.

In some areas of the coast, lineage-owned names were given to individual fish traps (Blackman 1990; De Laguna 1972), thus tying a lineage to the use of particular traps. The inextricable connection between lineages and resource ownership and management is also illustrated by the Tlingit "stream master," whose job it was not only to take care of salmon spawning streams, but also to manage relationships between humans and fish (Thornton 2012). At least in the post-contact era, access to a resource harvesting location was gained through permission by the owner or through marriage ties (Turner and Jones 2000). In places where weirs crossed entire rivers, blocking movement of fish, the owner of a weir would catch as much fish as needed and then open all or part of their weir to allow fish to move on to the next weir (Gunther 1927; Suttles 1955).

Classic clam gardens provide a good example of the role of permanent harvesting features in tenure systems. Stern (1934) records that a clam garden was owned by those who had cleared it; unmanaged clam beds could be used by anyone. This suggests that the act of clearing a beach, like that of clearing a camas plot or building a fish trap (Turner and Jones 2000), established some kind of claim of ownership to the clam bed. Archaeologically, the permanence and high visibility of classic clam gardens makes them ideal for assessing ancient systems of ownership.

Ancient tenure systems are detected in the archaeological record in diverse ways. Often, ownership is assumed through proximity of sites. That is, some or all of the people within the settlement closest to the resource procurement site are assumed to have controlled access to that location. The presence of a unique set of marine taxa in contemporaneous zooarchaeological assemblages can also be used to signal access to discrete, family-owned harvesting areas (Calvert 1980; McKechnie 2005). In some cases, the zooarchaeological record suggests that resources were shared among several communities living within a well-defined marine area (e.g., Lepofsky et al. 2007).

Worldviews and Social Relations

A significant aspect of the worldview of Northwest Coast peoples is the relationship between humans and non-human kin (e.g., Salmon People; see, e.g., Drucker 1951). By providing a framework for how to treat non-human kin respectfully, people were discouraged from taking more than was needed from the natural world. For example, in Heiltsuk territory on the central British Columbia coast, White (2011) notes that openings were intentionally left in fish trap walls so that fish could escape when the traps were not in use, or "gates" were opened to release the remaining fish after the trap users had taken what they needed. Archaeological examples of partially dismantled weirs may represent a similar set of protocols and beliefs (Losey 2010).

Protocols and rituals had to be followed or a resource, such as a run of fish, would fail to return in subsequent years (Jones 2002). For instance, stemming from the widespread belief that the life force of living beings is held in the bones and that life can be regenerated from the bones (Carlson 2011), many groups required that all salmon remains be returned to the water after processing. This practice ensured the return of salmon the following year (e.g., Carlson 2011; Gunther 1928; Siemthlut 2004).

Northwest Coast peoples participated in a variety of rituals that affirmed their connection to their ocean-bound kin. The most widespread example is the ethnographically documented First Salmon Ceremony (Amoss 1987; Berman 2000; Gunther 1926, 1927; cf. Swezey and Heizer 1977). Some groups also celebrated the return of other important species, such as herring and eulachon, with similar ceremonies (Drucker 1955; Hamori-Torok 1990; Kennedy and Bouchard 1990); neighboring groups in California practiced the First Sea Lion Hunt (Gould 1968). Archaeological evidence for rituals in general is elusive but comes in the imagery and masks that reflect the connection among people, animals, and the spirit and tangible worlds (e.g., Carlson 2011).

Coming together for the First Salmon Ceremony, to fish communally, and to gather shellfish and other resources provided opportunities to reinforce social relations and cultural knowledge and to maintain kinship ties through feasting, trading, and other social events. Situating resource use within this larger social system ensured that cultural regulations were followed, that resources were tended properly, and that the system of ownership and control of resources continued (Turner and Jones 2000).

Discussion

Management of marine resources was enacted both directly through choices about when, where, and how to harvest and tend resources and indirectly through social relations and rules about the right way to behave. Collectively, the marine management system resulted in long-term sustained and sometimes enhanced production of targeted resources. Contra Alvard (1995; Alvard and Kuznar 2001), aspects of conservation embedded in Northwest Coast marine management systems can not be viewed as unintentional consequences of low population densities and simple technology. In fact, the high population densities of Northwest Coast peoples (Ubelaker 2006) made active management of marine resources even that much more important. As Anderson (1996) suggests, since technologies such as nets and traps have the potential to wipe out salmon stocks, the healthy pre-contact salmon stocks must reflect conscious choices made to preserve salmon populations. Given the fundamental importance of marine resources in the livelihoods of Northwest Coast peoples, the sheer abundance of these remains in millennia-old archaeological middens, and the well-documented aspects of terrestrial management systems, discussions of human-marine interaction on the Northwest Coast should begin with the assumption that active management was widespread in the past.

In discussions of traditional resource management systems, the question of intentionality often arises. The issue of intention becomes particularly relevant when considering ancient management systems whose complex behaviors are usually represented by relatively simplified archaeological footprints. In our experience and that of other ethnographers on the Northwest Coast (e.g., Turner and Berkes 2006; Turner et al. 2000; Nathan Cardinal and Nicole Smith, pers. comm. to M. Caldwell), current ecological knowledge holders are well aware of the consequences of their management actions, whether played out in the physical or metaphysical realms. Widespread recognition of these tangible and intangible consequences is linked to systems of morality that dictate the "right way to behave" (Fowler and Lepofsky 2011; Reo 2011; Reo and Whyte 2011). While these rules may not be followed by all people at all times, they often play a role in people's conscious decision-making.

We can seldom know for certain if such awareness extended into pre-contact times, or whether the acts that resulted in conserving were intentional from the outset or were simply accidental byproducts of other harvesting choices (e.g., the behavior of the prey [Lyman 2003]). However, the archaeological evidence for clam management (size standardization, clam gardens, etc.) is compelling. Furthermore, indigenous peoples, because of their connections to and reliance on their natural surroundings, are often keen observers of ecological processes, and thus would have been quick to realize the benefits of their management actions (c.f., Turner and Berkes 2006). Given this, and how widespread knowledge of management was in the early contact era, the most parsimonious interpretation is that many pre-contact practitioners carried out management—in all its guises—with a high degree of awareness of the ways in which their actions would influence the "natural" world.

We further suggest that archaeologists sometimes stumble over the idea of intention because they fail to see the larger management system embedded within the physical remains associated with the archaeological record. For instance, a fish trap, which is what remains for archaeologists to record, is not in and of itself a management system. Rather, the use of that fish trap is embedded within a series of socio-economic actions and contexts that result in decisions about where to build the fish trap, when to use it, how much to catch, how much to release, the size of fish targeted, and who has access to the trap or net. These decisions are further embedded within larger networks of tenure, world views, and social relations that create enduring relationships among the people, resources, and the built environment.

In recognizing the extent of ancient marine management systems, we do not deny that Northwest Coast peoples sometimes negatively affected their marine environment. Given the high population numbers and complex socio-economic systems that supported and were supported by these large human populations, it would be highly surprising if humans did not have some kind of negative ecological footprint. The ecological effects of long-term efficient and extensive marine exploitation are evident in some zooarchaeological records that suggest locally depressed numbers of fish and sea mammals (Butler 2000; McKechnie 2007; Szpak et al. 2012). The extant evidence indicates that beyond these local effects, regional fish populations were consistently at high levels of abundance (Campbell and Butler 2010).

The ethnographic and archaeological records demonstrate that Northwest Coast marine management was enacted on different spatial and temporal social and ecological scales. Ecologically, resources were managed at the species level (e.g., seabird egg harvests, egg transplants, possibly clam size/age restrictions), at the level of the community (e.g., fish net sizes), and at the level of ecosystems (e.g., cleared beaches, removal of beaver dams). Ecosystem level management resulted in anthropogenic landscapes which attracted resources, increased and diversified habitats, and increased productivity. At social scales, management was enacted by individuals working alone and in groups and was part of daily actions and larger-scale ritual events.

These various scales of actions are not equally well represented in the ethnographic and archaeological records. Ethnographic data will always tend to highlight the more subtle, daily and often local actions involved in management and traditional ecological knowledge, whereas the archaeological record will tell the story of more dramatic landscape modifications and the cumulative actions of many events. This discrepancy between ethnographic and archaeological records is exemplified in the study of the Straits Salish reef net fishery. Based on ethnographic descriptions, we understand that this complex form of harvesting salmon involved extensive ecological knowledge which was embedded in a web of social relations, intergenerational knowledge sharing, ritual practices, and understandings of how the world works (Turner and Berkes 2006; Stewart 1977; Suttles 1974). In contrast, archaeological research on reef net fishing is limited to attempts at finding concrete evidence of this practice and dating its occurrence in the past, albeit with limited success (Boxberger 1985; Easton 1985, 1990; Moore and Mason 2011; Rozen 1981).

Considered together, the ethnographic and archaeological records provide complimentary information on traditional marine management systems. The strength of the archaeological record is that it provides tangible evidence of the deep history and evolution of resource management over time and across space. Ethnographic information, including past and present ecological knowledge, place names, and oral historical and personal stories, provides insights into the less tangible aspects of management (e.g., social relations, worldview, knowledge transmission) that are often hard to detect in the archaeological record. Sometimes, however, this information is not situated within a firm temporal framework, and changes over time can be condensed. Furthermore, whereas ethnographic information provides personal and family-based perspectives on resource management, it is less likely to inform about how management systems were enacted among multiple settlements. Thus, it is only by combining these two kinds of data and knowledge that we can fully appreciate the breadth of social, cultural, ecological, and technical contexts in which these management systems were enacted.

The value of documenting traditional marine management systems on the Northwest Coast goes well beyond recording important aspects of indigenous history. Recognizing the ecological and cultural place of these systems is linked to larger issues of indigenous rights and title, governance, and food security, as well as the value of integrating millennia-old indigenous knowledge with modern resource management. Given the coast-wide need to manage resources to sustain social and ecological resilience, it behooves us to pay careful attention to documenting this past knowledge for the future.

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Chapter 3: A Bird's Eye View of Northern Coast Salish Intertidal Resource Management Features, Southern British Columbia, Canada[2]

Abstract

Marine intertidal modifications are a prevalent part of the archaeological landscape of the Northwest Coast. These modifications are physical manifestations of resource management activities foundational to the cultures of the region. However, the ability to identify and record the regional variation in these intertidal feature complexes is hampered by the large distances that need to be covered within extremely short and rare low tide sequences. We used aerial photography from a low-flying helicopter during extreme low tides to cover large areal expanses of shoreline in the traditional territory of the Northern Coast Salish. Our bird's eye view allowed us to identify diverse intertidal modifications and a suite of "elements", the smallest repeating forms of intertidal modification. The elements that make up the features are in turn combined in different ways to create larger intertidal modifications. The elements provide the basis for an intertidal feature typology that is consistent with local oral historical knowledge about ancient management systems and activities.

Introduction

In the past two decades, there has been a subtle, but important shift in the way anthropologists conceptualize the interaction of pre-contact Northwest Coast peoples with their land- and seascapes. Whereas it was previously accepted that the region's natural bounty was foundational to many aspects of culture (e.g., Codere 1950; Donald and Mitchell 1975; Matson and Coupland 1995; Piddock 1965; Suttles 1960), an increasing number of researchers now understand that people of this region actively manipulated both terrestrial and aquatic ecosystems to increase natural diversity and abundance (Deur and Turner 2005). Furthermore, there is recognition that such actions are embedded within a complex social system that dictates the right way to behave (e.g., Campbell and Butler 2010; Turner and Peacock 2005). Support for this

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expanded view of human interactions with land- and seascapes comes from ethnographically documented examples (Deur and Turner 2005; Peacock and Turner 2000; Turner 1999; Turner and Peacock 2005), as well as mounting evidence that these behaviors have roots in the deep past (Campbell and Butler 2010; Lepofsky and Lertzman 2008; Weiser and Lepofsky 2009). This re-thinking of Northwest Coast peoples as active participants within and managers of their environments is in line with similar re-evaluations of cultural-ecological relationships among other complex hunter-gatherers of North America (e.g., Anderson 1992; Williams and Hunn 1982).

Nowhere is the extent and complexity of Northwest Coast management (sensu Lertzman 2009) more evident than in interactions with marine resources and ecosystems. Management of marine resources took many forms, including the ownership of prime harvesting areas (e.g., Donald and Mitchell 1975), control over the labor to extract resources (Ames and Maschner 1999:27), the selection of net size and location to capture specific taxa, and the right to officiate first salmon ceremonies (Gunther 1926). Complex fishing technologies, including the abundant traps found throughout the region, and clam gardens, are some of the material correlates of marine resource management systems (e.g., Harper et al. 1995; Langdon 2006, 2007; Losey 2010; White 2006; Williams 2006; Woods and Woods 2005).

Although intertidal management features in the form of clam gardens and fish traps have been identified throughout the Northwest Coast, there have been few focused studies on regional variation in these features (notable exceptions are Byram 2002; Carpenter et al. 2000; White 2006). In part, this is due to the high logistical costs of collecting data on a large number of features often located in remote regions. However, without detailed regionally-specific studies, variation in function associated with intertidal modifications may well be masked by simplistic or essentialist references to “fish traps” or “clam gardens.”

While the terms “fish trap” and “clam garden” are convenient ways of classifying intertidal modifications that either trap fish or enhance clam productivity, the terms do not adequately describe the formal and functional variation often encompassed within these archaeological features. Similarly, these collective terms may also inhibit understanding the ecological knowledge or social context embedded in feature construction. Our first step in assessing the complexities of these systems involves examining these features as clusters of structural components, rather than as functional “wholes.” Focusing on the variability of these structural components will allow us to understand the full functional range of these sometimes complex systems.

In this paper we use aerial fly-overs both to document the regional variation in ancient intertidal management features and as a means of developing a typology of the component parts of these features. Although intertidal features are relatively common along the Northwest Coast, our ability to identify and record variation in them is hampered by the large distances that need to be covered within short and rare low tide sequences. We focus specifically on the Northern Coast Salish region of British Columbia, where our research is embedded in an archaeological and heritage stewardship partnership between Tla'amin (Sliammon) First Nation and Simon Fraser University researchers (Tla'amin Archaeology 2009; Welch et al. 2011).

Our aerial survey and detailed analysis of air photographs builds on the work of others on the Northwest Coast, and beyond, who have recognized the utility of aerial photography for the identification of intertidal feature locations (Harper et al. 1995; Langouët and Daire 2009; Pomeroy 1976; Strandberg and Tomlinson 1970). However, we focus our typology on *elements*, which are the smallest parts of the intertidal features that occur on their own. We focus on elements rather than on complete features because these component parts emerge from the data set as discrete, repeatable, and identifiable forms. By approaching the modifications as clusters of elements, rather than as features with pre-determined functions (e.g., "fish trap," "fish dam," "clam garden," etc.), we open the door to understanding how the Northern Coast Salish varied and combined elements in particular ecological and cultural settings. Focusing on elements further allows for comparison to intertidal features in other regions, such as Heiltsuk traditional territory where a similar suite of types have been identified during preliminary research (Carpenter et al. 2000:27).

We begin our discussion with a summary of Northern Coast Salish management and use of marine resources gleaned from recent interviews with traditional knowledge keepers and ethnographic texts. This information provides the backdrop for our compilation of the aerial survey data on intertidal feature form and location. Our regional survey revealed a vast array of modifications throughout the intertidal zone that appear to promote bivalve production, attract fish species, and increase the harvest of a range of marine taxa. These management techniques range from those that involved little effort to those that involved more labor input and resulted in more significant ecosystem modifications.

The Northern Coast Salish and the Sea

First Nations who belong to the Northern Coast Salish language group inhabit the northern end of the Salish Sea of British Columbia (Figure 3.1). On the mainland are the Sechelt and the Ahayajuthem speakers, the closely related Tla'amin, Homalco and Klahoose First Nations; on Vancouver Island are the K'omoks (Comox) (Kennedy and Bouchard 1990:441). With many inlets and numerous islands, the shoreline within the mainland Northern Coast Salish territory stretches hundreds of kilometers and provides ample space, ecosystem diversity, and opportunity for management of intertidal resources.

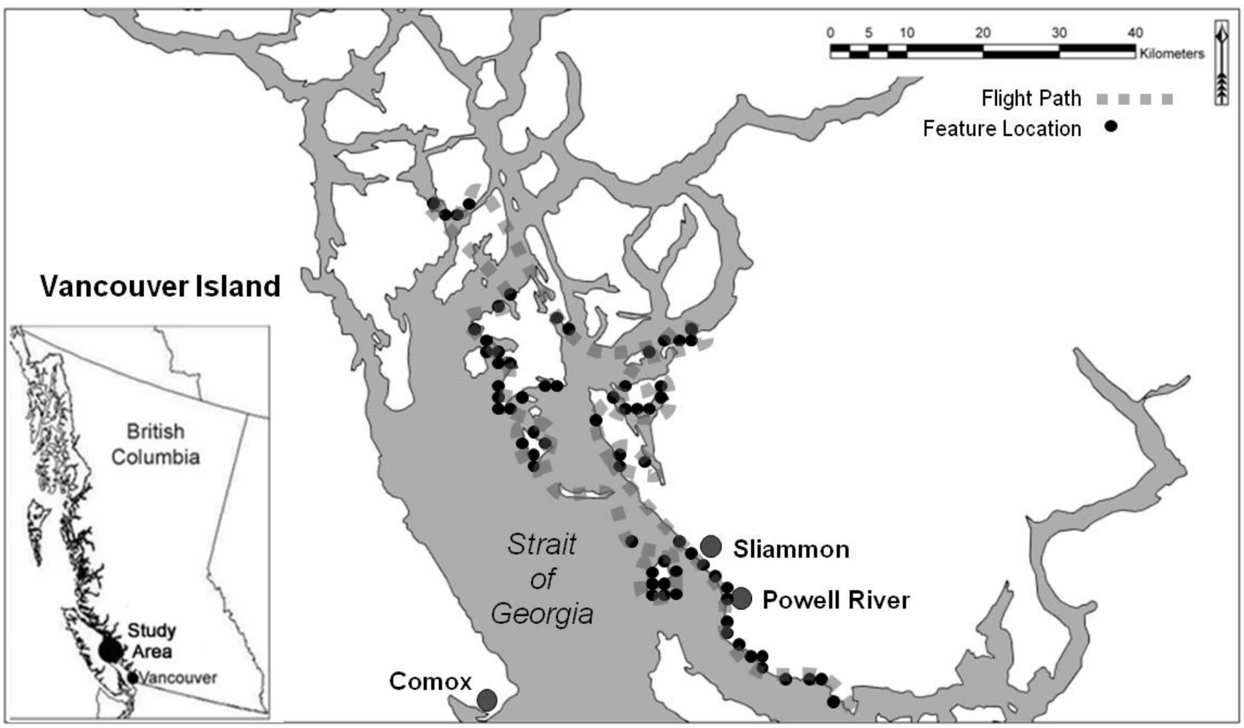

Figure 3.1. *Study area location depicting flight coverage and intertidal site locations.*

The sea plays central roles in many aspects of Northern Coast Salish life. It is a transportation medium and a major source of fish, sea mammals, shellfish, and marine plants (Kennedy and Bouchard 1983:26). Up until about 30 years ago when the impacts of industrial over-fishing became more pronounced, the Northern Strait of Georgia arguably was one of the richest marine systems in the world (Pauly et al. 1998). Even today, the Strait supports the Fraser River salmon runs, which despite significant depletions, remain among the largest runs globally (Northcote and Larkin 1989). People of both First Nations and non-native descent commonly recall salmon and herring populations sufficient to turn waters black during spawning season (Thompson 1993:118). Jerry Galligos (personal communication 2009) recalled that the herring were so abundant that they would constantly hit your fishing boots. In contrast to this past abundance, the Strait of Georgia today has been classified as one of the most ecologically at risk ecosystems in Canada (Gaydos et al. 2008; Glavin 1996).

Historically, Northern Coast Salish peoples employed a variety of methods to manage fish from a variety of marine ecosystems. These methods include the use of lattice-work basketry traps and weirs in rivers to catch salmon swimming upstream, and the use of tidal pounds constructed of stakes and rocks near the mouths of streams to catch returning salmon (Kennedy and Bouchard 1990:444). The Klahoose term *shíshitl'ech* ("lying on your back"), for instance, refers to tidal weirs which were used in small bays to catch a variety of fish. The term refers to latticework fencing anchored by a row a heavy rocks in the tidal flat in such a way that it lay flat at low tide and rose up to trap fish when the tide came in (Barnett 1935; Kennedy and Bouchard 1974:21). Tla'amin Chief Tom Timothy told Homer Barnett in 1935 that rock enclosures were built in the intertidal zone to catch fish by stranding them at low tide (Barnett 1935). Archaeological evidence from middens associated with intertidal features on the western shore of the Strait of Georgia suggests that these traps were likely also used to catch a variety of fish, including herring, sculpins and flatfish (Caldwell 2008; Mitchell 1990:347; Monks 1987). Management activities associated with fish traps include ownership and control of prime harvesting areas (Donald and Mitchell 1975), net size and location selection in order to capture specific taxa, and possibly creating habitat to attract fish (e.g. Byram 2002).

According to local knowledge, bivalve production was enhanced by clearing rocks from the beach. One Klahoose cultural expert, Rose Mitchell, noted that the term *wux̱wuthin* refers to rocks that are piled up when digging clams, or to a rock corral used to store fish caught in fish traps (Randy Bouchard, personal communication 2008). Sliammon elder Mary George confirmed that *wux̱wuthin* could be used as a general term to refer to a fish trap or other boulder constructions and noted that a variety of taxa were harvested from these features, including shellfish, fish, and octopus (personal communication 2008). Sliammon elder Emily August was told by her grandmother that people were supposed to roll rocks to the side of the beach any time they harvested clams. She remarked that the main beach at Sliammon was no longer tidy because people stopped clearing rocks in this way (personal communication 2009). Rocks were either piled on the side of the beach or beyond the low tide mark in an effort to make it easier to dig clams. These actions resulted in cleared expanses of beach, much like those we see in our archaeological survey (Charlie Bob, personal communication 2009; Kennedy and Bouchard 1974:48). Sliammon Elder Charlie Bob noted that beaches that have been cleared for clams could be further modified to trap fish. The rocks moved during clamming are piled up into walls and a gap is left in the middle for fish to enter. Once the clearing fills with fish on an incoming tide, the gap in the wall is sealed off, and the fish collected (Charlie Bob, personal communication 2009). *Wux̱wuthin, shíshitl'ech*, and other rock and stake alignments are the material correlates of Northern Coast Salish marine management systems. The various means through which intertidal features were created – as byproducts of other activities or as the result of purposeful creation of walls – represent a range of different activities.

The Bird's Eye View: Identifying Elements

We conducted an aerial survey from a low-flying helicopter during two extreme low tides in June and July 2009. Our survey covered over 250 km of shoreline in the Northern Coast Salish region (Figure 3.1), and focused on areas of the region that had not been subject to previous intertidal survey (Johnson 2010). Over 2,500 high-resolution digital photographs of the coastline were taken of all areas that may have contained features, whether or not features were observed from the air. We avoided steep cliffs and heavily developed shorelines. We identified intertidal modifications by reviewing each photograph on a large computer screen.
Through our detailed examination of the photographs we identified eight distinct forms of modifications (Figure 3.2). We use the term "elements" to describe these basic forms. These elements are repeated in several locations and are found on their own or in combinations. We use the term "features" to describe modifications that contain combinations of elements (Table 3.1). Many of these features would typically be classified as fish traps or clam gardens. In addition to describing the form of each of the eight elements, we also describe where they are found within the intertidal. We determined tidal location by observing the placement of each modification in relation to both the high tide strandline and the tidal position at the time the photograph was taken (~ +/- 0.2m in tidal height from the maximum low tide of 0m during the fly-overs).

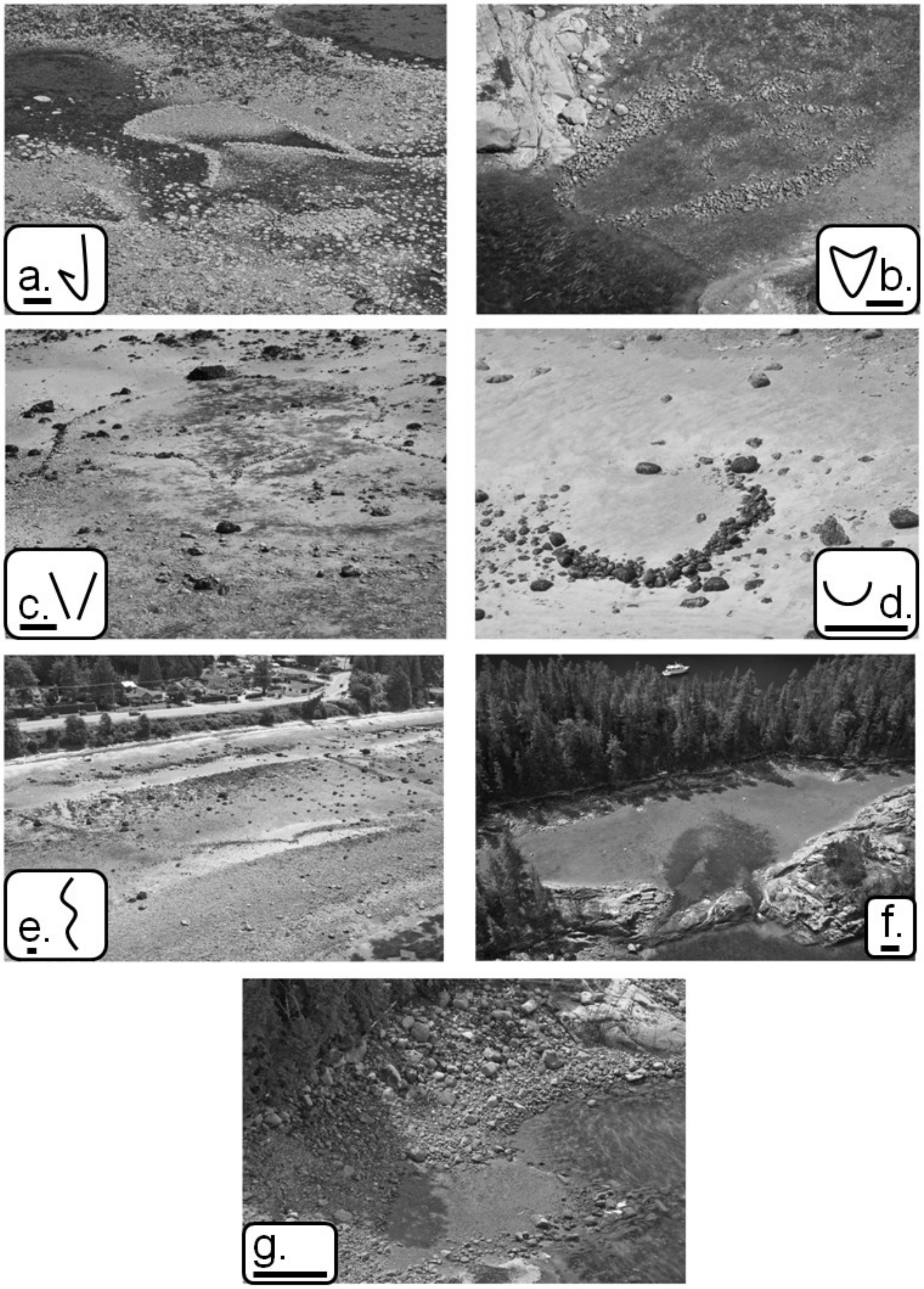

Figure 3.2. *Examples of elements with line drawings of built stone wall forms. Black bar represents 2m scale for each photo. a) hook, adjacent to a cleared beach; b) heart, sitting on top of a cleared beach element; c) V, with associated lead line visible; d) crescent, sitting on a naturally sandy beach; e)linear; f)cleared bedrock depression; g) cleared beach. (G. Combes photos)*

We identified 51 locations with intertidal modifications comprised of a total of 144 elements and 66 features (Figure 3.1). The 144 elements can be placed into one of eight element categories (Table 3.1; Figure 3.2). Six element categories are defined by the buildup of rock into low-lying walls of various forms: hook; heart; V; crescent; linear; undefinable. Two are defined by the removal of rocks: cleared beach; cleared bedrock depression. We paid particular attention to distinguishing natural from cultural, and ancient from modern modifications. In distinguishing natural from cultural modifications, we looked for the distinct shape of the latter, and placement of these modifications on the beach. Comparing known modern disturbances in the area to archaeological features, the archaeological features generally occur in the middle to lower portions of the intertidal zone, while recent constructions or destructions are most often in the upper intertidal zone.

In addition to the eight elements, we also identify "lead lines." Lead lines are low-lying rock walls of variable lengths and configurations. In contrast to the eight element types, lead lines are always paired with a stone wall element, and never occur alone. Their function appears to be to lead taxa into the other element forms, but not to hold taxa themselves. Lead lines differ from linear elements (description below) which, like the other built-up elements, create impoundments. The lead line category also differs from the eight element categories in that it is identified and described in terms of function rather than form.

The Elements

Hook Element

The hook element (N=30) is shaped like a "six" or "fish hook," with a horseshoe shaped curved wall and an attached shorter straight wall angled approximately 45º inwards (Figure 3.2a). These elements are associated, in 30% of our cases, with long lead lines that extend from the element across the beach, increasing the area from which the element can draw in fish. Placement of the hook element is both perpendicular and parallel to the beach. Hook elements are generally found in the middle and lower zones of the intertidal.

Table 3.1. *Distribution and associations of intertidal element types.*

	Number of times elements co-occur with themselves and other elements												
	Hook	**Heart**	**V**	**Crescent**	**Linear**	**Bedrock depression**	**Cleared beach**	**Undefinable**	**Lead line**	**Element occurrences**	**Occurrences by itself (%)**	**Occurrences with other elements (%)**	**% of total elements**
Hook	8	1	1	3	0	0	10	3	9	30	10.00	90.00	20.83
Heart	1	0	2	1	0	0	3	1	2	8	50.00	50.00	5.56
V	1	2	6	1	1	0	6	4	9	27	11.11	88.89	18.75
Crescent	3	1	1	5	1	0	4	1	1	22	9.09	90.91	15.28
Linear	0	0	1	1	0	0	0	0	0	6	83.33	16.67	4.17
Bedrock depression	0	0	0	0	0	0	0	0	0	2	100.00	0.00	1.39
Cleared beach	10	3	6	4	0	0	5	8	8	32	9.38	90.63	22.22
Undefinable	3	1	4	1	0	0	8	3	3	17	11.76	88.24	11.81
Lead line	9	2	9	1	0	0	8	3	7	33	N/A	N/A	N/A

Heart Element

The heart element (N=8) consists of two mirrored, curved walls forming the shape of a heart (Figure 3.2b). The walls usually touch at the point of the heart but do not meet at the curved end. Heart elements can be accompanied by lead lines, but generally are not. Heart elements are found in the low to sub-tidal zone of the intertidal. Elsewhere on the Northwest Coast, heart elements were made of stone and wood together (Mobley and McCallum 2001) and just wood stakes (Greene 2010).

V Element

The V element (N=27) consists of two straight walls angled toward each other (45º - 70º), but do not meet at the apex of the V (Figure 3.2c). V elements are oriented with the apex towards the water. In one third of its occurrences, the V element is enclosed on the inland side by a lead line that partially surrounds the trap and extends from either side of the V towards the water. Based on ethnographic sources for the coast as a whole, this form was often used to trap fish with outgoing tides. It was used in conjunction with a lattice-work basket trap secured at the point of the V-shape, which led fish to the basket trap (Stewart 1983). V elements are found in our study area in the middle and lower zones of the intertidal.

Crescent Element

The crescent element (N=22) consists of either a semi- or completely circular stonewall (Figure 3.2d). Somewhat common in our study area, crescent elements are located in the high to low intertidal zone. Crescents are similar to the *shíshitl'ech* features described in the ethnographic texts (Kennedy and Bouchard 1974:21).

Linear Element

The linear element (N=6) is a continuous straight or slightly curved wall of variable length (Figure 3.2e). Linear elements are found from the high to low zones of the intertidal, including offshore reefs.

Cleared Bedrock Depression Element

This element is a modification of a naturally occurring depression within bedrock outcrops located within the mid to lower intertidal zone (Figure 3.2f). We identified two cleared bedrock depressions in our aerial flyover, and we know of at least two others from previous ground-based survey in areas not covered in the aerial flyovers, although these are not included in our discussion below. Cleared bedrock depressions naturally hold water during low tides, but are augmented by removing cobbles from the floor of the depression, and adding rock walls to the natural outflows in order to restrict movement of water and marine taxa during tidal movement.

Cleared Beach Element

Cleared beaches (N=32) are portions of or entire beaches where larger cobbles and small boulders have been removed and placed along the edges of the cleared area, but do not form a distinct wall (Figure 3.2g). In some cases, the buildup of stone occurs at the low tide line in a fashion characteristic of clam gardens in other regions (c.f. Harper et al. 1995). The buildup of rocks around the edges of a cleared beach may allow cleared beaches to hold water, although not all do. Further, the buildup of rock around the edges can have areas that are left open or clear; when cleared beaches are combined with stone wall elements, the walls tend to be positioned on the water side of these openings. Based on information shared by Tla'amin community members, cleared beach elements are likely the result of past clam digging and management.

Undefinable Elements

We were unable to classify only a small number (N=17) number of rock elements in our sample. These undefinable elements consist of piled rocks that are not formed into walls and whose form is not repeated at multiple locations. Undefinable rock alignments may lack recognizable form because they are the result of other activities (e.g., creating cleared beaches) and have no intended function, or are now-destroyed elements that we can no longer classify.

Element Distribution

Our overall sample is numerically dominated by four groups of elements (Table 3.1), cleared beaches, hooks, Vs, and crescents, while the other four element types (heart, linear, cleared bedrock depression and undefinable) occur less frequently. Cleared bedrock depressions always occur as singular elements, and linear and heart elements occur by themselves more often than the other elements occur by themselves. The other five element types are rarely found as the sole element in a feature, occurring as single elements less than 12% of the time. Correspondingly, heart, linear and bedrock depression elements are unlikely to co-occur with other elements (<50%), while the other five elements have high frequencies of co-occurrence (>88%).

From Elements to Features

Our data suggest that Northern Coast Salish peoples were equally as likely to construct multi-element intertidal features as they were to build a single element. Features are composed of anywhere from one to 14 elements (Figure 3.3). Half of our identified features contain only one element. The other half of features contain two or more elements, with the majority of these (30% of overall features) being composed of only two elements. Two large and complex features exist in our study area, containing 11 and 14 elements respectively.

While any pairing of elements is possible, some element types never co-occur with certain other types and other combinations are relatively common in our study area (Table 3.1). For example, hook and V elements are often found with cleared beach and undefinable elements, and with each other. However, hook and V elements are only found once with each other. Furthermore, some element types are frequently found in combination with other elements (hook, V, crescent and cleared beach elements) while others are more likely to be found by without any other elements (linear and heart elements). Lead lines, by definition, are always found with one or more elements, but are most often associated with particular types of elements (hook, V, cleared beaches and undefinable) than others.

In relatively rare cases, we find areas of modification that include multiple features on a beach that are not physically connected (N=26 features, ~39% of features). Since these features are separated by less than 100 meters, they are considered a “site” by the archaeological

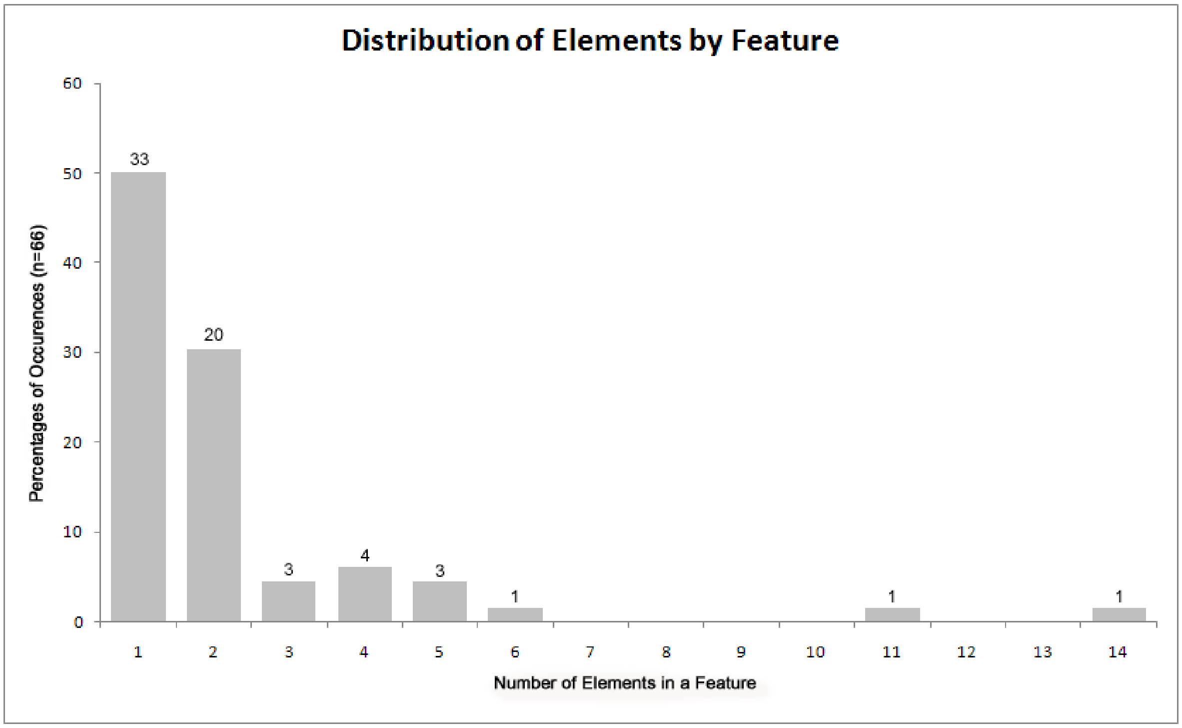

Figure 3.3. *Distribution of the number of elements present in a given feature, displayed as percentage of occurrences. Numbers above the bars are a raw count of occurrences.*

standards of British Columbia (Cynthia Lake, personal communication 2010). However, there is the possibility that while they are located on the same beach, they did not function together. It is also possible that not all of the features at multi-feature sites were built and used at the same time. Of our multi-feature sites (N=11), the majority are composed of two features (N=8), with the remaining being composed of three or four features (N=2 and 1, respectively). Whether feature co-occurrence is due to social or ecological factors is unknown, and an important question is whether these multi-feature sites were owned, managed or used by different social groups.

By combining elements and constructing multiple features in relatively restricted areas, people living in the Northern Coast Salish area developed a series of locations at which they managed a suite of intertidal resources. For example, in one bay along Malaspina Peninsula, four areas are enhanced by five features which include both cleared beaches and stone wall elements, covering approximately 1.5 km of shoreline. Additionally, our analysis of aerial photographs revealed that some elements are more common in certain sub-regions of our study area (Figure 3.4). The majority of hook elements (93.33%), for instance, are more common in the southern portion of our study area. Heart (75%) and V (70.74%) elements, on the other hand, occur more

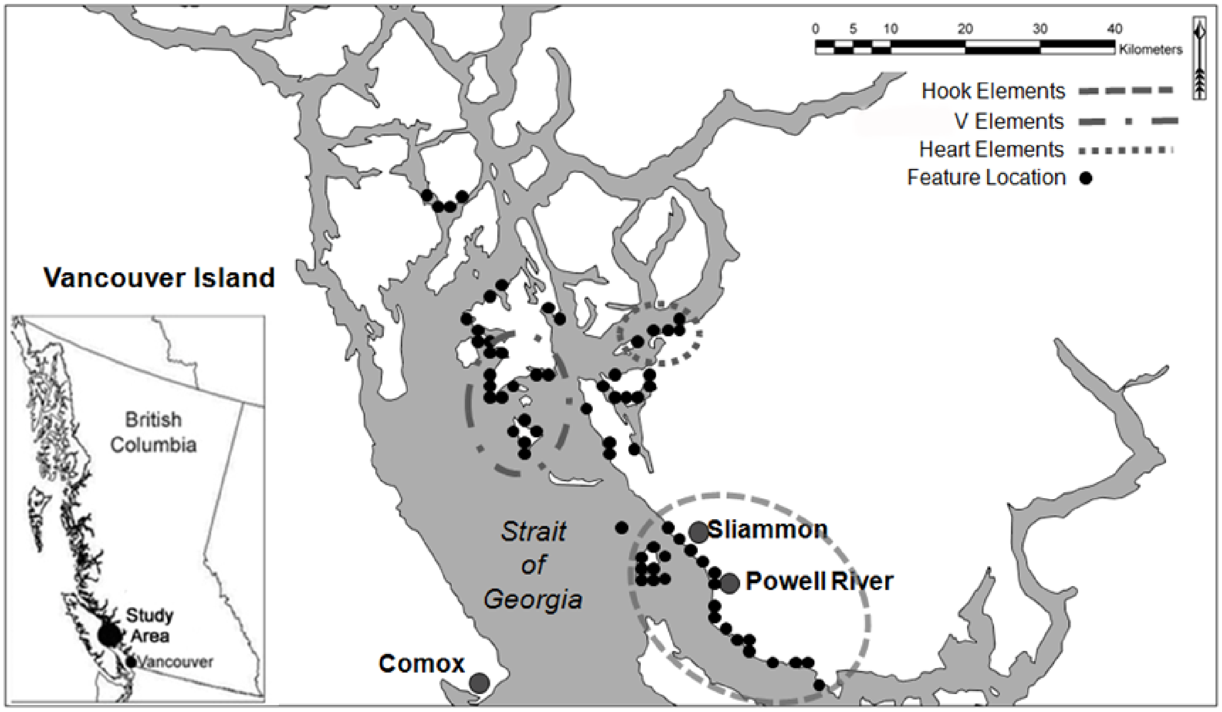

Figure 3.4. *Sub-regions dominated by certain element forms.*

frequently in the north. Other elements, such as cleared beaches are almost evenly distributed throughout our study area.

