MODELLING NUU-CHAH-NULTH LAND USE: THE CULTURAL LANDSCAPE OF CLAYOQUOT SOUND

by

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Modelling Nuu-Chah-Nulth Land Use: The Cultural Landscape of Clayoquot Sound

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ABSTRACT

This thesis concerns land use and land tenure among the Aboriginal people resident in Clayoquot Sound. I begin by discussing the system in practice among the Nuu-chah-nulth as described in the ethnographic and ethnohistoric literature. From this synthesis, I develop a tabular summary of land use by physiographic areas of Clayoquot Sound. The next step entails testing the parameters of the summary of Nuu-chah-nulth land use to determine if it conforms to the archaeological record of Clayoquot Sound. I propose two land use models to compare spatial patterning of known archaeological sites to those recorded as the ethnographic pattern. First, I translate all components of the land use summary onto the landscape to create the Cultural Landscape Model. Its function is to predict the types of archaeological features that would be found within each physiographic setting, based on land use activities described in the ethnographic and ethnohistoric literature. The second model is the Habitation Site Model; its sole function is to predict the locations of habitation sites. Developing models from the ethnographic and ethnohistoric record brings together several strands of research material. The amount of data dedicated to the synthesis is best organized using geographic information systems (GIS) software.

Given its parameters, the Cultural Landscape Model explains the known archaeological record suggesting there is some antiquity to the ethnographic pattern of land use. In lieu of a sustained and extensive excavation program that would prove otherwise, the Cultural Landscape Model can confidently predict the geographic location of archaeological features. In contrast, the Habitation Site Model showed little conformity with the archaeological record. Few archaeological sites inferred as former habitation sites coincided with areas the Habitation Site Model identified as favourable. While disturbing, such results are still valuable as they can inform future research. The objective that arises from the apparent weakness in this model is to refine its function by identifying the confounding variables and correcting for them.

This thesis demonstrates that a multi-stepped approach to modelling land use, using ethnographic and ethnohistoric sources as a starting point, can inform archaeologists about ancient land use. Combined with a rigorous field program, land use models may help us find archaeological signatures of Nuu-chah-nulth land use and land tenure in Clayoquot Sound. A long term objective is, of course, to determine whether the land use and tenure described by early observers is consistent with Nuu-chah-nulth lifeways prior to contact.

To Cam, with love.

History came to life and it stayed that way, in the sense that, as I later came to embellish the idea, all of human consciousness was a continuous moment, causes inextricably linked to effects, stretching backward and forward in an unbroken chain from Beginning to End.

Paul William Roberts, 2003

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CHAPTER ONE:

INTRODUCTION

INTRODUCTION

In North America, the analysis of how Aboriginal peoples use the land and resources of their areas of residence has been of widespread interest to archaeologists for decades (Trigger 1995). Prior to the 1960s, studies of land use concentrated on settlement patterns and subsistence strategies (e.g., Steward 1938). After this time and continuing through the 1980s, regional studies expanded as large-scale developments occurred throughout North America (Berry 1984; Brody 1988; Spurling 1982). While regional analysis continues to be of interest to the academic community (e.g., Dalla Bona 2000; Dalla Bona and Larcombe 1996; Mackie 2001; Maschner and Stein 1995), most regional land use studies are a requirement of heritage legislation and cultural resource management programs (Berry 1984; Spurling 1982). This is also true of the Northwest Coast where most archaeological research is undertaken by consultants and takes the form of surface reconnaissance through inventories and impact assessments (e.g., Arcas 1998a, 1998b; Arcas and Archeo Tech 1994; Mason et al. 1999; Stryd and Eldridge 1993). Most regional land use studies seek to develop locational, or land use, models that assist archaeologists in predicting where archaeological sites may be found (e.g., Arcas 1998b).

Attempts at building locational models on the Northwest Coast have typically concentrated on predicting where sites, particularly habitation or village sites, might be found, given the presence of a suite of environmental conditions (e.g., Maschner and Stein 1995). As in other regions, the environmental factors used for the models are typically found in the ethnographic literature or are inferred through inductive reasoning from the archaeological sites that have already been discovered (Kohler and Parker

1986). Both approaches rely on existing sets of data, which are not always consistently complete or accurate (Kvamme 1988b).

In this thesis, I present models of land use that rely on existing environmental factors as identified in the ethnographic and ethnohistorical literature. While each of the land use models I propose can contribute to our understanding of land use among the Nuu-chah-nulth of Clayoquot Sound, when used together as part of a multi-stepped research program, including fieldwork that could be used to refine the variables used in the models, their utility can be more fully realized.

Goals and Objectives of the Research

One of the major goals of the research presented here is to contribute to an understanding of Aboriginal land use and land tenure, or ownership of land and resources, among the Nuu-chah-nulth of the west coast of Vancouver Island during the ethnographic period. The sheer abundance of literary sources for the Nuu-chah-nulth area allows for a synthesis of Aboriginal land use during the ethnographic and ethnohistoric period that commenced in the late eighteenth century and continued into the twentieth century. These sources include ethnographies and oral narratives (e.g., Arima 1983; Arima and Dewhirst 1990; Drucker 1951; Sapir and Swadesh 1978; Sproat 1987; Webster 1983) and ethnohistorical accounts and summaries (e.g., Beaglehole 1967; Galois 1994; Guillod 1881, 1887; Jewitt 1987; Meares 1967; Menzies 1923; Moziño 1991; O'Reilly 1886, 1889; Powell 1873, 1875; Tello 1930; Walker 1982). Interpretations of ancient Nuu-chah-nulth land use can be found in the archaeological literature (e.g., Arcas 1988, 1989, 1998a, 1998b; Arcas and Archeo Tech 1994; Dewhirst 1978, 1980; Mason et al. 1999; Mitchell 1990; McMillan 1996, 1999). Similar to other areas along the Northwest Coast, most of the archaeological data has been amassed through the work of archaeological consultants and is only found in unpublished reports that are often difficult to access (Moss and Erlandson 1995). For this reason, a synthesis of the data for Clayoquot Sound is long overdue.

