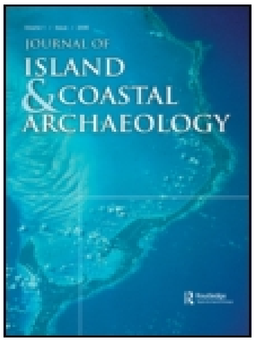

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A Bird's Eye View of Northern Coast Salish Intertidal Resource Management Features, Southern British Columbia, Canada

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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

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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.

Keywords intertidal features, resource management systems, Northwest Coast, survey methods, aerial photography

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 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 1996; 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 article 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 predetermined functions (e.g., "fish trap," "fish dam," "clam garden"), 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 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.

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

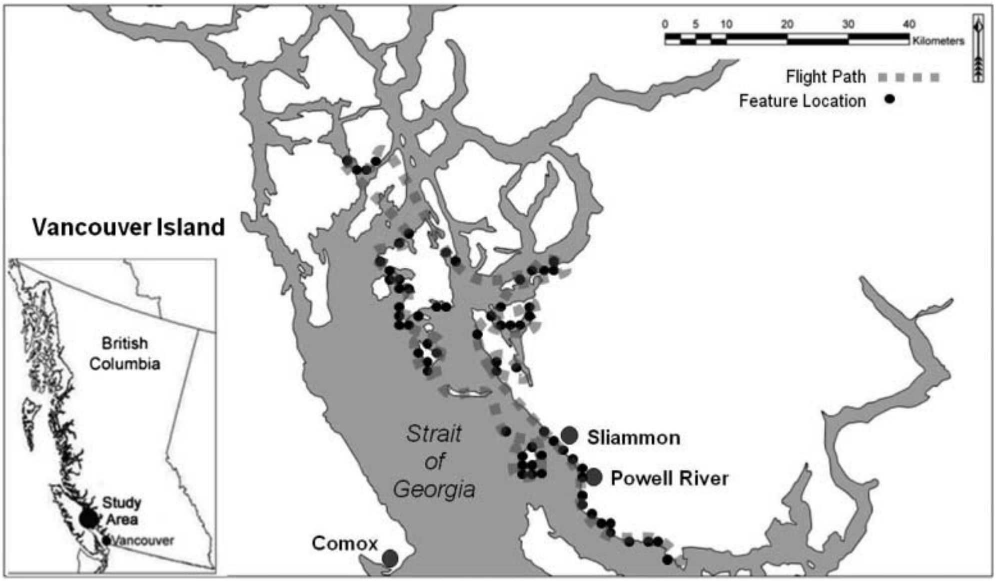

Figure 1. *Study area location depicting flight coverage and intertidal site locations.*

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 latticework 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). Tla'amin 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). Tla'amin 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). Tla'amin 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 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 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 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 ($\sim +/-0.2$ m in tidal height from the maximum low tide of 0m during the fly-overs).

We identified 51 locations with intertidal modifications comprised of a total of 144 elements and 66 features (Figure 1). The 144 elements can be placed into one of eight element categories (Table 1; Figure 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