Additional data are needed on the ecological setting of these features, but we suspect that these sub-regional differences are the result of differences in tide and current action, water temperature, and fish and shellfish behavior. Alternatively, the variation encountered in Northern Coast Salish intertidal features could simply be due to stylistic variation amongst local groups, rather than functional differences. Analyzing ecological and physical variation in element and site settings is part of our ground truthing protocol, and will assist us in determining spatial variation amongst intertidal resource features and in assessing function.

Evaluating the Bird's Eye View

While aerial survey is an effective tool for defining a typology of intertidal management elements, it does have some limitations. First among them is that not all intertidal modifications will be evident in the aerial imagery. While stone elements and cleared beaches are highly visible in aerial photographs, we are unable to identify wooden features in aerial photographs (e.g., stake fish traps). It is also difficult to ascertain from aerial photographs if the elements in a feature are contemporaneous, or if their co-occurrence is the result of repeated activity at different points in time.

Among stone elements, visibility in a photograph is dependent on several factors. For instance, camera angle combines with element height to determine visibility. In other regions, researchers have produced dramatic images of ancient landscape features by taking advantage of low-angle morning light (e.g., Heisey 2004). However, since low tides in our region occur near midday, we cannot use this technique. Furthermore, since many features in our region occur in the lowest intertidal zone, the aerial view is most useful in the three hour window around lowest tides of the year.

Once identified, the degree of disturbance will influence our ability to place elements in a typology. In our study, wave action, logging, mariculture, and other recent development activities have impacted the foreshore and thus the intertidal archaeological sites. In some cases, these disturbances likely altered elements to such an extent that it is no longer possible to discern their original shape. These examples are currently grouped into our small "undefinable element" category. Alternatively, it is also possible that some of the undefined elements are single examples of elements that would fit into a group of elements if we had a larger sample. As researchers in other regions adopt this element approach to describing intertidal features, new elements groups can be made that potentially include some of our undefined elements. Potential expansion of this typology will further enhance our understanding of the variability present in intertidal resource features on the Northwest Coast.

Discussion

Aerial survey is an effective and efficient means of obtaining broad areal coverage and identifying repeated patterning in some forms of intertidal features. This method is especially effective in regions like ours where the distance between sites is considerable, and the low tide windows are few and narrow. In the Northern Coast Salish region, with only about 10 suitable daylight tides (<0.3masl) in any given year, there is not enough time to access a wide range of sites by boat and then conduct pedestrian surveys. The aerial survey, however, allowed us to create a large database of high-resolution photographs that we could scrutinize for repeated elements and features. Our post-flight examination of the images also allowed us to identify subtle features that might be missed during traditional ground survey and to distinguish natural background from recent and ancient foreground features.

People living in the Northern Coast Salish area employed a diverse set of techniques to modify a range of ecosystems, including small, sheltered bays and long, open beaches, and the upper, mid and lower levels of the intertidal zone. We believe that modifications to the foreshore represent a range of intertidal resource management techniques spanning the intertidal and sub-tidal zones. These techniques range from incidental clearing of beaches while gathering clams, to extensive feats of engineering to enhance clam production and capture a range of marine taxa. In any given location, elements can occur separately or in combinations to create one or more features. Importantly, many of these features mix elements that would typically be labelled by archaeologists as "fish traps" or "clam gardens." By clumping intertidal modifications into such gross categories, prior researchers may have missed elements or features that do not comfortably fit into these groupings. For instance, we expect that many researchers have missed the prevalence of cleared beaches, either in isolation or as part of larger intertidal systems.

Extant local ecological knowledge suggests that intertidal features were traditionally named by feature form, not by individual elements. Sometimes the names are for general forms (e.g., rock walls associated with cleared beaches – *wuxwuthin*) and other times they are associated with specific intertidal features (e.g., stone walls with attached latticework fences – *shíshitl'ech*). Outside of the intertidal zone, river traps were referred to as *tékwus*, meaning 'closed at the head' (Kennedy and Bouchard 1974:21). We suggest, however, that it is also likely that elements were recognized and possibly even named in the past. The fact that different forms (e.g., hook, heart and V elements) are located in different sub-regions of our study area supports the idea that these element forms were recognized as discrete units.

We are currently analyzing associated middens to determine possible element and feature age and also function. Because the features are constructed from stone, traditional radiocarbon dating methods are inapplicable. Although there is ethnographic evidence that Northern Coast Salish stone intertidal features often had associated wooden components (Kennedy and Bouchard 1974:48), we have been unable to locate wooden remains. We will use our zooarchaeological analysis of shell middens to provide not only information on targeted taxa, but also indirect dating of the features. Specifically, the midden analyses may reveal changes in resource use that may indicate the advent of intertidal resource features (c.f., Caldwell 2008). Analysis of the functional variation present in these features will occur as part of our on-going collection of detailed information about the elements (e.g., size, ecological setting, age, combinations with other elements) is complete.

Deciphering the social context underlying the association of intertidal elements and features, and intertidal features with terrestrial sites, is the obvious next step of our research. The intertidal modifications present in our study area are the end result of a range of activities. On one end are activities such as clearing the beach of large cobbles each time it is used (Kennedy and Bouchard 1990:445), and inadvertently creating cleared beaches. On the other end is the undertaking of extensive feats of engineering to create large, complex sets of intertidal management elements. Within these two extremes are a suite of other behaviors, including building less labor-intensive structures, upkeep of intertidal features, and perhaps even selective harvesting of the resources taken from the intertidal zone. To understand the range of activities, and their social implications, we will combine feature placement relative to tidal level, tidal direction, and dominant winds and currents, as well as associated knowledge about taxa-specific ecological preferences, with traditional knowledge to establish the functions of various element types. We will also assess element and feature size, construction materials and methods, and distance to different types of terrestrial sites. We will combine these data with those from excavations of associated shell midden deposits, interviews with traditional knowledge keepers, and ethnohistoric and ethnographic data to determine the social causes and implications of Northern Coast Salish intertidal resource management.

Marine management systems encompass several hallmarks of complex hunter-gatherer societies on the Northwest Coast. These include technologies for efficient resource extraction, manipulation of the environment, ownership and control over landscapes, resources, and people. As well, they embody extensive ecological knowledge and complex social structures. Our study of variation in intertidal modifications in the Northern Coast Salish region is strengthened through the use of aerial survey. Using this method, we have identified a range of modifications to the intertidal zone. However, we have only just begun to understand the associated social structures embedded within these management systems. As we continue our research programme with intertidal ground truthing and excavation of associated midden sites, as well as further interviews with traditional knowledge holders, we will be better able to associate the presence of intertidal resource features with the practices that resulted in their construction and use. Finally, this method has allowed us to identify a range of elements present in intertidal resource features, and to create a typology that can be modified and applied elsewhere on the Northwest Coast, and throughout the world.

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Chapter 4: Ancient Marine Management in Northern Coast Salish Territory

Introduction

Indigenous people worldwide, including those who traditionally did not rely on intensive agricultural production, actively shaped their ecosystems in diverse and complex ways (e.g., Balee 2015; Hames 2007; Hunn et al. 2003; Kirch 2005; Lyman and Cannon 2004). On the west coast of North America, traditional management systems in general (e.g., Turner 2014), and marine management systems in particular (e.g., Deur et al. 2015; Lepofsky and Caldwell 2013; Lepofsky et al. 2015; Thornton 2015), are widespread and have considerable time depth. Encompassed within marine management systems are a myriad of nested and linked conscious and subconscious actions. These actions are manifest in and influenced by the tangible and intangible elements of social-ecological systems (Lepofsky and Caldwell 2013; see Chapter 2, Table 2.1).

Traditional management systems are culture specific and composed of diverse kinds of knowledge, actions, and social institutions, encompassed within particular worldviews (Berkes 2012). Understanding ancient management systems requires not only bringing together diverse kinds of evidence, but also recognizing the social and ecological contexts within which these systems operated (see Chapter 2). Seen this way, zooarchaeological data do not simply provide a list of what people harvested and ate, but also are indicative of a range of culturally-situated management decisions including harvesting restrictions, seasonal variability in harvests, and the choices people make about the ecological impacts of their resource use over time (Chapter 2). Similarly, the spatial relationship of management technologies, such as fish traps and clam gardens, to settlements and other features (e.g., burials, rock art), and how these are situated on the landscape, can offer insights into tenure, ownership, and worldview. Combined, these two archaeological data sets offer a powerful means to examine ancient marine management systems.

In this study, we take a broad approach to understanding ancient marine management systems among the ancestral Northern Coast Salish by examining both intertidal features and zooarchaeological data (Figure 4.1). We carry out this approach at several nested scales, using the levels of traditional knowledge defined by Berkes (2012), to make inferences about social and ecological aspects of ancient marine management (Figure 4.2). The archaeological remains of marine management systems examined in this paper include both intertidal fish traps, which

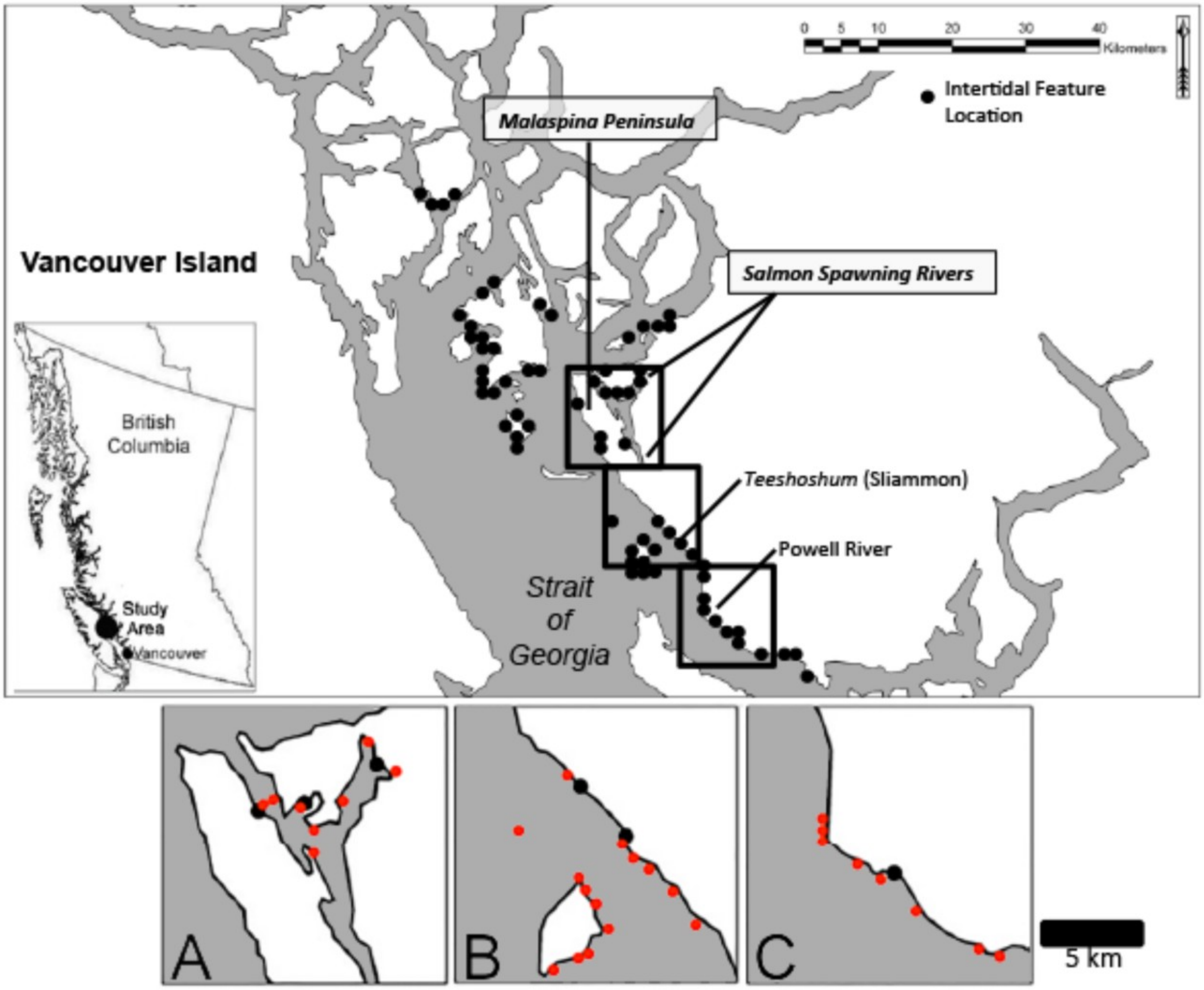

Figure 4.1. *Approximate locations of shell midden sites sampled in this study (black dots), and of the intertidal features found within <5 km of those sites (red dots; some dots represent more than one feature).* ***(A)*** *From left, EaSe-76, EaSe-11, and EaSe-18. The intertidal features noted are only those within the inlet system; more traps exist to the north in Desolation Sound and to the west on the Georgia Strait side of the peninsula. Salmon spawning streams are located at the head of both Theodosia Inlet (to the northeast of the inlet system) and Okeover Inlet (to the south of the inlet system).* ***(B)*** *From top, DlSd-3 and DlSd-6. DlSd-6 is located on the present- day Sliammon IR-1. The island is Ahgykson, or Sliammon IR-2, which was and still is frequently used by the Tla'amin as a resource gathering location.* ***(C)*** *Location of DkSc-13.*

can catch many fish per day and have the potential to alter marine ecosystems, and 'clam gardens', which enhanced intertidal zones that were designed to facilitate clam growth rates and abundances (Groesbeck et al. 2014, Lepofsky et al. 2015). How these features were employed in managing marine resources is assessed by exploring variations in forms and combinations of elements, identifying their ecological settings and their relationships to each other and to settlement sites, and by analyzing marine faunal remains from the nearby shell middens.

Employing nested scales to consider our data allows us to explore the multi-dimensionality of marine resource management, ranging from the daily use of intertidal features to ancestral Northern Coast Salish worldviews. The social implications of these marine management systems are examined in the discussion.

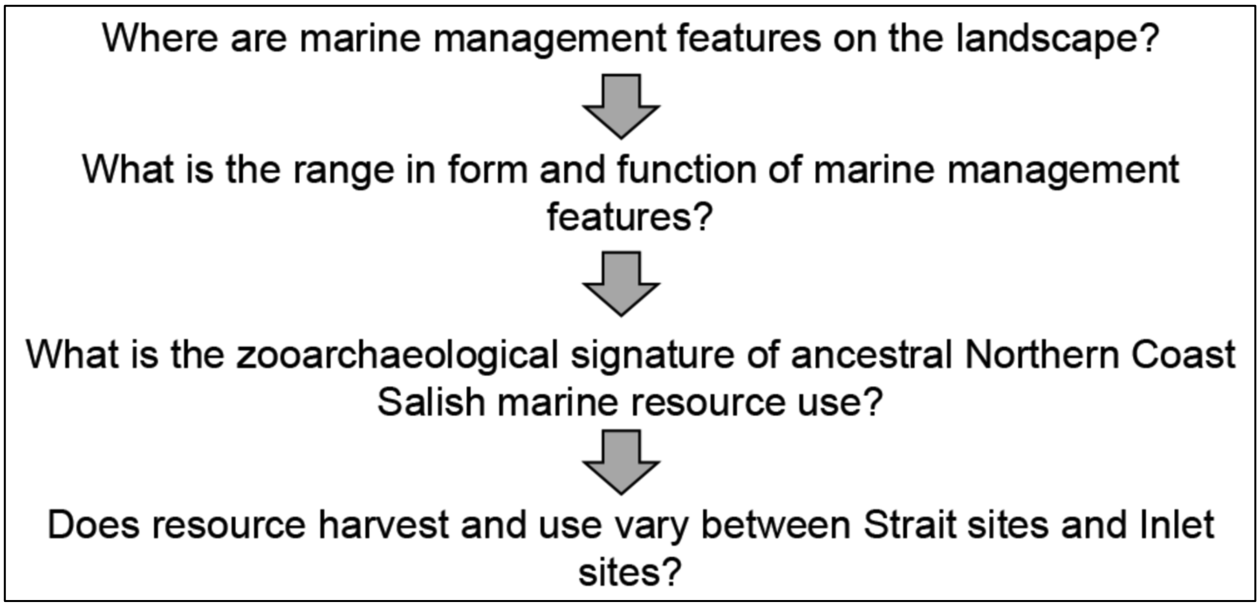

Figure 4.2*. Nested scales used to make inferences about social and ecological aspects of ancient marine management.*

The data presented in this paper were collected as part of the Tla'amin First Nation – Simon Fraser University Archaeology and Heritage Stewardship Project between 2008 and 2011. This study is a collaborative effort to record and understand the archaeological and cultural heritage of Tla'amin First Nation (Welch et al. 2011). A key objective was to document Late Holocene land use, including the extent of intertidal management features in Tla'amin traditional territory.

The Study Area

The project study area is situated at the confluence of the Northern Strait of Georgia and the southern end of Johnstone Strait; specifically, the Strait of Georgia side of the Malaspina Peninsula and the protected inlet system on its eastern side (Figure 4.1). This area is the traditional territory of the Tla'amin, Klahoose, and Homalco, who are closely related Northern Coast Salish Nations. The current project focuses on the core of Tla'amin traditional territory.

This portion of the Strait of Georgia has relatively weak (slow) tides compared to areas directly north and south, but still experiences variation in flow speed throughout the tidal cycle and is vulnerable to winter storm surges (Thomson 2014). The inlet system on the other side of the Malaspina Penninsula (hereafter, “Malaspina Inlet”) has more sheltered waters. Unsurprisingly, many ancestral Northern Coast Salish settlements and intertidal structures are located in the Inlet’s protected bays and coves. However, settlements and intertidal features are also common on the Strait of Georgia side of the peninsula.

The study region is part of the Oregonian shellfish province (Harbo 1997), with largely rocky intertidal zones. Some sandy beaches are present, mostly on islands in the Strait of Georgia. The region as a whole is dominated by pelagic fish, and provides rearing habitat for Pacific herring (*Clupea harengus pallasii*) and Pacific salmon (*Oncorhynchus* spp.; Masson and Perry 2013). Many demersal species are present throughout the year (e.g., rockfish, sculpins, greenlings, lingcod, halibut and other flatfishes). Invertebrate taxa are dominated by bivlaves (e.g., littleneck clams, butter clams, bentnose macomas, bay mussels), although univalves, urchins, and crabs are also abundant. Many other marine species used or known by the Northern Coast Salish also live or move through the area, including larger invertebrates like the great pacific octopus, and seals, dolphins, whales, and a variety of birds are also present.

Some broad differences in local ecology between the Strait of Georgia versus Malaspina Inlet likely resulted in variability in quantity and temporal availability of some marine taxa. For example, the Strait of Georgia was utilized by many runs of salmon that passed by on their way to their natal streams (such as the Fraser River) and also provided habitat for demersal species (e.g., lingcod or halibut) that prefer its deeper waters. In contrast, the Inlet hosts taxa that are rare on the open expanses of beach of the Strait, such as the bay mussel. Although the Inlet salmon runs are limited to those whose natal streams are at the heads of the inlets, this region would have been an easier place to catch salmon than the Strait, as its narrower waterways serve to corral and concentrate the fish. Adult herring are present throughout the year in all waters, and spawn in late winter/early spring (Haegele and Schweigert 1985; Masson and Perry 2013). These differences in ecology and water flow would have influenced how the intertidal features on both sides of the Malaspina Peninsula functioned, as discussed further below.

Methods and Materials

Two lines of evidence are used to examine the nested scales of the marine resource management systems in the study area: archaeological evidence of intertidal features and zooarchaeological data from habitation sites. Methods to gather these data include identification of intertidal features, excavation at shell midden sites to obtain faunal remains, and identification and analysis of those remains. Northern Coast Salish traditional knowledge about marine management systems, which plays an important role in understanding ecological resource management, is presented in Chapters 2 and 3, and incorporated in the discussion below.

Intertidal Features

Intertidal features were initially identified during two aerial surveys of the region, which are described in Chapter 3 (Caldwell et al. 2012), and a subset of features were more closely documented through subsequent site visits. Our aerial surveys of the study area resulted in the recording of an abundance of diverse intertidal features (Chapter 3). Intertidal features were visited to record the construction material employed (wood, stone, or both materials), if the substrate had been altered (i.e., removal of rocks/small boulders), the size of boulders used in constructions, and the width, height, and horizontal extent of built elements. Care was taken to record post-use disturbance, whether caused by humans or natural processes. At five locations, minimal excavation/movement of rocks was undertaken amongst and behind the stone walls to look for wooden components, but none were observed.

Archaeological Excavation

Archaeological excavation was undertaken at six shell midden sites adjacent to intertidal features. We chose sites in both the Strait of Georgia (N = 3) and Malaspina Inlet (N = 3; Figure 4.1) to examine if people were using and managing marine resources differently in these two different ecological contexts. We chose sites with well-preserved shell midden that could be classified as multi-generational settlement sites based on their size and depth. These sites also typically display surficial evidence of house structures (house pits or terra-formed platforms). We also selected sites directly adjacent to or in close proximity (<5 km by boat; or one hour of canoe travel time [Ames 2002]) to intertidal features for our faunal samples. Such sites presumably will be dominated by the remains of the marine fauna harvested in the nearby intertidal features and in nearby open water. The sizes of excavation units varied from site to site (Table 4.1). Samples sizes depended on the depth of the archaeological deposits. From relatively shallow sites, bulk samples from 50 x 50 cm units were collected, while deeper sites were sampled using either 20 x 20 cm column samples on exposed midden faces, or as column or bulk samples within larger units (100 x 100 cm).

During excavation, care was taken to collect samples for radiocarbon dating. At each site, we sought to whenever possible collect a charcoal sample from the bottom, middle and top stratigraphic layers. When charcoal was not present, we collected charcoal rich sediments, mammal bone (deer), or shell. When considering which samples to submit to dating for this project, we decided to focus on bottom dates, as most sites were known to be used into the historic period, and a reasonable recent age could be the contact period of the 1800s or later. Dates for five sites are presented in Table 4.2; the sample submitted for DlSd-3 (deer bone) did not contain enough collagen for dating. All the faunal samples analyzed date within the last 4,000 years, with most dating within the last 2,000 years (Table 4.2).

Zooarchaeological Identification and Analysis

Samples of faunal remains were collected from 10 cm arbitrary levels, except when such layers crossed stratigraphic boundaries. In the field, excavated material was screened through 3.175 mm mesh, and all faunal remains were collected for later analysis. Bulk samples were wet-screened in the laboratory through 2 mm mesh. Samples were then sorted to recover all vertebrate elements and the non-repeatable elements of invertebrate remains. Elements were identified to the finest possible taxonomic level (typically family, genus, or species) using comparative faunal materials curated at the Department of Anthropology, University of Alberta, and the Department of Archaeology, Simon Fraser University. Occasionally, published guides (Cannon 1987; Butler 2009) were consulted. For fish remains, no attempts were made to identify rib, ray, or spine elements; this is standard practice in zooarchaeological studies on the Northwest Coast. The data were calculated as either number of identified specimens (NISP) counts for vertebrates, or minimum number of individuals (MNI) counts for invertebrates.

To adjust for variation in unit size and stratigraphic sample volumes, the zooarchaeological data are presented as measures of either %NISP/L or %MNI/L, by litre of *in situ* excavated material (following Cannon 2000). Quantifications of some invertebrate taxa

Table 4.1. *Archaeological shell midden sites included in the study. See Table 4.3 for radiocarbon dates for sites.*

Site	Location	Site Size	Unit Size	Depth of Unit	Associated Intertidal Feature Types	Proximal (<5 km) Intertidal Features Discussed in Appendix A
DkSc-13	Georgia Strait	9,000 m^2	50x50 cm	50 cm	Stone fish trap offshore of site (<2 km by boat)	DkSc-16; DkSc-17
DlSd-3	Georgia Strait	700 m^2	50x50 cm	103 cm	Stone fish traps on shore in front of site	DlSd-1
DlSd-6	Georgia Strait	8,960 m^2	100x100 cm	80 cm	Stone fish traps within 2 km by boat	DlSd-1; DlSd-11; DlSd-12; DlSd-13; DlSd-37; DlSd-39
EaSe-11	Inlet	18,375 m^2	20x20 cm	244 cm	Stone fish traps and cleared beach on shore in front of site	EaSe-34; EaSe-71; EaSe-74; EaSe-138
EaSe-18	Inlet	4,500 m^2	20x20 cm	205 cm	Stone and wooden fish traps within 2 km by boat	EaSe-34; EaSe-51; EaSe-137
EaSe-76	Inlet	9,000 m^2	Fish: 20x20 cm Invertebrates: 100x100 cm	Fish: 220 cm Invertebrates: 95 cm	Stone fish traps and cleared beaches offshore of site <2 km by boat	EaSe-71; EaSe-74; EaSe-138

Table 4.2. Radiocarbon dates for archaeological shell midden sites included in the study.

Lab #	Site	Sample Material	Conventional Radiocarbon Age (BP)	2-sigma cal. BP (P=95%)
Beta-261183 (invertebrate sample)	EaSe-76[1]	Charcoal	2180 ± 50	2330 - 2040
Beta-285599 (fish sample)	EaSe-76[1]	Charred Material	3770 ± 40	4250 - 4070 *and* 4040 - 3990
Beta-285597	EaSe-11	Charred Material	970 ± 40	950 - 790
Beta-285594	EaSe-18	Charred Material	910 ± 40	920 - 730
Beta-263324	DlSd-6[4]	Charred Material	910 ± 40	920 - 730
Beta-300560	DkSc-13	Organic Sediment	2140 ± 30	2300 - 2260 *and* 2160 - 2040

unlikely to have been consumed as food sources (remains of very small (<1 cm) barnacles, limpets, whelks, and land snails) were made but are not included in the results. Refer to Appendix B for further details on methods and results of the zooarchaeological analyses.

Northern Coast Salish Traditional Knowledge

Northern Coast Salish traditional knowledge and practices are summarized from published literature (Barnett 1955; Kennedy and Bouchard 1974, 1983; Paul 2014; Peterson 1990; Siemthlut 2004) and unpublished sources, the latter including traditional use study interviews undertaken with Tla'amin in the 1990s as part of the Tla'amin treaty process (Sliammon Nation TUS and MIS). Interviews with Tla'amin members were also undertaken as part of the Tla'amin-SFU research project, which included questions regarding marine resource management. Overall, these data provide information pertaining to Northern Coast Salish marine resource use, along with broader information about management practices.

Results

We organize our analysis into a series of nested scales (Figure 4.2). We infer that social relations were played out at and encompassed by these different scales. Some of the data encompassed within the larger spatial scales have been presented elsewhere (Chapter 3) and are only slightly expanded upon and summarized here. The analysis of the built structures of the intertidal zone and the zooarchaeological analyses are the focus of the results presented in this chapter. The discussion that follows situates the ancestral Northern Coast Salish marine management system within a larger context of management practices and their social implications.

Where are marine management features on the landscape?

Aerial survey of the study area revealed 66 features at 51 localities in an estimated 1,000 km^2 area (Caldwell et al. 2012; Chapter 3). Our terrestrial survey added another 13 locations to this total. The new locations consist of either wooden features, which were not visible in the aerial survey, or of features identified in areas not included in the fly-over. These results indicate that aerial photography during extreme low tides is an efficient and effective tool in identifying and recording stone intertidal features, but is less adept at identifying wood structures, particularly small ones (see Chapter 3). Overall, our aerial survey indicates that features are pervasive on the intertidal landscape in our study area. While not every beach contains an intertidal feature, it is rare to find a beach without some form of alteration. Expanses of shoreline without intertidal features are typically either rocky bluffs without beaches, or areas with heavy post-contact alteration of the beach (e.g., marinas, mills, etc.). Areas of the coastline within our study area that were not covered in the aerial survey were surveyed on the ground, and the pattern of intertidal alteration observed on the other beaches also held true for these areas.

In addition to the abundant intertidal features recorded here, terrestrial archaeological surveys in the region (Acheson and Riley 1976, 1977; Springer et al. 2014) also indicate a long-term history of dense occupation. A detailed analysis of the association of marine management features and settlement locations is ongoing as part of the larger Tla'amin-SFU project. However, the ubiquity of both intertidal and terrestrial features indicates that the vast majority of management features are located close enough to settlements to promote their daily use, and to indicate that the intertidal structures featured strongly in the ancestral Northern Coast Salish sense of place. For example, for the six sites sampled here, a minimum of four intertidal feature locations are within 5 km, or one hour, canoe ride from the site. Four sites have intertidal features located on the immediately adjacent beach.

The location and form (see below) of the intertidal features suggests that stone and wooden features were designed to target different species of fish. In particular, all of the recorded wooden traps, but none of the stone traps, are located at the mouths of streams. This placement suggests that wooden traps were placed to take advantage of salmon waiting to enter their natal streams at spawning time. With traps placed in these locations, people potentially could have harvested 100% of the salmon going up stream. To ensure future salmon harvests, decisions had to be made about how the wooden trap would be employed, including the duration for which it would be used. Stone traps, on the other hand, are often associated with historically known herring spawning locations (Gauvreau et al. 2011), and thus we infer that they were designed to target herring as well as the many species that prey on these fish. Given that herring will deposit eggs on almost any surface in the lower intertidal zone that is free from siltation (Haegele and Schweigert 1985), we surmise that the stone features also provided spawning substrate for herring. Providing additional suitable habitat for spawn may have resulted in increased numbers of herring larvae overall, and contributed to a sustainable fishery over millennia. People also would have had to make decisions about the use of these traps, such as the duration and season(s) of their use. However, because herring are less spatially restricted than salmon during spawning, the stone traps potential for adversely impacting herring was probably far less than that of the wooden salmon traps.

What is the range in form and function of marine management features?

There is considerable diversity in form and function of intertidal management features in our study area, but also some commonalities among them (Chapter 3). We identified eight categories of stone elements that are found in various combinations (Table 4.3), and we add a ninth category for 'wooden stake' elements. These latter elements are lines or scatters of wooden stakes in the intertidal zone, typically located at the mouths of streams. Including intertidal features previously recorded by other investigators, there are 221 elements, making up 100 features at 83 discrete locations within the study area. Of the 100 features identified, 39 include cleared beaches, which are always found in conjunction with stone walls interpreted as fish trap features. Entirely wooden intertidal features were identified at six sites in the region, all dating to the last 600 years (Table 4.4). Not enough stakes were present to determine the size or shape of these features, or to assign them to wooden stake ‘types’ identified elsewhere on the Northwest Coast (cf. Greene 2005; Losey 2010; Mobley and McCallum 2001).

We collected detailed information for 23 stone features, and six wooden features. A high level of variation in size and form was recorded in the 23 ground-truthed stone features, with some being only a few meters long, and others being well over 100 m long and representing

Table 4.3. *Intertidal resource management features mapped as part of this project.*

Site	Type of Feature	Element(s) Present*	Feature Size	Wall Height	Wall Width	Beach Type^
DkSc-16	Stone fish trap	Hook; lead line	20 x 25 m	20 cm (lower at apex)	2 m	OE – SoG
DkSc-17	Stone fish trap	Hook; lead line	20 x 25 m	25-35 cm (lower at apex)	1.5 – 2 m	OE – SoG
DlSd-1	Stone fish trap and modified clam bed	Hook; cleared beach	45 x 80 m	15 – 30 cm; 40 cm water depth	1 – 3 m	OE – SoG; LI
DlSd-11	Stone fish trap and tidal pool	Crescent (2); undefined	100 x 100 m	15 cm	30 cm – 5 m	OE – SoG; LI
	Stone fish trap	Crescent (34)	2 x 2 m each	10 – 20 cm	20 – 40 cm	
	Stone fish trap and modified clam bed	Crescent (17+); cleared beach	100 x 250 m	20 – 80 cm	30 cm – 1 m	
DlSd-12	Stone fish trap and modified clam bed	Hook; lead line (2); cleared beach (2)	65 x 80 m	25 – 30 cm; 30 cm water depth	1 – 3 m	OE – SoG; LI
	Stone fish trap and modified clam bed	V; hook; lead line (2); cleared beach	35 x 90 m	25 – 35 cm; 30 cm water depth	2 – 4 m	
	Stone fish trap (not identified on ground)	Hook (2)	20 x 20 m			
	Stone fish trap (not identified on ground)	Crescent	30 x 50 m			
DlSd-13	Stone fish trap	Hook (2)	20 x 25 m	15 – 20 cm	1 m	OE – SoG
DlSd-37	Stone fish trap	Crescent	15 x 17.5 m	20 cm	50 cm	OE – SoG
DlSd-38	Stone fish trap and modified clam bed	Heart; undefined (6); lead line; cleared beach	110 x 120 m	15 – 25 cm; 75 cm water depth	2 m	OE – SoG
DlSd-39	Stone fish trap	Hook; disturbed walls	10 x 15 m	10 – 15 cm	50 cm	OE – SoG
DlSe-54	Wooden fish trap	Wooden stakes	55 x 155 m			HI
DlSe-55	Stone fish trap and modified clam bed	Undefined; lead line (2); cleared beach (2)	125 x 140 m	15 – 25 cm; 20 cm water depth	20 – 30 cm	SB
EaSd-1	Wooden fish trap	Wooden stakes	10 x 10 m			DB
EaSd-2	Wooden fish trap	Wooden stakes	20 x 20 m			DB
EaSd-3	Wooden fish trap	Wooden stakes	15 x 15 m			DB
EaSe-34	Stone fish trap	V	10 x 10 m	15 – 20 cm	50 – 75 cm	DB
EaSe-51	Stone fish trap and modified clam bed	Crescent; undefined (3); cleared beach	40 x 120 m	25 – 75 cm	3 – 5 m	OE – IS
EaSe-71	Stone fish trap and modified clam bed	Crescent; cleared beach	30 x 60 m	10 – 15 cm	20 – 30 cm	OE – IS
EaSe-74	Stone fish trap and modified clam bed	Hook; cleared beach	50 x 70 m	15 – 20 cm	1.5 – 3 m	OE – IS
EaSe-86	Stone fish trap and modified clam bed	Undefined (3); cleared beach (2)	115 x 150 m	15 cm –1.5 m	2 – 5 m	OE – SoG; BRP
EaSe-118	Wooden fish trap	Wooden stakes	40 x 60 m			DB
EaSe-136	Stone fish trap and modified clam bed	Heart; lead line (2); cleared beach	75 x 120 m	25 – 35 cm	2 m	OE - IS
EaSe-137	Wooden fish trap	Wooden stakes; associated cobbles	10 x 15 m			HI
EaSe-138	Stone fish trap and modified clam bed	Undefined; cleared beach (2)	15 x 20 m	30 cm; 20 cm water depth	1 – 2 m	OE – IS; BRP
EaSf-43	Stone fish trap and modified clam bed	Undefined (3); cleared beach (2)	25 x 95 m	15 – 30 cm; 20 cm water depth	1 – 3 m	BRP

* Element types are described in Chapter 3

^ Beach types are described in Table 4.5, this chapter

Table 4.4. *Radiocarbon dates from wooden fish trap stakes.*

Lab #	Site	Conventional Radiocarbon Age	1-sigma cal. BP (P=68%)	2-sigma cal. BP (P=95%)
Beta-263325	EaSd-3	310 $\pm$ 40	440 to 350 *and* 340 to 300	490 to 290
Beta-263326	EaSd-1	380 $\pm$ 40	500 to 430 *and* 360 to 330	510 to 310
Beta-263327	EaSd-2	430 $\pm$ 50	520 to 480	540 to 430 *and* 370 to 320
Beta-263328	EaSe-118	540 $\pm$ 50	620 to 610 *and* 560 to 520	650 to 580 *and* 570 to 510
Beta-263329	EaSe-43	360 $\pm$ 30	490 to 430 *and* 370 to 320	500 to 310
Beta-305567	DlSe-54	100.4 $\pm$ 0.3 pMC[1]	Modern	modern
Beta-305568	DlSe-54	90 $\pm$ 30	260 to 220 *and* 140 to 30	270 to 210 *and* 140 to 20

[1] This sample is measured in "pMC", or "percent modern carbon," which indicates more ^{14}C present in the sample than a modern (AD 1950) reference standard used by Beta Analytic, suggesting that the sample dates to after the 1950s. However, on the lower end of the 2-sigma reading, the pMC reads at less than 100, a result which allows for the probability for 18th, 19th, or 20th century origin. As the other sample from DlSe-54 is also recent, it is our strong belief that this sample comes from the late 19th or early 20th century, when fish traps were still being used by Tla'amin people.

significant labor investment (Table 4.3). Wall height also varies greatly, from as low-lying as 10 cm, to as high as 1.5 m. The shorter walls in most instances do not appear capable of holding back fish by themselves. They may be the remnants of traps similar to those described ethnographically by Barnett (1955) and Kennedy and Bouchard (1974), which functioned in association with wooden elements. Alternatively, or in addition, many of the traps may have filled in with sediment after falling out of use. In fact, one local remembered the wall height of one feature being higher in his youth. It may be that cleaning sediment and other debris out of the features was part of their regular maintenance. Walls also vary greatly in width, from as narrow as 20 cm to as wide as 5 m, with a median width of 1 m. This variation could be related to whether a feature functioned in conjunction with now-lost wooden fences or woven elements such as basketry traps, and thus needed less of a stone barrier to hold back fish, or perhaps to the strength of the current and tides, with thicker walls necessary where water movement is stronger.

We also made observations at several of the intertidal sites during tidal cycles to consider how the features would have interacted with tidal movements. In general, it appears that the features were carefully engineered to incorporate local water flow patterns associated with tidal changes and the physical structure of the beaches. All walls, whether made of stone or wood, would have retained fish during outgoing tides. Some stone walls appear to have been constructed to take advantage of the unique tidal movements of specific beaches, or to function in concert with the exposed natural bedrock formations along beaches, which in places have complex shapes and multiple drainage points. Built elements at these features restricted the drainage points of these bedrock areas, retaining fish within a pool of water, or facilitated making the drainage point easier to block, perhaps with wooden or basketry traps (Figure 4.3). Any feature that retained water throughout an entire tidal sequence would have allowed for the release of live fish once harvest was complete, as people could have removed portions of the trap or blockage elements (e.g., baskets) to let the fish escape (Figure 4.4). Langdon (2006a, 2006b) and Losey (2010) have made similar suggestions regarding the function the gaps found in fish traps elsewhere on the Northwest Coast.

Figure 4.3. *Cleared beach in a bedrock formation at EaSf-43. The image to the left shows the cleared bedrock pool, with larger rocks moved to the edges. The image to the right shows stone walls built up at the outlet to the bedrock formation to restrict the drainage point. The beach was covered in broken bivalve shells.*

Figure 4.4. *Examples of water running out of traps even at extreme low (0 m) tides (Left: DlSd-1; Right: DlSd-12). Also visible are gaps in the stone walls where traps may have been placed to catch fish, and removed when not needed.*

Harvested fish and invertebrates would have been available to the ancestral Northern Coast Salish year-round through use of intertidal features. Trap elements would have assisted in harvesting herring and salmon *en masse* during their respective spawning seasons, and these features also could have been used to catch fish and invertebrate taxa on a daily basis, providing low-levels of fresh food year-round. Many (39%) of the intertidal features in our study area are more than just fish traps – they have cleared beach elements that likely would have enhanced clam habitats and numbers in a manner similar to classic clam garden structures (Groesbeck et al 2014; Lepofsky et al. 2015). Clams are available year-round, and with the exception of instances of red-tide, often could have been harvested and consumed on a daily basis. In addition to seasonal and daily harvest of fish and invertebrates from these features, the harvested resources also could have been easily stored for later consumption by drying or smoking the flesh, an important aspect of harvesting fish *en masse* during spawning seasons.

The harvesting of marine resources was not limited to the use of the intertidal features. Salmon and herring, for instance, come inshore only while spawning, but could be caught at other times of their lifecycles along with other year-round residents in the Strait of Georgia. Salmon, and other fish such as lingcod, hake, or halibut, could have been individually captured through hook and line bait fishing, gillnetting, and other forms of fishing. Herring balls would have been a regular event, and these likely provided good opportunities for harvesting these fish and their prey throughout the year. The archaeological remains of marine taxa harvested in these other manners cannot be separated from those taken through use of the intertidal features. Both types of harvest make up separate but complementary aspects of the overall management system.