A second goal of the research is to use techniques of spatial analysis to investigate the antiquity of the ethnographic land use pattern of the Nuu-chah-nulth of Clayoquot Sound. Archaeological evidence indicates that the Nuu-chah-nulth have resided on the west coast of Vancouver Island for more than 4,000 years (Dewhirst 1978, 1980; Mitchell 1990; McMillan 1999) and in Clayoquot Sound specifically for at least 1,200 years (Calvert 1980; Haggarty 1982). Nuu-chah-nulth land use in recent history has been described in detail by ethnographers (e.g., Drucker 1951). However, the antiquity of the ethnographic pattern of land use remains unknown and is the subject of considerable debate (e.g., Haggarty 1982; Inglis and Haggarty 2000; Mitchell 1990; McMillan 1999).

An evaluation of the potential of geographic information systems (GIS) and other computer software for spatial analysis is an auxiliary objective of this study. GIS offer a sophisticated means of organizing and analysing complex spatial data. Its capabilities allow researchers to conduct studies that would have been impractical before the technology became available (Wheatley and Gillings 2002). I provide a detailed review of the use of GIS in archaeology in Appendix A. Without GIS, the study I present here would have been extremely difficult and time consuming to undertake.

Components of the Research

The research I present in this thesis has three components. First, using ethnographic and ethnohistorical sources, I provide a synthesis of how the Nuu-chah-nulth used the land in the contact period. The second component consists of the formulation of two land use models. The Cultural Landscape Model predicts how the ethnographic pattern of land use would appear in the archaeological record. Whereas the Cultural Landscape Model focuses on all aspects of land use, the Habitation Site Model concentrates only on habitation sites. It predicts the location of archaeological habitation sites based on environmental variables identified by the ethnographers (e.g., Arima 1990; Drucker 1951) as relevant to the Nuu-chah-nulth when locating their villages, or habitations. The final component of the study is a comparison of these two models to the known archaeological record. The purpose of the comparison is to ground truth the models against the known archaeological record to evaluate how well the models represent ancient land use among the Nuu-chah-nulth in Clayoquot Sound. A lack of correlation between what the models predict and the archaeological record would suggest problems with the models or the data, or simply that the models do not reflect ancient land use.

In developing the Cultural Landscape Model, I followed a cultural landscape approach that is guided by the basic tenets of landscape archaeology, but relies on the integration of various sources of information (Buggey 1999). The cultural landscape approach views the archaeological record as a continuous surface, not as discrete locales where evidence of activities of the past exist in the present day. This perspective recognizes that Aboriginal people of the past used the entire landscape, whether or not the use of the land left an imprint (Buggey 1999). Thus, models developed from ethnographic and ethnohistorical records should also consider how people used the landscape in its entirety.

The cultural landscape approach to model building cannot be used to develop grand theories as it relies heavily on the specific history of the culture being studied. Instead, the focus is on explaining a limited range of data. In the particular case of this research, I focussed on developing models regarding land use and tenure using ethnographic, ethnohistoric and traditional knowledge observations. Trigger (1991) calls such an approach 'holistic archaeology.'