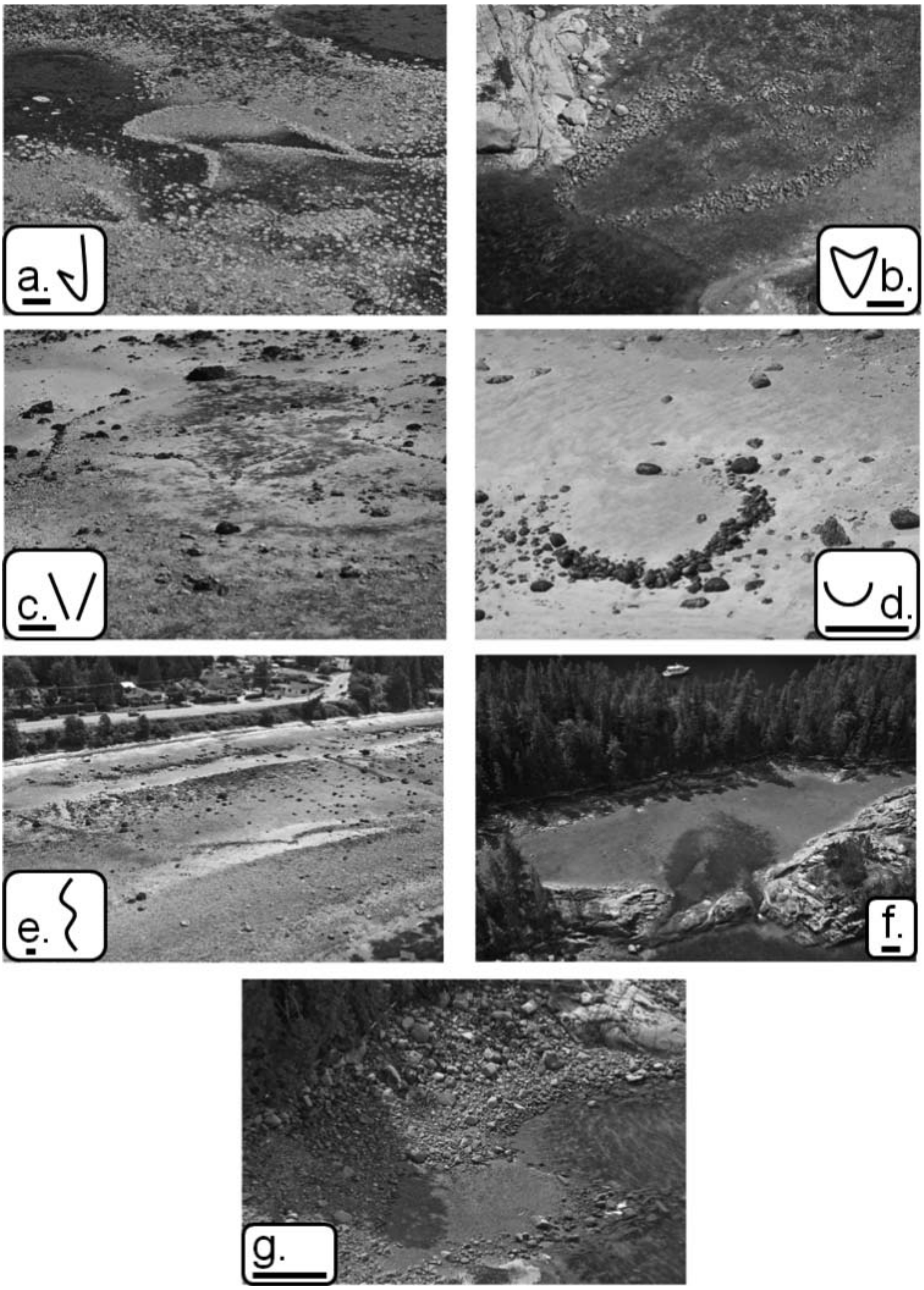

Figure 2. *Examples of elements with line drawings of built stone wall forms. Black bar represents 2 m scale for each photo. a) hook, adjacent to a cleared beach; b) heart, sitting on top of a cleared beach element; c) V, with associated lead line visible; d) crescent, sitting on a naturally sandy beach;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

Table 1. **Distribution and associations of intertidal element types.**

	Number of times elements co-occur w/ themselves and other elements												
	Hook	Heart	V	Crescent	Linear	Bedrock depression	Cleared beach	Undefin-able	Lead line	Element occurrences (N)	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

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 45° inwards (Figure 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.

Heart Element

The heart element (N = 8) consists of two mirrored, curved walls forming the shape of a heart (Figure 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 (45°–70°), but do not meet at the apex of the V (Figure 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 2d). Somewhat common in our study area, crescent elements are located in the high to low intertidal zone. Crescents are similar in form 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 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 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 2g). In some cases, the buildup of stone occurs at the low tide line in a fashion characteristic of clam gardens in other regions (see 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 ($N = 17$) 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 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). 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 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 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