What is the zooarchaeological signature of ancestral Northern Coast Salish marine resource management?

Study of marine faunal remains allows us to better understand the activities and choices made by the ancestral Northern Coast Salish in the use and management of their marine resources. Archaeological remains of marine resources, namely fish and invertebrates, are the best evidence available for ancestral Northern Coast Salish marine resource use and management. These remains directly represent the choices made and activities undertaken by the ancestral Northern Coast Salish on a daily basis, and also represent seasonal and annual activities, such as mass harvesting, processing, and storage. We look at fish and invertebrate remains from six village sites to understand the use and management of these marine resources (Tables 4.5 and 4.6). Through time, all sites have similar species richness and demonstrate an overall reliance on a few key taxa; namely, herring, salmon, dogfish, rockfish, perch, bay mussels, littleneck clams, butter clams, and cockles. While remains of other fish and invertebrates are present, they appear in much smaller numbers, are rarely ubiquitous across sites, and could be argued to be present as by-catch rather than targeted taxa. The number and range of marine taxa identified are in keeping with other Northern Coast Salish archaeological sites (e.g., Bilton 2014; Caldwell 2011; Monks 1987).

Fish use, as measured by relative taxonomic abundances, is relatively consistent through time, with an overall focus on the use of herring at all six sites (Figure 4.5). For herring, %NISP rarely drops below 50% in any given level, and the average relative abundance of herring at all sites is never less than 70%. These data indicate that herring were present in large enough numbers through the Late Holocene for people to consistently harvest enough of these fish to meet their needs. Despite the problem of time-averaging in the archaeological record, the consistency of this pattern across sites in turn suggests traditional methods of herring harvest did not deplete past herring stocks. These results parallel those of McKechnie et al. (2014) for other sites in the Salish Sea south of our study area.

Like herring, salmon is found at all six sites, although in much lower numbers. Average relative abundance of salmon at all sites is never higher than 20%. However, at all sites except DlSd-3, salmon is the second most abundant fish taxa identified. This abundance speaks to the importance of salmon, and also to the pervasiveness of herring. Although the frequency of salmon fluctuates greatly throughout the samples of all six sites, it continues to be present even in the uppermost levels. This persistence suggests that while the number of salmon used at these sites was relatively low compared to herring, there is no evidence for any reduction in salmon use from either the Strait or the Inlet sites, and thus no evidence for a decline in salmon populations during this same period.

Marine invertebrate use too is generally stable over time, although some fluctuations are observed (Figure 4.5). Bay mussel and littleneck clam are the most commonly identified invertebrate taxa in the region, with bay mussel overwhelmingly dominating the invertebrate assemblages at two of the three Inlet sites (EaSe-11 an EaSe-18), while littleneck clams

Table 4.5. *Fish taxa identified by site.*

Site	Location	Anchovy	Dogfish Shark	Eulachon	Flatfish	Greenling	Hake	Herring	Lingcod	Midshipman	Perches	Rockfish	Salmon	Sculpins	N Taxa at Site	Total Site NISP	Sample Volume (L)
DkSc-13	Georgia Strait		10			2		210		5	6	3	32	1	**8**	**269**	**10**
DlSd-3	Georgia Strait		13		1	3	1	556	1	4	6	4	6		**10**	**595**	**16**
DlSd-6	Georgia Strait		24			3		1239		5	15	11	34	1	**8**	**1332**	**16**
EaSe-11	Inlet	2	39			2		969	31	4	32	25	280		**9**	**1384**	**41.39**
EaSe-18	Inlet		65		1	5		4845	11	1	85	82	605	15	**10**	**5715**	**50.85**
EaSe-76	Inlet		23	12	3			680		3	15	45	182		**8**	**963**	**38**
N Sites with Taxa		**1**	**6**	**1**	**3**	**5**	**1**	**6**	**3**	**6**	**6**	**6**	**6**	**3**			
%Ubiquity		**16.7**	**100**	**16.7**	**50**	**90**	**16.7**	**100**	**50**	**100**	**100**	**100**	**100**	**50**			
Total NISP Across Sites		**2**	**174**	**12**	**5**	**15**	**1**	**8499**	**43**	**22**	**159**	**170**	**1139**	**17**			

Table 4.6. *Invertebrate taxa identified by site.*

Site	Location	Bay Mussel	Bentnose Clam	Butter Clam	Chiton	Cockle	Crab	Dire Whelk	Dogwinkle	Horse Clam	Littleneck Clam	Moon Snail	Native Oyster	Sea Urchin	N Taxa at Site	Total Site MNI	Sample Volume
DkSc-13	Georgia Strait	56	21	264		29				1	440			4	**7**	**814**	**10**
DlSd-3	Georgia Strait	21	2	9		2	1			2	69			5	**8**	**109**	**16**
DlSd-6	Georgia Strait	36	40	95		90				2	510	1		7	**8**	**779**	**16**
EaSe-11	Inlet	1126	7	21	1	6		1	2	1	89			28	**10**	**1282**	**41.39**
EaSe-18	Inlet	1712	24	86	1	113		1	1	42	250	8	2	102	**12**	**2342**	**50.85**
EaSe-76	Inlet	140	4	146	26	9		4	5	20	585	2		8	**11**	**949**	**28**
N Site with Taxa		**6**	**6**	**6**	**3**	**6**	**1**	**3**	**3**	**6**	**6**	**3**	**1**	**6**			
% Ubiquity		**100**	**100**	**100**	**50**	**100**	**16.7**	**50**	**50**	**100**	**100**	**50**	**16.7**	**100**			
Total MNI Across Sites		**3091**	**98**	**621**	**28**	**249**	**1**	**6**	**8**	**68**	**1943**	**11**	**2**	**154**			

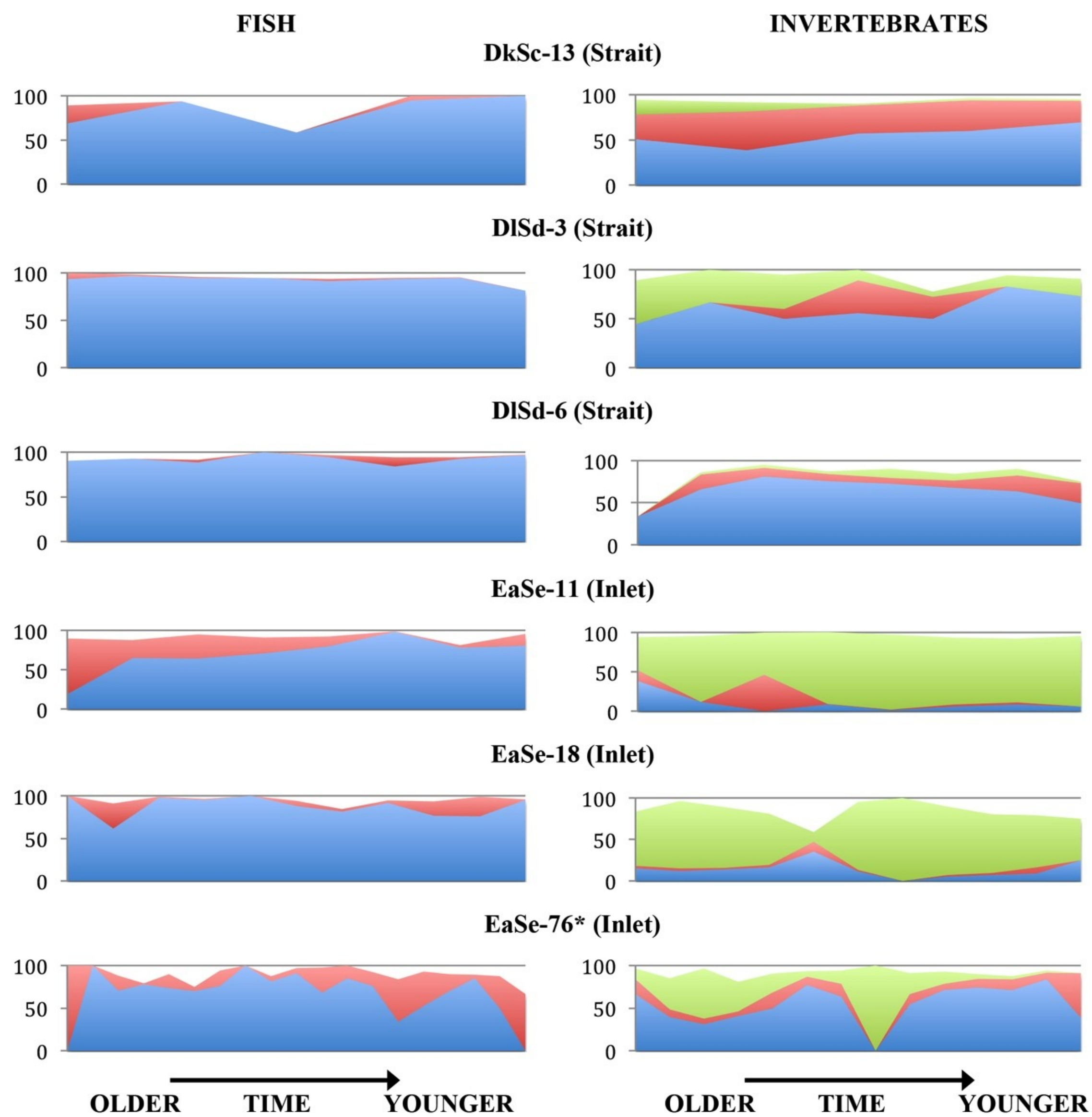

Figure 4.5. *Left column: relative abundance (%NISP/L) of herring (blue) and salmon (red) through time. Right column: relative abundance (%MNI/L) of littleneck clam (blue), butter clam (red), and bay mussel (green) through time. Empty areas in both columns consist of mixed taxa; a complete listing of taxa by site is found in Table 4.3 and Table 4.4. *EaSe-76 identifications for fish and invertebrates are from two separate units.*

dominate at all three Strait sites. These results mirror the relative abundance of bay mussels versus clams in the Inlet versus Strait intertidal ecosystems. Site EaSe-76 deviates somewhat from this pattern in that it is located on the Inlet but is dominated by littleneck clam. This site also exhibits more variation in bivalve use through time than the other sites. We explore the reasons for this difference below. Other types of clams, including butter clam and cockle, are typically present but almost always in relatively small quantities.

Sea urchins, although identified at all six sites, are likely underrepresented in our analysis. This bias is because the non-repeating element used to quantify sea urchin, the demi-pyramid, occurs as five paired (or ten total) elements in a single individual. While counts of demi-pyramids may appear high, the calculation of MNI greatly renders the estimate of individuals present to very small numbers (19 individual demi-pyramids can equate to an MNI of only 2). Furthermore, unlike bivalves, the demi-pyramid of most individuals (especially the smaller, more commonly found red and green sea urchins) may pass through 2 mm mesh. Therefore, we posit that the importance of sea urchin is underestimated in these data, especially at DlSd-6, in which complete layers of urchin spines (up to 3 cm thick) were encountered during excavation.

Does resource harvest and use vary between Strait sites and Inlet sites?

A comparison of taxa identified between the Inlet and Strait sites indicates minor differences in the types of fish harvested in these two regions (Figure 4.6). Only two taxa are found uniquely in either ecological setting–hake at the Inlet site of DlSd-3 and anchovy at the Strait site of EaSe-11. Hake are an offshore species that prefers deeper water, so it is not surprising that it apparently absent at sites within the shallower, enclosed inlet system (Beamish 2014). Anchovy spend a lot of time in bay and estuary systems (Beamish 2014), and so their identification at an Inlet site is expected. However, as anchovy are commonly found in massive schools, its relative scarcity within all of our samples suggests that they were not a typical inhabitant of the study area.

There is a relatively higher abundance of salmon at Inlet sites compared to Strait sites (Table 4.5). However, even at the Inlet sites, salmon accounts for less than 20% (by NISP) of the marine fish specimens identified. The relatively higher abundance of salmon remains at Inlet sites is likely the result of ease of access to these fish as they headed to the rivers at the mouth of Theodosia and Malaspina Inlets for spawning. When traveling through the relatively narrow inlets to their natal spawning grounds, the adult salmon could have been easily caught in the intertidal features common throughout the inlet. Conversely, although salmon move through the Strait of Georgia on their way to spawn, they do not congregate inshore until they reach their

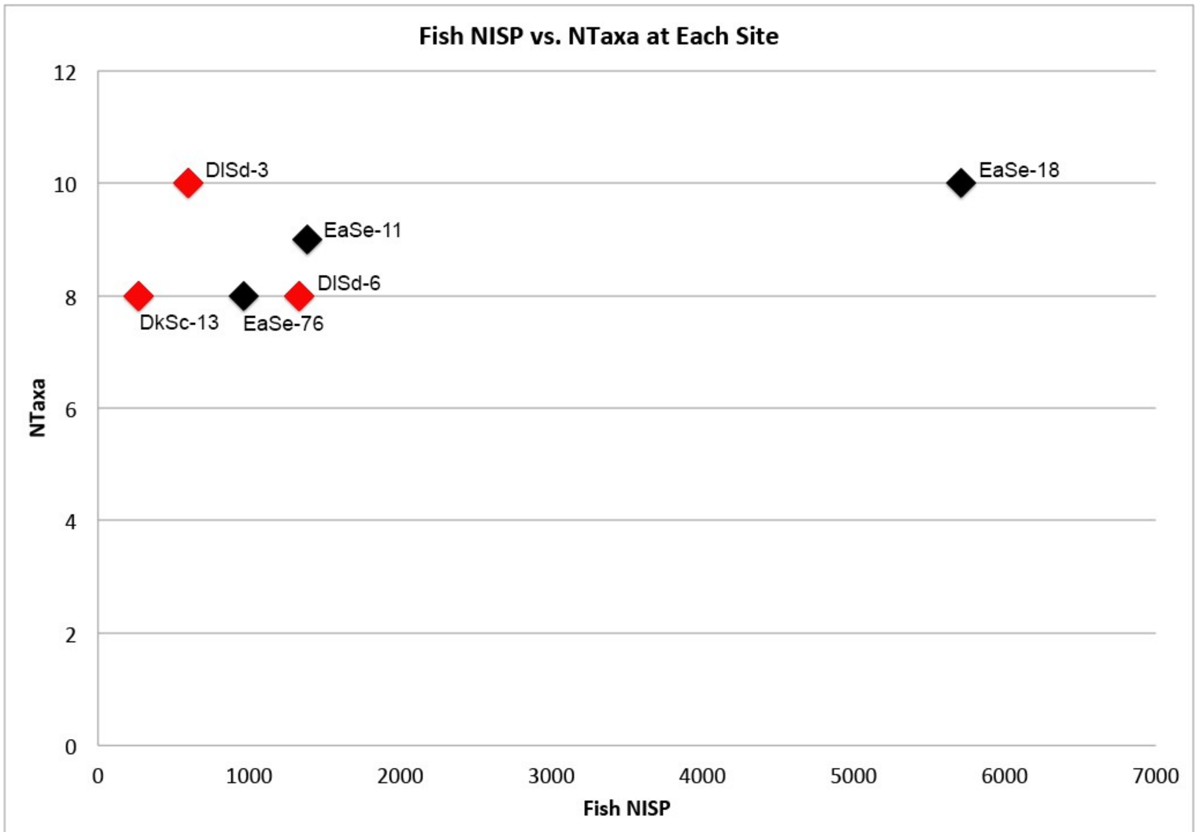

Figure 4.6. *Fish NISP vs. NTaxa at each shell midden site. Inlet sites are in black, Strait sites are in red.*

natal streams. In order to catch salmon in abundance on the Strait side of the Malaspina Peninsula, people would have had to either fish offshore using nets or line-trolling, or wait for the salmon to mass at the mouths of spawning creeks and rivers. These strategies would have involved far more search time than fishing for salmon within the narrow inlets. The fact that some salmon remains are present in the Strait sites suggests that a combination of these harvesting strategies was used by people inhabiting these settlements.

Several trends are apparent in the invertebrate data (Table 4.6). First, the lower relative abundance of bay mussel at EaSe-76 is likely related to the site being situated in a less protected bay than the other Inlet sites. Even at this site, though, bay mussel still makes up a significant portion of the assemblage for most of the sequence (and average MNI of 21.46% for all levels; overall %MNI for the sample is 10.42%). Furthermore, the Inlet sites consistently have greater numbers of identified invertebrate taxa than the Strait sites. In part, this difference can be accounted for by the effects of sample size, as the Inlet site samples have larger MNI values than the Strait sites, and correspondingly, more taxa are represented in the former (Figure 4.7). However, the greater number of invertebrate taxa in the Inlet sites is consistently due to the presence of the same few taxa, namely chitons, dire whelk (*Searlesia dira*), and dogwinkle, a frequency which may suggest that ecological differences play a role in structuring both the taxonomic richness and composition of the samples. Two of the three inlet sites are dominated by bay mussel, which attach to rock and woody debris on the surface of the intertidal zone. The third inlet site, EaSe-76, is clam dominated, but also contains some mussel remains. The invertebrate taxa only present at the Inlet sites prefer the same sorts of rocky intertidal habitats in which bay mussels predominate (Harbo 2014). Their low numbers suggest that they may have been collected as encountered when mussels were being targeted. Finally, crab remains were identified only at DlSd-3, but were observed living at almost all intertidal features during on-ground reconnaissance. It is likely that crabs were captured in/at these features, but because they preserve poorly in most archaeological contexts (Losey et al. 2004), crabs are highly underrepresented in our study, where sample sizes are relatively small.

Overall, the invertebrate data indicate use of the immediately local intertidal environment, and the taxa present at the sites are generally expected given the ecological settings of the sampled sites. Like the finfish, there are no clear trends in shellfish suggesting directional changes in taxa use through time. In other words, there is no evidence suggesting that specific shellfish species were overexploited in this region during the time periods represented in our samples. The dominant taxa at the sites vary very little through time, and when they do, the manner in which they vary differs from site to site in no particular pattern. Therefore there is no indication of changes in species availability through time, and the variation observed is most likely due to local ecological variability.

Discussion

In this paper, we provide a deep time perspective of Northern Coast Salish marine management by posing a series of research questions at various scales, questions which are then addressed using data on a suite of the region's intertidal features and faunal remains from six habitation sites. As we indicated in the introduction, by looking at our data through a series of nested scales, we were forced to explore the multi-dimensionality of marine resource management. We now consider the social implications of our findings.

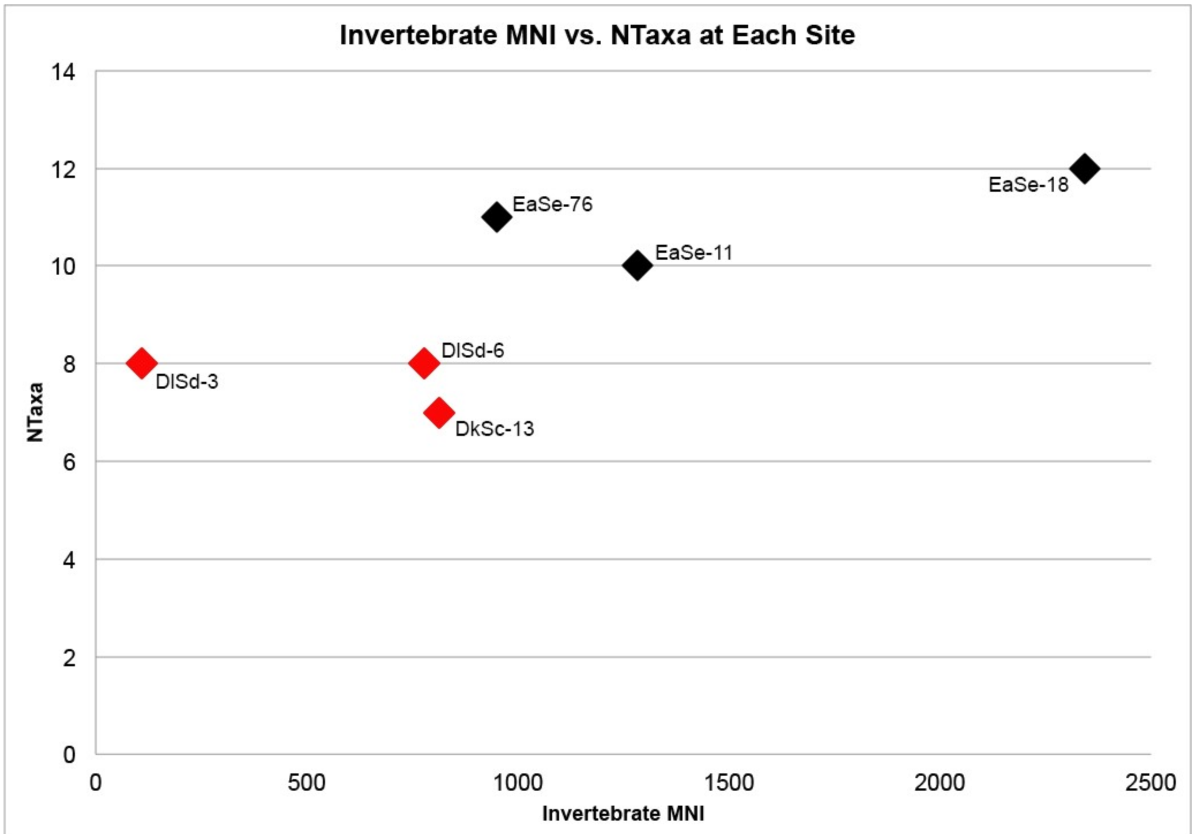

Figure 4.7. *Invertebrate MNI vs. NTaxa at each shell midden site. Inlet sites are in black, Strait sites are in red.*

At the landscape level, intertidal features are clearly ubiquitous in the study area (see Chapter 3). Each of the settlement sites considered in this study has at least one intertidal resource management feature present within five kilometres (~1 hour of canoe travel), and several others within a single day's traveling distance. It therefore seems plausible that the features could have been used for daily consumption needs, with bivalves being tended and harvested from the cleared beach elements and unmodified intertidal habitats, and a diversity of fish (and other fauna) collected from nearby traps as tidal movements allowed. The features also likely played important seasonal social and economic roles in the harvest of massing/spawning fish such as herring and salmon. The sheer abundance of intertidal features in the study area indicates that they were one of the main ways that marine resources (especially near shore fish and invertebrates) were procured and managed.

Furthermore, the ubiquitous nature of intertidal sites across the landscape suggests that they would have featured in an ancestral Northern Coast Salish sense of place, as it would have been impossible to travel without encountering them. Construction of intertidal features on a beach is certainly an indication of some form of tenure, as some were probably constructed and maintained over many generations, indicating people's ties and investment in a place. While it cannot be known if the features were considered to be 'owned' at any sort of level (individual, family, or larger community), it is probable, based both on the frequency of features in the region and on traditional knowledge from elsewhere on the Northwest Coast, that some level of ownership would have been acknowledged, especially for built features.

Use of the intertidal features too would have required leadership and organization, especially during the mass harvesting associated with salmon and herring spawning, perhaps in the form of a *hegus*, or community leader (Paul 2014). The features would have become a locus of social interactions, in which generations of ancestral Northern Coast Salish peoples came together to harvest and process fish, and to share knowledge. Leadership and traditional knowledge would have factored prominently in the organization and carrying out of these activities. Spawning times were important for teaching new generations about management practices, social conventions, and deeper history, through observation, practice, and stories. Outside of these short, intense periods of interaction, the year-round use of the intertidal features and the tasks associated with them would have been a venue for daily learning and community building. Other forms of marine resource harvest also were important arenas of social gathering and learning. Although they may not have elicited the same level of community gathering, hook and line fishing for salmon or lingcod, or harvesting herring and other taxa from herring balls, were also opportunities to teach the next generation about local ecological knowledge and management practices. For example, Paul (2014) recounts how the area in front of *Teeshosum* was a place where Northern Coast Salish communities would gather to harvest both herring and its roe in the springtime, bringing people from all over the region together to socialize, and to pass knowledge to the next generations.

Cleared beaches may have been the unintended result of moving rocks during the daily harvesting of bivalves. Some Northern Coast Salish were taught to keep beaches 'clean' by rolling away larger rocks when harvesting clams (E August, pers. comm. to D. Lepofsky), and such activities may have been an individual, daily contribution to marine resource management. Built walls, on the other hand, were likely the results of organized, communal efforts to modify the intertidal zone. Smith (2007) introduces the concept of 'ecosystem engineers' to the millennia-old human practice of modifying of local environments. Ecosystem engineers develop broad, integrated, and coherent forms of manipulation of the world around them. The patterned occurrences of intertidal features in our study area, structures which encompass combinations of elements targeting various taxa, represent concentrated efforts to manipulate the intertidal zone. These constructions were most likely planned and organized as group efforts, perhaps under individual leadership, with specific, intended management outcomes. Once built, stone walls also would have required continued maintenance, which also may have been organized, especially if there was some level of ownership and control over the features.

Overall, our data show that the ancestral Northern Coast Salish had an extensive system of marine management. The prevalence of intertidal sites, composed of diverse features, is indicative of a thorough understanding of local ecological systems, with the choice of location for intertidal features tied to a detailed knowledge of local ecological characteristics and landforms. Many intertidal features were clearly built to take advantage of the natural ebb and flow of the tide, or to function in concert with the physical features of the beaches they are located on, such as exposed bedrock. Others were located where movement of fish through an area was already impeded by the surrounding environment (the Inlet system). Furthermore, we postulate that some were constructed in places where they would have *attracted* fish, with the built elements potentially acting as spawning substrate for herring, or as enhanced environment for bivalves. When a stone wall feature was built to form a fish trap, a cleared beach might be produced, ultimately facilitating the taking of fish while also improving and increasing clam habitat (although it remains to be seen if these features have a similar effect on clam growth as do clam gardens (c.f. Groesbeck et al. 2014)). Furthermore, as Monks (1987) proposes, retaining fish within traps would also attract predators, including seals, birds, and other fish, prey which also could have been utilized by those monitoring the traps.

Faunal remains analyzed from the six habitation sites are the only data presently available for directly assessing ancient marine fauna use in the region, and thus are key data on the marine management system used by the ancestral Northern Coast Salish. Overall, the zooarchaeological data presented here indicate that people focused their marine procurement and management activities on a few key taxa: herring, salmon, littleneck clams, butter clams, bay mussels, and sea urchins. Other species are also ubiquitous but occur in much smaller numbers (Table 4.5 and Table 4.6). These common and in some cases highly abundant taxa are indicative of a reliance on a specific suite of marine resources throughout the region. The localized, specific knowledge held by the ancestral Northern Coast Salish allowed for these select resources to be identified for management, beginning at least several thousand years ago, and these practices persisted and remain known among the region's current indigenous peoples (see Chapter 2 and Chapter 3).

Our data also point to sustained use of a broad suite of marine taxa over the last 2-4,000 years. The same taxa were used at similar levels over time at many sites, a record which indicates that their use was carried out in a sustainable manner among many communities over multiple generations. This persistence is particularly notable, since mass harvesting with intertidal traps could have led to overharvesting, as could have the on-going modification of beaches. While we have no way of directly confirming socially imposed harvesting restriction in this marine resource management system, our results are consistent with their use in the study area. The continuous abundance of the primary marine taxa at six sampled sites supports the hypothesis that some degree of selective harvesting and habitat creation was occurring. This management in turn permitted the ancestral Tla'amin to consistently use a select suite of taxa without any measurable impacts to their availability.

Our results indicate that the greatest difference in resource use among sites can be accounted for by proximity to variable local ecosystems. In particular, the inlet sites show far higher relative and absolute abundances of salmon than those sites located on the Strait (Figure 4.3; Table 4.5), a difference which could be accounted for by the relative proximity of the former sites to spawning streams. The social and economic implications of this differential access are unknown, but may have been offset to some extent by the widespread access to other marine taxa, or through inter-group trade. Other than this difference, there is no evidence in the suite of taxa identified at the six sites to indicate any differences from site to site in access to either the features or the resources gathered within them. Our samples lack the acuity needed to determine if there were differences in access between individuals within single communities.

Herring, which numerically dominate all of our faunal assemblages, were a widely-available resource that likely contributed greatly to this lack of differential access to marine foods in the study area. Because of its far less localized spawning requirements than salmon, people would have faced greater difficulty in controling access to this important food source. Gauvreau and colleagues (2011) have shown that almost all beaches in the study area supported either spawning or massing herring in the recent past. Therefore, the majority of intertidal resource management features constructed in the region by default were placed in areas in which they could have targeted herring. In fact, it is difficult to argue that any of the features were not intended to target herring in one way or another. Perhaps only the wooden stake features found at the mouths of salmon streams were not designed for these fish. However, even these features were located in herring spawning areas and might have been used to capture these fish, or were used by them as spawning substrate. Overall, herring clearly played an important role in the economic and social spheres of the ancestral Northern Coast Salish, just as they have in the historic period (McKechnie et al. 2014).

Seasonal variation in the availability of certain taxa also would have affected how the ancestral Northern Coast Salish managed these resources. While herring and salmon were available in the Strait of Georgia all year round, both types of fish seasonally mass for spawning. These seasonal fluctuations in availability and distribution would have necessitated a system of resource management that ensured people had food throughout the year. This problem was in part solved by the fact that herring spawned in the spring and salmon in the summer and fall, and that invertebrate faunal were available throughout the year (although red tide is typically more active in summer and would restrict use of bivalves at that time). The ability to capture, process, and store seasonal accumulations of taxa *en masse* was the second critical part of this marine management system. Socio-economic systems, such as kinship connections, inter-community trade, and the potlatch system also played a role through managing seasonal and yearly fluctuations through food sharing and redistribution.

Although the invertebrate fauna identified at the habitation sites are in general available throughout the territory, effort was taken to clear some beaches of rocks, a practice which would have eased the collection of bivalves in these areas. Such efforts could have resulted in differential access to shellfish, as the historical data suggest that such maintained resources might have been family owned (see Chapter 3). The variability in the relative frequencies and types of invertebrates identified at the six study sites, however, most likely is the product of ecological variation and not necessarily differential access. For example, some taxa prefer the sandier beaches found in the Strait (bentnose clams), some prefer the sheltered bays of the inlet system (bay mussels), while others are able to inhabit a range of ecological settings (littleneck and butter clams). Our data show that all of these taxa were exploited in the past, and it can be assumed that equal access was available to these foods, at least from community to community. The most abundant marine resources identified archaeologically are those described by the Northern Coast Salish as the key fauna utilized historically (Kennedy and Bouchard 1974), and are the fauna that for the most part are widely available in the region today (although invasive species have altered local availabilities).

Finally, with regards to harvesting restrictions, we know that Northern Coast Salish ecological knowledge teaches that herring should be gathered after they have spawned (M Washington, pers. comm. to D Lepofsky). Although herring roe was also used, by delaying harvest of the adult fish until after the spawn, people ensured that they had the opportunity to reproduce. While we cannot tell from the remains of herring whether or not they spawned before being harvested, the lack of a decline in the relative abundance of herring through time indicates ongoing, sustainable harvests of this fish. Indeed, the zooarchaeological data do not indicate any form of resource depression in any of the key taxa identified, despite continued mass harvesting throughout the study area. Further, it is possible that the cleared beach features found in the study area had the positive ecological impact of increasing clam growth rates and abundances, similar to that of classic clam gardens (c.f., Groesbeck et al. 2014). Although not all practices have to be sustainable or ecologically enhancing to be considered management (Lertzman 2009), it would seem that the management practices of the ancestral Northern Coast Salish left no evidence for adverse impacts to marine fauna.

In conclusion, by integrating the study of intertidal features and their locations on the landscape with zooarchaeological data on marine fish and invertebrate use, we are able to more thoroughly understand the complete marine management system of the ancestral Northern Coast Salish. More broadly, several key aspects of the ancestral Northern Coast Salish culture and society, including tenure and ownership systems, harvesting rights and restrictions, and impacts of resource use on the local ecology were addressed by combining these different lines of archaeological data in a series of nested scales. Each set of data informs the other, and allows for an overall closer examination and consideration of the ancestral Northern Coast Salish marine management system as a whole. The results of this analysis show that the ancestral Northern Coast Salish had a complex system of management for marine resources that promoted sustainable use of a suite of taxa over thousands of years.

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Chapter 5: Conclusion

As set out in the introduction, this dissertation had three main goals. First, this research aimed to summarize the main components of the marine management system on the Northwest Coast of North America by reviewing documentary sources on traditional resource and environmental management. The second goal, building on this first objective, was to document the specific characteristics of Northern Coast Salish marine resource management. The third and final goal was to document the archaeological signatures of marine resource management in the Northern Coast Salish region by recording both the extent of intertidal resource management features and the nature of marine fish and shellfish faunal assemblages.

As outlined in Chapter 2, complexity and deep temporal depth also characterize Northern Coast Salish marine resource management practices. Chapters 3 and 4 show that marine resource management practices were well developed along the Northwest Coast, and included an extensive body of knowledge and practice that persists today in local communities. Furthermore, these practices have left an archaeological signature that includes expansive and extensive modifications of the intertidal environment, and evidence of sustained use of a key suite of marine taxa over thousands of years. The research presented in this dissertation has in many ways fulfilled its three primary goals, but at the same time has raised a number of other questions that can be addressed in future research. Additionally, this research has a number of overarching conclusions that link these three goals, and the results, together.

Overarching Conclusions

This dissertation has provided four clear conclusions about marine resource management as practiced by the Northern Coast Salish that may also be applicable to other areas of the Northwest Coast. First, cultural keystone species (Garibaldi and Turner 2004), such as herring, salmon, and clams have been staples of ancestral Northern Coast Salish diets for at least the last 4,000 years, and likely much longer. The intensity of use of marine fauna over this period, evident in their consistent presence and ubiquity in the six archaeological sites studied in this dissertation, shows that the ancestral Northern Coast Salish were successful stewards of their marine resources. These species continue to be important to the Northern Coast Salish today, as food sources and as the focus of harvesting activities that are key for cultural continuity, learning, and community socialization (Paul 2014; Siemthlut 2004). This continuity is in itself remarkable, as these marine fauna have remained important despite the loss of direct access to many of them. This loss has occurred through the decimation of the herring fishery in the 1980s (Gauvreau et al. 2011), the 1950s damming of the Theodosia River, an event which greatly depleted the main salmon run in Tla'amin traditional territory, and the continued pollution of many beaches, a situation which renders shellfish harvested inedible and toxic (Paul 2014; Sliammon Nation 1993). These profoundly negative impacts on Tla'amin lifeways and wellbeing are beyond the scope of this study, but clearly merit additional consideration.

Second, marine resource management was a central part of life for the ancestral Northern Coast Salish. The zooarchaeological analyses and documentation of intertidal sites indicate that most marine foods used within Northern Coast Salish traditional territory could have been obtained on a daily basis on the beaches right in front of the village sites whose shell middens provided the materials for analyses. Even foods with more specific ecological needs, such as sea urchins, cockles, and bentnose clams, were only a short canoe trip away. Managed marine fauna also likely were important elements of broader social interaction and exchange. Historically, marine resources were traded both along the coast, and with inland groups such as the Lillooet and Chilcoltin, although this trade also consisted of granting rights to fish in Northern Coast Salish territories (Lane 1953; Teit 1906). Tla'amin Elder Elsie Paul (2014) remembers neighbouring groups gathering at the main Tla'amin reserve, *Teeshosum* (Sliammon), to harvest both herring and herring roe in the spring. Most likely, ancestral Northern Coast Salish food procurement practices were similar to those known from the post-contact period.

Third, marine resource management practices were complex and widespread in Northern Coast Salish traditional territory. Intertidal resource management features are common on beaches in the study area, and we know from the ethnographic and archaeological evidence that these features targeted both fish and shellfish taxa, as well as many other intertidal taxa such as sea cucumbers, crabs, and octopi. Intertidal resource management features are found in almost every location in which there is a suitable beach. The features are often large in size, with some being over 100 m long, and cover multiple intertidal subzones. These features were constructed by individuals who had an in-depth understanding of tidal movements and local ecologies, and knowledge of construction techniques useful for managing these locations and their marine fauna and flora. These features also represent a significant amount of labour in terms of both their initial construction and subsequent upkeep and use. The presence of a wide breadth of management practices and traditional knowledge associated with marine and terrestrial resources is indicative of a long-standing, locally developed marine resource management system. Although the dates on wooden traps in the region are recent, consistent use of the same suite of marine taxa over 4,000 years within the territory suggests similar collection and management strategies were being employed over multiple generations.

Finally, the knowledge that the Tla'amin continue to hold about these features in the 21st century also speaks to the importance of marine resource management in Tla'amin culture. This knowledge persists despite the fact that fish trap use was banned in British Columbia at the end of the 19th century (Newell 1993), and other intertidal resource management features have not been actively used in decades. Some Tla'amin community members born in the 1950s and 1960s have childhood memories of the teachings of their parents regarding the use of intertidal features. The subsequent decline and eventual abandonment of intertidal resource management activities likely can be traced to the decline in availability or edibility of marine resources, and increasing urbanization of Tla'amin territory. The loss of the use of intertidal features has impacts on this community equaling or surpassing the loss of access to marine resources themselves.

The overarching conclusions of this research are broad and many speak to future lines of research, which are described below. First, this research contributes to Tla'amin cultural history specifically and Northern Coast Salish cultural history broadly. As the Northern Coast Salish region is still relatively unknown both ethnographically and archaeologically, this contribution is important both to the academic community and to the Tla'amin. The second contribution is to the growing body of knowledge on intertidal resource management systems on the Northwest Coast. As management features are just starting to be evaluated beyond simply recording presence and age, this research provides a foundational body of data. Finally, this research adds an example of Northwest Coast resource management to the expanding scholarship on various forms of indigenous management practices and knowledge throughout the world.

Future Lines of Research

The results of this dissertation suggest a number of future lines of research. First, the archaeological results presented here can be expanded and strengthened through further analysis of faunal remains from both the sites already analyzed, and more sites within Tla'amin traditional territory. Specifically, our understanding of Northern Coast Salish marine resource management could be increased by looking at sites in areas not represented in this research: the major islands in the Strait of Georgia and along the Theodosia River, the largest salmon-bearing river in Tla'amin traditional territory. Island sites were subsequently visited by members of the Tla'amin-SFU project, so those data will be forthcoming. Theodosia River sites were not investigated due to logistical complications, but may become key components of future research.

Additional archaeological fieldwork also should be conducted on intertidal marine resource management features. Not all of the features identified in aerial surveys were visited on the ground as part of this project due to time constraints; they should be visited to record information on their size and function. Additionally, terrestrial survey should be undertaken at the mouths of all rivers and streams in the area in order to identify any other wooden stake structures that might exist. Dating of these features will help in understanding the timing of the development of intertidal resource management features in the region. As well, although limited attempts were made to locate wooden remains in association with the numerous stone fish traps in the study area, none were found. Because Northern Coast Salish ethnographic accounts indicate that most of these structures would have functioned in conjunction with wooden elements, further attempts to locate them should be made, as wooden elements could be used for radiocarbon dating the stone features.

In addition to this archaeological work, ecological surveys and experiments similar to those conducted by Groesbeck and colleagues (2014) should be carried out on the cleared beach features found in the study region. Although it appears that these features would have functioned similarly to formal clam gardens in terms of increasing clam productivity by keeping the beach clean of rocks and small boulders, without controlled ecological experiments such arguments cannot be substantiated. Furthermore, measuring growth rates of archaeological clam remains and using biogeochemical anaylses to assess season of harvest can aid in understanding the local histories of resource use and management (e.g., Burchell et al. 2013; Cannon and Burchell 2009). Analyses of this kind would go far to aid in understanding the nature of Northern Coast Salish clam management, and could be undertaken with the samples already collected by the Tla'amin-SFU project.

Finally, given that the marine management system of the ancestral Northern Coast Salish was so extensive and highly developed, we can expect that they also practiced terrestrial resource management in the past. A combination of ethnohistoric and archaeological research should be undertaken in the region to examine the role and extent of terrestrial resource management for both plants and animals. The results of this research, combined with the research presented here on marine resource management, would provide a more complete understanding of traditional resource and environmental management among the Northern Coast Salish.

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Appendix A: Intertidal Resource Management Features[3]

[3] This appendix also appears as: Caldwell, M. (2014) Appendix E: Intertidal Subsistence Features. In C. Springer, M. Caldwell, N. Chalmer, J. Jackley, and D. Lepofsky (2014) *Final Report on Archaeological Investigations (2009-0132) by the Simon Fraser University – Tla'amin First Nation Archaeology and Heritage Stewardship Project, Powell River Regional District, British Columbia*. Report on file at the Ministry of Forests, Lands and Natural Resource Operations, Victoria, British Columbia, pp. 605-671.