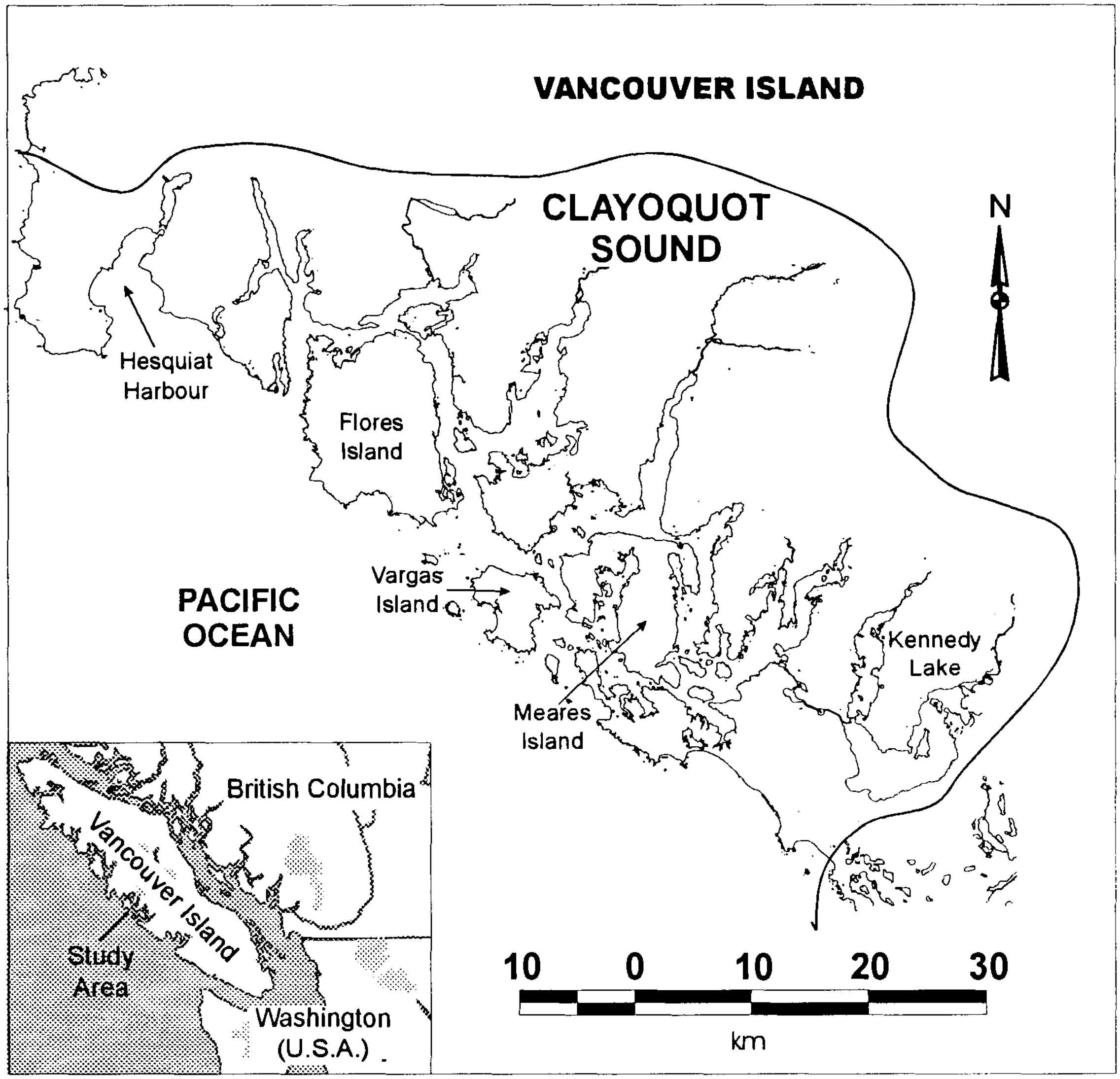


Figure 1. Map of Clayoquot Sound, West Coast of Vancouver Island.

THE PHYSICAL SETTING

Clayoquot Sound is located on the central west coast of Vancouver Island, spanning approximately 100 kilometres of coastline (Figure 1). It is a geographical unit defined by its watershed, encompassing all the lands that drain into the sound (Greer and Kucey 1997; Bouchard and Kennedy 1990). The watershed covers approximately 350,000 hectares, 262,600 of which comprise the land (Smith 1998).

Situated within the biogeoclimatic zone described as the Coastal Western Hemlock Zone, Clayoquot Sound is characterized by relatively high amounts of precipitation and abundant diversity of flora and fauna. Two subzones of the Coastal Western Hemlock biogeoclimatic zone are present in the study area: the Very Wet Maritime and the Very Wet Hypermaritime. They are, on average, the rainiest in British Columbia (Pojar et al. 1991). Mild, cloudy and wet winters and relatively dry summers with moderate temperatures are typical for this location (Hebda 1995). Heavy rains and winds from southeasterly storms arrive in early autumn and persist until spring (Arima 1983; Arima and Dewhirst 1990; Drucker 1951).

In spite of the poor, thin soil of the area, the land supports a lush and diverse forest (Drucker 1951). The forest canopy consists mainly of coniferous trees, the most culturally important of which is western redcedar (*Thuja plicata*). The understory is comprised of a variety of ferns, and berry producing shrubs including salmonberry (*Rubus spectabilis*) and other members of the raspberry family (*Rubus* spp.), salal (*Gaultheria shallon*), and various huckleberries (*Vaccinium* spp.), all of which figure prominently in the Aboriginal diet. Culturally important terrestrial fauna within this biogeoclimatic zone include coast deer (*Odocoileus hemionus columbianus)*, black bear (*Ursus americanus)*, beaver (*Castor canadensis*), wolf (*Canis lupis*) and cougar (*Felis concolor*) (Clayoquot Sound Scientific Panel 1995; Pojar et al. 1991).

The main source of protein for the Nuu-chah-nulth diet since ancient times came from the sea (Dewhirst 1978; Mitchell 1990; McMillan 1999). Marine fauna is considerably more abundant and diverse than that found on the land. A large variety of bivalves are found throughout Clayoquot Sound as are a number of culturally important sea mammals, including seals (*Callorhinus ursinus* and *Phoca vitulina*), grey whales (*Eschrichtius robustus*), humpback whales (*Megaptera novaengliae*), and orcas (*Orcinus orca*). Five species of salmon (*Oncorhynchus* spp.), Pacific halibut (*Hippoglossus stenolepis*), lingcod (*Ophiodon elongatus*) and Pacific herring (*Clupea harengus pallasi*) are also widely available throughout the study area (Clayoquot Sound Scientific Panel 1995).

The present day climate and vegetation of the west coast of Vancouver Island has only been in place for 2,000 years (Hebda 1995). Pollen analysis indicates that in the period before 13,000 BP, the climate was cool to cold and possibly somewhat drier than today. The following 3,000 years were characterized by a mixed conifer forest and a cool moist climate. As the climate warmed between 10,000 and 9,000 BP, Douglas-fir (*Pseudotsuga menziesii*) gained a foothold and expanded. By the middle Holocene, beginning about 6,000 BP, increasing moisture and cooler temperatures favoured the presence of western hemlock (*Tsuga heterophylla*) and, somewhat later, favourable conditions led to the appearance of western redcedar. By 2,000 years ago, the present climatic regime developed and the extant vegetation pattern was established (Hebda 1995).

The physical landscape of Clayoquot Sound is characterized by an open outer coastline broken into a number of inlets, which radiate landwards. Numerous streams drain into the inlets from the mountains to the northeast, which reach elevations from 600 to 1200 metres above sea level. At the entrance to Clayoquot Sound are two large islands, Flores and Vargas, which protect the inside waters from the effects of the often turbulent Pacific Ocean. Within these sheltered waters are numerous islands and rocky islets (Arima and Dewhirst 1990; Greer and Kucey 1997; Haggarty and Inglis 1983; Morgan 1981). At the south end of Clayoquot Sound is the largest tidal flat complex on Vancouver Island, which is completely sheltered from the open Pacific Ocean (Clague and Bobrowsky 1993).

The physiography of the study area is the product of natural forces actively sculpting the landscape of Clayoquot Sound. Habitable land all but disappeared under a sheet of ice during the Pleistocene epoch. At its maximum extent, the edge of the Cordilleran Ice sheet appears to have closely coincided with the west coast of Vancouver Island. Close to its margin, the ice was likely relatively thin in comparison to other coastal regions, but the entire study area would have been covered, and affected by, the presence of glacial ice (Clague et al. 1980; Clague et al. 1982).