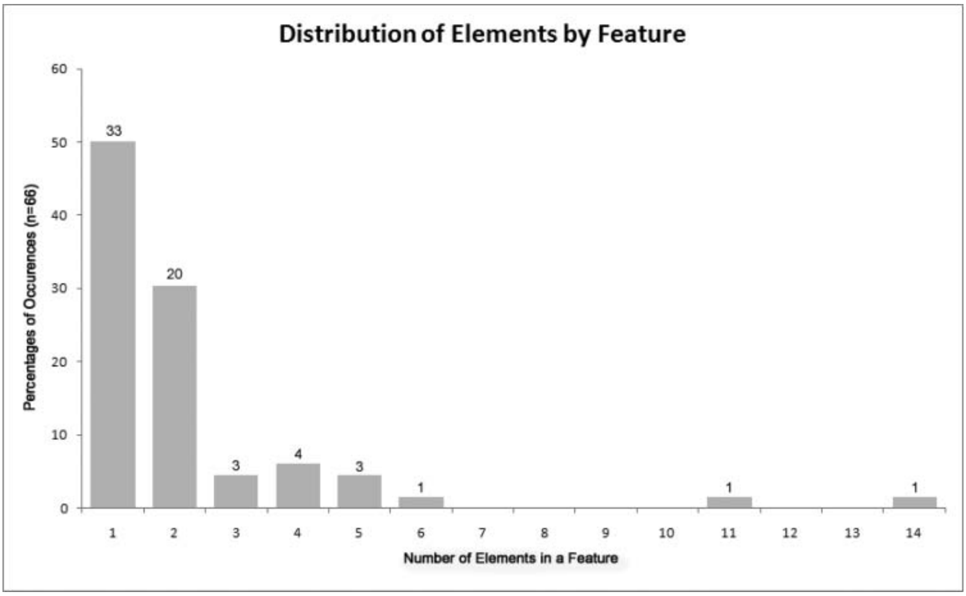

Figure 3. *Distribution of the number of elements present in a given feature, displayed as percentage of occurrences. Numbers above the bars are a raw count of occurrences.*

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 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 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

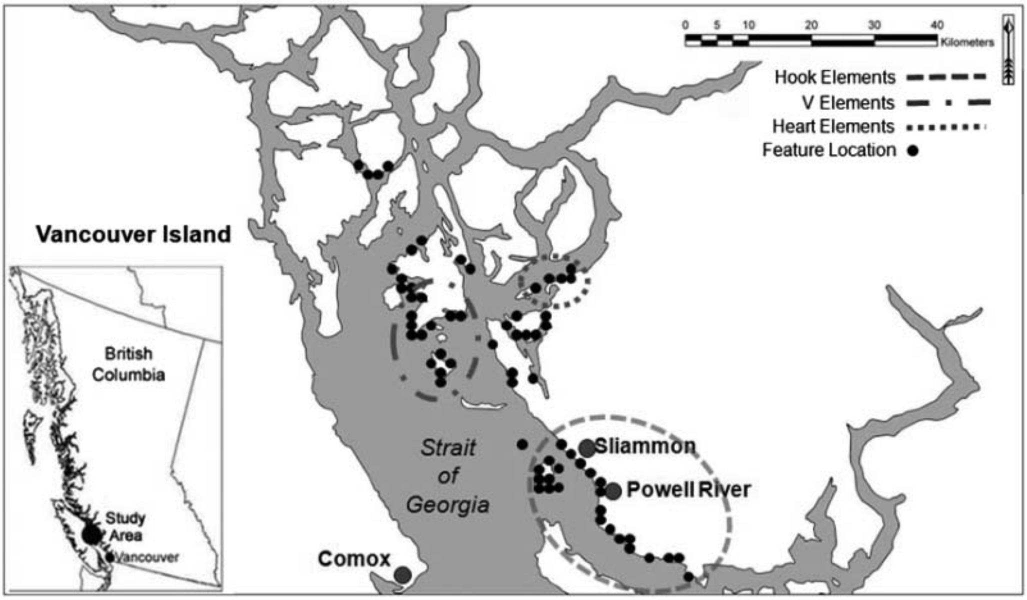

Figure 4. *Sub-regions dominated by certain element forms.*

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 (e.g., stake fish traps) in aerial photographs. 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 (<0.3 masl) 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 labeled 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—*wux̱wuthin*) 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 *téḵwus*, 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 (see Caldwell 2008). Analysis of the functional variation present in these features will occur as part of our ongoing collection of detailed information about the elements (e.g., size, ecological setting, age, combinations with other elements).

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, and 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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