Appendix A: List of Figures

(Unless otherwise stated, all photographs were taken by Megan Caldwell)

Appendix A: List of Tables

Overview Summary

During June and July 2009, members of our research team conducted two aerial surveys from a low-flying helicopter. Photographs were taken covering more than 250 km of shoreline in the Northern Coast Salish region, both within and outside of the area covered by Permit 2009-0132. The permit area is roughly outlined in red in Figure A.1; approximate feature locations are indicated both within and outside of the permit area in this figure.

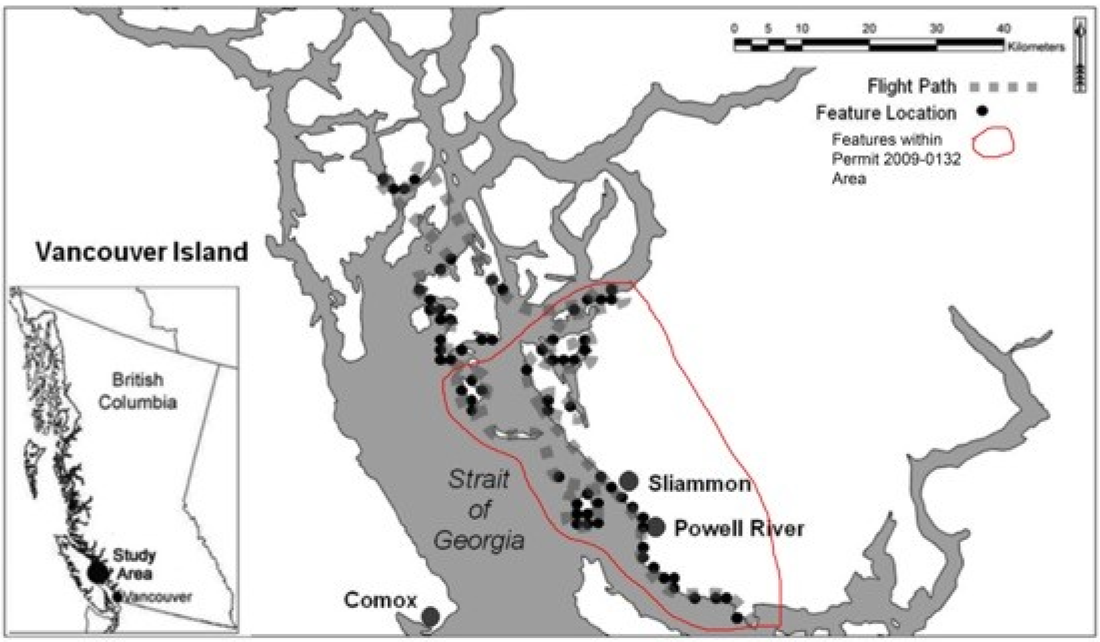

Figure A.1. *Permit area location depicting flight coverage and intertidal site locations. (Modified from Figure 1, Caldwell et al. 2012:222)*

Over 2,500 high-resolution digital photographs of the coastline were taken of all areas that may have contained features, whether or not features were observed from the air. Intertidal modifications were then identified by reviewing each photograph on a large computer screen, and using the high resolution of the photographs, 'zooming' in to enlarge the size of the image. A total of 51 intertidal modification locations were identified from the aerial photography, both within and outside of the current permit area. This appendix reports on intertidal subsistence features at 11 of the locations newly identified through aerial photography, along with features at 13 other locations which have previously recorded archaeological sites which have been expanded to included intertidal components. Of these sites, 18 sites have intertidal subsistence features constructed from stone, while the remaining six intertidal subsistence features are made up of wooden stake formations.

Description of Elements and Features

Analysis of the features from aerial photographs led to the development of eight element categories for intertidal modifications (Caldwell et al. 2012). Six of these categories are defined by the buildup of rocks and small boulders into low-lying walls of various forms: hook; heart; V; crescent; linear; undefinable. The other two are defined by the removal of rocks: cleared beach; cleared bedrock depression. In addition to the eight elements, many features also contain "lead lines," which are low-lying rock walls of variable lengths and configurations. Finally, our pedestrian surveys of intertidal zones identified instances of wooden stake intertidal features as well. The different types of elements identified are described in Table A.1; stone wall element types are exemplified in Figure A.2.

Table A.1. *Description of intertidal modification 'elements' identified through aerial photography and field reconnaissance.*

Element Type	**Description**
Hook Element	Shaped like a "six" or "fish hook," with a horseshoe shaped curved wall and an attached shorter straight wall angled approximately 45º inwards.
Heart Element	Two mirrored, curved walls forming the shape of a heart. The walls usually touch at the point of the heart but do not meet at the curved end.
V Element	Two straight walls angled toward each other (45º - 70º), but do not meet at the apex of the V. V elements are oriented with the apex towards the water.
Crescent Element	Either a semi- or completely circular stone wall.
Linear Element	Continuous straight or slightly curved wall of variable length.
Cleared Bedrock Depression Element	Modification of a naturally occurring depression within bedrock outcrops located within the mid to lower intertidal zone. Cleared bedrock depressions naturally hold water during low tides, but are augmented by removing cobbles from the floor of the depression, and adding rock walls to the natural outflows in order to restrict movement of water and marine taxa during tidal movement.
Cleared Beach Element	Cleared beaches are portions of or entire beaches in which larger cobbles and small boulders have been removed and placed along the edges of the cleared area, but do not form a distinct wall (Figure A.2g). In some cases, the buildup of stone occurs at the low tide line in a fashion characteristic of clam gardens in other regions.
Undefinable Elements	Piled rocks that are not formed into walls and whose form is not repeated at multiple locations. Undefinable rock alignments may lack recognizable form because they are the result of other activities (e.g., creating cleared beaches) and have no intended function, or are now-destroyed elements that we can no longer classify.
Lead Lines	Low-lying rock walls of variable lengths and configurations. Lead lines are always paired with a stone wall element, and appear to function as 'leads' to draw taxa into other element forms, but not to hold taxa themselves. Lead lines differ from linear elements that, like the other built-up elements, create impoundments. The lead line category also differs from the eight element categories in that it is identified and described in terms of function rather than form.
Wooden Features	The remains of alignments of wooden stakes, probably associated with latticework and basketry that has since decayed.

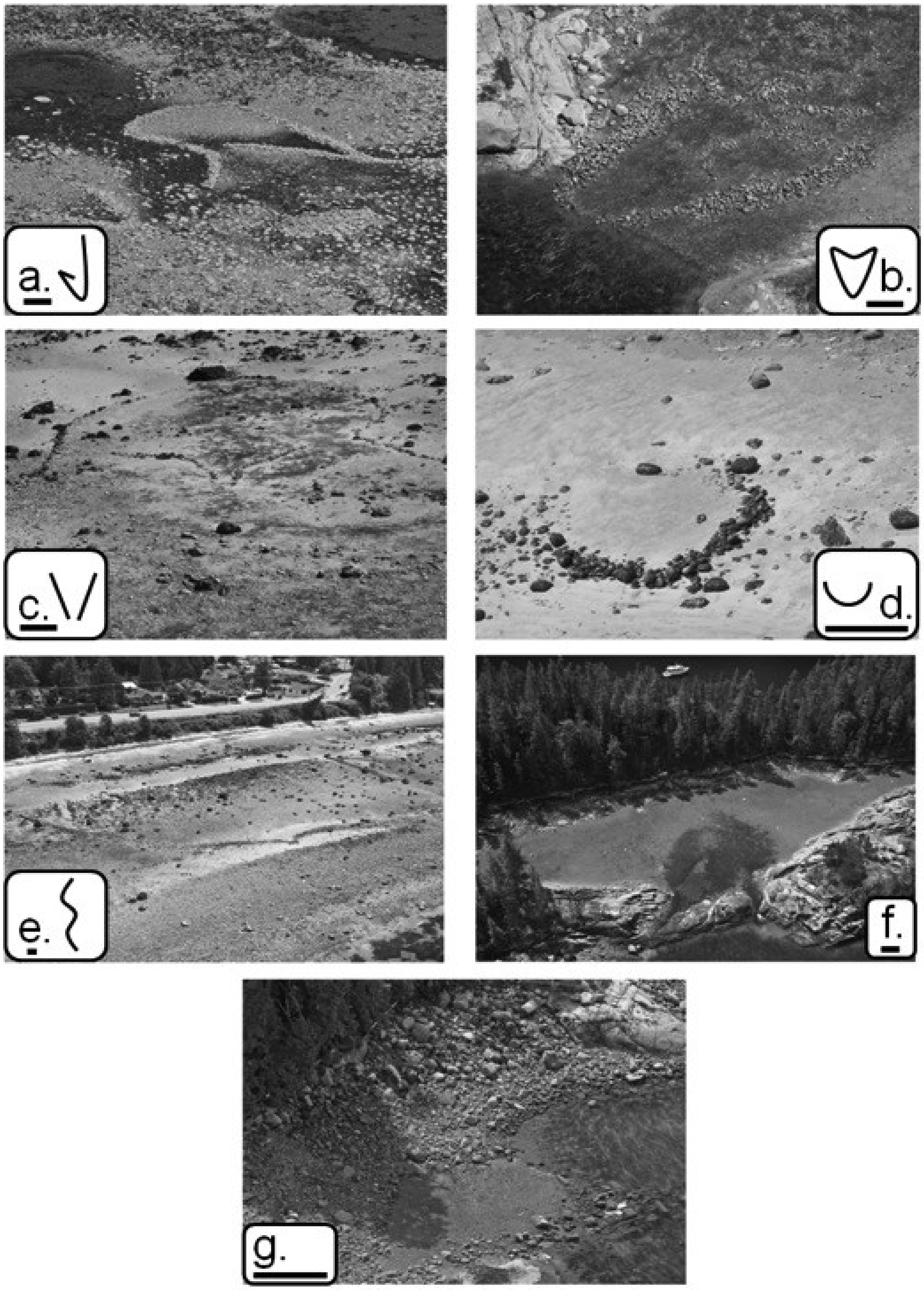

Figure A.2. *Examples of elements with line drawings of built stone wall forms. Black bar represents 2 m scale for each photo. a) hook, adjacent to a cleared beach; b) heart, sitting on top of a cleared beach element; c) V, with associated lead line visible; d) crescent, sitting on a naturally sandy beach; e) linear; f) cleared bedrock depression; g) cleared beach. (G. Combes photos) (Figure 2, Caldwell et al. 2012:224)*

Intertidal Features Recorded as part of Permit 2009-0132

DkSc-16

DkSc-16 is located just southwest of Albion Point, south of Powell River (Figure A.3). The site was identified through aerial photography (Figure A.4) and visited June 12, 2010. It is adjacent to DkSc-9, a shell midden site first recorded by Acheson and Riley in 1977. Also in the vicinity is DkSc-17. DkSc-16 consists of a stone wall intertidal feature composed of a hook element and associated lead line. It is located in the lower intertidal zone, and is accessible only during extreme low tides.

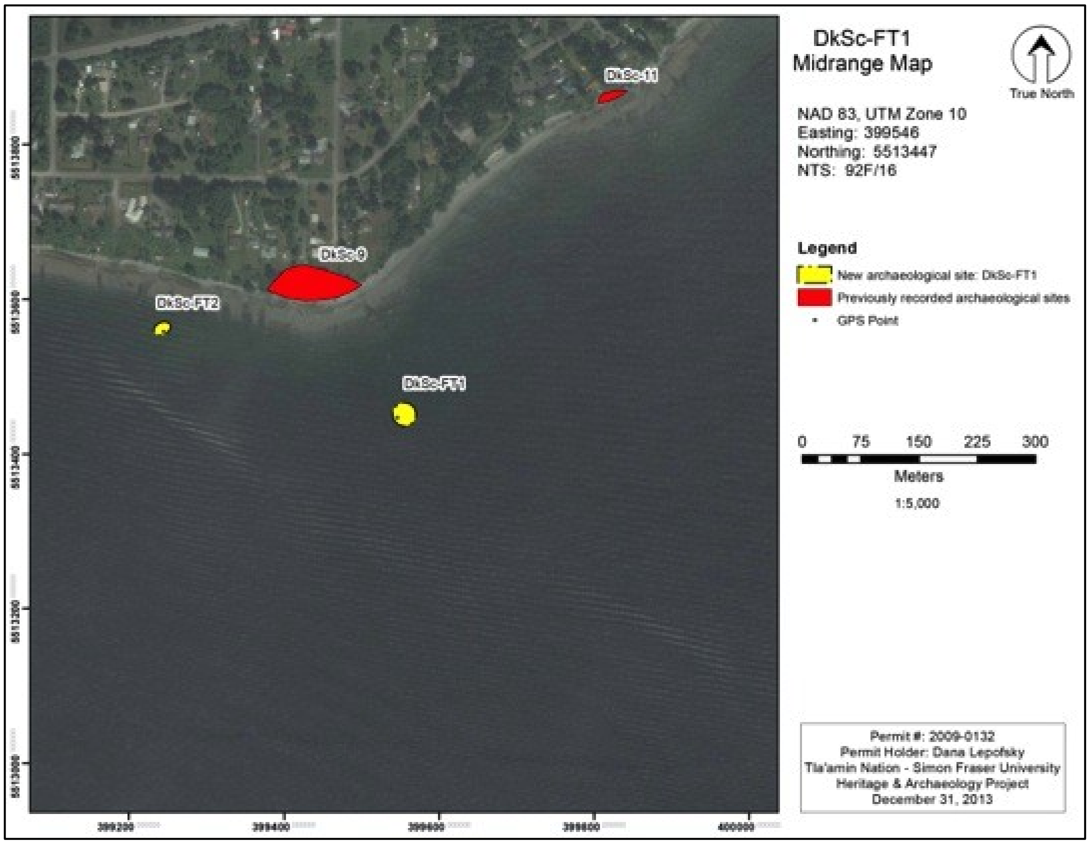

***Figure A.3**. Midrange map showing the location of DkSc-16 (This map was created before the Borden Code was assigned and shows its temporary site designation).*

Figure A.4. *Aerial photograph of the intertidal subsistence feature at DkSc-16. (G. Combes photograph)*

The stone wall feature at DkSc-16 has walls approximately 2 m wide, and 20 cm high, with two courses of stones (Figure A.5). At the apex of the hook shape, the stone walls are lower (Figure A.6). Many of the hook elements visited during this project have a similar reduction in wall height at their apex, suggesting that an additional element, such as a basket, was used in conjunction with the stone walls to capture marine resources. No organic materials were observed at DkSc-16, and the feature remains undated. The matrix around the feature consists of a muddy sand with small rocks and cobbles up to 30 cm in size, as well as some smaller boulders. The area around the feature has not been cleared.

Figure A.5. *Example of stone walls at DkSc-16. (A. Van Merlin photographs)*

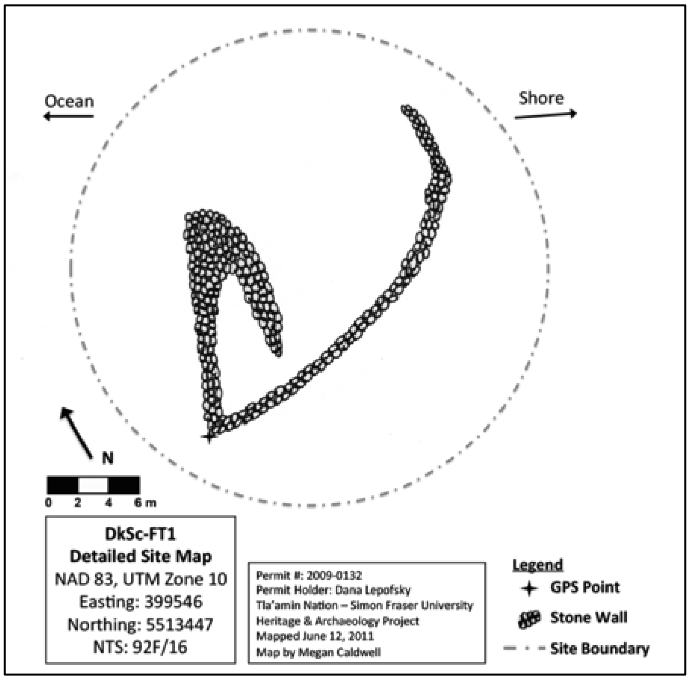

Figure A.6. *Detailed site map of DkSc-16 (This map was created before the Borden Code was assigned and shows its temporary site designation).*

E.3.2 - *DkSc-17*

DkSc-17 is located just southeast of Albion Point, south of Powell River (Figure A.8). The site was identified through aerial photography (Figure A.7), and visited June 13, 2010. It is adjacent to DkSc-9, a shell midden site first recorded by Acheson and Riley in 1977. Also in the vicinity is DkSc-16. DkSc-17 consists of a stone wall intertidal feature composed of a hook element. It is located in the lower intertidal zone, and is accessible only during extreme low tides.

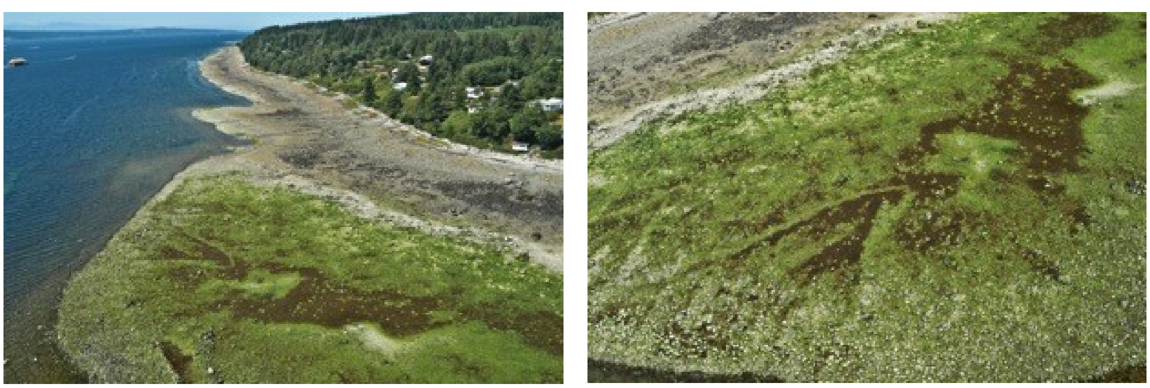

Figure A.7. *Aerial photographs of the intertidal subsistence feature at DkSc-17. (G. Combes photographs)*

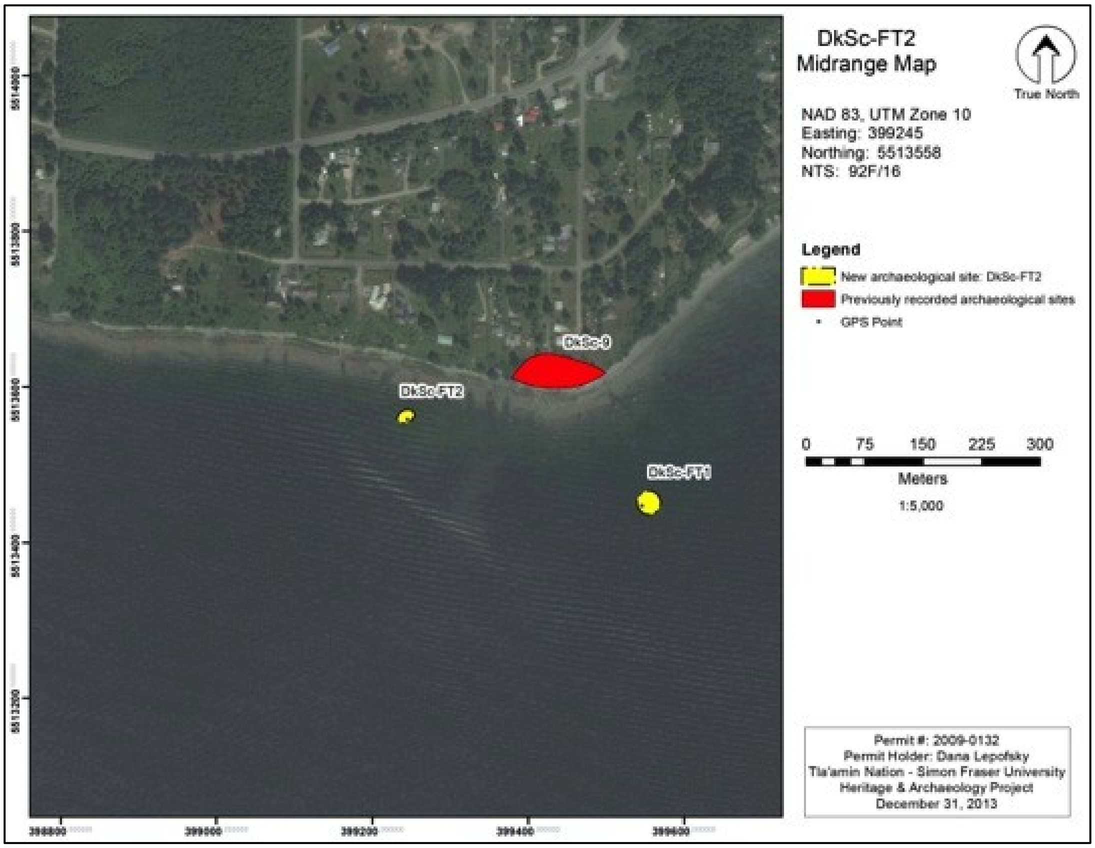

Figure A.8*. Midrange map showing the location of DkSc-17 (This map was created before the Borden Code was assigned and shows its temporary site designation).*

The stone walled feature at DkSc-17 has walls approximately 1.5-2 m wide, and two to three courses or 25-35 cm high (Figure A.9). At the apex of the hook shape, the stone walls are lower (Figure A.10). Many of the hook elements visited during this project have a similar reduction in wall height at their apex, suggesting that an additional element, such as a basket, was used in conjunction with the stone walls to capture marine resources. No organic materials were observed at DkSc-17, and the feature remains undated. The matrix around the feature consists of a muddy sand with small rocks and cobbles up to 30 cm in size, as well as some smaller boulders. The area around the feature has not been cleared.

Figure A.9. *Example of stone walls at DkSc-17. (A. Van Merlin photograph)*

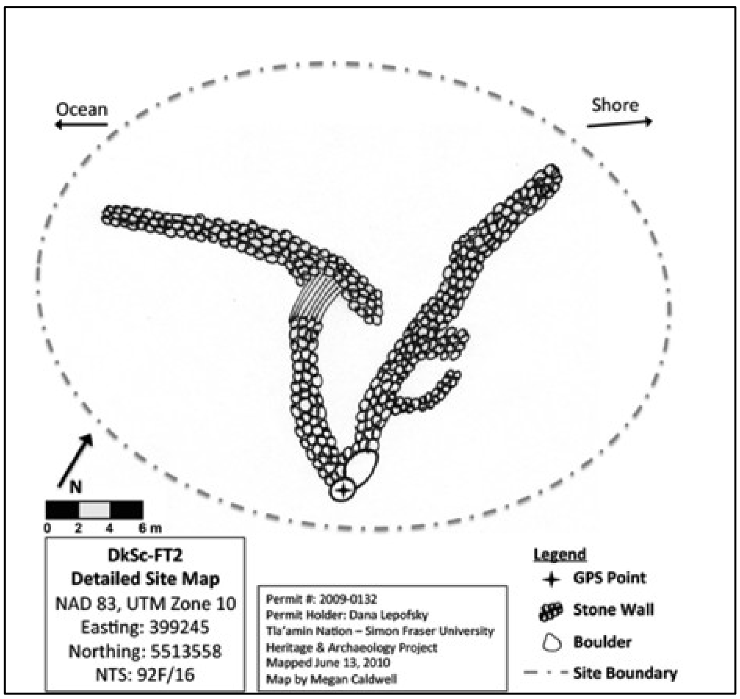

Figure A.10. *Detailed site map of DkSc-17 (This map was created before the Borden Code was assigned and shows its temporary site designation).*

E.3.3 - *DlSd-1 (Gibson Gully)*

In addition to the shell midden site investigated and described in the main body of this report, DlSd-1 also has an intertidal component. DlSd-1 is located just south of Gibson's Beach in Powell River (Figure A.11). The intertidal component was identified through aerial photography (Figure A.12), and was visited for recording on April 20, 2011.

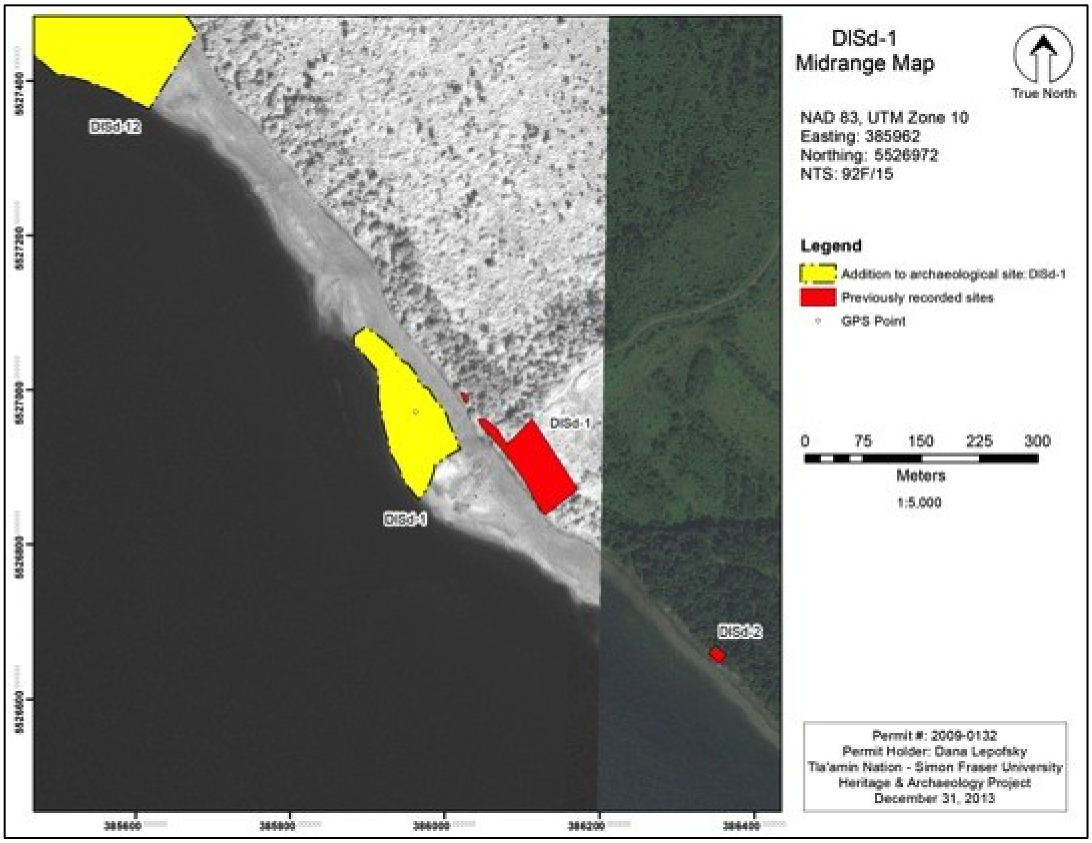

Figure A.11. *Midrange map showing the location of DlSd-1.*

Figure A.12. *Aerial photograph of the intertidal subsistence feature at DlSd-1. (G. Combes photograph)*

On the beach below the shell midden site is a large cleared beach feature, 80 m by 45 m in size, that holds water even at the lowest tides. The cobbles and small boulders are piled around the upper edges of the pool. There are two openings leading into the cleared beach pool, and midway along the ocean side edge of the pool is an opening and a stone wall hook shaped fish trap. Water drains out of this opening throughout the entire tidal sequence, and it could have been blocked in order to trap fish in the pool. The floor of the cleared beach consists of sandy mud with small cobbles (≤10 cm in diameter). Water in the pool is 40 cm in depth at the deepest point, in the centre of the pool (Figure A.13).

Figure A.13. *Example of cleared beach and stone walls at DlSd-1.*

To the northwest of the cleared beach is a hook element stone wall fish trap, and beyond that an area of disturbed stone walls of which no shape can be discerned. To the south of the pool is a large stone wall that is lined up with the opening of the gully feature. Although there is not currently a stream running through this gully, there was in the past. The stone wall to the south of the feature may have guided water from this stream through the larger cleared beach feature. The stone walls of this feature are variably between 1 m and 3 m in width, and 15 cm to 30 cm in height, standing from one to three courses of stones high (Figure A.14).

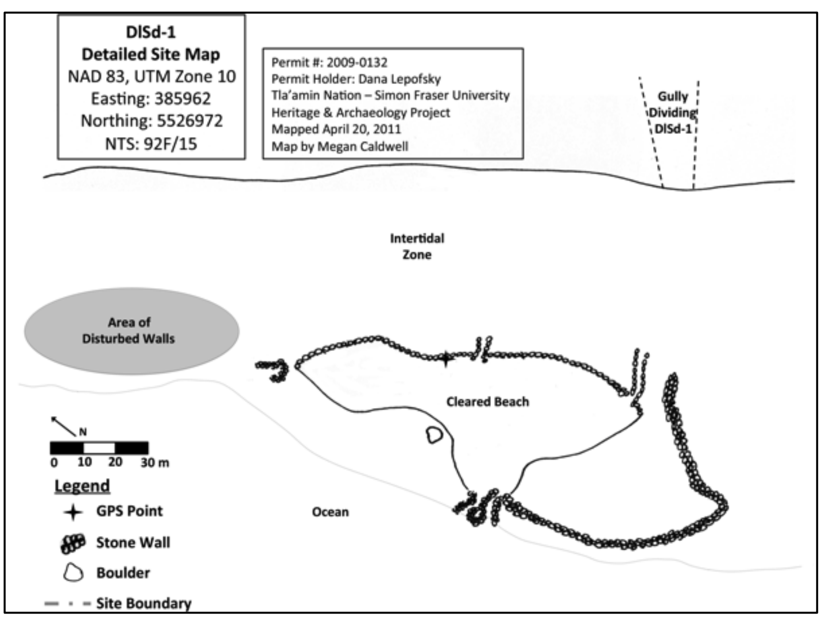

Figure A.14. *Detailed site map of DlSd-1 intertidal features.*

E.3.4 - ***DlSd-11***

DlSd-11 is a large shell midden site located at Sliammon (Figure A.15). The site was originally recorded by Acheson and Riley in 1976. In addition to the on-land component, there are three intertidal features at DlSd-11. Feature 1 is a widespread, low-lying stone wall fish trap. Feature 2 is a series of small (1-2 m wide) crescent fish traps at the lowest edge of the intertidal zone. Feature 3 is an extensive series of stone walls built up around Sliammon Point.

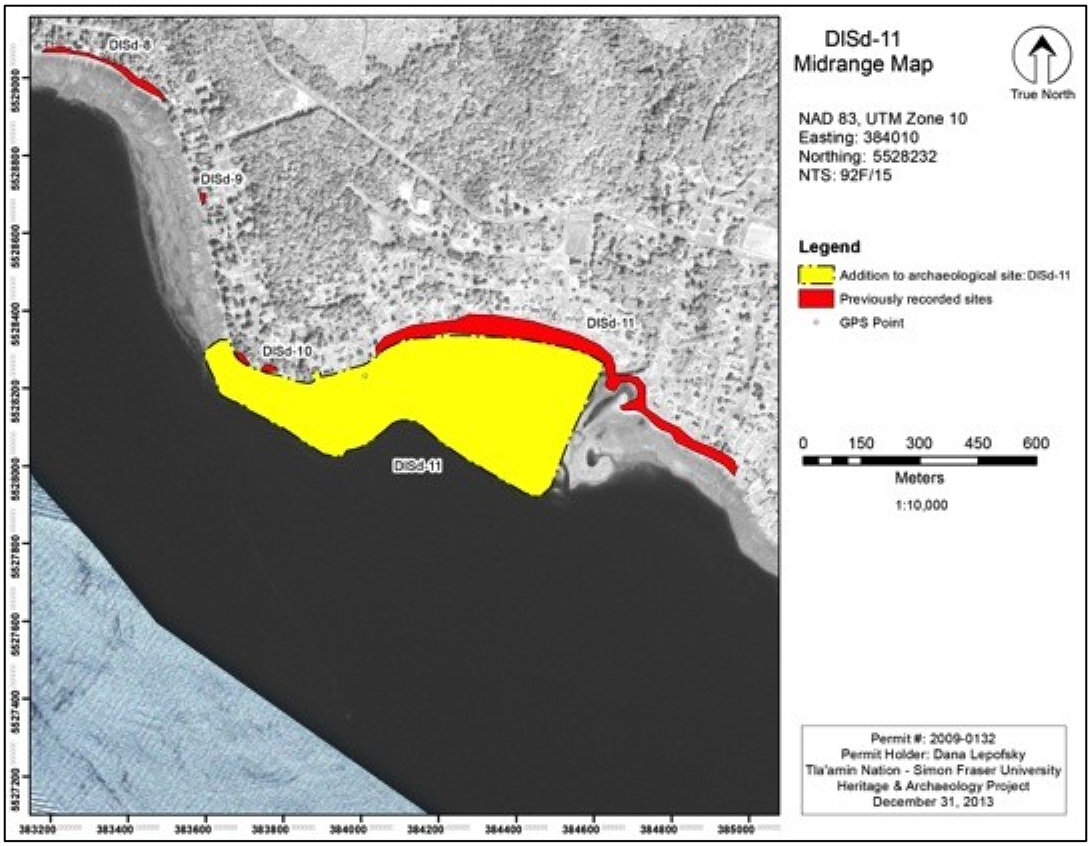

Figure A.15. *Midrange map showing the location of DlSd-11.*

Feature 1 of DlSd-11 was identified through aerial photography (Figure A.16) and recorded on June 14, 2010. It consists of a series of single course (<15 cm in height) stone walls, ranging between 30 cm and 5 m in width. The walls appear scattered, perhaps due to tidal action. Along with the stone walls is a large tidal pool that holds water through the low tide. Tla'amin members remember taking herring from this pool during the spawning season (Figure A.17).

Figure A.16. *Aerial photograph of intertidal Feature 1 at DlSd-11 (rough area of Feature 1 outlined in pink) and on the ground photograph of stone walls showing scatter. (Aerial photograph – G. Combes)*

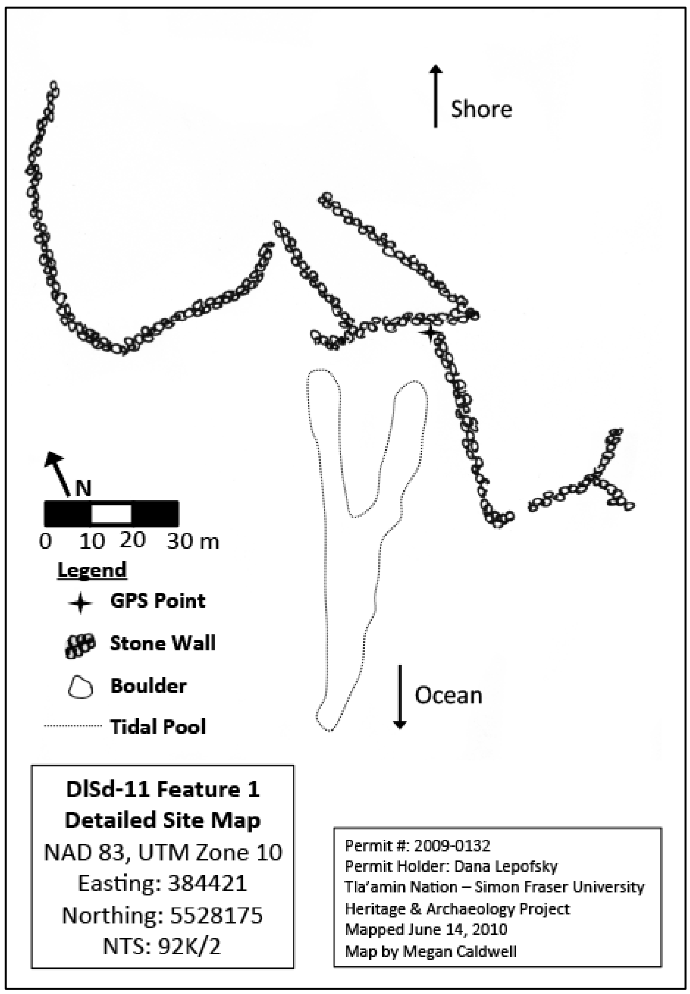

Figure A.17. *Map of intertidal Feature 1 at DlSd-11.*

Feature 2 is a series of 34 small, less than 2 m in width, crescent elements located along the lowest edge of the intertidal zone. These features were identified through aerial photography

(Figure A.18). Subsequently, their locations were recorded using GPS on June 15, 2011, when the tide was low enough to expose them for approximately 30 minutes. However, the crescents were not exposed for a long enough period to allow for them to be mapped beyond their GPS locations. Each crescent measures between 1-2 m in width, and consists of a one or two course, or 10-20 cm high wall, with their apices facing the water (Figure A.19). The crescents are found along the edge of where the intertidal flat in front of where Sliammon meets Sliammon Point (Figure A.20).

Figure A.18. *Aerial photograph of intertidal Feature 2 at DlSd-11. (G. Combes photograph)*

Figure A.19. *Examples of crescent elements of intertidal Feature 2 at DlSd-11.*

Figure A.20. *GPS Locations of the 21 crescent features that make up intertidal Feature 2 at DlSd-11.*

Feature 3 is an expansive series of connected crescent elements, wrapping around Sliammon Point (Figure A.21). Today the feature stretches approximately 250 m around the point, and 100 m from the land to the water. In the past, before boat ramps were constructed with bulldozers in the intertidal zone, the feature stretched much farther, as can be seen in Figure A.22, an aerial photograph of Sliammon Point from 1965.

Figure A.21. *Aerial photographs of intertidal Feature 3 at DlSd-11. (G. Combes photographs)*

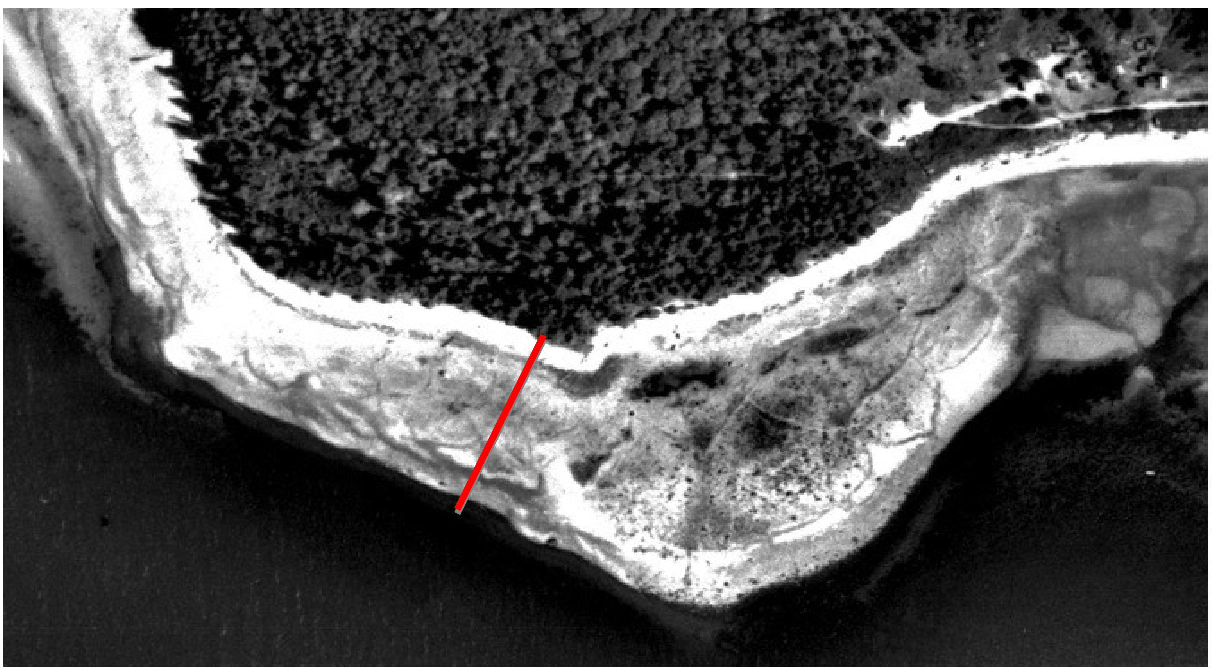

Figure A.22. *1965 aerial photograph of Sliammon Point, showing continuation of walls around the point. The red line indicates the point beyond which the stone walls are now disturbed.*

Feature 3 was partially mapped by total station (Figure A.23). The walls of Feature 3 range in size between 30 cm and 1 m in width, and 20 cm and 80 cm in height, usually three to four courses of stones high. A total of 10 walls were mapped as part of this project, and at least seven other walls remain undisturbed. Additionally, portions of walls can still be seen in the areas between boat ramps in the disturbed portion of the site.