Fluctuations of relative sea levels have also impacted the shoreline of the study area. Beginning with the onset of deglaciation approximately 15,000 years ago, there have been dramatic changes in relative sea level along the west coast of Vancouver Island (Friele 1991). Radiocarbon dating of glaciomarine sediments indicates that the minimum age for deglaciation in southern Clayoquot Sound is 13,780 ± 110 years BP (Clague and Bobrowsky 1993:180). At this time, shorelines were well above present levels; the upper limit recorded for Clayoquot Sound of 32 to 34 metres above present sea level was recorded in Hesquiat Harbour and dates to approximately 13,000 years ago (Clague et al. 1982). During the early Holocene epoch, sea levels rose and fell relative to the land as coastlines adjusted to the warmer climate (Clague et al. 1982). In Clayoquot Sound specifically, geological evidence indicates that by 5,000 BP, sea levels reached three metres above the modern level, and remained stable for 1,000 years, before dropping steadily until the present day (Friele 1991). Today, relative sea levels continue to slowly and steadily fall along the west coast of Vancouver Island, which is the result of tectonic uplift (Clague et al. 1982).

The phenomenon of plate tectonics continues to influence the near shore environment of Clayoquot Sound because it lies in the vicinity where two crustal plates meet. The oceanic Juan de Fuca plate and the continental North American plate form the Cascadia subduction zone where great earthquakes of magnitude eight or more, and associated tsunamis, are possible (Clague and Bobrowsky 1993; Hutchinson and McMillan 1997). Evidence of sudden subsidence and an associated tsunami has been documented in the study area at some time between 100 and 400 years ago. (Clague and Bobrowsky 1993). Nuu-chah-nulth oral narratives corroborate the occurrence of great earthquakes and associated tsunamis in the past (Budhwa 2002; McMillan and Hutchinson 2002).

Clayoquot Sound can be divided into discrete physiographic regions. I relied on the eight environmental settings identified by Arcas and Archaeo Tech (1994) (also Arcas 1998a) for Clayoquot Sound to develop land use models during the course of this research. Each environmental setting differs from one another in terms of physical characteristics and available animal and plant resources (Table 1). These differences have clear implications for Aboriginal land use within the study area which is explored further in the models presented in chapter three.

Table 1. The Environmental Settings of Clayoquot Sound (Arcas and Archeo Tech 1994).

Environmental Setting	Physical Characteristics	Available Resources
Outside Coast	• rocky headlands, extensive sand beaches, high rock arches and sea caves • islets and reefs also common	• sea mammals, various fish species, shellfish, and land mammals such as deer and black bear • plant resources limited due to exposure to wind, rain and salt air
Inside Coast	• channels, bays and short inlets that are protected from the open ocean • generally less rugged than the Outside Coast but similarly comprised of islets, small bays, rock bluffs and beaches	• similar marine resources to Outside Coast, but with less diversity and abundance • plant resources considerably richer than Outside Coast, including large stands of tall straight redcedars and many fruit and berry species
Inlets	• steep rocky shorelines, deep channels and few islands	• rich in timber, but other resources are limited
Estuaries	• typically located at the heads of inlets although several estuaries, at the mouth of the Kennedy River for example, are found further down the inlets	• salmon, shellfish, land and sea mammals and migrating waterfowl • abundant plant resources, especially excellent quality redcedars
River Valleys	• associated with Estuaries • elevations increase dramatically in a short distance from the shore	• the valley floor is rich in fish and terrestrial mammal resources • hillsides dominated by redcedar and western hemlock with high diversity of berry resources on the valley floor
Kennedy Lake	• the only significantly large lacustrine environment in Clayoquot Sound	• abundant fish, particularly salmon, and animal resources • abundant timber and terrestrial plants
Coastal Mountains	• comprised of the mountains that rise from the coastal plain of the Inside Coast, and reach elevations between 700 and 800 metres above sea level	• limited diversity of terrestrial mammals • substantial forest resources, but limited diversity and abundance of plants in the understory
Inland Mountains	• the source of water flowing through the river valleys • mountain reach elevations of more than 1,200 metres above sea level	• as elevation increases, plant and animal resources decrease

DEFINITIONS

Like any academic discipline, archaeology is replete with jargon. Some terms are exclusive to archaeology; others are borrowed from other disciplines. This section offers definitions for the archaeological terminology used throughout this thesis. Unless otherwise specified, these definitions follow those provided by Arcas (1998b:2).

The *Northwest Coast* is a cultural division used to describe the Aboriginal communities that lived along the Pacific Coast of North America for thousands of years. The culture area is defined geographically by the Copper River delta on the Gulf of Alaska, the Winchuk River, just south of the Oregon-California border, and in the east by the inland mountain ranges that parallel the coastline (Suttles 1990a:1). *Traditional use sites* are the locations where the people of the Northwest Coast engaged in a variety of activities, some of which are still pursued today. *Archaeological sites* are traditional use sites that contain physical evidence of past activities, such as village sites and fishing stations. *Cultural,* or *archaeological, features* are the physical remains found in archaeological sites. In Canada, archaeological sites are designated with *Borden Numbers* when they are accepted into an inventory, or database, of archaeological sites. A Borden Number consists of four letters and a number relating to geographic coordinates. The Borden Number system is a grid-based system that uses the National Topographic Service (NTS) map series (Fladmark 1978).

In the following section, I provide a description of the typical cultural features found in archaeological sites in the study area (following Mackie 2001; Mason et al. 1999). While individual feature types provide us with some insight into what the site was used for, they are often found in association with one another. The unintended consequence is to alter interpretations of site function. As my research focuses only on Aboriginal sites, only features consistent with those sites are described.

Shell midden deposits typically represent the remains of domestic refuse due to extended use of a village or habitation site. They also occur in intensively used non-habitation sites such as shellfish procurement areas. In general, midden deposits are characterized by alternating layers of shell and other cultural material, such as fire-cracked rocks, animal bones, and artifacts, with black, greasy organic soil.

Large middens, especially when house depressions or platforms, berms and ridges are visible, are often interpreted as village locations. Smaller middens are normally inferred as temporary camps or seasonal resource procurement areas. Small, shallow shell midden deposits are also found in caves and rockshelters throughout the study area. Investigators most often interpret these locations as temporary camps for travellers, unless human remains are present.