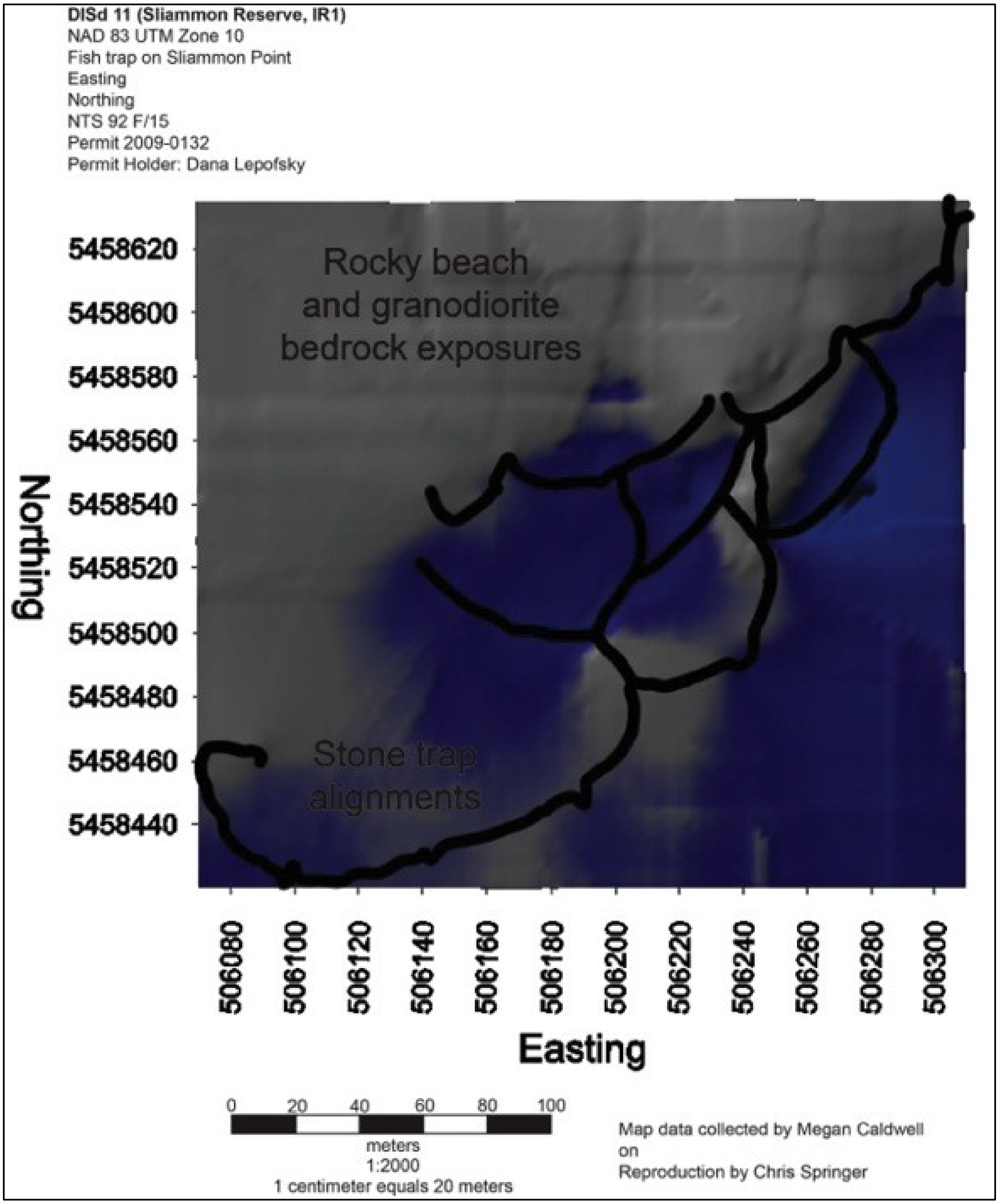

Figure A.23. *Partial Total Station map of stone walls of intertidal Feature 3 at DlSd-11.*

E.3.5 - *DlSd-12*

DlSd-12 is a small shell midden site at Gibson's Beach recreation area, adjacent to Sliammon (Figure A.24). The site was first identified by Acheson and Riley in 1976. Two intertidal features were identified by air (Feature 1 and Feature 2), and subsequently visited April 19, 2011. Additionally, Feature 3 has been identified previously through aerial photography, but has subsequently been buried due to accumulation of sand and can no longer be located when visiting the site on foot. Finally, Feature 4 was identified after DlSd-12 was visited, from Google Maps imagery.

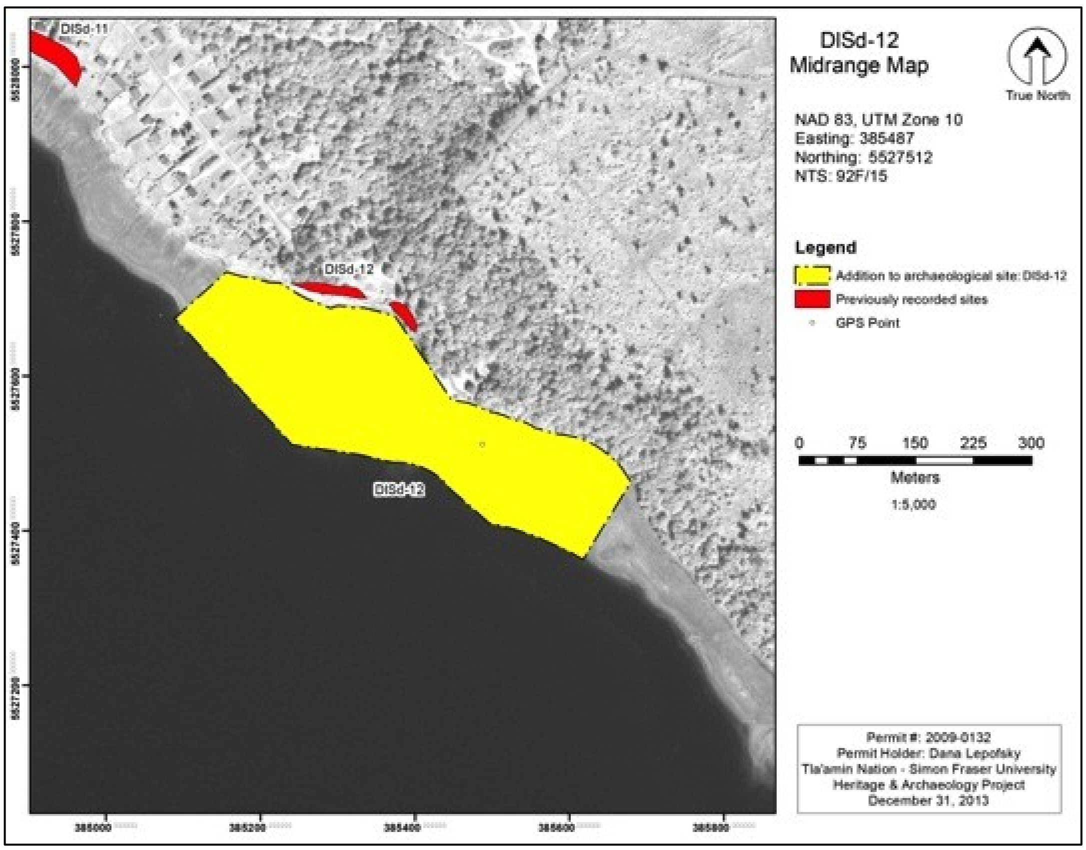

Figure A.24. *Midrange map showing the location of DlSd-12.*

Feature 1 consists of two cleared pools, lead lines leading to the upper pool, and a hook element at the ocean side of the lower pool (Figures 25 and 26). The feature is 80 m by 65 m in size. The two pools are cleared of large cobbles and small boulders, and hold water up to 30 cm in depth even at the lowest tides. The pools are connected by a cleared path of stones, through which water flows continuously as the tide recedes. The lead lines at the northwestern edge of the upper pool appear to direct fish into the pool. They would then be drawn down through the pools with the outgoing tide, and finally reach the hook element. On the eastern side of the hook element is a drainage path, which could be blocked with a small boulder or basket trap to retain fish. The hook itself is completely closed except where the short arm meets the long arm of the hook; here again, the opening could be blocked with a small boulder or basket trap to retain fish. The walls of this feature are between 1 and 3 m in width, and stand two to three courses of stones high, or 25-35 cm (Figure A.27).

Figure A.25. *Aerial photograph of intertidal Feature 1 at DlSd-12. (G. Combes photograph)*

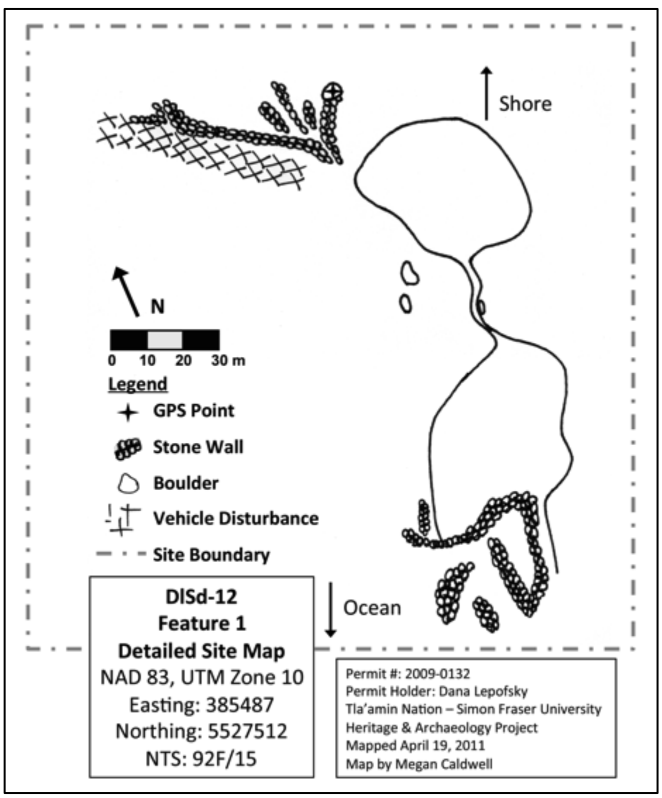

Figure A.26. *Site map of intertidal Feature 1 at DlSd-12.*

Figure A.27*. Stone walls from intertidal Feature 1, between the upper and lower pools (right) and lower hook (left).*

Feature 2 consists of a single cleared pool, with built up stone walls around it, measuring 90 m by 35 m in size (Figures 28 and 29). The pool holds water during even the lowest tides, and has a cleared path leading into it from even farther up the beach; presumably to direct fish towards the feature. Oceanward from this pool is a cleared path through which water flows, meeting first a V element, and then a large hook element. The stone walls of this feature are between 2 and 4 m in width, and two to three courses, or 25-35 cm, in height (Figure A.30). The hook element is open to the ocean, with no wall at its apex, or at the point where the short wall meets the long wall; again like other features, these openings could have been closed with small boulders or basket traps. The uppermost portion of this feature has been disturbed by vehicle activity.

Figure A.28*. Aerial photograph of intertidal Feature 2 at DlSd-12. (G. Combes photograph)*

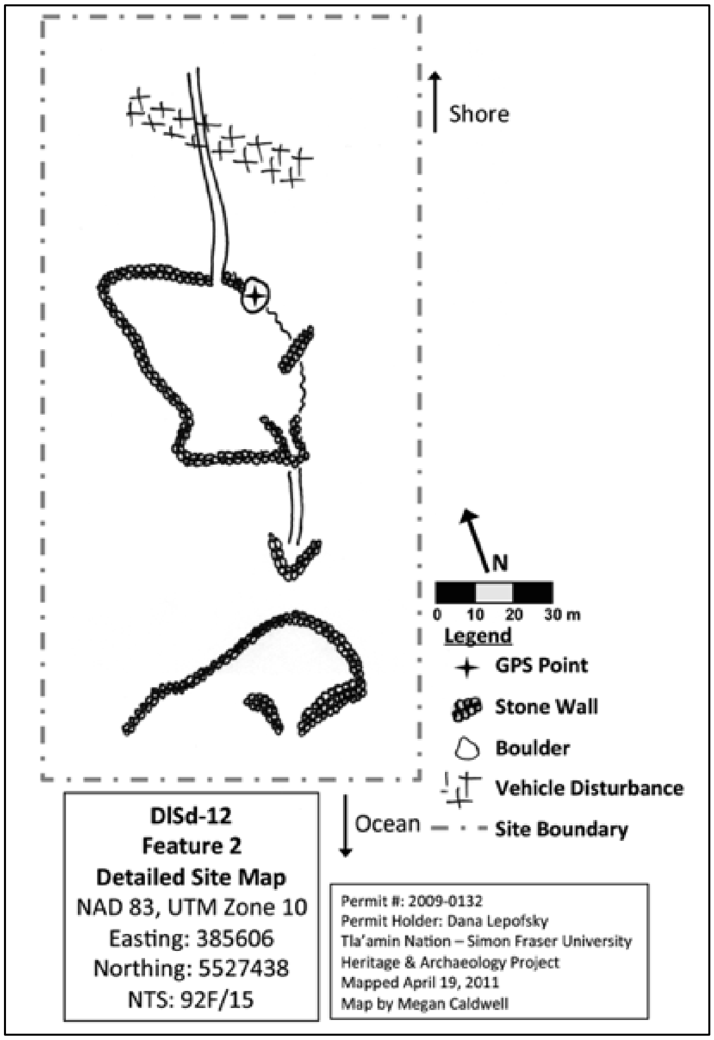

Figure A.29. *Site map of intertidal Feature 2 at DlSd-12.*

Figure A.30. *Hook element of intertidal Feature 2, emerging as the tide recedes.*

Feature 3 consists of two symmetric hook elements, similar in nature to those found at DlSd-13 (below). These hooks have been identified in aerial photography taken in 2008 by Georgia Combes, not for the current project (Figure A.31). When the site was visited in 2010, Feature 3 had subsequently been covered up with sands deposited through tidal action and was no longer visible. In satellite imagery from Google Maps, the area of Feature 3 can be seen to have more sand deposits than is present in the 2008 aerial photograph, although the date of the Google Maps imagery is unknown (Figure A.32).

Figure A.31. *Aerial photograph of intertidal Feature 3 taken in 2008. The feature is no longer visible. (G. Combes photograph)*

Figure A.32. *General area of intertidal Feature 3 outlined on Google Maps imagery; date of Google Maps photo unknown.*

Feature 4 has not been visited in person. It consists of a large crescent element, approximately 30 m by 50 m in size (Figure A.33). It is similar in shape to the largest crescent element at DlSd-11. This site should be revisited in the future, to properly record Feature 4.

Figure A.33. *Intertidal Feature 4 at DlSd-12; not visited in person, identified from Google Maps.*

E.3.6 - ***DlSd-13***

DlSd-13 is a shell midden site first identified by Acheson and Riley in 1976 (Figure A.35). Newly identified in the vicinity of DlSd-13 as part of this project is an intertidal feature consisting of two symmetric hook elements. The feature was identified through aerial photography, and visited on July 11, 2010 (Figure A.34).

Figure A.34. *Aerial photograph of intertidal subsistence feature at DlSd-13. (G. Combes photograph)*

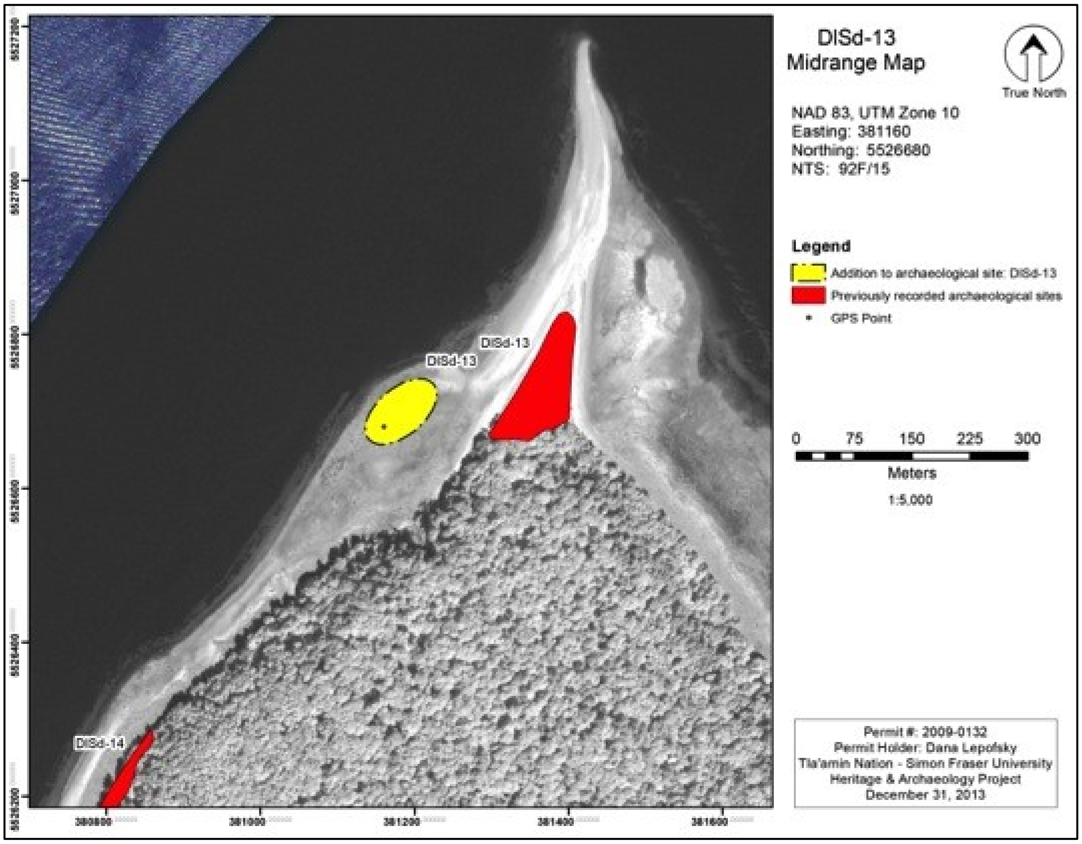

Figure A.35. *Midrange map showing the location of DlSd-13.*

The feature is 20 m by 25 m in size, and sits on a long expanse of beach on the northwestern side of Ahgykson. The hook elements are two to three course high stone walls, approximately 15-20 cm in height and 1 m in width, and sit on a beach matrix of small rocks (≤10 cm diameter) and muddy sands (Figure A.36). Larger cobbles are found in the area of the feature, as well as three large glacial erratics (>2 m in diameter; noted in Figure A.37). The hooks are closed on the beachward side, but there is an opening at the apex of each hook in the ocean side. No stones are piled in these openings, but they would have been easy to block with a large cobble or basket trap to catch fish with the outflowing tide. Similar openings are present between the long and short arms of the hook elements.

Figure A.36. *Examples of stone walls at DlSd-13.*

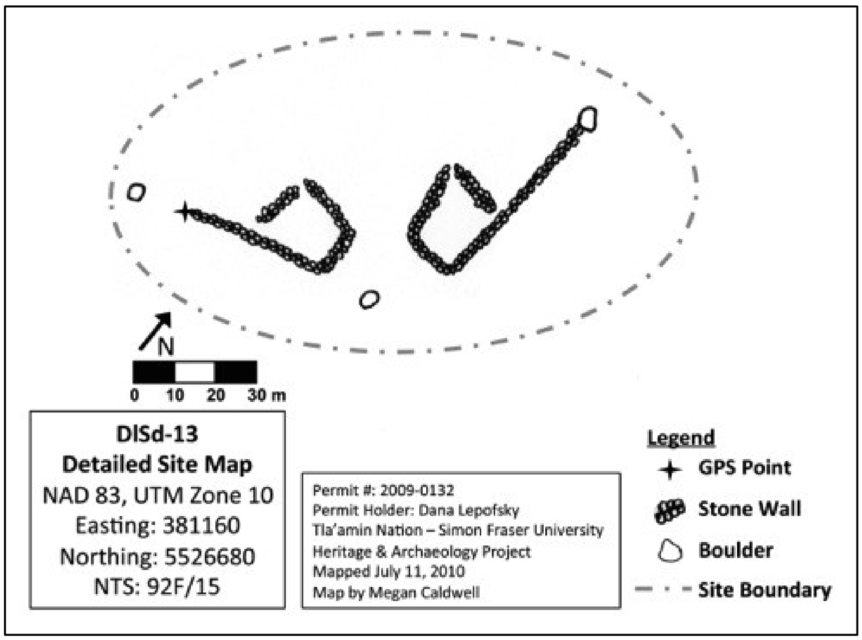

Figure A.37. *Detailed site map of DlSd-13.*

E.3.7 - *DlSd-37*

DlSd-37 is located along the eastern side of Ahgykson, facing Sliammon (Figure A.38). It is a small feature, consisting of only a single crescent wall element. The feature is 15 m by 17.5 m in size, and consists of a two course high stone wall, 0.5 m in width and 20 cm in height (Figure A.39). The crescent sits on a muddy sand matrix, and there are very few cobbles or small boulders in the vicinity. The apex of the crescent points directly towards water and would serve to retain fish behind it with an outgoing tide (Figure A.40). This feature was not identified through aerial photography, but instead was found through pedestrian survey of the beach on July 11, 2010.

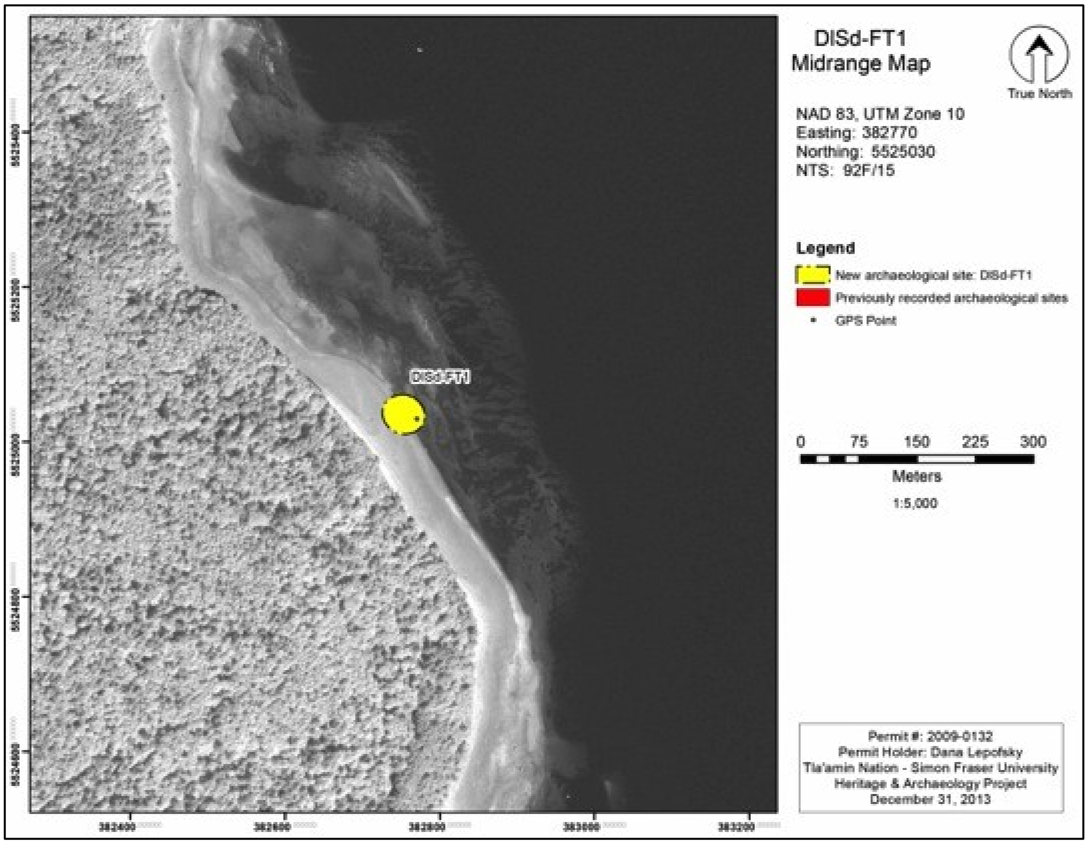

Figure A.38. *Midrange map showing location of DlSd-37 (This map was created before the Borden Code was assigned and shows its temporary site designation).*

Figure A.39. *Views of both sides of the stone wall at DlSd-37.*

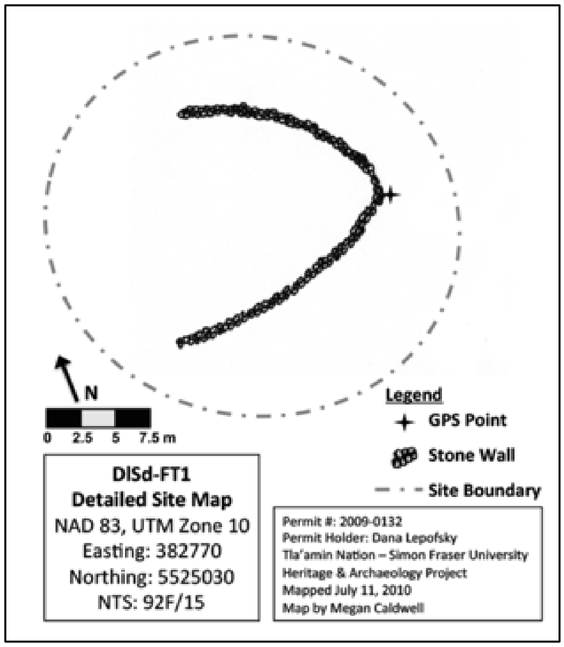

Figure A.40. *Detailed site map of DlSd-37 (This map was created before the Borden Code was assigned and shows its temporary site designation).*

E.3.8 - *DlSd-38*

DlSd-38 is located on the southeastern side of Ahgykson, facing Texada Island (Figure A.42). The feature was identified through aerial photography (Figure A.41), and was visited June 12, 2010. It consists of a large, 120 m by 110 m cleared beach area, with stone walls built up across the centre of the feature. The cleared beach holds water up to 75 cm in depth, and the water drains out towards the ocean through an opening at the southern end of the feature. The matrix of the cleared area consists of muddy sand, with some small cobbles up to 10 cm in size.

Figure A.41. *Aerial photographs of intertidal subsistence feature at DlSd-38. (G. Combes photograph)*

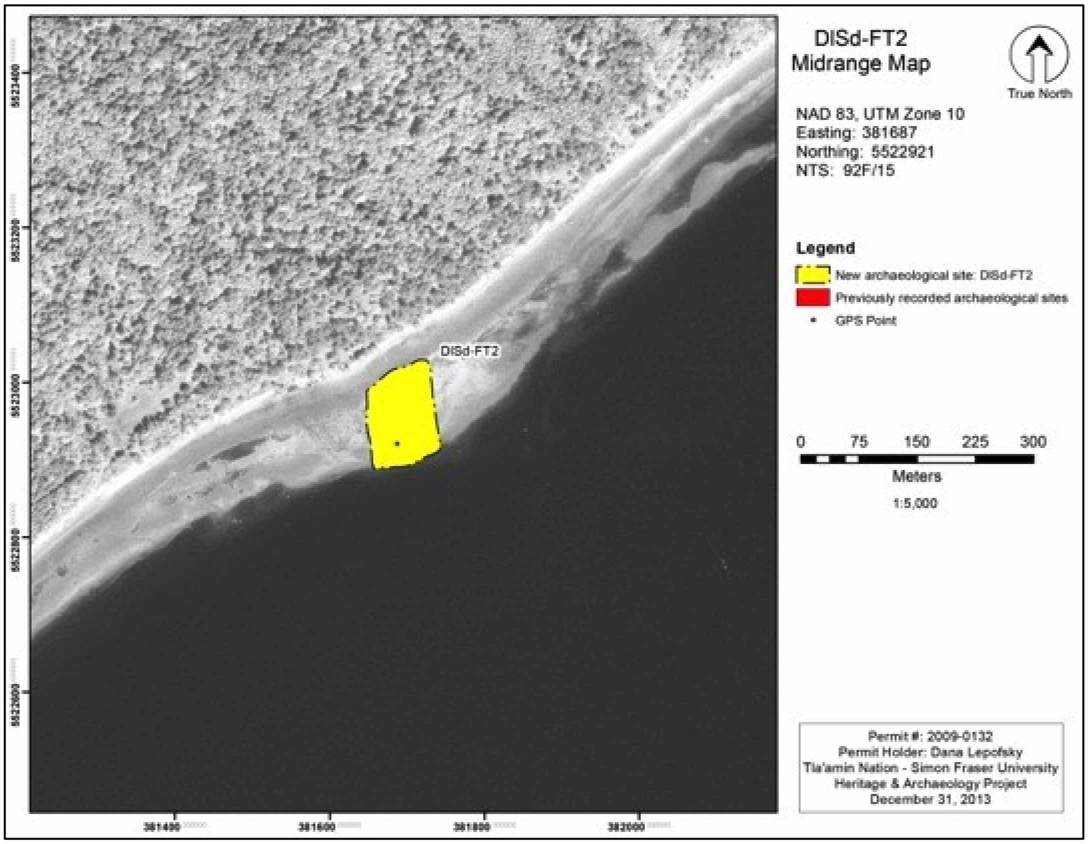

Figure A.42. *Midrange map showing the location of DlSd-38 (This map was created before the Borden Code was assigned and shows its temporary site designation).*

There are seven stone walls interspersed across the centre of the feature. They are all approximately 2 m in width, and stand two to three courses high, or 15-25 cm in height. Six of the walls are undefined, with no discernable shape. They vary in length from 2-8 m, and may at one time have been more defined. The final wall consists of a heart element, with a long lead line, and two openings on the ocean side which could be blocked to retain fish during the outgoing tides (Figure A.43).

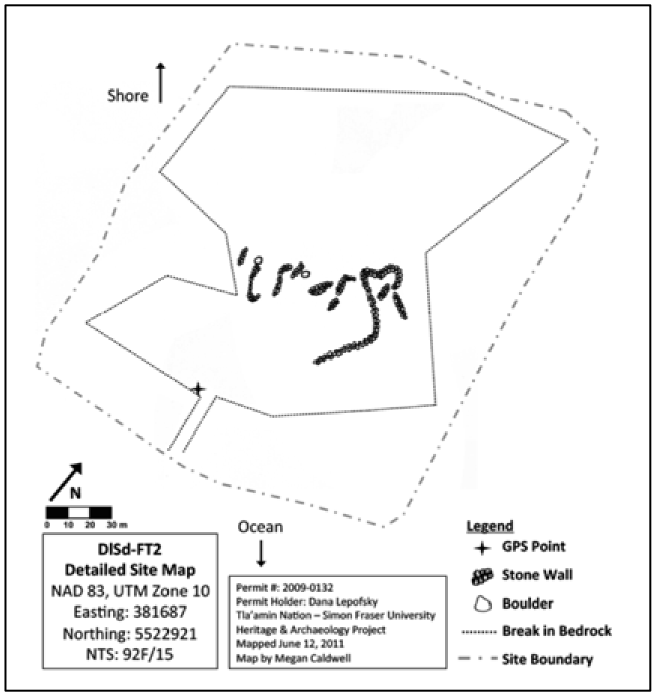

Figure A.43. *Detailed site map of DlSd-38 (This map was created before the Borden Code was assigned and shows its temporary site designation).*

E.3.9 - *DlSd-39*

DlSd-39 is located on the eastern side of Ahgykson (Figure A.44). The site was identified through aerial photography (Figure A.45), and visited on July 11, 2010. There are three large glacial erratics (3-5 m in diameter) that have been used to define the boundaries of the site. Within this area, there is one well formed hook element, along with an area of scattered cobbles and small boulders that used to be stone wall formations. The beach matrix at this site consists of muddy sand, with mostly rocks of less than 10 cm in diameter, with some scatters of larger cobbles and small boulders.

Figure A.45. *Aerial photograph of intertidal subsistence feature at DlSd-39, including area of disturbed walls. (G. Combes photograph)*

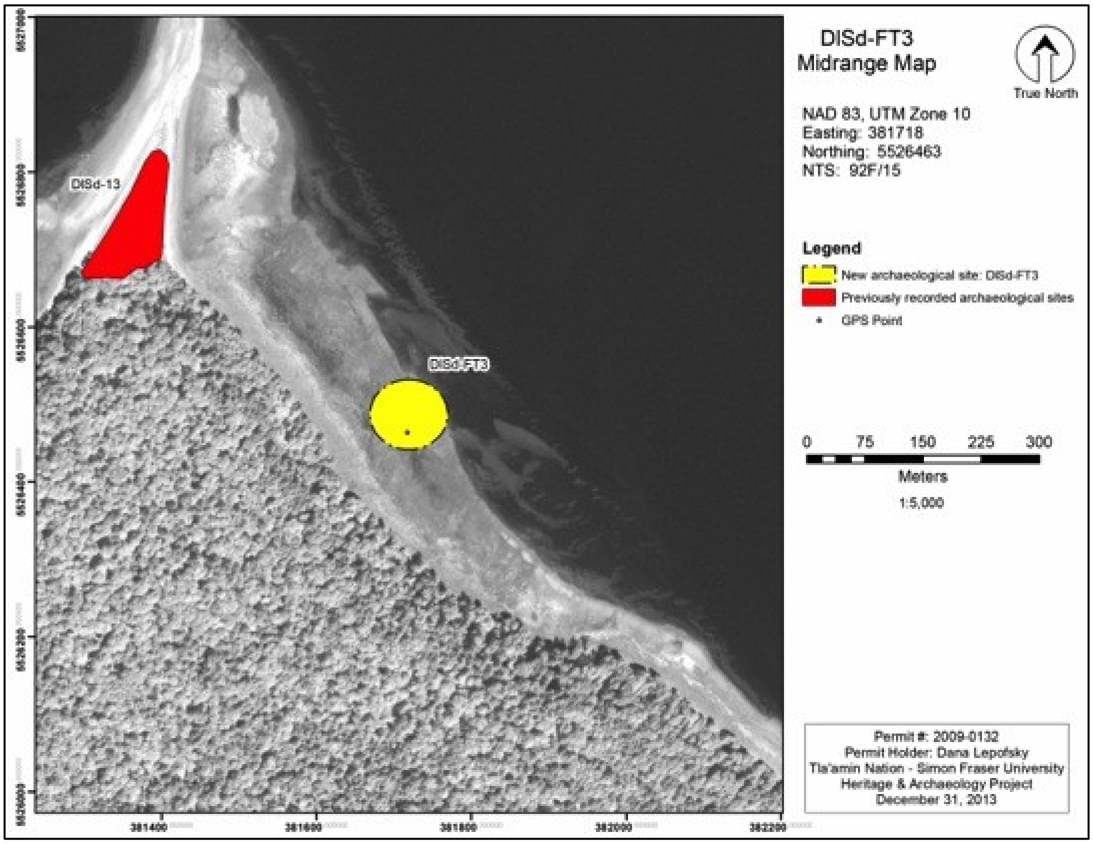

Figure A.44*. Midrange map showing the location of DlSd-39 (This map was created before the Borden Code was assigned and shows its temporary site designation).*

The hook element is well formed, 10 m by 15 m in size. The walls are approximately 0.5 m in width, and one course high (Figure A.46). The wall stones are scattered, and it is possible that they were two courses high in the past. The hook is closed except for the point at which the short wall comes to meet the long wall; here there is an opening, on the land side of the element. With the scattered stone walls, it was impossible to tell if the ocean side apex of the element had lower stones or an opening in the past. However, since the other hook elements recorded in this project all had this feature, it is probable that this element also had an opening of some sort at the ocean side apex.

Figure A.46*. Example of stone walls at DlSd-39.*

The area of disturbed walls has no discernable shape when seen on the ground, however, faint outlines of walls are visible in the aerial photograph. Attempts were made when visiting the site to discern the pattern of the (former) stone walls, however the were too disturbed and covered in sand to be assessed. Their location is noted on the site map (Figure A.47).

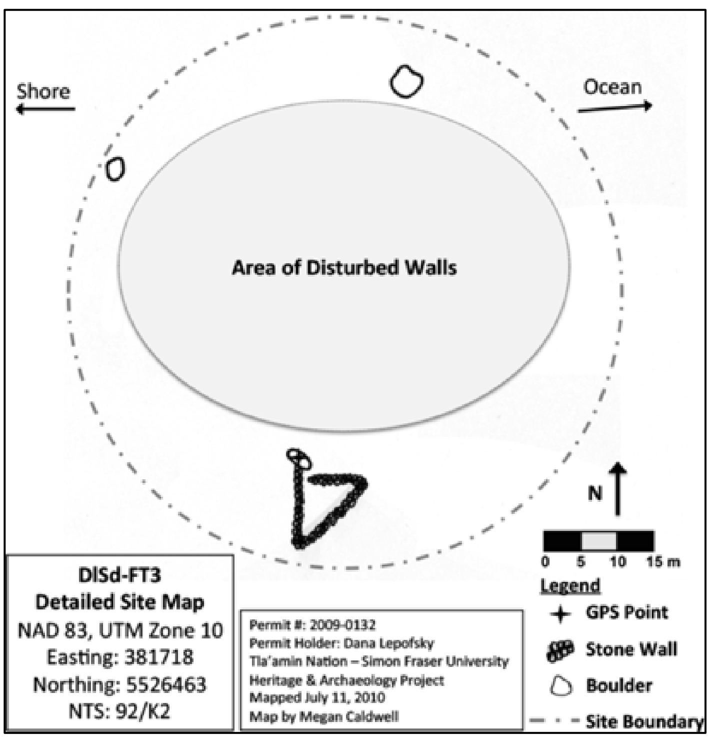

Figure A.47*. Detailed site map of DlSd-39 (This map was created before the Borden Code was assigned and shows its temporary site designation).*

E.3.10 - *DlSe-54*

DlSe-54 is located at the head of Okeover Inlet (Figure A.48). The site is located at the lowest end of a large intertidal bay, at the mouth of a large freshwater stream. There is a recorded shell midden site on shore (DlSe-6), and Tokenatch (Tla'amin Reserve #5) is located nearby. The stream breaks up into a number of rivulets as it approaches the end of the intertidal zone, and numerous wooden stakes are clustered around the main rivulet (Figures 49 and 50). The stakes are embedded in a muddy matrix, which is probably subject to constant erosion and deposition activity based on tidal movements and stream activity. Therefore it is likely that more stakes are preserved underneath the mud, and that subsequent visits will reveal different configurations of stakes.

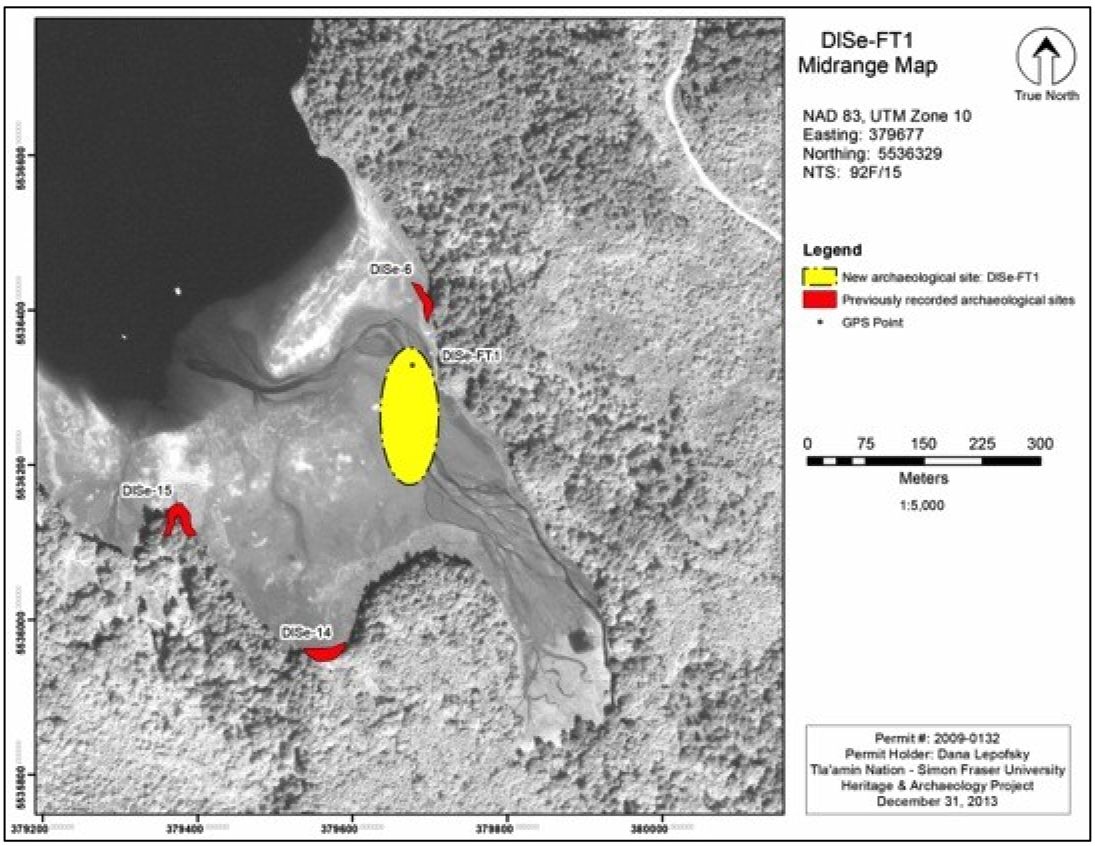

Figure A.48. *Midrange map showing the location of DlSe-54 (This map was created before the Borden Code was assigned and shows its temporary site designation).*

Figure A.49. *Wooden stakes exposed by erosion from rivulet (Indicated by red arrows) at DlSe-54.*

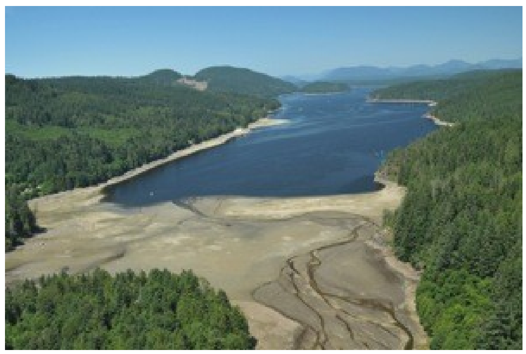

Figure A.50. *Aerial photograph of DlSe-54. (G. Combes photograph)*

DlSe-54 was visited on June 12, 2011, when the wooden stakes were first identified, and subsequently recorded (Figure A.52). The top of two stakes were sawn off by hand using a collapsible handsaw (Figure A.51) and submitted for radiocarbon dates. One stake returned a modern date (Beta-305567); the other stake was dated to 270-210 Cal. B.P. and 140-20 Cal. B.P. (Beta-305568).

Figure A.51. *Sawing top off wooden stake as a radiocarbon sample; remaining wooden stake left in the sand at DlSe-54.*

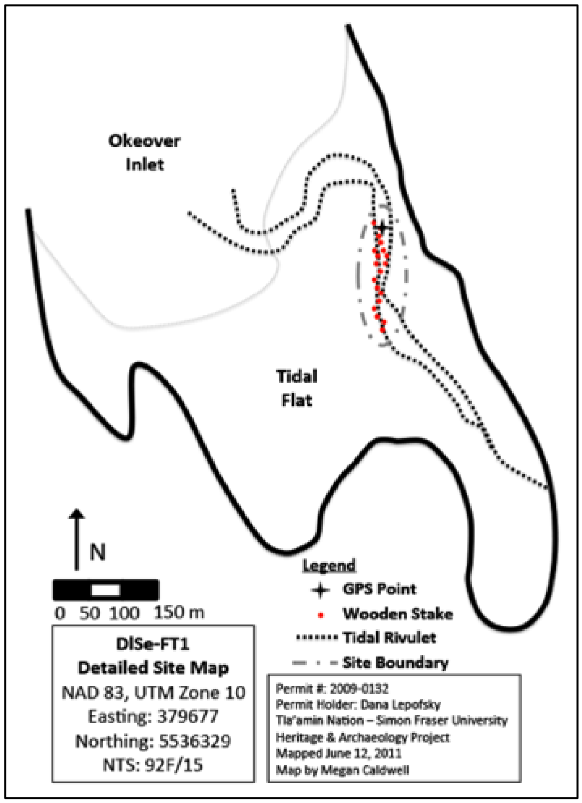

Figure A.52*. Detailed site map of DlSe-54 (This map was created before the Borden Code was assigned and shows its temporary site designation).*

E.3.11 - *DlSe-55*

DlSe-55 is located on the southeastern tip of Ahgykson in the Strait of Georgia (Figure A.54). The site is located within a bay 125 m by 140 m in size, with a bearing of 160 degrees. The site was identified through aerial photography (Figure A.53), and was visited June 12, 2010.

Figure A.53*. Aerial photograph of intertidal subsistence feature at DlSe-55. (G. Combes photograph)*

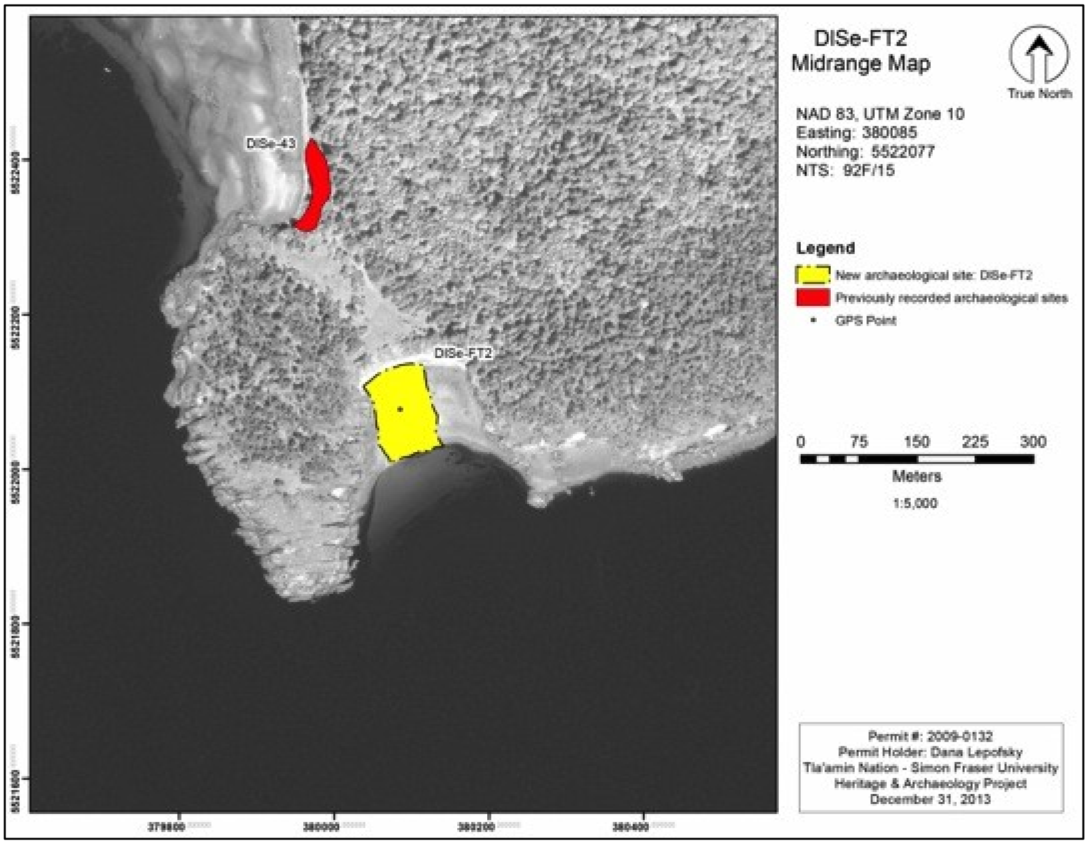

Figure A.54. *Midrange map showing the location of DlSe-55 (This map was created before the Borden Code was assigned and shows its temporary site designation).*

The site consists of a large intertidal feature with both cleared beach and stone wall elements. Two cleared beaches are present, one directly up beach from the other, with stone wall guide lines connecting them (Figure A.55). At the ocean side end of the lower cleared beach are additional stone wall guidelines leading down into the lowest intertidal area. Both cleared beaches have muddy sand bottoms with small cobbles (≤10 cm diameter), and stones piled up around them, two or three courses high, approximately 15-25 cm in height. The higher cleared beach drains completely with the lowest tides (but not always completely when low tides are higher), while the lower cleared beach holds water up to 20 cm in depth at the lowest tides.

Figure A.55. *The two cleared beach elements at DlSe-55; potential third clear beach can be seen on the far side of the feature. (A. Gauvreau photograph)*

The higher cleared beach is approximately 30 m by 30 m in size, with leads to the lower pool of approximately 20 m in length. The leads between the higher and lower cleared beaches are not well defined, usually only a course high, and with no clear definition between walls. It is possible that wave action has disturbed the walls in this area. The lower cleared beach is approximately 35 m in length by 15 m in width, with leads to the ocean of approximately 25 m in length. The leads from the lower cleared beach are well defined, and create two channels through which flowing water can be observed both as the tide drains and as it flows back in. The lower lead walls are two to three courses high, and could be blocked with larger cobbles or baskets to trap fish with the outgoing tide (Figures 56 and 57).

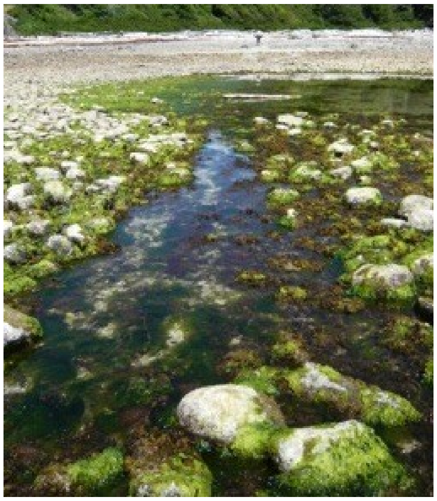

Figure A.56. *On the left are the lead lines between the two cleared beach elements at DlSe-55. On the left are the leads between the lower cleared beach and the ocean at DlSe-55.*

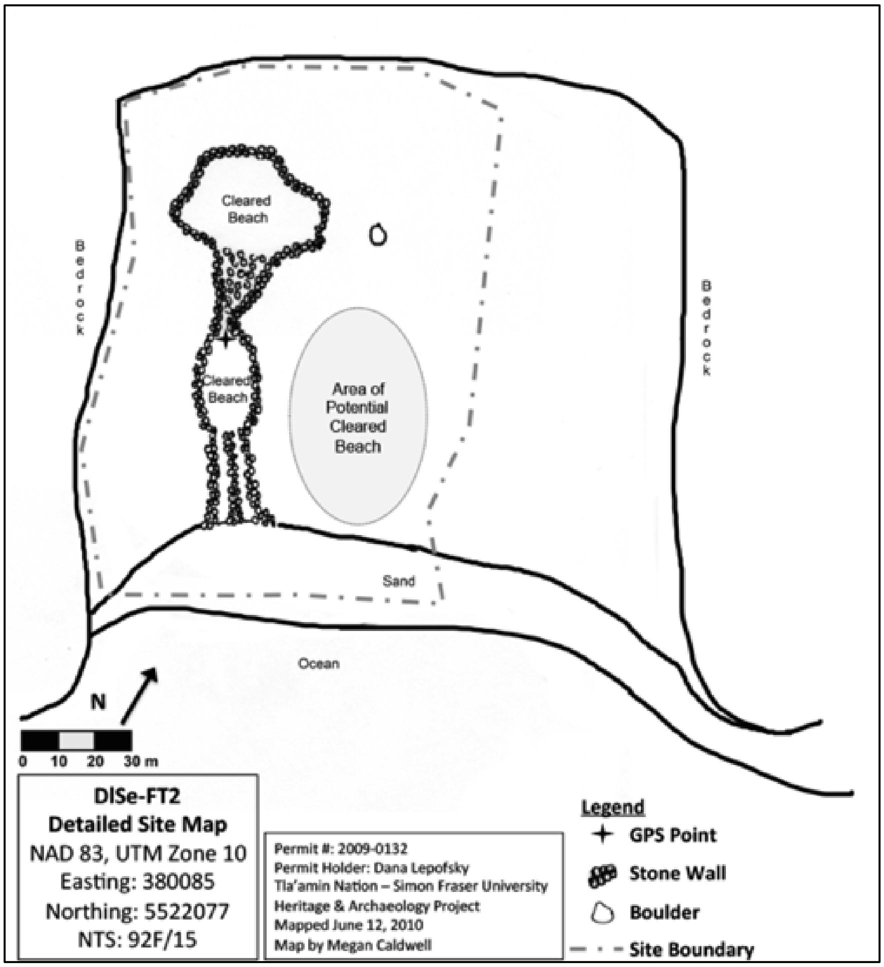

Figure A.57. *Detailed site map of DlSe-55 (This map was created before the Borden Code was assigned and shows its temporary site designation).*

E.3.12 - *EaSd-1*

EaSd-1 is located at the head of Laura Cove, in Prideaux Haven (Figure A.58). There is a freshwater stream running through the centre of the site. The site is a large village site and was first recorded by Acheson and Riley in 1977. At the lower end of the intertidal zone in front of EaSd-1 numerous wooden stakes are clustered around the mouth of the stream (Figure A.59 and 60). The stakes are embedded in a muddy/sandy/stony matrix, which is probably subject to constant erosion and deposition activity based on tidal movements and stream activity. Therefore it is likely that more stakes are preserved underneath the mud, and that subsequent visits will reveal different configurations of stakes. EaSd-1 was visited on May 28, 2009, when the wooden stakes were first identified. The site was revisited to record the wooden stakes on July 24, 2009 (Figure A.61). During the second visit, the top of one stake was sawn off by hand using a collapsible handsaw and submitted for a radiocarbon date. The returned age is 510-310 Cal. B.P. (Beta-263326).

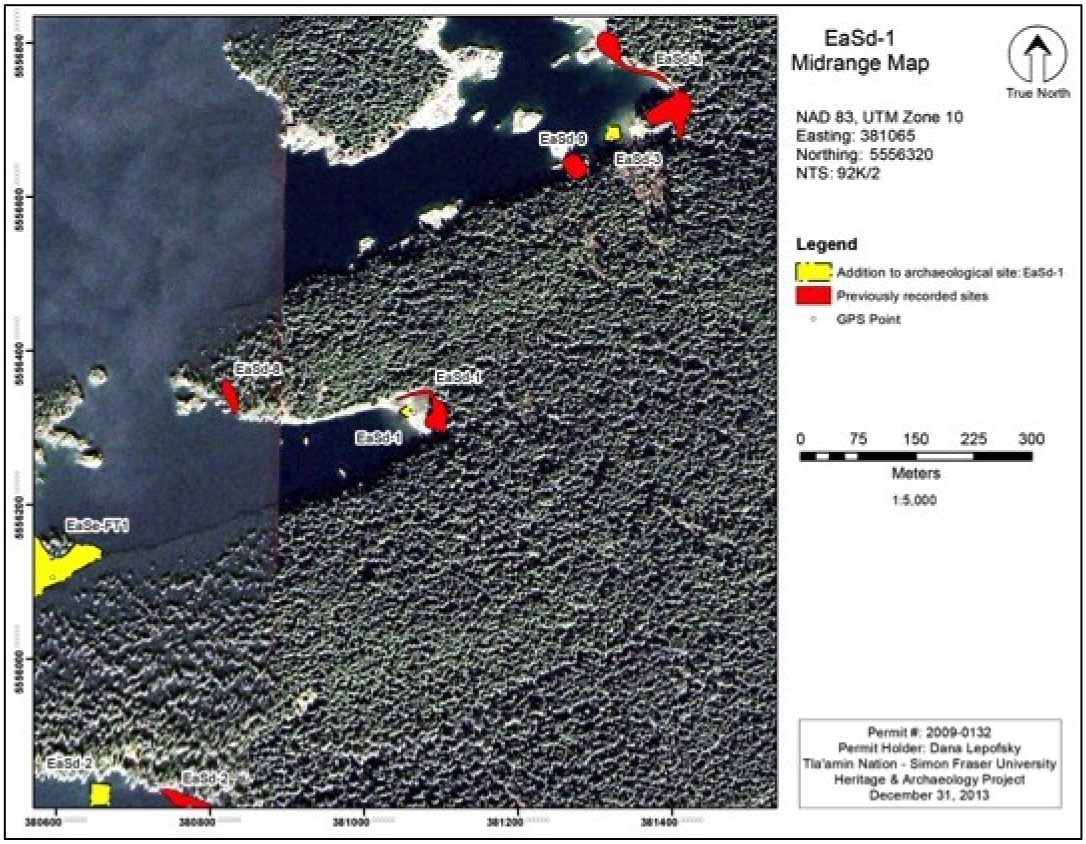

Figure A.58. *Midrange map showing the location of EaSd-1.*

Figure A.59. *Aerial photograph showing the intertidal zone at EaSd-1. (G. Combes photograph)*

Figure A.60. *Wooden stakes at EaSd-1.*

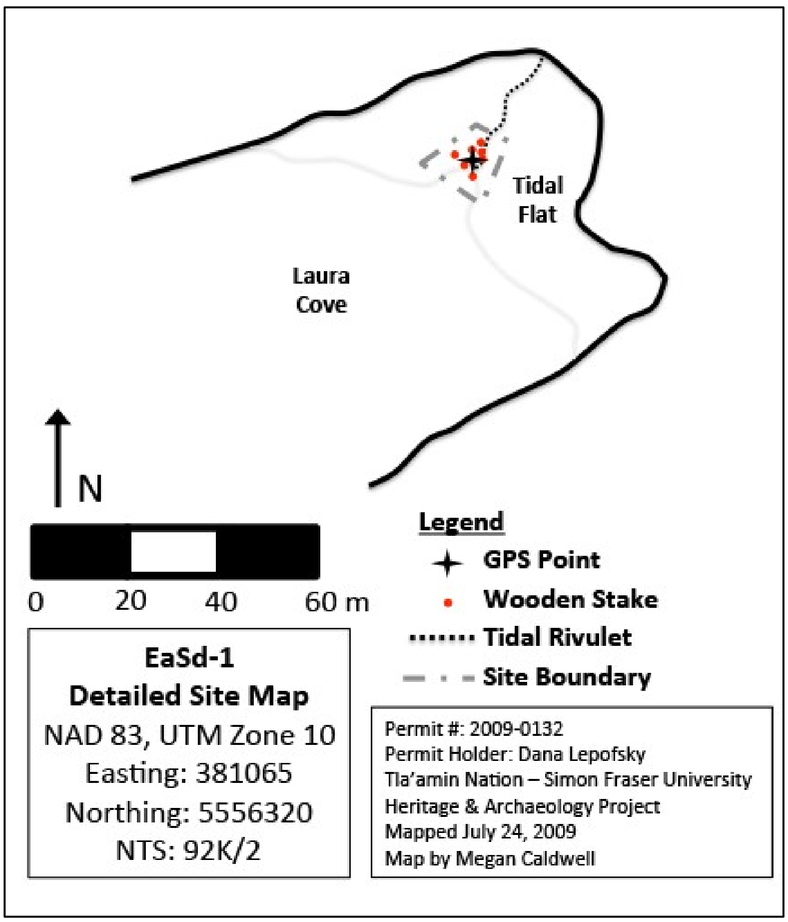

Figure A.61. *Detailed site map of the intertidal subsistence feature at EaSd-1.*

E.3.13 - *EaSd-2*

EaSd-2 is located at the head of Melanie Cove, in Prideaux Haven (Figure A.62). There is a freshwater stream running through the centre of the site. The site is a large village site and was first recorded by Mitchell in 1968. At the lower end of the intertidal zone in front of EaSd-2 numerous wooden stakes are clustered around the mouth of the stream (Figure A.63 and 64). The stakes are embedded in a muddy matrix, which is probably subject to constant erosion and deposition activity based on tidal movements and stream activity. Therefore it is likely that more stakes are preserved underneath the mud, and that subsequent visits will reveal different configurations of stakes. EaSd-2 was visited on June 22, 2009, when the wooden stakes were first identified. The site was revisited to record the wooden stakes on July 24, 2009 (Figure A.65). During the second visit, the top of one stake was sawn off by hand using a collapsible handsaw and submitted for a radiocarbon date. The returned age is 540-430 and 370-320 Cal. B.P. (Beta-253327).

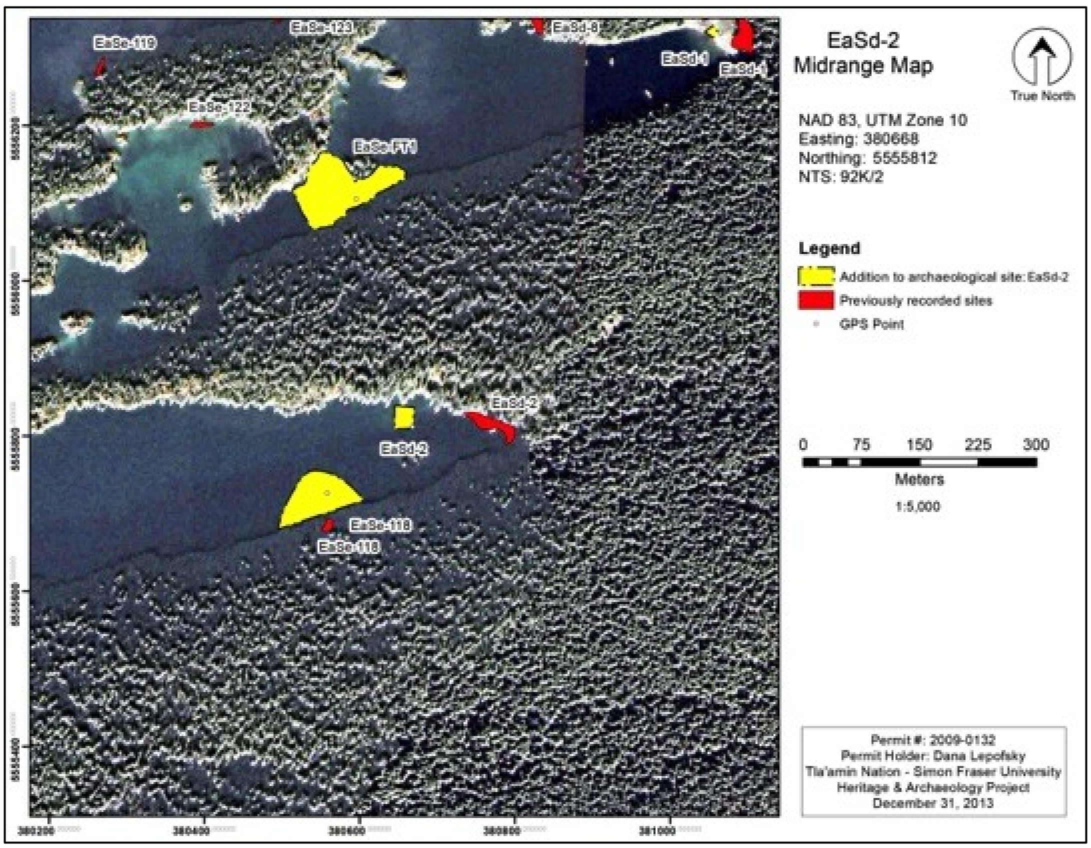

Figure A.62. *Midrange map showing the location of EaSd-2.*

Figure A.63. *Aerial photograph showing the intertidal zone at EaSd-2. (G. Combes photograph)*

Figure A.64. *Wooden stakes at EaSd-2.*

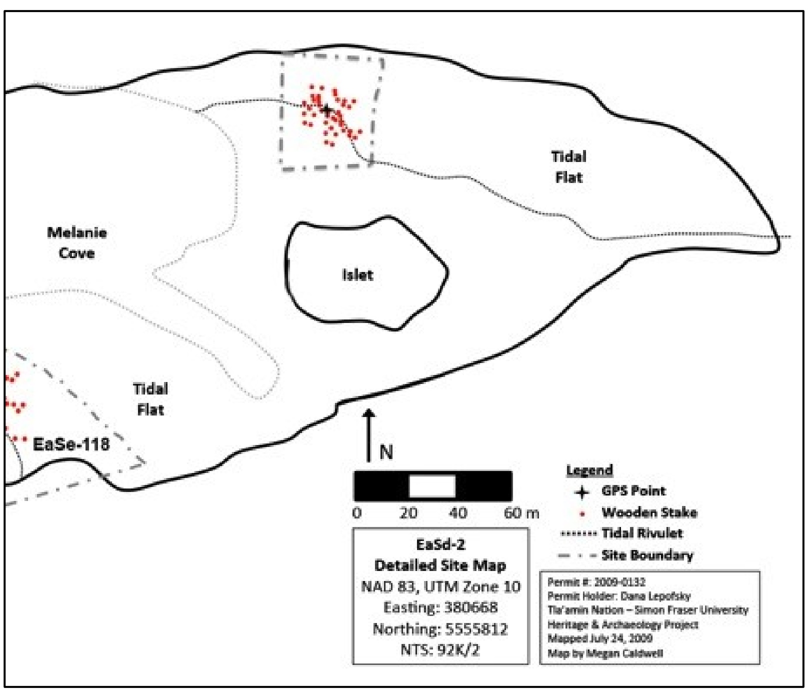

Figure A.65. *Detailed site map of the intertidal subsistence feature at EaSd-2.*

E.3.14 - *EaSd-3*

EaSd-3 is located in Roffey Cove, in Prideaux Haven (Figure A.66). There is a freshwater stream running through the southern portion of the site. The site is a large village site and was first recorded by Storie in 1966. At the lower end of the intertidal zone in front of EaSd-3 numerous wooden stakes are clustered around the mouth of the stream (Figure A.67). The stakes are embedded in a muddy/stony matrix, which is probably subject to constant erosion and deposition activity based on tidal movements and stream activity. Therefore it is likely that more stakes are preserved underneath the mud, and that subsequent visits will reveal different configurations of stakes. EaSd-3 was visited on June 22, 2009, when the wooden stakes were first identified. The site was revisited to record the wooden stakes on July 24, 2009 (Figure A.68). During the second visit, the top of one stake was sawn off by hand using a collapsible handsaw and submitted for a radiocarbon date. The returned age is: 490-290 Cal. B.P. (Beta-263325).

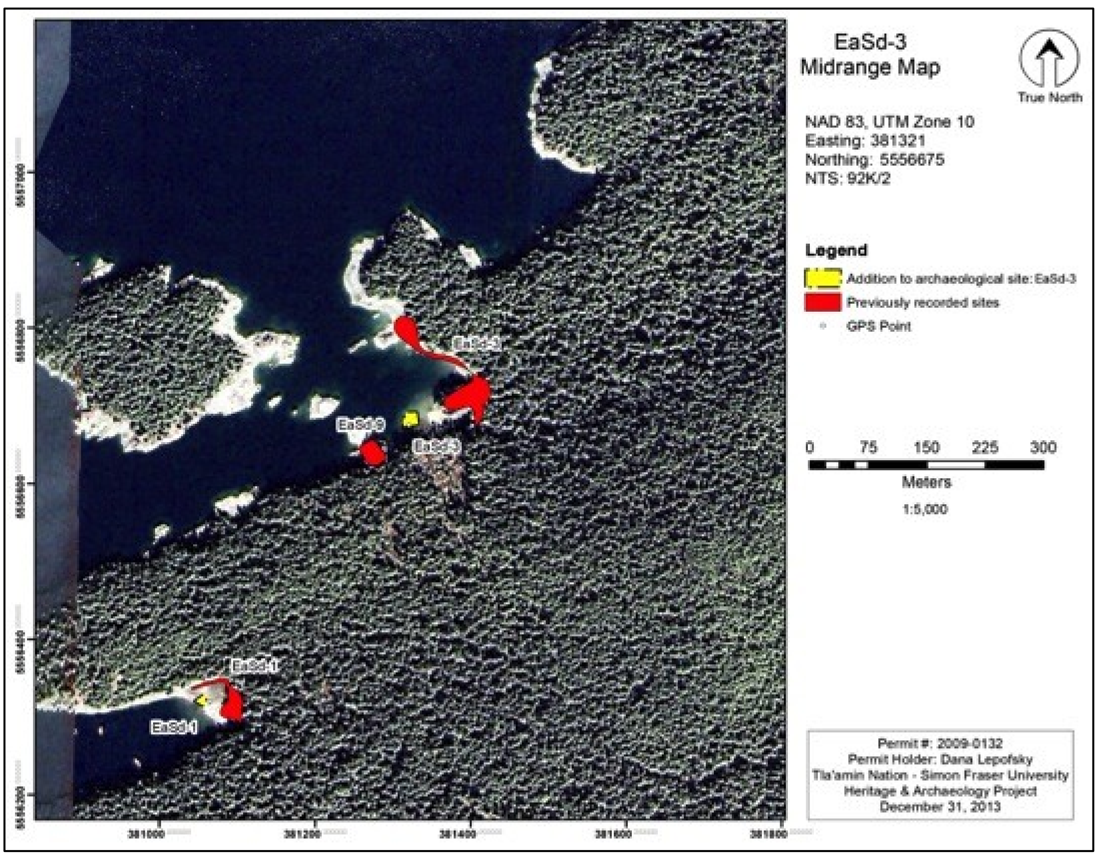

***Figure A.66**. Midrange map showing the location of EaSd-3.*

Figure A.67. *Wooden stakes at EaSd-3.*

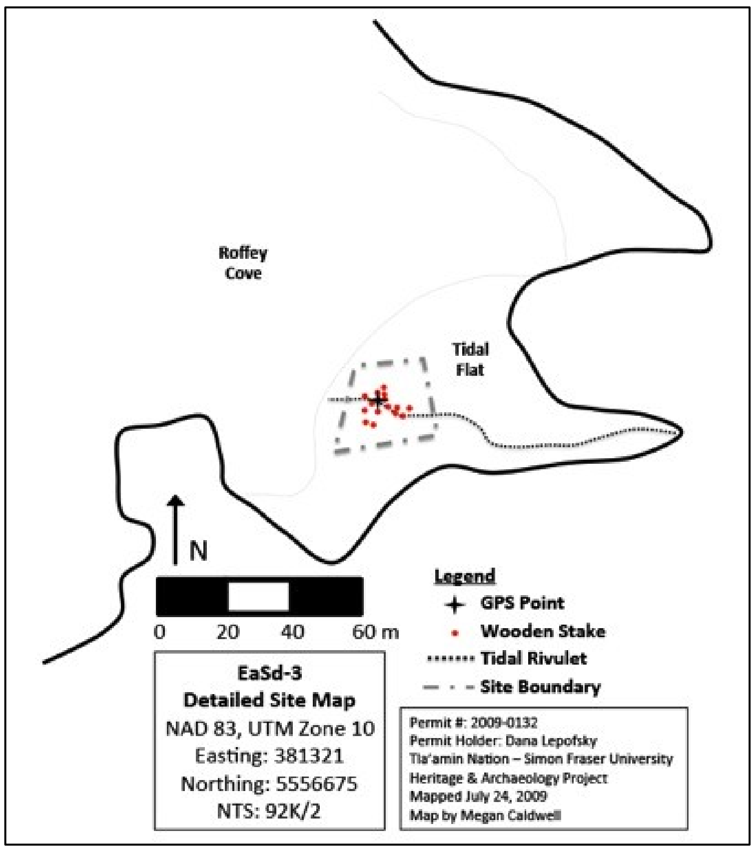

Figure A.68. *Detailed site map of intertidal subsistence feature at EaSd-3.*

E.3.15 - *EaSe-34*

EaSe-34 is a small shell midden site on the northern edge of Isabel Bay in Lancelot Inlet (Figure A.69). The site was originally recorded by Acheson and Riley in 1976. In the intertidal zone adjacent to the shell midden, in a passage between the site and a small islet, is a V element intertidal feature (Figure A.70). The feature was identified through survey of the intertidal zone by boat in July 2008, and recorded on June 13, 2011.

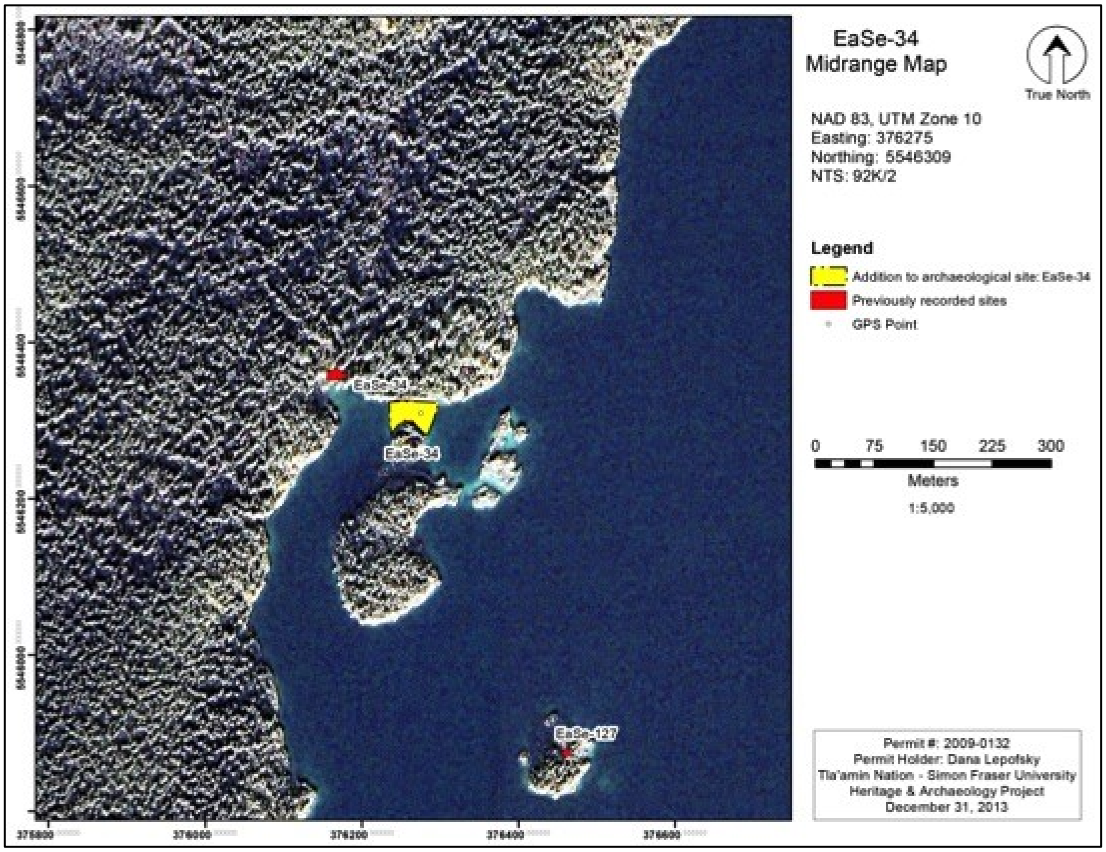

Figure A.69. *Midrange map showing the location of EaSe-34.*

Figure A.70. *V element intertidal subsistence feature at EaSe-34.*

The feature consists of two convergent stone walls, shaped like a V. The walls meet at the apex, pointing east. The stone walls are one to two courses, or 15-20 cm in height, and 0.5 – 0.75 m in width (Figure A.71). The apex of the stone walls sits lower, at 5-10 cm in height, and could have been blocked with a small boulder or basket trap to retain fish with the outgoing tide. The walls sit on a muddy substrate containing rocks up to 15 cm in diameter.

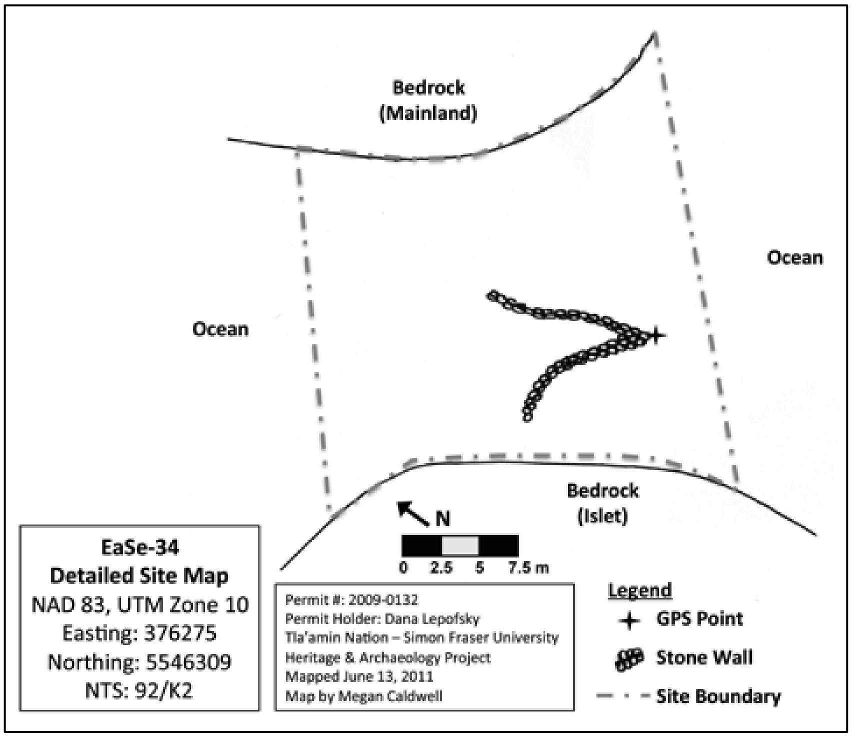

Figure A.71. *Detailed site map of intertidal subsistence feature at EaSe-34.*

E.3.16 - *EaSe-51*

EaSe-51 is located along the northern side of Theodosia Inlet, about halfway down the inlet (Figure A.73). It is a shell midden site first recorded by Acheson and Riley in 1976. In the intertidal in front of the site is a large intertidal feature, which was identified through aerial photography (Figure A.72), and visited June 25, 2010.

Figure A.72. *Aerial photograph of intertidal subsistence feature at EaSe-51. (G. Combes photograph)*

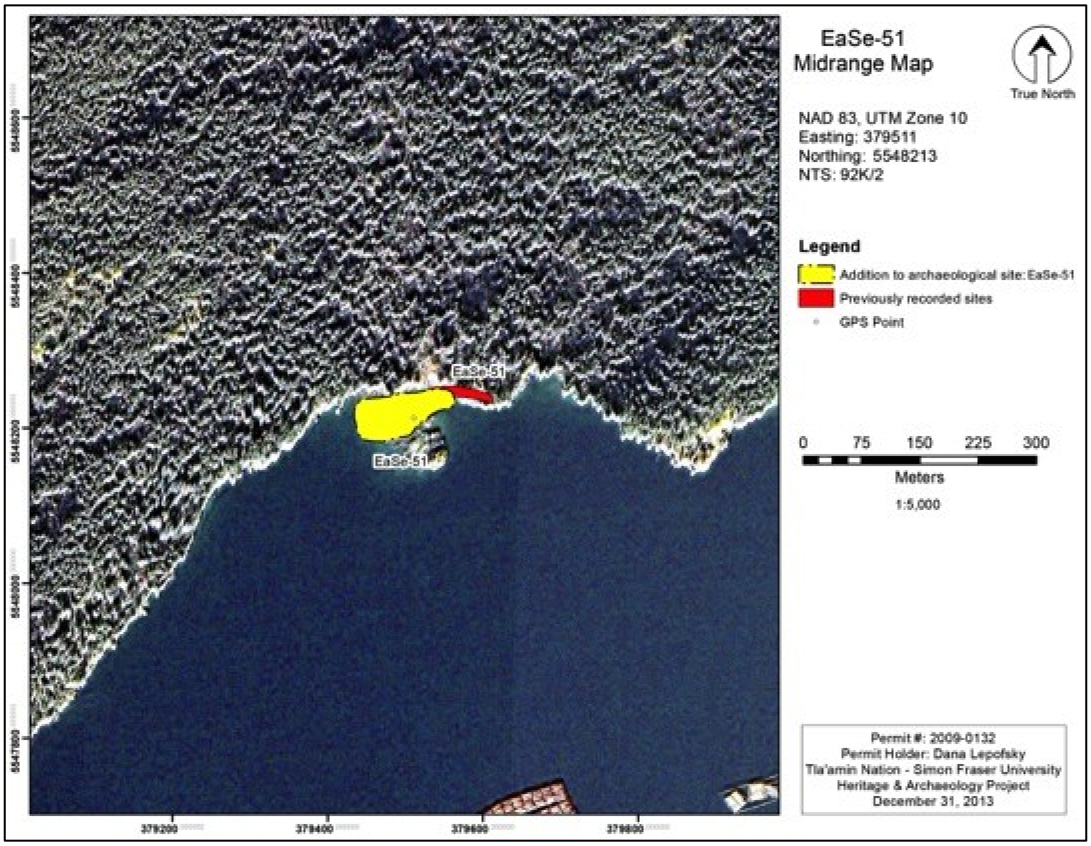

Figure A.73. *Midrange map showing the location of EaSe-51.*

The feature makes use of the natural bedrock outcrop to move fish through a drainage that has been blocked by a series of stone walls, presumably to retain the fish. In addition, there is a cleared beach area, constrained by both bedrock and stone walls (Figure A.74). The feature measures 120 m by 40 m in size. At the eastern end of the feature is a tall, 1 m high wall made up of boulders >50 cm in diameter, that appears to have been created from clearing the adjacent beach during logging activities in the past. The wall does not appear to be part of the feature, and its construction is quite different.

Figure A.74. *Stone walls and cleared beach at EaSe-51.*

The stone walls of the feature are between 3-5 m in width, and stand 2-4 courses, or 25-75 cm high. Through the drainage, the walls are lower in the middle, and could have been blocked with small boulders or basket traps to retain fish as the tide flows out. The cleared beach consists of very muddy sand matrix, and is blocked at what would have been an open end by a crescent shaped wall. This wall would have served to move fish back towards the drainage feature as the tide receded, to an area in which they would be more easily trapped. Beyond the crescent wall to the west is an area of possible disturbed stone walls, of which no shape could be discerned (Figure A.75).