Defensive sites are typically located on steep-sided, flat-topped islands or peninsulas and are normally found in association with village sites. In the study area, these sites often contain shell midden deposits as well. They likely offered additional protection during times of war.

Canoe skids are linear impressions one to three metres in width and resulted from clearing cobbles to facilitate beaching canoes. They are typically found on cobble and boulder beaches. They are readily discernible, especially at low tide, as a cleared area outlined by linear alignments of cobbles.

Canoe skids are often found in association with other features such as shell midden deposits or other resource procurement features, such as culturally-modified trees, or fish traps or weirs. When canoe skids are the only features present, interpreting site function is difficult. The canoe skids indicate that people pulled their canoes ashore, but in the absence of other features, the investigator cannot, with confidence, interpret whether the area was used for resource procurement or as a temporary camp or stopover.

Fish traps, comprised of stone walls, or *fish weirs*, constructed of wood, were used to catch spawning salmon at the mouths of streams. Similar to canoe skids, these features are most easily discernable at low tide. The best preserved of these features are made of stone, many of which may have incorporated wood and basketry items to facilitate trapping of the fish. Basketry and wood are highly perishable, but weirs comprised of wooden stakes have been recorded all over the Northwest Coast. Significantly, wooden weirs can be radiocarbon dated (Moss et al. 1990).

Fish traps and weirs indicate that the site function would be resource procurement, so they are often found in association with shell middens and canoe skids. Depending on the whole complex of features, particularly the size and depth of the shell midden, the investigator may interpret the site as a resource processing site, a camp or a habitation. Depending on the location and the presence of structural features, investigators may be able to state with confidence that some of these sites were fall fishing stations.

A *culturally modified tree (CMT)* is defined as "a tree that has been altered by native people as part of their traditional use of the forest" (Ministry of Forests 1997:7). The most common types of CMTs exhibit scars from bark-stripping or have been logged to obtain materials for traditional woodworking. Bark-stripped trees are typically standing trees with one or more tapered or rectangular bark removal scars. Aboriginal logging practices left behind stumps, standing trees or logs with plank removal scars, trees with holes that are inferred as tests for heartwood soundness (called test-holes), trees with undercut scars, and canoe blanks or preforms.

CMT sites are most often comprised solely of CMTs. In this case, the investigator would interpret the site function as resource procurement. Sometimes, CMTs are found in association with other features. The researcher would then consider the complex of features that are present and the intensity of use to guide their interpretation.

As dictated by their customs, Nuu-chah-nulth interred *human remains* in caves, rockshelters, on islets or prominent points of land and in trees. The oldest and most common method was interment in trees (Koppert 1930). Typically, an individual was first placed in a grave box and then put in one of the places noted above. Caves and rockshelters often contain the remains of multiple individuals. With tree burials, remains were placed on platforms, and once the platform rotted away, the human remains would be scattered at the base of the tree. Although rare, burials have been recorded in shell midden deposits in the Nuu-chah-nulth culture area.

Both types of *rock art* - *pictographs*, images that have been painted onto a rock surface, and *petroglyphs*, images that have been carved or pecked into a rock surface - have been recorded in Nuu-chah-nulth territory. Zoomorphic, anthropomorphic and geometric forms are among the most common motifs. In the study area, rock art is typically found unassociated with other archaeological features.

OUTLINE OF THE CHAPTERS

In this thesis, I present land use models for the Nuu-chah-nulth people of Clayoquot Sound, based on a thorough examination of ethnographic and ethnohistoric sources. The following chapters describe the methodology I used to create and evaluate the models against the known archaeological record and the results of my research.

Chapter two presents a discussion of model building. The chapter begins with a summary of general ethnographic and ethnohistorical information for the Nuu-chah-nulth of Clayoquot Sound. I follow this with a review of the impacts of contact with non-Aboriginal people during the global era and a discussion of Nuu-chah-nulth culture history. I then provide a summary of the theory that structured my research and an evaluation of the sources of information I used. I follow this with a description of the methods I used in collecting, organizing and converting my data into formats that allowed me to develop, present and evaluate the models. I then describe the steps I followed in developing and evaluating the models against the archaeological record.

In chapter three, I provide the results of my research. In the first section of the chapter, I review the patterns of post-contact land use and land tenure as described in the ethnographic and ethnohistoric literature. Based on this review, I developed a summary table of land use using the environmental settings described above, which I also present in chapter three. I then decided to correlate types of archaeological remains with land use activities as described in the ethnographic and ethnohistoric literature. Refining its parameters resulted in a predictive device I label the Cultural Landscape Model. By refining further the parameters of the Cultural Landscape Model, I develop the Habitation Site Model, based on a subset of the data, as another predictive device. It places the emphasis on variables identified by ethnographers as pertinent in locating habitation sites. While the Cultural Landscape Model encompasses all of Clayoquot Sound, the Habitation Site Model applies specifically to habitation sites. For general comparison, I offer a brief inventory of the archaeological and traditional use sites that other researchers have recorded in Clayoquot Sound. The chapter concludes with a comparison of the Cultural Landscape Model and the Habitation Site Model against the known archaeological record.

In chapter four, I provide conclusions regarding the results of the research I present in this thesis. Each of the main goals I identified early in this chapter - to contribute to an understanding of Nuu-chah-nulth land use, to develop models to test the antiquity of the ethnographic pattern of land use and, to evaluate the potential of GIS in archaeological research - are evaluated in turn. I then provide some of my thoughts on using models in archaeological research. The chapter, and the thesis, concludes with a discussion of the implications of my current research.

CHAPTER TWO:

MODEL BUILDING

In this thesis, I present land use, or locational, models for the Nuu-chah-nulth of Clayoquot Sound. The most basic method is a thorough review of ethnographic, ethnohistoric and archaeological literature. I begin chapter two with a survey of the cultural history of the Nuu-chah-nulth I compiled from published and unpublished sources. Then I discuss the theoretical underpinnings of the research, including a discussion of the cognitive mapping that Aboriginal people use to relate to their environments. Locational or land use models, as related to cultural ecology and the ecological approach, are at the heart of this study. Many such models that have been developed for Aboriginal populations fail to incorporate the Aboriginal group's perspective on their environment; an understanding of the cognitive maps that circumscribe the land can make locational models more robust and relevant. Landscape archaeology, particularly the cultural landscape approach is also described as it entails integration of all available lines of information to understand how an entire landscape was used and perceived by an Aboriginal group.