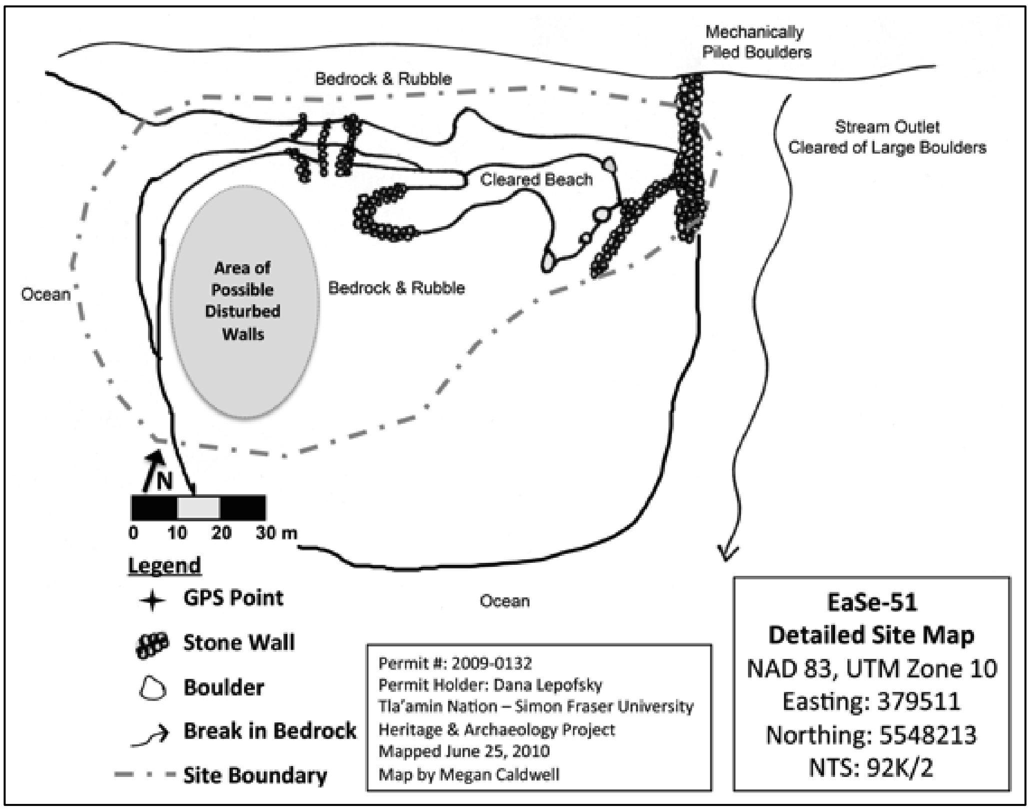

Figure A.75. *Detailed site map of intertidal subsistence feature at EaSe-51.*

E.3.17 - *EaSe-71*

EaSe-71 is located to the northwest of Hare Point in Malaspina Inlet (Figure A.76). It is a small shell midden site first recorded by Acheson and Riley in 1976. Within the intertidal zone immediate in front of the shell midden is a large intertidal feature consisting of both a cleared beach and a fish trap. Additionally there are two canoe skids in the intertidal zone. The feature was identified through aerial photography (Figure A.77), and visited June 22, 2010.

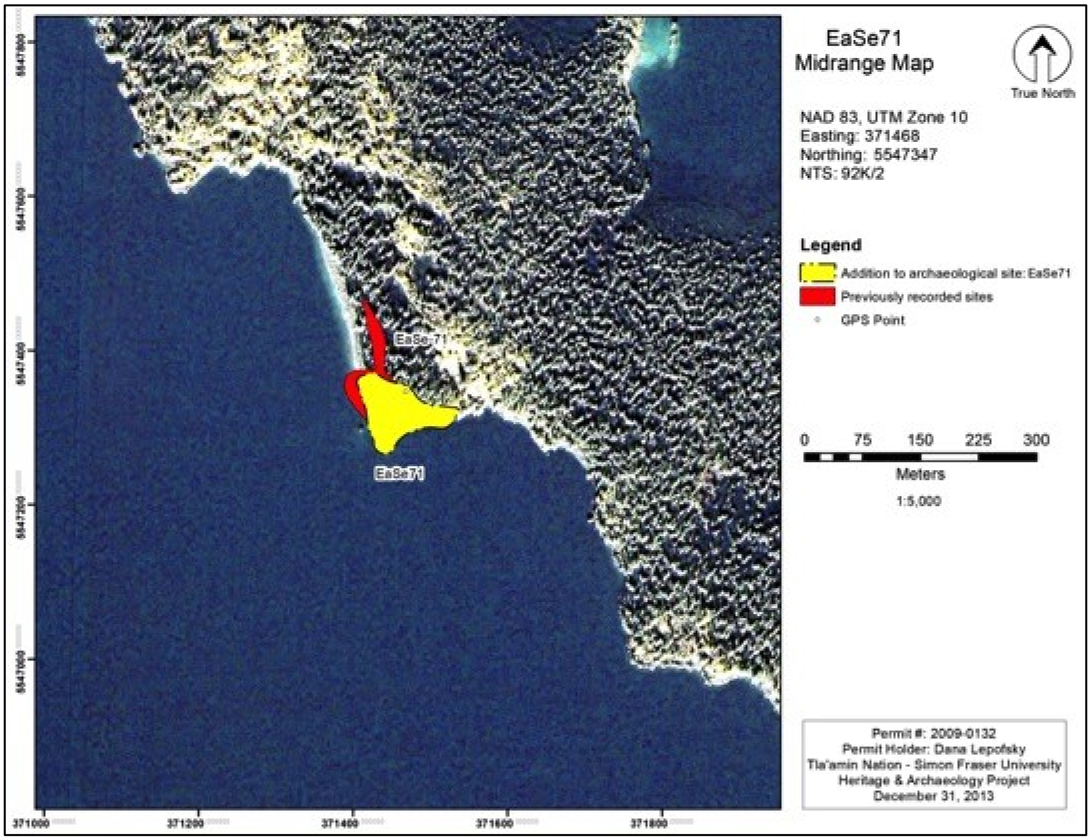

Figure A.76. *Midrange map showing the location of EaSe-71.*

Figure A.77. *Aerial photograph of intertidal subsistence feature at EaSe-71. (G. Combes photograph)*

The cleared beach element is 60 m by 30 m in size. All cobbles and small boulders larger than 10 cm in diameter have been removed from the beach and piled at the ocean edge (Figure A.78). The substrate of the cleared beach is sandy, with pebbles and small cobbles up to 10 cm in diameter. The cleared beach is drained of all water during most low tides. The piled up cobbles and boulders create a wall at the ocean edge, within which a clear path, or canoe skid, is constructed. On the landward side of the cleared beach, in line with the canoe skid in the ocean wall, is a second canoe skid, leading into the tree line (Figure A.78).


Figure A.78. *Cleared beach and canoe skid at EaSe-71.*

In addition to the cleared beach and canoe skids, there is also a small fish trap located between two bedrock outcrops. The fish trap consists of a small circular crescent element 7 m in diameter, which is exposed only during the lowest tides (Figure A.79). The walls are 20-30 cm in width and only one course, or 10-15 cm, in height. The trap sits on a substrate of muddy sand, with small cobbles up to 20 cm in diameter in the vicinity of the trap (Figure A.80).


Figure A.79. *Crescent shaped fish trap at EaSe-71.*

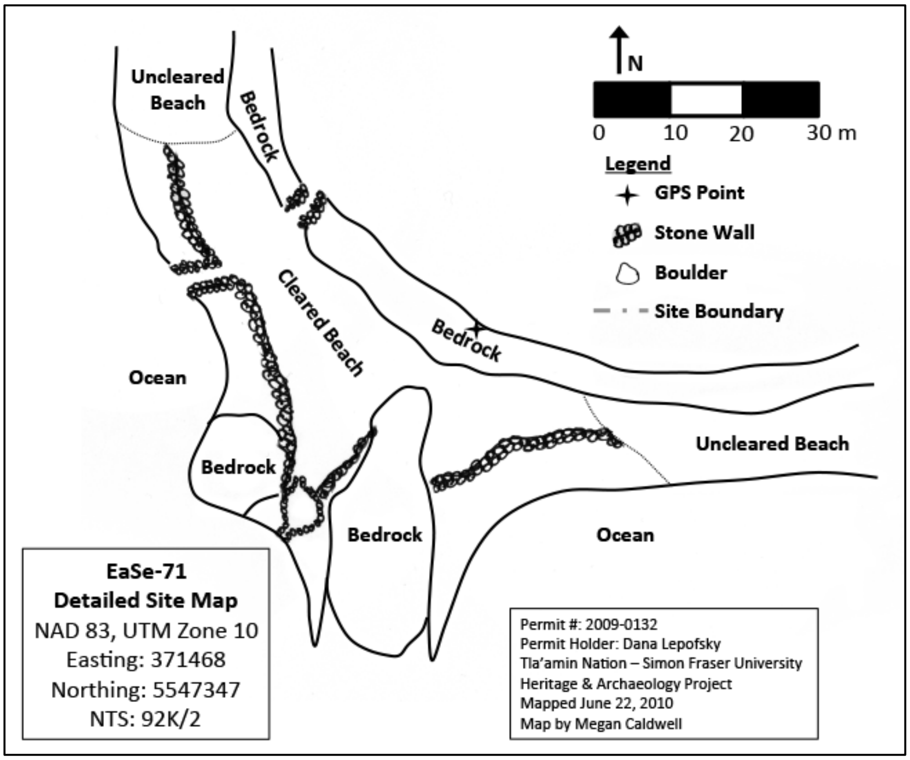

Figure A.80. *Detailed site map of the intertidal subsistence feature at EaSe-71.*

E.3.18 - *EaSe-74*

EaSe-74 is located on a small islet in Malaspina Inlet, just southwest of Hare Point (Figure A.81). It is a small shell midden site first recorded by Acheson and Riley in 1976. Within the intertidal zone immediately in front of the midden is a small intertidal feature, consisting of a cleared beach and a stone wall hook element. The site was visited on foot and recorded June 15, 2011. The site measures 70 m by 50 m in size.

At the southern end of the feature is the small hook element, which is open to the eastern side, and would catch fish as they are pushed through when the tide recedes. The stone walls are 1.5 – 3 m in width, and only one or two courses, or 15-20 cm in height. The cleared beach is to the northern end of the feature and is open to the east to the ocean. The site makes use of the natural bedrock formation, and has a muddy sand matrix with cobbles up to 15 cm in size. All larger boulders have been moved out of the area (Figures 82 and 83).

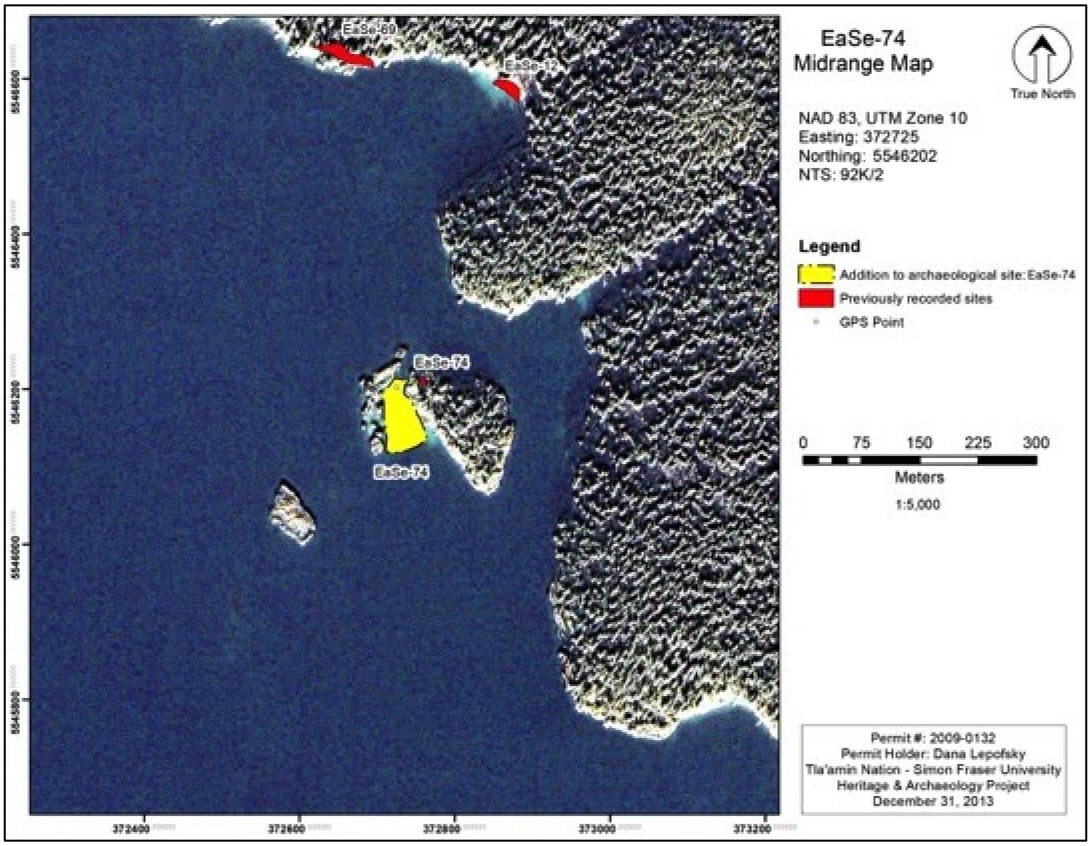

Figure A.81. *Midrange map showing the location of EaSe-74.*


Figure A.82. *Hook element and cleared beach at EaSe-74.*

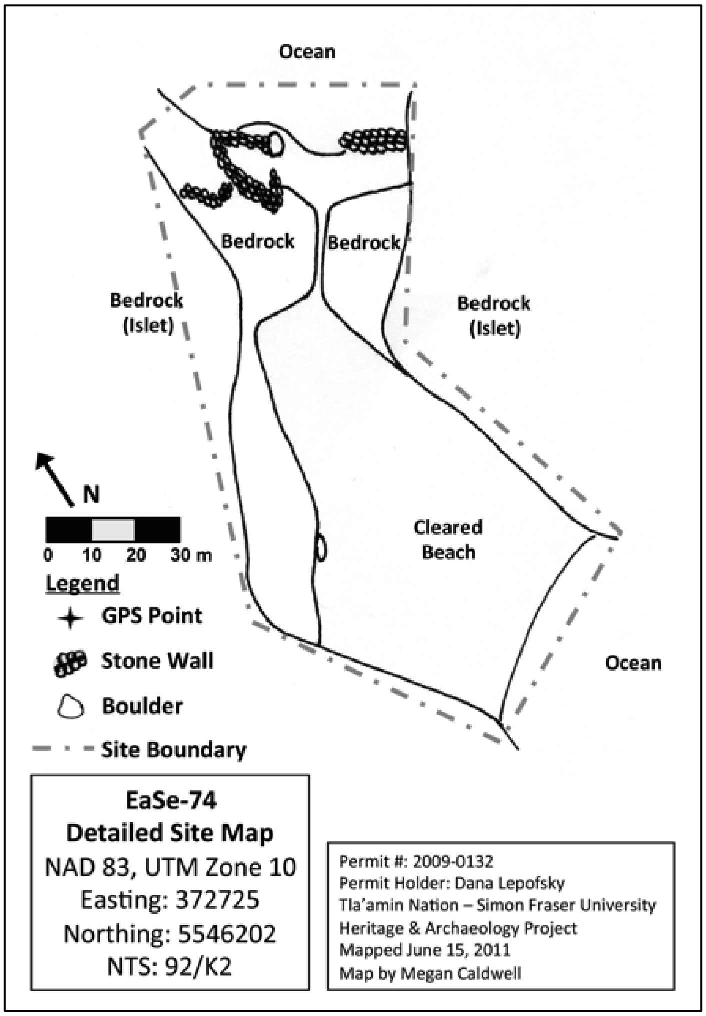

Figure A.83. *Detailed site map of EaSe-74.*

E.3.19 - *EaSe-86*

EaSe-86 is a small shell midden site on the northern tip of the westernmost island in the Copleands archipelago (Figure A.84). The site was first recorded by Acheson and Riley in 1976, and has not subsequently been visited. Our team identified a large intertidal feature adjacent to the site, identified from the aerial surveys, and recorded on June 16, 2011.

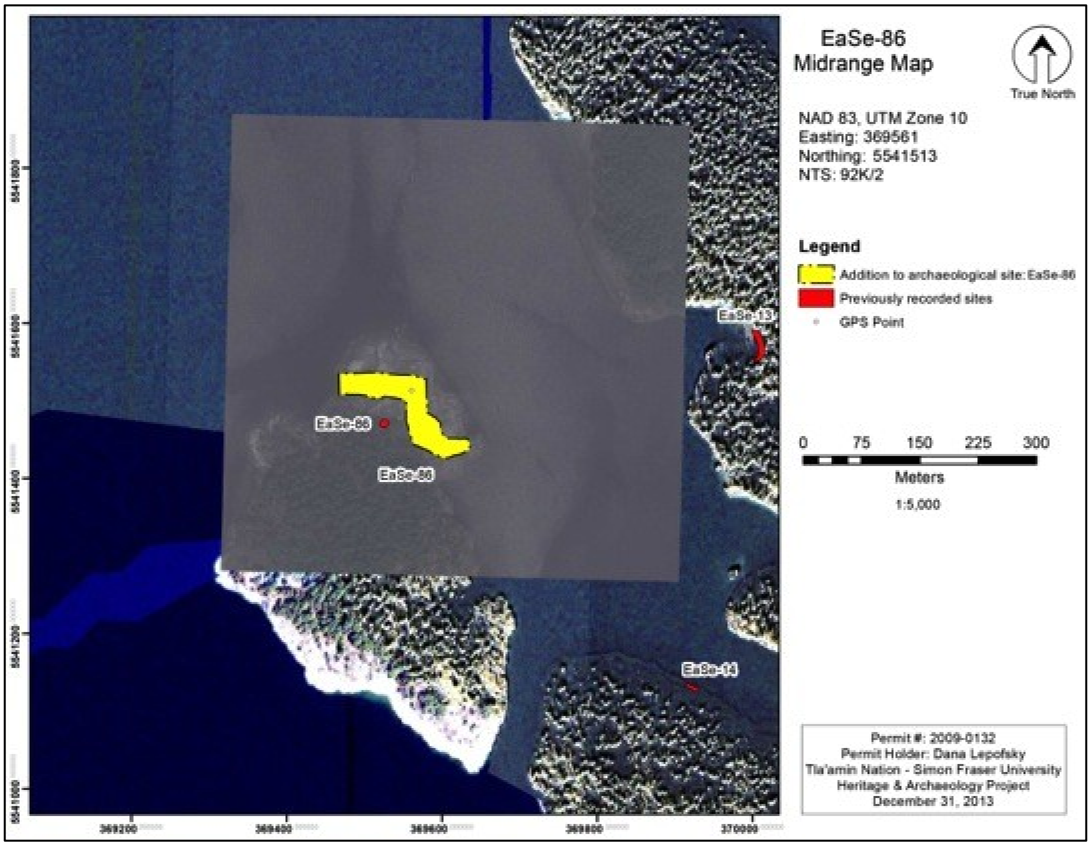

Figure A.84. *Midrange map showing the location of EaSe-86.*

The feature utilizes the entire adjacent bedrock outcrop, through which water flows with the in-coming and out-going tides. The feature consists of stone walls built up to retain fish in three areas, as well as a large cleared beach that retains water at the lowest of tides in a pool in its centre. All together, the feature is 115 m by 150 m in size. The stone wall at the northeastern corner of the feature is 5 m in width, and 1.5 m high. It appears to have been constructed to completely block movement through a small pass in the bedrock in this area. Two other stone walls sit to the north and west of the cleared beach feature. These walls are smaller, only two to three courses high (15-25 cm), and 2 m in width. Their function appears to be to hold water in the cleared beach pool, as they are situated along its edges, where the water might otherwise flow out (Figure A.85).

Figure A.85*. Stone wall and cleared beach feature at EaSe-86.*

Finally, at the northwestern opening of the feature, there is a large pile of small boulders and cobbles, 25 m by 55 m in size. Although the original piling of these boulders and cobbles appears to be natural, the pile has been added to through the clearing of the beach on either side (Figure A.86). In addition to the cleared beaches around the pile, the pile would serve to restrict movement of fish out through this opening, redirecting them towards the cleared beach and pool, where they might be retained as the tide flows out of the feature (Figure A.87).

Figure A.86*. Natural boulder pile with cleared beach at EaSe-86.*

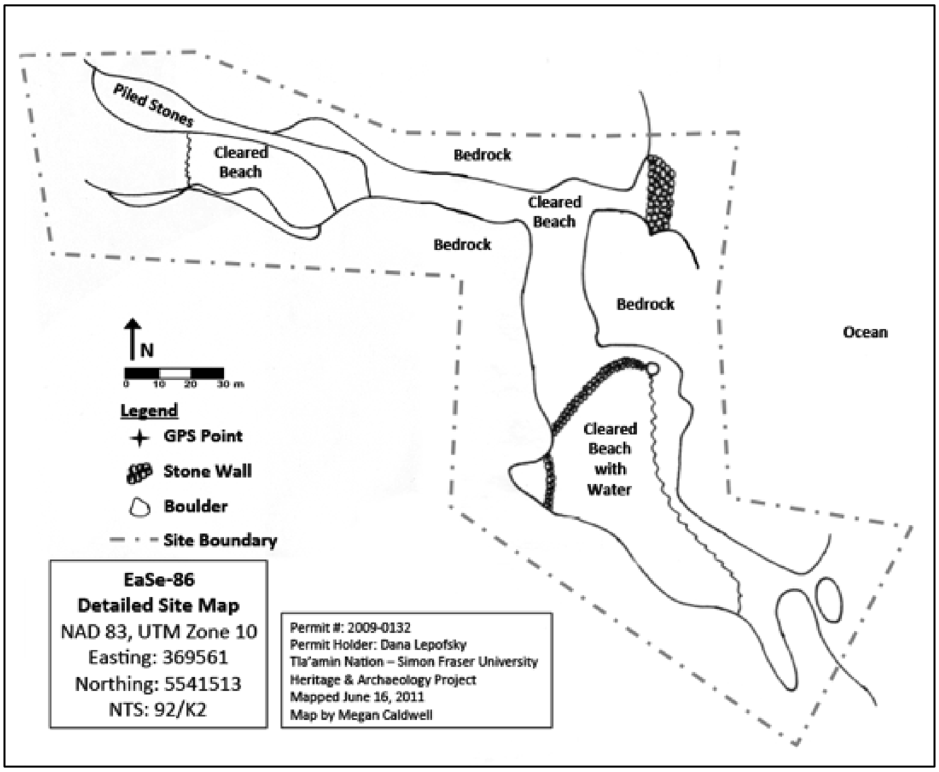

Figure A.87. *Detailed site map of EaSe-86.*

E.3.20 - *EaSe-118*

EaSe-118 is located on the southern edge of Melanie Cove, in Prideaux Haven (Figure A.88). There is a small freshwater stream running through the centre of the site. The site was recorded by Acheson and Riley (1977) in 1977 as the location of a small shell midden deposit. In the intertidal zone, directly in front of EaSe-118, are a number of wooden stakes (Figure A.89). The stakes are embedded in a muddy matrix, which is probably subject to constant erosion and deposition activity based on tidal movements and stream activity. Therefore it is likely that more stakes are preserved underneath the mud, and that subsequent visits will reveal different configurations of stakes.

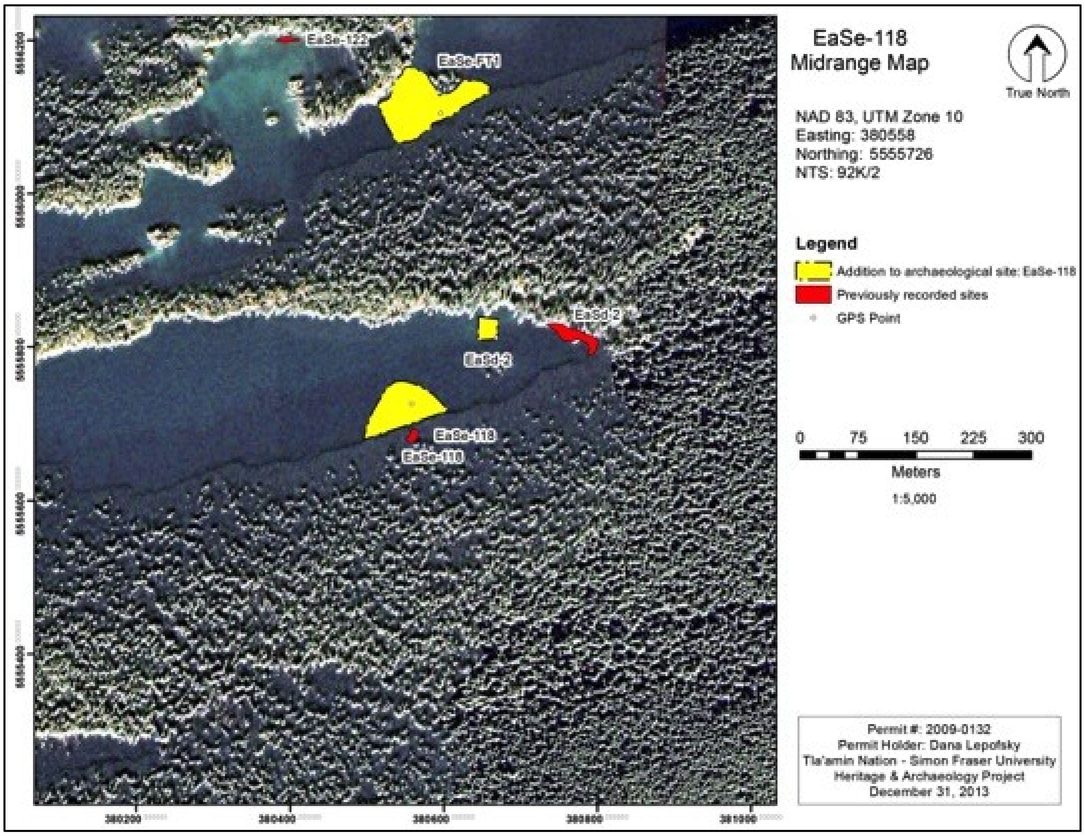

Figure A.88. *Midrange map showing the location of EaSe-118.*

Figure A.89. *Aerial photograph showing the intertidal zone at EaSe-118. (G. Combes photograph)*

EaSe-118 was visited on June 22, 2009, when the wooden stakes were first identified (Figure A.90). The site was revisited to record the wooden stakes on July 24, 2009 (Figure A.91). During the second visit, the top of one stake was sawn off by hand using a collapsible handsaw and submitted for a radiocarbon date. The returned age is 650-580 and 570-510 Cal. B.P. (Beta-263328).

Figure A.90. *Wooden stakes at EaSe-118.*

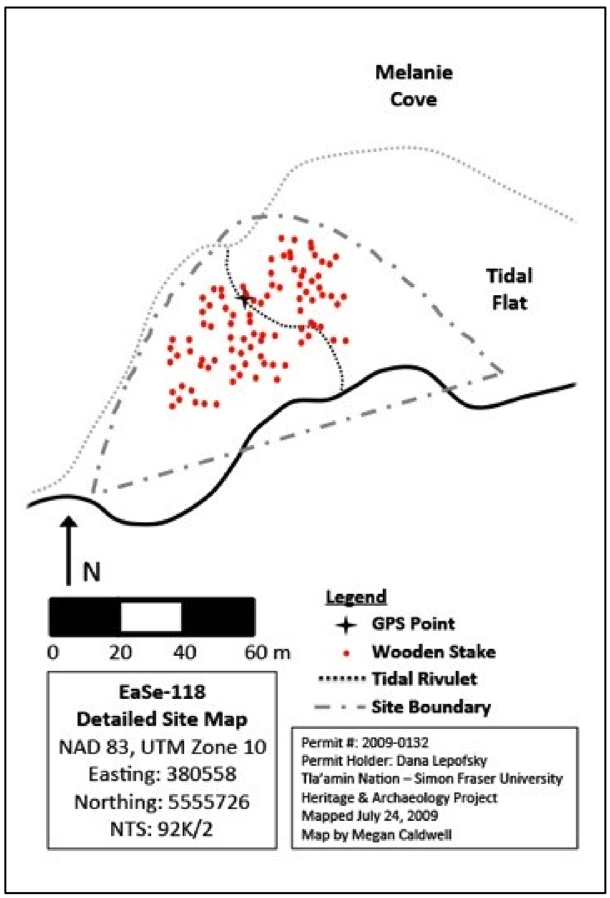

Figure A.91. *Detailed site map of EaSe-118.*

E.3.21 - *EaSe-136*

EaSe-136 is a large intertidal feature located between Copplestone Island and Melanie Point in Prideaux Haven (Figure A.92). The site was identified through aerial photography (Figure A.93), and was visited June 02, 2011. The feature consists of a large expanse of cleared beach, a heart element, and two lead lines. In total, the feature measures 120 m by 75 m in size.

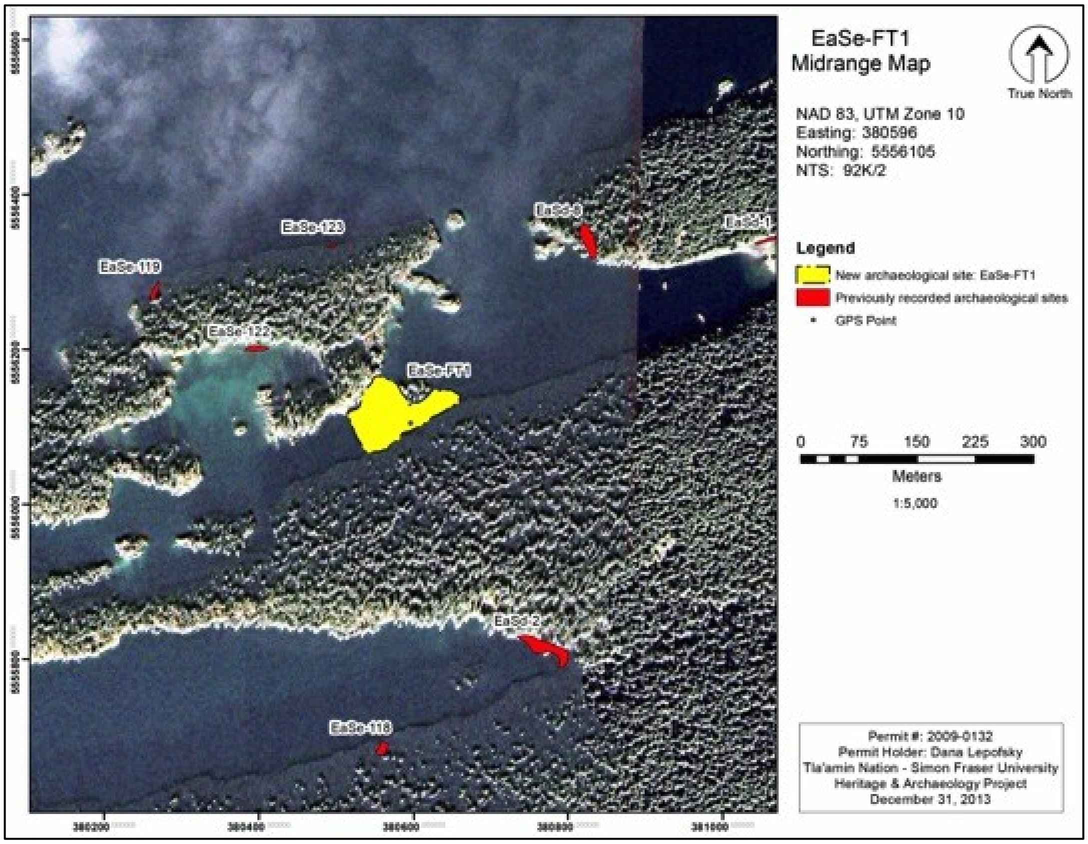

Figure A.92. *Midrange map showing the location of EaSe-136 (This map was created before the Borden Code was assigned and shows its temporary site designation).*

Figure A.93. *Aerial photograph of intertidal subsistence feature at EaSe-136. (G. Combes photograph)*

The cleared beach sits between an islet and Melanie Point, and is exposed completely on most tidal cycles. The matrix in the cleared area is a sandy mud. There is a series of large erractics in the area of the cleared beach, and the area around these has not been as well cleared. The lead lines come off the cleared beach, pointing west, and would serve to guide fish into the heart element as the tide recedes (Figure A.94). The heart element is located at the western edge of the feature, and consists of walls 2 m in width, and two to three courses high, or 25-35 cm. Directly behind the heart element is an area of cobble and small boulder rubble, which may have been additional lead lines that have subsequently been disturbed possibly through tidal action. The water runs quite quickly through this area, and it is completely dry only on the lowest of tides (Figure A.95).

Figure A.94. *Stone wall elements of intertidal feature at EaSe-136.*

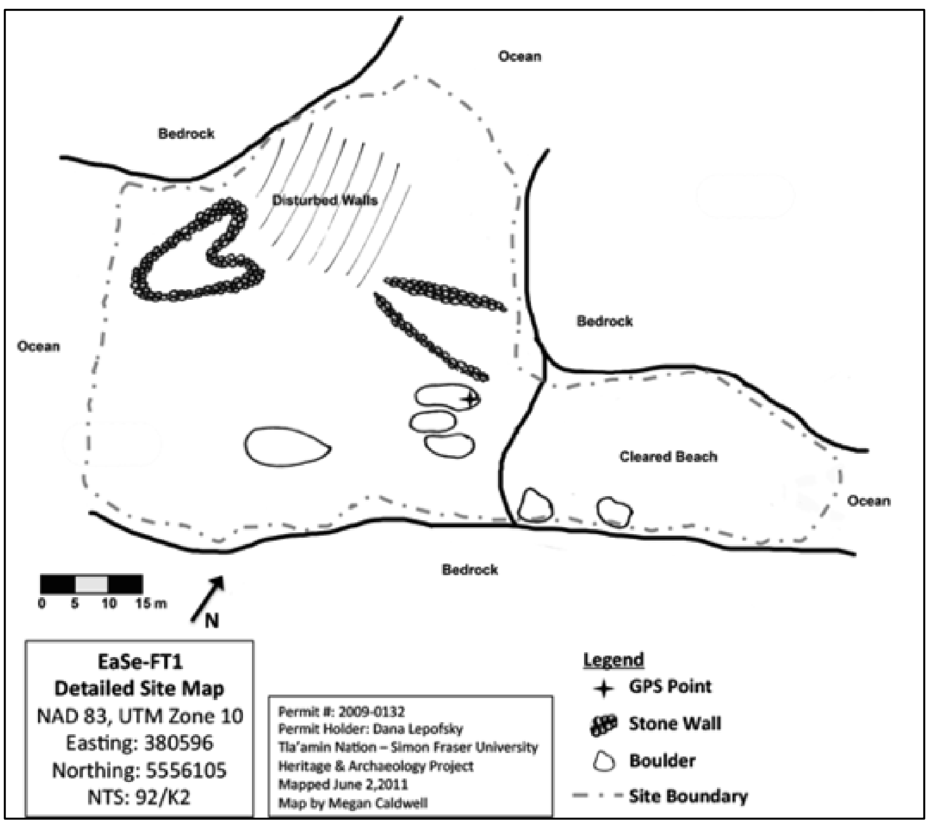

Figure A.95. *Detailed site map of EaSe-136 (This map was created before the Borden Code was assigned and shows its temporary site designation).*

E.3.22 - *EaSe-137*

EaSe-137 site is located in a small bay, located at the northeastern end of Wootton Bay (Figures 96 and 97). There is a small freshwater stream that runs roughly down the centre of the bay. Numerous wooden stakes were found at the lowest end of the intertidal zone, clustered around the stream mouth along with piles of cobbles up to 20 cm in diameter (Figure A.98 and 99). The stakes are located within a muddy/sandy matrix, which is probably subject to constant erosion and deposition activity based on tidal movements and stream activity. Therefore it is likely that more stakes are preserved underneath the mud, and that subsequent visits will reveal different configurations of stakes. The top of one stake was sawn off by hand using a collapsible handsaw and submitted for a radiocarbon date. The returned age is 500-310 Cal. B.P. (Beta-263329).

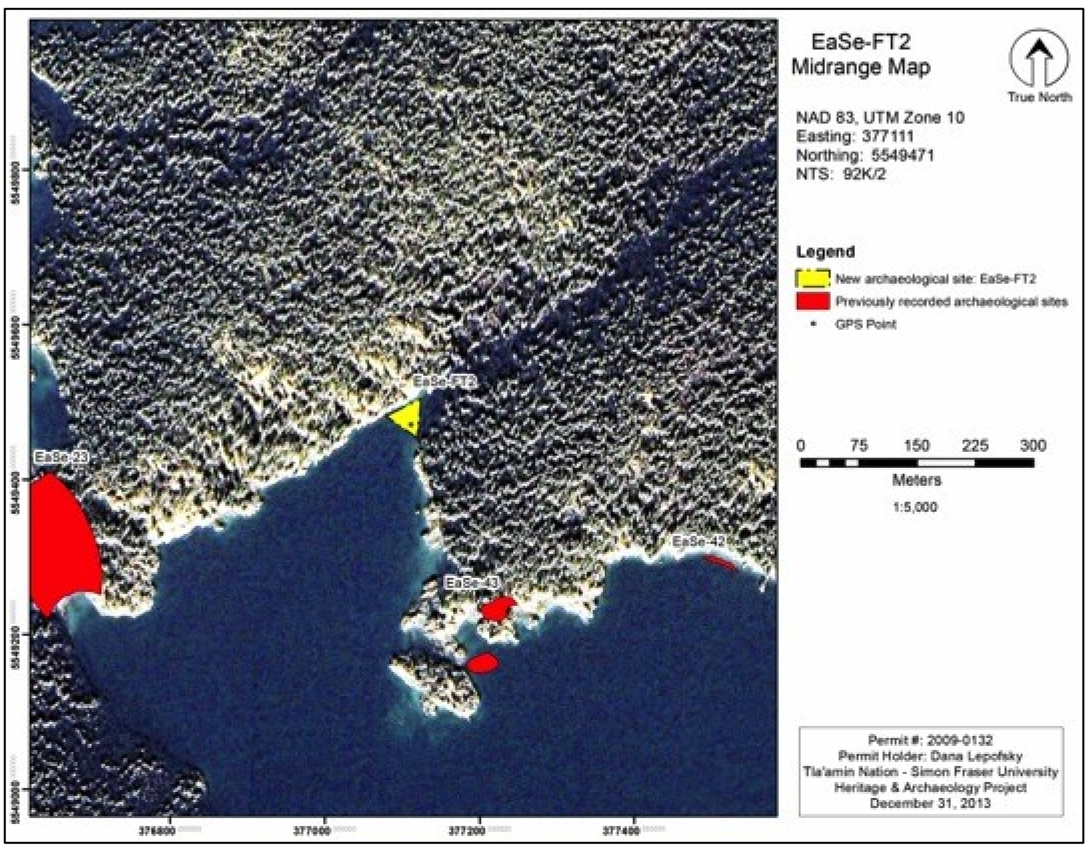

***Figure A.96**. Midrange map showing the location of EaSe-137 (This map was created before the Borden Code was assigned and shows its temporary site designation).*

Figure A.97. *Aerial photograph of the intertidal zone at EaSe-137. (G. Combes photograph)*

Figure A.98. *Wooden stakes at EaSe-137.*

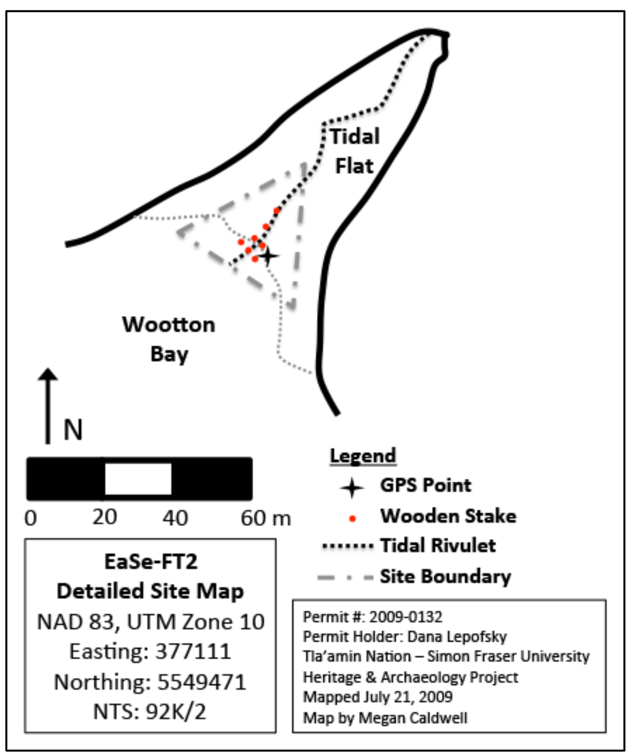

Figure A.99. *Detailed site map of EaSe-137 (This map was created before the Borden Code was assigned and shows its temporary site designation).*

E.3.23 - *EaSe-138*

EaSe-138 is a small shell midden site at the northern end of Coode Island (Figure A.100). It was first recorded by Acheson and Riley in 1976. In the intertidal zone adjacent to the shell midden, in a passage between the peninsula and a small islet, is an intertidal feature. The feature was identified through survey of the intertidal zone by boat, and recorded on June 13, 2011.

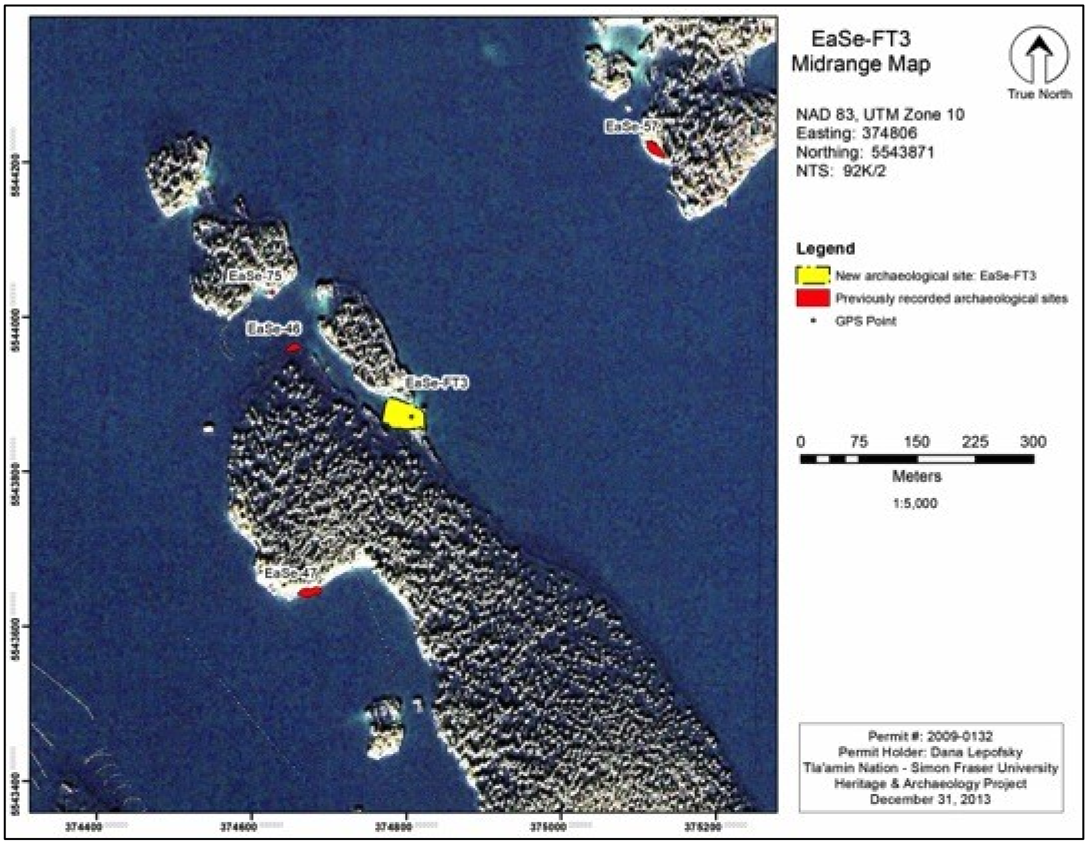

Figure A.100. *Midrange map showing the location of EaSe-138 (This map was created before the Borden Code was assigned and shows its temporary site designation).*

The feature consists of two sets of stone walls, set within a bedrock depression, that appear to have served to guide fish, possibly into basket traps, when the tide was moving through the passage. Around the feature is a muddy sand substrate, and the eastern end of the passage has water standing approximately 20 cm deep even at low tide (Figure A.101). The stone walls are 1-2 m in width, and one to two courses, or 30 cm, in height. Two sandy areas, exposed at low tide, may be cleared beaches, but as the entire passage has a sandy substrate it is not clear if these areas were ever covered with cobbles (Figure A.102).

Figure A.101. *Stone walls and standing water at EaSe-138.*

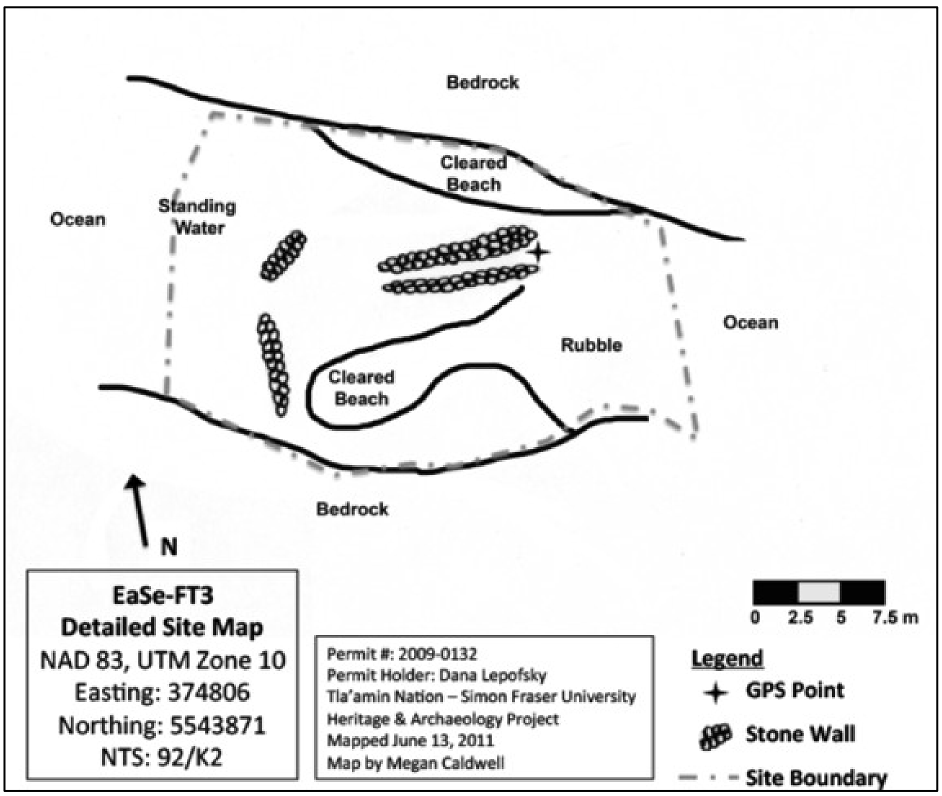

Figure A.102. *Detailed site map of EaSe-138 (This map was created before the Borden Code was assigned and shows its temporary site designation).*

E.3.24 - *EaSf-43*

EaSf-43 is an intertidal site, located on the northeasternmost Powell Islet, the smallest of the islets (Figure A.103). The site was identified when surveying the foreshore by boat and was recorded June 16, 2011. The feature consists of two cleared beaches within bedrock depressions, with built up walls at their outlets. The feature is 25 m by 95 m in size, and is intersected by a beach that is naturally free of cobbles. The larger cleared beach points northwest, and is 45 m by 20 m in size. It holds water to a depth of 20 cm at the lowest tide, and has stone walls measuring 1-3 m in width at its opening. These walls create a small opening, which could be blocked by a small boulder or basket trap to retain fish with a receding tide (Figure A.104).

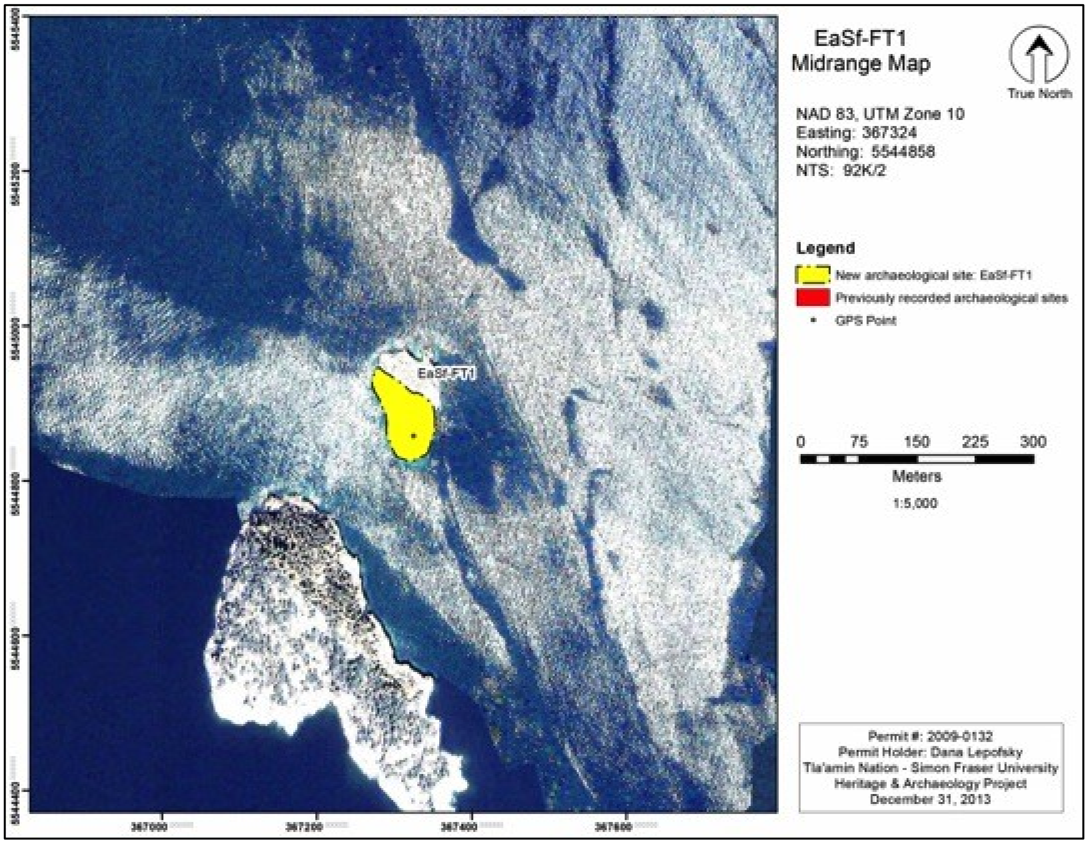

Figure A.103. *Midrange map showing the location of EaSf-43 (This map was created before the Borden Code was assigned and shows its temporary site designation).*

Figure A.104. *Larger cleared beach with close-up of walls at the opening at EaSf-43.*

The smaller depression measures 20 m by 15 m in size. At a juncture in the middle, 1 m wide stone walls are built up, restricting the flow of water. At the opening of the depression to the ocean, which faces east, additional walls are built up, about 1.5 m in width, a structure which again restrict the movement of water, and thus fish, through them (Figure A.105). The opening could be blocked with a small boulder or basket trap to retain fish during the outgoing tide (Figure A.106).

***Figure A.105**. Smaller cleared beach walls built up at opening at EaSf-43.*

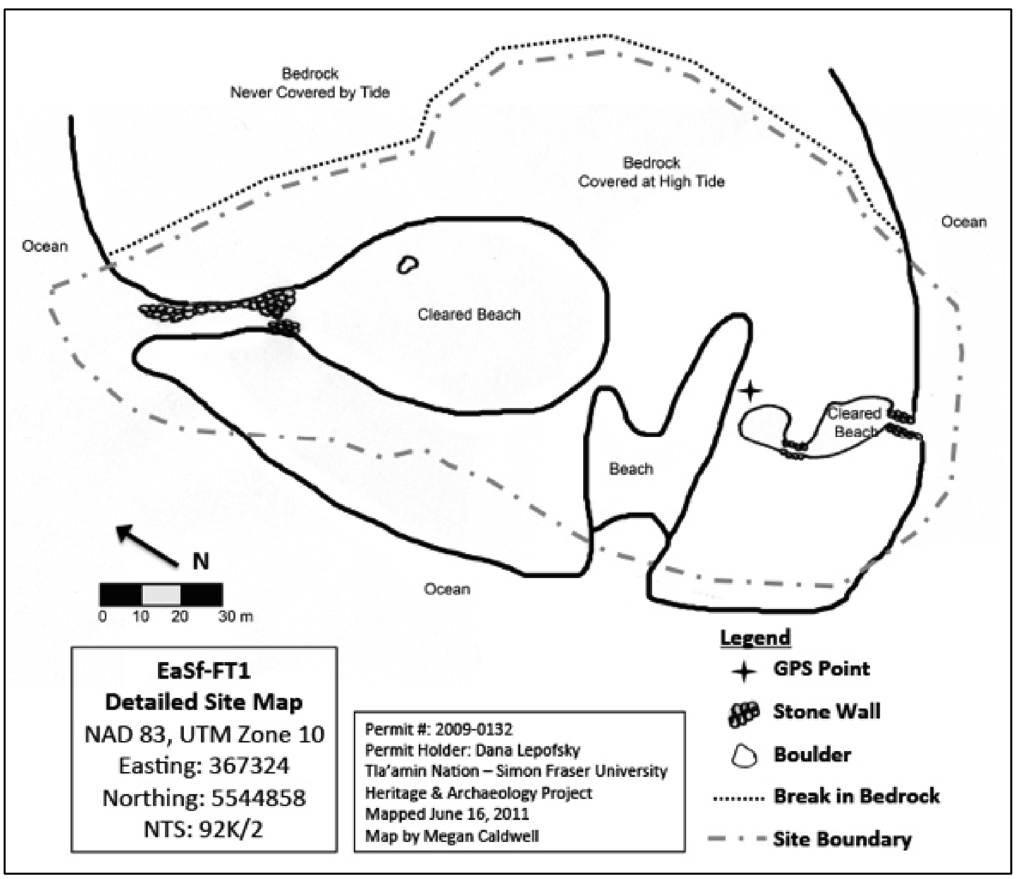

***Figure A.106**. Detailed site map of EaSf-43 (This map was created before the Borden Code was assigned and shows its temporary site designation).*

Summary

Intertidal subsistence features are found throughout the study area. They range in size from just a few metres to a few hundred meters, and the form can be comprised of a single stone wall or cluster of wooden stakes, to expansive and extensive modifications of the intertidal zone that combine both cleared beaches and wall formations. It is evident that the ancestral Tla'amin invested time and effort into manipulation of the foreshore environment in order to enhance its productivity.

The extensive intertidal modifications found in the study area, along with thousands of years of archaeological faunal records that indicate sustained fishing and shellfishing practices, suggest that the ancestral Tla'amin both exploited and managed the marine resources available to them. Although intertidal subsistence features are found almost everywhere in the study area, there is no clear evidence for over-harvesting of marine resources in the study area over a period of 3,000+ years. The ancestral Tla'amin were keen observers of the environment around them, able to manipulate the intertidal zone to enhance productivity without creating population declines or collapses in the marine species they exploited.

In addition to the 24 intertidal features described here, an additional 37 features were identified in the aerial survey; these sites have not yet been recorded through site visits. The 24 sites reported here are a testament to the extensive modification of the intertidal zone in the study area. The variety of sites demonstrate a deep knowledge of the local environment, with sites constructed specifically to manipulate and enhance individual site characteristics.

At the time of my visit, each of these sites was in good condition. This degree of preservation is most likely due to the fact that they tend to sit in the lowest reaches of the intertidal zone. Therefore, they are not exposed except during the lowest tidal sequences and are unlikely to be disturbed in the normal course of human activity. Additionally, historical modifications to the intertidal zone, such as clearing of rubble for boat ramps, or alterations made in the course of logging, are generally restricted to the middle and upper intertidal zone. Some sites, such as those within Desolation Sound Marine Park and in front of private residences, are likely subject to more ongoing disturbances than those in more restricted areas, such as on Ahgykson.

Regardless of where an intertidal site is located, they are all continuously impacted through the daily cycle of tides. Some sites, such as DlSd-12 and DlSd-39, along with all sites with wooden elements, already show evidence for disturbance through ongoing tidal action. Other sites are likely to undergo similar disturbances over time. All the sites recorded here should be observed for disturbances, both due to human activity and due to ongoing tidal action.

References

Acheson, S. and S. Riley. 1976. *Gulf of Georgia Archaeological Survey: Powell River and Sechelt Regional Districts.* Report on file at The Archaeological and Cultural Heritage Branch, Victoria, B.C.

Acheson, S. and S. Riley. 1977. *An Archaeological Resource Inventory of the Northeast Gulf of Georgia Region.* Report on file at The Archaeological and Cultural Heritage Branch, Victoria, B.C.

Caldwell, M., D. Lepofsky, G. Combes, M. Washington, J.R. Welch, and J.R. Harper. 2012. A Bird's Eye View of Northern Coast Salish Intertidal Resource Management Features. *Journal of Island and Coastal Archaeology* 7:219-233.

Appendix B: Zooarchaeological Analyses

Appendix B: List of Tables

Appendix B: Zooarchaeological Analyses

Faunal remains were analysed from six archaeological sites within Tla'amin traditional territory for this project. This appendix presents the results of zooarchaeological analyses that form the data presented in Chapter 4. Information on the excavation of these sites, and other types of archaeological materials recovered and analysed from each of them, can be found in the archaeological permit report submitted by the project to the British Columbia Archaeology Branch (Springer et al. 2014).

The six sites were excavated as part of the Tla'amin-Simon Fraser University Archaeology and Heritage Stewardship Project between 2009 and 2011. Unit samples were excavated by trowel and screened through 3.175 mm mesh. Bulk samples were excavated by trowel and screened through 2 mm mesh; bulk sample volumes were measured both before and after screening (captured materials). Materials were cleaned by wet-screening, and air-dried. Once dried, samples were sorted at either the Department of Anthropology at the University of Alberta (U of A) or the Department of Archaeology at Simon Fraser University (SFU). During sorting, all vertebrate elements and all non-repeating elements of invertebrates were removed from the samples. These elements were then identified to the finest possible taxonomic level (typically Family, Genus, or Species) using comparative faunal materials (U of A and SFU collections) or published materials (Butler 2009; Cannon 1987). For fish remains, no attempts were made to identify rib, ray or spine elements (as is typical of Northwest Coast fish assemblage analyses). Attempts were made to identify all other vertebrate elements, but when identification was not possible they are noted as unidentified fish, mammal, or bird.

The results of these analyses are presented here by NISP and NSP (vertebrate) or NISP and MNI (invertebrate) counts; %NISP and %MNI are calculated by taxa for the fish and invertebrate remains (respectively) for each site, and are presented as Figure 3 in Chapter 4. The merits and pitfalls of these counts have been discussed in detail elsewhere (c.f., Lyman 2008), and these methods of counting were chosen for this project because of the overall small sample sizes. For invertebrates, weight measurements are often used to quantify materials, although there are arguments against this method as well (e.g., Classen 2000; Glassow 2000; Mason et al. 1998). For this project, weight measurements were not used due to differences of shell weight to dietary contribution ratios and differences in preservation between the identified taxa (e.g., mussel and sea urchin remains break into much smaller pieces than larger, sturdier bivalve shells (littleneck clam, butter clam, etc.) and are more likely to pass through even the fine mesh screen in disproportional amounts). To account for these differences, MNI and %MNI are employed to quantify invertebrate remains. MNI counts based on non-repeatable elements (NRE) for non-bivalve taxa have been critiqued (Giovas 2009), however non-bivalve invertebrates occur so infrequently in these samples that NRE counts are not seen as problematic in this study. Invertebrate counts also include quantification of some invertebrate species unlikely to have been used as food sources (e.g., intrusive land snails, and invertebrate remains <1cm in size such as barnacles, limpets, and whelks that likely were brought back to village sites attached to mussels).

DkSc-13

DkSc-13 is a large shell midden bearing site located along Highway 101 south of Powell River. The site is largely disturbed by a highway and housing development; the sample presented here was recovered when the last undeveloped property was under construction in April/May 2011. A 50 x 50 cm unit was excavated in a relatively undisturbed portion of the site. The deposit consists of three stratigraphic layers. No humic top soil was present; it is unconfirmed, but most likely the top layers of the midden were removed prior to the excavation of this unit as part of the lot development. Layer I consists of shell midden deposits in a dark brown/black sandy loam with broken and crushed shell, vertebrate remains, and charcoal spotting. Layer II contains mostly whole bivalves, thick charcoal and ash banding, pockets of sea urchin remains, and an abundance of vertebrate faunal remains. The layer was recorded as a single stratigraphic unit, but it is likely that excavation of a larger area would reveal continuation of banding and deposits that are unobservable in a small unit. Layer III consists of crushed shell in a rich loamy dark brown, charcoal-rich matrix and 2-3 cm thick. The shell is mostly broken, and vertebrate faunal remains are relatively abundant. No artifacts were noted in the field, and none were recovered in the lab. A radiocarbon date from the basal deposits returned an age of 2140 ± 30 BP (Beta Analytic 300560).

Table B-1. Fish remains at DkSc-13.

Level/Layer	Dogfish Shark	Greenling	Herring	Midshipman	Perch	Rockfish	Salmon	Sculpin	Total NISP	Unidentified	Total NSP
1/I (0-10 cm)			3						3	4	7
2/I (10-20 cm)			38				2		40	29	69
3/I (20-30 cm)		2	7	1	1	1			12	12	24
4/I (30-40 cm)	1		59	1	1	1			63	61	124
5/I (40-50 cm)	9		103	3	2	1	30	1	149	299	448
Total NISP	10	2	210	5	4	3	32	1	267	405	672
% NISP	3.75	0.75	78.65	1.87	1.50	1.12	11.99	0.37	39.73	60.27	
% Ubiquity	40	20	100	60	60	60	40	20			

Table B-2. Invertebrate remains at DkSc-13.

Level/Layer	Bay Mussel	Bentnose Clam	Cockle	Horse Clam	Landsnail	Limpet	Littleneck Clam	Sea Urchin	Whelk	Total MNI	Total MNI 'Foods'
1/I (0-10 cm)	2	2	2		1		73	1		81	80
2/I (10-20 cm)	4	2	4			1	98		2	111	108
3/I (20-30 cm)	3	6	13	1	1	1	113			138	136
4/I (30-40 cm)	19	8	5				70	2	1	105	104
5/I (40-50 cm)	28	3	5			3	86	1	15	141	123
Total MNI	56	21	29	1	2	5	440	4	18	576	551
% MNI	9.72	3.65	5.03	0.17	0.35	0.87	76.39	0.69	3.13		
% MNI 'Foods'	10.16	3.81	5.26	0.18	0.36	0.91	79.85	0.73	3.27		

Table B-3. Non-fish vertebrate remains at DkSc-13.

Level/Layer	Unidentified Mammal	Unidentified Bird	Total NSP
1/I (0-10 cm)	0		0
2/I (10-20 cm)	3		3
3/I (20-30 cm)	2		2
4/I (30-40 cm)	4		4
5/I (40-50 cm)	8	1	9
Total NSP	17	1	18

DlSd-3

DlSd-3 is located north of Sliammon, on the Strait of Georgia side of the Malaspina Inlet. There are no intertidal features in the bay directly in front of the site, but it is adjacent to Atrevida Reef, where an intertidal feature was recorded in 1976. A 50 x 50 cm unit was excavated to a depth of 80 cm below surface, with a further 23 cm of material excavated using a bucket auger. Five cultural layers were recorded, including two ash lenses interpreted as hearth dumps. Although a fragment of deer long bone was sent for radiocarbon dating, the bone was too decomposed to obtain a reliable date and the unit remains undated.

Table B-4. Fish remains at DlSd-3.

Level/Layer	Dogfish Shark	Flatfish	Greenling	Hake	Herring	Lingcod	Midshipman	Perch	Rockfish	Salmon	Total NISP	Unidentified	Total NSP
1/I	2				30		2	1	2		37	6	43
2/I	6				145		1			1	153	33	186
3/II		1		1	74		1		1	1	79	31	110
4/II	1				85	1		4		2	93	34	127
5/II			2		72			1	1		76	58	134
6/V	3				69					1	73	33	106
7/V			1		66					1	68	34	102
8/V	1				15						16	1	17
Total NISP	13	1	3	1	556	1	4	6	4	6	595	230	825
% NISP	2.18	0.17	0.50	0.17	93.45	0.17	0.67	1.01	0.67	1.01	72.12	27.88	
% Ubiquity	62.5	12.5	25	12.5	100	12.5	37.5	37.5	37.5	62.5			

Table B-5. Invertebrate remains at DlSd-3.

Level/Layer	Barnacle	Bay Mussel	Bentnose Clam	Butter Clam	Cockle	Horse Clam	Littleneck Clam	Sea Urchin	Whelk	Total MNI	Total MNI 'Foods'
1/I		2					8	1	1	12	11
2/I	1	4	1			2	29	1		38	37
3/II		1	1	4	2		9	1		18	18
4/II		1		3			5			9	9
5/II		7		2			10	1	1	21	20
6/V	1	2					4		1	8	6
7/V	1	4					4	1	1	11	9
8/V										0	0
Total MNI	3	21	2	9	2	2	69	5	4	117	110
% MNI	2.56	17.95	1.71	7.69	1.71	1.71	58.97	4.27	3.42		
% MNI 'Foods'		19.09	1.82	8.18	1.82	1.82	62.73	4.55	3.64		

Table B-6. Non-fish vertebrate remains at DlSd-3.

Level/Layer	Small Mammal	Medium Mammal	Medium-Large Mammal	Unidentified Mammal	Small-Medium Bird	Total NSP
1/I		1				1
2/I	4				1	5
3/II						
4/II			1	1		2
5/II		9	1			10
6/V		2				2
7/V			1	3		4
8/V						
Total NSP	4	12	3	4	1	24

DlSd-6

DlSd-6 is a large midden site, ~ 8,960 m^2 in size. It is located just north of Sliammon and south of DlSd-3, along the Georgia Strait side of the Malaspina peninsula. Faunal results from one unit at DlSd-6 are used in this project; further samples are presented elsewhere (Jackley 2011, 2014). The unit was excavated to a depth of 130 cmbs. The materials in this unit have been interpreted as shell midden deposited on top of an abandoned house; only midden materials were included in this analysis (depth of 80 cmbs). A radiocarbon sample from the house deposits dates to 910 ± 40 BP, while dog remains from midden remains 20-30 cmbs have been dated to 312-499 BP (Springer et al. 2014). No vertebrate remains other than fish were identified in the bulk samples from the excavation unit considered here. However, mammal and bird remains were identified elsewhere at DlSd-6 and include deer (*Odocoileus* spp.), canid remains (confirmed as domesticated dog (*Canis familiaris*) through DNA analysis (Springer et al. 2014)), bear (*Ursus* spp.), gull (laridae), unidentified sea mammal remains, and unidentified bird remains.

Table B-7. Fish remains at DlSd-6.

Level/Layer	Dogfish Shark	Greenling	Herring	Midshipman	Perch	Rockfish	Salmon	Sculpin	Total NISP	Unidentified	Total NSP
2		2	385		6	2	4		399	216	615
3	10	1	484	3	8	5	9	1	521	278	799
4	8		133			1	16		158	128	286
5	3		167	2	1		4		177	138	315
6			6						6	9	15
7	1		32			2	1		36	78	114
8	1		13						14	20	34
9	1		19			1			21	5	26
Total NISP	24	3	1239	5	15	11	34	1	1332	872	2204
% NISP	1.80	0.23	93.02	0.38	1.27	0.83	2.55	0.08	60.44	39.56	
% Ubiquity	75	25	100	25	37.5	62.5	62.5	12.5			

Table B-8. Fish remains at DlSd-6.

Level/ Layer	Barnacle	Bay Mussel	Bentnose Clam	Butter Clam	Cockle	False Green Jingle	Horse Clam	Limpet	Littleneck Clam	Moon Snail	Sea Urchin	Total MNI	Total MNI 'Foods'
2		4	17	71	27		2		147		28	296	296
3		67	6	150	15	1	4	1	514	1	49	808	805
4		37	9	39	16		4		307		41	453	453
5	1	28	2	18	8		2		194		14	267	266
6	1	5	4	16	17		1		142		2	188	187
7		4		13	6				98			121	121
8		1	2	9	4		3		33			52	52
9	1								1		2	4	3
Total MNI	3	146	40	316	93	1	16	1	1436	1	136	2189	2183
% MNI	0.14	6.67	1.83	14.44	4.25	0.05	0.73	0.05	65.60	0.05	6.21		
% MNI Foods		6.69	1.83	14.48	4.26		0.73		65.78		6.23		

EaSe-11

EaSe-11 is the site of Kah Kay Kay, a large winter village settlement located in Grace Harbour, and the location of Tla'amin IR 6. The site would have provided excellent shelter from winter storms, inside Grace Harbour and protected by Jean Island. EaSe-11 also has a large, modified intertidal pond, the centre of which has been cleared of large boulders, likely to improve clam habitat in a manner similar to clam garden construction by holding water through the tidal cycle. The pond sits between the mainland site location and a small islet, known as Speaker's Rock. On either side of the pond, between the mainland and Speaker's Rock, are stone walls constructed to trap fish with the outgoing tide. Three funnels, one on the west side and two complementary ones on the east side, could be close to trap fish in, or opened to let fish escape. When observed in 2009, water continued to funnel out both sides of the feature throughout the entire low-tide cycle until the tide began to rise again.

Faunal remains from a column sample (CS 1) excavated at the front of the site were analysed for this project. The topmost layer of CS 1 was a mix of midden material and historic trash material (gardening glove, rusted metal), representing mid-late 20th century use of the site. Archaeological deposits extend below ground surface. The surface is composed of eroded midden materials, but excavating back towards the exposed face, and then down in line with the column sample, revealed intact archaeological deposits, resting on top of bedrock. Charcoal obtained from the basal layer of the column sample (just above bedrock) dates to Cal. BP 950-790 (Beta-285597).

Table B-9. Fish remains at EaSe-11.

Level/Layer	Anchovy	Dogfish Shark	Greenling	Herring	Lingcod	Midshipman	Perch	Rockfish	Salmon	Total NISP	Unidentified	Total NSP
2/I		2		50			1		11	64	83	147
5/I	2	3		164			4		29	202	226	428
5/II				134	28		1	2		165	121	286
7/III				95			1		1	97	38	135
8/II		3		34	3		2	1	8	51	125	176
9/IV		1		92			7	1	14	115	84	199
11/VI		4		114		1	1	3	32	155	104	259
12/VII		2		27					13	42	25	67
14/VI		2		12		1	3	1	4	23	43	66
15/VIII		7	2	128		2	6	11	56	212	291	503
18/VIII		4		95			4	2	23	128	139	267
19/IX		5		15			1	2	54	77	112	189
22/IX				5			1	1	15	22	35	57
24/IX		2		4				1	20	27	54	81
Total NISP	2	35	2	969	31	4	32	25	280	1380	1480	2860
% NISP	0.14	2.54	0.14	70.22	2.25	0.29	2.32	1.81	20.29	48.25	51.75	
% Ubiquity	7.14	78.57	7.14	100	14.29	21.43	85.71	71.43	92.86			

Table B-10. Invertebrate remains at EaSe-11.

Level/Layer	Bay Mussel	Bentnose Clam	Butter Clam	Chiton	Cockle	Dire Whelk	Dogwinkle	Horse Clam	Littleneck Clam	Native Oyster	Sea Urchin	Total MNI	Total MNI 'Foods'
2/I	15	1							4			20	20
5/I	126	2				1			6		4	139	138
5/II	108		5		2				10	2	9	136	136
7/III	81		2		1				6	3	2	95	95
8/II	58	1	1						7		1	68	68
9/IV	399		3		1				6	1	8	418	418
11/VI	156	1	1		2		2		8		1	171	169
12/VII	7		6									13	13
14/VI	118	1	2					1	17			139	139
15/VIII	36			1					5		1	43	43
18/VIII												0	0
19/IX												0	0
22/IX	15	1	7						19		1	43	43
24/IX	7								1		1	9	9
Total MNI	1126	7	27	1	6	1	2	1	89	6	28	1294	1291
% MNI	87.02	0.54	2.09	0.08	0.46	0.08	0.15	0.08	6.88	0.46	2.16		
% MNI 'Foods'	87.22	0.54	2.09	0.08	0.46			0.08	6.89	0.46	2.17		

Table B-11. Non-fish vertebrate remains at EaSe-11.

Level/Layer	Unidentified Mammal	Unidentified Bird	Total NSP
2/I			
5/I			
5/II	13	3	16
7/III	4		4
8/II			
9/IV	7		7
11/VI	7		7
12/VII	3		3
14/VI			
15/VIII	3		3
18/VIII	6		6
19/IX	8		8
22/IX			
24/IX	10		10
Total NSP	61	3	64

EaSe-18

EaSe-18 is a large midden site ~4500 m^2 in size located at the mouth of Theodosia inlet. There is an expansive intertidal zone in front of the site, but no modifications were identified on the beach. A column sample, C.S. 1, (20 cm x 20 cm x 205 cm) was excavated from exposed midden face at the front of the site in order to obtain faunal remains for this project. Charcoal obtained from the basal level (just above sterile sands) dates to Cal. BP 920-730 (Beta 285594). The sample was excavated through several layers of stratified midden, including crushed and whole bivalves, urchin remains, and abundant fish remains, with layered, horizontally level hearths in the top metre, including stake holes in the hearths. No non-fish vertebrate remains were identified in this sample, and other samples from EaSe-18 have not been identified at this time. During excavation, the inner horn of a mountain goat (*Oreamnos americanus*) was identified in a separate sample.

Table B-12. Fish remains at EaSe-18.

Level/Layer	Dogfish Shark	Flatfish	Greenling	Herring	Lingcod	Midshipman	Perch	Rockfish	Salmon	Sculpin	Total NISP	Unidentified	Total NSP
1/I	3			147				3	1		154	56	210
3/II	1	1		188					57		247	322	569
4/III	9			235			2	20	83		349	351	700
5/III	2			283			1	10	33		329	307	636
6/IV	5		4	746			21	14	23		813	250	1063
7/V				31			5	1	1		38	19	57
7/VI	1			29			1		2		33	18	51
8/VIII				1					2		3	0	3
9/X	3			79			6		4		92	13	105
12/X	1		1	706		1	9	2	6	7	733	160	893
14/XI	2			1620			2	13	20	1	1658	1696	3354
15/XII	29			683	1		9	7	226		955	689	1644
17/XII	8			67	10		28	11	129	6	259	786	1045
20/XII	1			28			1	1	18	1	50	94	144
21/XIII				2							2	6	8
Total NISP	65	1	5	4845	11	1	85	82	605	15	5715	4767	10482
% NISP	1.18	0.08	0.09	84.78	0.19	0.08	1.49	1.43	10.59	0.26	54.52	45.48	
% Ubiquity	80	6.67	13.33	100	13.33	0.08	73.33	66.67	93.33	26.67			

Table B-13. Invertebrate remains at EaSe-18.

Level/Layer	Barnacle	Bay Mussel	Bentnose Clam	Butter Clam	Chiton	Cockle	Dire Whelk	Dogwinkle	Horse Clam	Landsnail	Limpet	Littleneck Clam	Moon Snail	Native Oyster	Sea Urchin	Whelk	Total MNI	Total MNI 'Foods'
1/I	26	73	8	3		3		3		10	3	17		1	3	17	167	108
3/II	103	423	9	18		8			2		20	62			1	65	711	523
4/III	44	183	1	4		2			1	3	3	38	1		1	23	304	230
5/III	37	131	2	4		34		1	3		37	21			1	63	334	196
6/IV	64	92	2	5		18	1	3	3		11	24			1	22	246	145
7/V		2		2		5			1		2	6			1	2	21	17
7/VI	9	36		1		2					2	5				8	63	44
8/VIII		5									2					1	8	5
9/X	1	8		6		2					4	4				21	46	20
12/X	82	332	1	3	1	6			3		15	18			31	33	525	395
14/XI	19	146	1	5		7			3	1	2	15			30	2	231	207
15/XII	16	96		8		10			7		1	15	4	1	12	5	175	149
17/XII	66	143		6		6		1	14		3	19	3		19	24	304	207
20/XII	12	40		21		9			5	1	2	5			2	23	120	82
21/XIII	1	2				1						1					5	4
Total MNI	480	1712	24	86	1	113	1	8	42	15	107	250	8	2	102	309	3260	2332
% MNI	14.72	52.52	0.74	2.64	0.03	3.47	0.03	0.25	1.29	0.46	3.28	7.67	0.25	0.06	3.13	9.48		
% MNI 'Foods'		73.41	1.03	3.69	0.04	4.85			1.80			10.72		0.09	4.37			

EaSe-76

EaSe-76 is a large midden site, ~ 8500 m^2 in size, located in Cochrane Bay in Desolation Sound Marine Park. The site includes constructed terraces and in-ground structures visible on the surface as cultural depressions. While the beaches directly in front of EaSe-76 have been highly disturbed from logging and aquaculture activities, and therefore no intertidal features have been identified, the Cochrane Islands, immediately adjacent to the site, host cleared bedrock depression and fish trap features. Faunal material analysed for this project come from two separate units at this site: an 1 x 1 m excavation unit (invertebrates) and a 20 x 20 xm column sample taken from an exposed stream wall (vertebrate remains). Both units were excavated by hand using trowels. For the excavation unit, material was screened through 3.175 mm mesh, and bulk samples were collected for fine mesh screening in the lab. For the column sample, all materials were collected bulk and wet screened through 2mm mesh. Fish remains from the column sample are presented as they represent ~4,000 years of site use (charred material from the bottom of the column sample unit dates to Cal. BP 4250 to 4070/4040 to 3990 (Beta 285599)); invertebrates are relatively absent in the column sample, therefore invertebrate remains were considered from a separate excavation unit. The unit used for invertebrates produced a basal date of Cal. BP 2330-2040 (Beta 261183).

No vertebrate remains other than fish were identified in the column sample. Analysis of vertebrate remains from other portions of EaSe-76 have identified a variety of non-fish vertebrate remains (Springer et al. 2014). Identified mammals include: deer (*Odocoileus* spp.), mustelids (mustelidae), canid remains (confirmed as domesticated dog (*Canis familiaris*) through DNA analysis (Springer et al. 2014)), bear (*Ursus* spp.), sea otter (*Enhydra lutris*), and harbour seal (*Phoca vitulina*). Identified bird remains are limited to the American coot (*Fulica americana*) and the orders falconiformes, passeriformes, and columbiformes. Unidentified remains of both mammals and birds are also numerous.

Table B-14. Fish remains at EaSe-76.

Level/Layer	Dogfish Shark	Eulachon	Flatfish	Herring	Midshipman	Perch	Rockfish	Salmon	Total NISP	Unidentified	Total NSP
1						1		2	3	3	6
2				8		1	1	6	16	30	46
3	2			40		1	2	2	47	61	108
4	10	5		142	1	1	4	39	202	172	374
5/IV		1		51		1	5	39	97	190	287
9/V	3	2		15			2	22	44	162	206
10/V	1			5				12	18	9	27
10/VI	5	3		111		1	2	13	135	123	258
11/VI				23				4	27	46	73
12/VI				28		2	1	12	43	53	96
13/VI				31			1	2	34	31	65
14/VI				13			2	1	16	20	36
15/VI				24					24	13	37
16/VI				51		3	1	12	67	80	147
17/VI				14			5	1	20	38	58
18/VI	1			36	2		2	8	49	112	161
19/VI	1		3	75		4	16	1	100	324	424
20/VI		1		12			1	3	17	13	30
21/VIII				1					1	1	2
22/VIII								3	3	7	10
Total NISP	23	12	3	680	3	15	45	182	963	1488	2451
% NISP	2.39	1.25	0.31	70.61	0.31	1.56	5.67	18.90	39.29	60.71	
% Ubiquity	35	25	5	90	10	45	70	90			

Table B-15. Invertebrate remains at EaSe-76.

Level/Layer	Bay Mussel	Bentnose Clam	Butter Clam	Chiton	Cockle	Dire Whelk	Dogwinkle	Horse Clam	Landsnail	Limpet	Littleneck Clam	Moon Snail	Sea Urchin	Whelk	Total MNI	Total MNI 'Foods'
1		1	46		1	1		5		2	34		1		91	88
2	4	1	16	2	3		1	5		2	167		1	35	237	199
3	2		7	1			4	1			40		1	5	61	52
4	3	1	6	1	2			2		1	43			9	68	58
5	2		1					1			10			8	22	14
6	8	1	4	1	1						18		1	7	41	34
7	1														1	1
8	5		5	2						2	21			1	36	33
9	2		3					1			24	1		29	60	30
10	12		10	2	1	1		1		4	27		1	70	129	54
11	13		2	5		2					15			45	82	35
12	36		4	2					1	4	19		1	53	120	62
13	25		6	5	1			2		8	27	1	1	64	140	67
14	27		36	5				2		10	140		1	34	255	211
Total MNI	140	4	146	26	9	4	5	20	1	33	585	2	8	360	1343	938
% MNI	10.42	0.30	10.87	1.94	0.67	0.30	0.37	1.49	0.07	2.46	43.56	0.15	0.60	26.81		

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