I then outline the specific details of the land use models. As I was aware that the models would only be as good as the data I derived them from, the first step was to scrutinize the data and their sources. Confident that the data were adequate, I began to organize and manipulate them into forms that supported model building. This process, along with the methods I used to compare the models to the archaeological record, are also described in this chapter.

THE NUU-CHAH-NULTH

The Ethnographic Setting

The Aboriginal inhabitants of Clayoquot Sound are culturally affiliated with the Nuu-chah-nulth, formerly known as the Nootka and sometimes referred to as the West Coast People. The people of Clayoquot Sound participated in the common culture of all Nuu-chah-nulth groups. Many Nuu-chah-nulth customs have antecedents in the archaeological record, exhibiting considerable time depth (Mitchell 1990). Their language is of the Wakashan family and it bears linguistic affinity to the language of their Kwakwaka'wakw neighbours (Arima and Dewhirst 1990; Bouchard and Kennedy 1990; Drucker 1951).

The lands of the Nuu-chah-nulth are oriented northwest to southeast along the west coast of Vancouver Island. The name Nuu-chah-nulth translates to "all along the mountains," referring to the mountain range of central Vancouver Island (Bouchard and Kennedy 1990:15). They believe that they have occupied this land since time immemorial and have no oral traditions of migration from another place (Arcas and Archeo Tech 1994).

Of the twenty to twenty-two autonomous groups noted by early ethnographers, amalgamations throughout the early contact period resulted in the fifteen Nuu-chah-nulth groups recognized today (McMillan 1999). Following Drucker (1951), who wrote the most detailed and comprehensive ethnography, the Nuu-chah-nulth can be divided geographically and linguistically into three associated groupings: Northern, Central and Southern. According to this classification, the people of Clayoquot Sound belong to the Central Nootkan tribes. Drucker (1951) proposed that groups living together within a natural geographic division had more intimate and regular contact with each other than groups in neighbouring sounds or inlets, which resulted in these linguistic divisions.

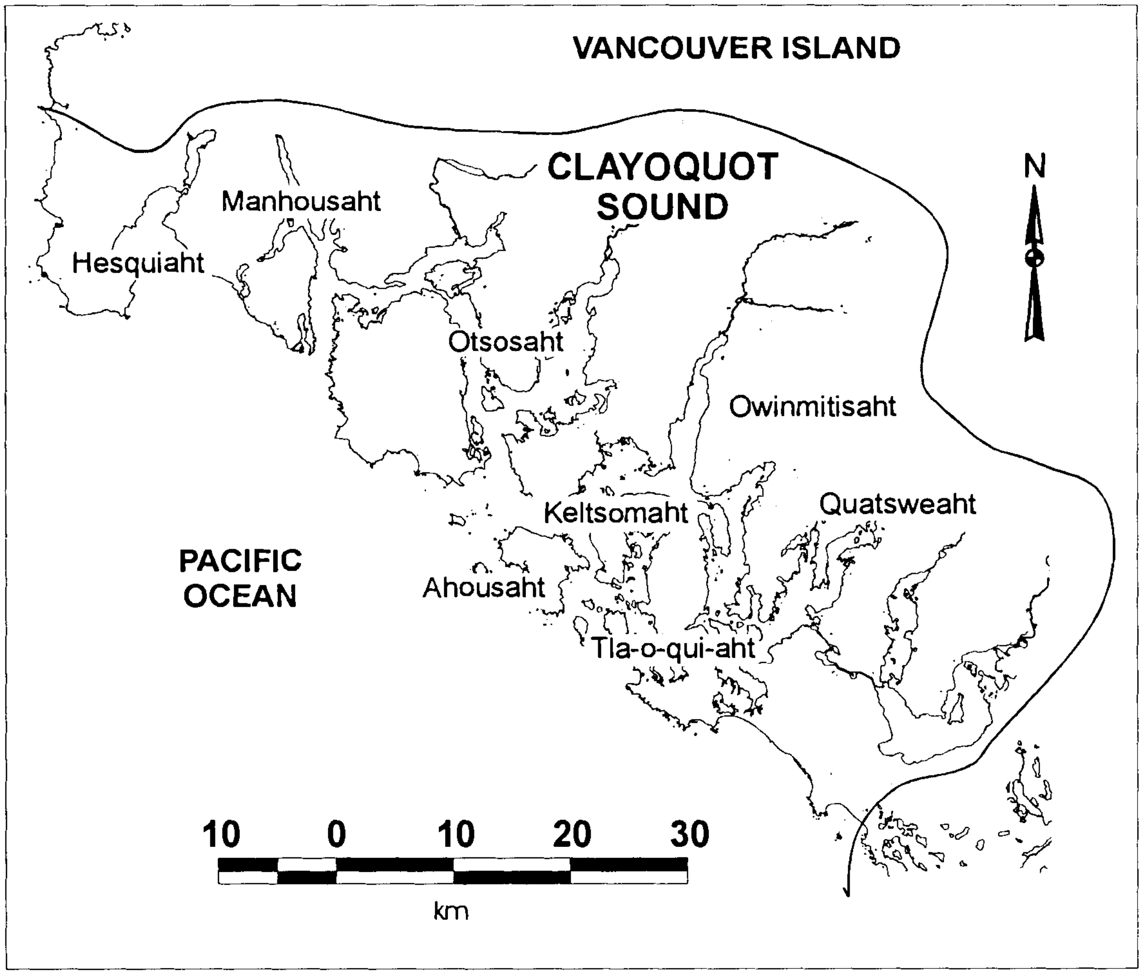


Figure 2. Precontact Occupants of Clayoquot Sound.

Clayoquot Sound was the Aboriginal homeland of nine Nuu-chah-nulth groups (Figure 2) (Drucker 1951; Bouchard and Kennedy 1990; Wilson et al. 1991). However, only three distinct groups reside in the study area today: the Hesquiaht at the north end of the sound, the Ahousaht who occupy the lands in the centre of the sound and the Tla-o-qui-aht who reside at the southern end of the study area, including the shores of Kennedy Lake. In addition, Ucluelet's traditional territory extends into the Clayoquot Sound watershed (Arcas and Archeo Tech 1994; Smith 1997). Among the Nuu-chah-nulth, regular intraregion contact resulted in either the development of federations or alliances, or the rise of a dominant group through conquest. Sociopolitical development in Clayoquot Sound particularly seems to conform with the latter process (Drucker 1951). Amalgamations of the nine groups into three groups known today are mainly a result of wars that raged across the west coast of Vancouver Island in the early nineteenth century. These wars are described in Arima (1983), Drucker (1951), Bouchard and Kennedy (1990), Sapir and Swadesh (1978) and Webster (1983).

The main motivation for warfare among the Nuu-chah-nulth was economic - a need for obtaining more, or more desirable, resource territories - but often resulted in a major shift of power (Drucker 1951; Langdon 1976). For example, the Tla-o-qui-aht, an amalgamation of local groups based in the Kennedy Lake area, expanded their territory by attacking groups to the west, decimating or absorbing smaller, less powerful groups as they went (Arima 1983; Drucker 1951; Bouchard and Kennedy 1990). In the late precontact period, they took the site of Opitsat, already a major village, from the Keltsomaht and installed Wickaninnish as their head chief. Chief Wickaninnish rose to be the dominant leader by the time that European and American mariners arrived in Clayoquot Sound in 1787 (Howay 1941; Koppert 1930; Lane 1991; Meares 1967; Tello 1930; Wagner 1933).

The Global Era

Common to all Aboriginal groups throughout Canada is their uneasy integration into the world system. It brought significant change to Nuu-chah-nulth lifeways, but this change was more gradual than noted for other Aboriginal groups. Instead, it appears that the Nuu-chah-nulth maintained their lifeways for a considerable period of time following contact, with each significant event affecting their use of the land in different ways (Table 2). The Nuu-chah-nulth's steadfast preservation of their customs during the global era suggests that there may be some continuity of lifeways from ancient times, therefore the ethnographic and ethnohistorical literature provide a relevant analogue.

Table 2. Post-Contact Timeline for the Nuu-chah-nulth (from Morgan 1981, Smith 1998, and Wike 1951).

	Event	Impact on Land Use
1971	Road to Tofino is paved and Pacific Rim National Park Reserve is established, bringing tourism to Clayoquot Sound.	
1955	Forest Management Licences 20 and 21 awarded, later combining to form tree farm licence 44 (MacMillan Bloedel, now Weyerhaeuser Company). Large-scale industrial logging begins, bringing large numbers of non-Aboriginal people to Clayoquot Sound.	As logging and other resource activities increase in intensity and spatial extent, Aboriginal people become further contained on their Indian Reserve 'enclaves.' Many Aboriginal men seek employment in logging industry.
1905 to 1908	Timber Rights staked by early timber entrepreneurs. Small-scale logging begins.	
Entire 20th Century	Full impact of market economy, Federal government administration under the *Indian Act*, and arrival and expansion of resource industries lead to decrease in Nuu-chah-nulth power over land and resources.	Travel restrictions and decreased resource control imposed under the *Indian Act* leads to increased year-round sedentism. Increased reliance on store-bought goods and services and employment leads to settlement on Indian Reserves closest to market and employers.
1880s	Sealing ships offer long-term employment to Nuu-chah-nulth men, leading to long and dangerous excursions to the Bering Sea.	Men away for long periods, thus less time spent on subsistence activities and increased dependence on trading posts; results in less seasonal movement.
	Federal government establishes Indian Reserves throughout Clayoquot Sound.	Nuu-chah-nulth retain summer and winter villages and fishing stations, but lose control of resources.

	Event	Impact on Land Use
1875	Father Brabant establishes mission at Hesquiaht.	'Christianization' leads to Nuu-chah-nulth groups moving closer to church.
1860s	Trade with non-Aboriginals returns with increased demand for dogfish oil.	Results in people spending winters in summer villages along coastline to take advantage or trade opportunities.
1852	Major smallpox epidemic arrives.	Dramatic population decrease results in shift in subsistence pattern, land use and social system.
1803	Mowachaht warriors seize two trade ships and massacre nearly the entire crews. Increased danger and decrease in pelts results in cessation of trade.	Precontact pattern re-establishes.
1790s	By end of decade, dramatic decrease in numbers of sea otters in Nuu-chah-nulth area; trade decreases. Increased demand for sea otter pelts leads to main harbours becoming loci for trade.	Centralization of wealth and power among the Nuu-chah-nulth leaders controlling the ports. Leaders obtain pelts from outlying groups.
1784/5	Captains Barkley and Meares arrive specifically to obtain sea otter pelts for sale in Canton.	Intense pressure on sea otters and other fur bearing animals.
1778	Captain Cook arrives in Nootka Sound, which leads to global trade in sea otter pelts. Syphilis transmitted to Nuu-chah-nulth.	Despite syphilis, populations remain robust; pre-contact patterns remain intact.
1774	First contact with Nuu-chah-nulth when Captain Perez anchors off Nootka Sound.	Pre-contact subsistence/settlement pattern continues.

The global era commenced for the Nuu-chah-nulth in 1774 when Captain Juan Perez anchored off of Yuquot in Nootka Sound. While no one from the ship went ashore, a group of Nuu-chah-nulth rowed out in their canoes to greet the ship (Drucker 1951). The first sustained contact took place in March 1778 when Captain Cook arrived at Yuquot and stayed for nearly one month and traded European goods for sea otter pelts with the Nuu-chah-nulth residents. When Cook arrived in Canton, China, the value of sea otter pelts was quickly realized and the period of intensive trade with Aboriginal people of the Northwest Coast began (Beaglehole 1967). In 1787, Captain Charles Barkley became the first European trader to drop anchor in Clayoquot Sound (Lane 1991), with

Captain John Meares arriving the following year (Meares 1967). Between 1778 to 1805, more than 50 European and American ships visited Nuu-chah-nulth shores (Inglis and Haggarty 2000). Early trade was dominated by the British, but international political issues led to the Americans rapidly taking complete control of trade on the Northwest Coast (Wike 1951).

When the American traders took over west coast trade, their sole agenda was to make profit. They had no interest in staking claim to territories for their government (Wike 1951). Therefore, they did nothing to acculturate their trading partners, and Aboriginal groups maintained considerable autonomy (Wike 1951). The introduction of firearms in the trade for sea otter furs placed Aboriginal groups in a strong bargaining position, allowing them to influence the extent and content of trade (Wike 1951). In general, they demanded items that were technologically suitable to their existing subsistence practices (Cole and Darling 1990; Wike 1951).

By the 1790s, there was a dramatic decrease in availability of sea otter skins, and trade within Nuu-chah-nulth territory declined until it virtually stopped by 1805 (Morgan 1981; Drucker 1951; Wike 1951). Only in the 1850s and 1860s did limited trading return to the area as demand for dogfish oil to supply the sawmill industry on Vancouver Island increased (Drucker 1951; MacFie 1865; Morgan 1981). By the 1880s most Aboriginal groups along the west coast of Vancouver Island were earning a living by processing dogfish oil (Guillod 1881; MacFie 1865; Powell 1875).

Introduced disease had a huge impact on the Nuu-chah-nulth people in the second half of the nineteenth century. While syphilis was present in the late eighteenth century, there was little illness among the Nuu-chah-nulth (Tello 1930). The first major smallpox epidemic to affect the Nuu-chah-nulth arrived in 1852 and resulted in a dramatic decrease in population (Drucker 1951:12; Morgan 1981). Minor outbreaks of smallpox continued to recur over the following decades (Drucker 1951). Population estimates for the entire Nuu-chah-nulth territory at time of contact vary widely from 6,000 to 9,000 to as much as 23,000 people (Wike 1951:57). Boyd's (1990) research suggests a number closer to 6,000 for the Northern and Central tribes in 1774, which probably decreased by two-thirds by 1881. One Spanish explorer in 1791 estimated the population of Opitsat, the Tla-o-qui-aht's main winter village, to be as much as 2,500 people, and the total population of Clayoquot Sound as approximately 8,500 people (Wagner 1933). According to the Federal government Indian Agent and the Reverend Charles Moser, a missionary living in Clayoquot Sound, the total population of the Nuu-chah-nulth had fallen to 3,698 by 1881 and 1,634 by 1929 (Koppert 1930:4). In Clayoquot Sound the total population in 1881 was 995, and by 1929 their numbers had decreased to 548 (Koppert 1930:4). The high number of deaths throughout this period could have impacted both ceremonial life and land use strategies. Increasing frequency of funerals, particularly of high status individuals, would have required that more frequent potlatching, house construction and canoe building took place coincident with a declining labour pool. The raw material required for these activities would have placed greater demand on workers to harvest cedars (Pegg 2000).

British Columbia joined Canada in 1871, and within a few years, the Nuu-chah-nulth of Clayoquot Sound were experiencing the full effects of Canada's federal policy for Aboriginal people. Indian Reserves were established throughout the area between 1886 and 1889 (O'Reilly 1886, 1889). Groups retained small tracts of land around their winter and summer villages and fishing stations so there was no separation of groups. Subsequently, they lost control of their resources (Canada and British Columbia 1914; Drucker 1951; Morgan 1981; Powell 1875; White-Harvey 1994). By 1875, Christianity arrived in Clayoquot Sound when Father Brabant established a Catholic mission at Hesquiaht (Drucker 1951; Morgan 1981). In 1899, the Federal government opened the Christie Indian Residential School on Meares Island in Clayoquot Sound to encourage Christianization and assimilation of Nuu-chah-nulth children (Drucker 1951). In 1914, Indian Agent Charles Cox noted that there was "no child here of school age that does not go to school" (Canada and British Columbia 1914:16).

The market economy began to make serious inroads into Clayoquot Sound at the same time. Isolation on small Indian Reserves prevented First Nations people from earning a living from the resources within their traditional territories, so they turned to whatever employment opportunities were available (White-Harvey 1994). In the 1880s, sealing ships began to offer long-term employment opportunities to adult males, taking them away from their communities to the Bering Sea for long periods of time (Drucker 1951; Guillod 1881; Morgan 1981). The same companies that operated the sailing ships established several trading posts, including one at Clayoquot (Morgan 1981).

Throughout the twentieth century, Federal government administration expanded under the *Indian Act.* Subsequently, the arrival and expansion of resource industries all contributed to a decrease in Nuu-chah-nulth power over, and access to, their traditional lands and resources. Paradoxically, they increased their participation in these new industries and provided the labour to extract the resources from their traditional lands. All of these factors led to a shift away from well-established subsistence practices (Drucker 1951; Morgan 1981). In the last few decades, however, there has been a resurgence of interest by Nuu-chah-nulth peoples in their ancient practices, particularly in regards to resource use and stewardship (Clayoquot Sound Scientific Panel 1995; Turner and Jones 2000).

Culture History

The archaeological sequences for the Nuu-chah-nulth area appear quite simple when compared to other culture areas (Table 3). However, this apparent simplicity is partially due to the paucity of archaeological sites excavated in this area. In fact, the majority of archaeological attention for the Nuu-chah-nulth has focussed on Nootka Sound and Barkley Sound, with archaeological work being limited to intensive surface survey in parts of Clayoquot Sound (Wilson et al. 1991).

Table 3. Archaeological sequences for the Nuu-chah-nulth culture area.

Time (BP)	Phase	Characteristics
pre-5,000	Early Period	Speculative. No sites radiocarbon dated to more than 4,200 years ago (Matson and Coupland 1995). However, artifacts consistent with this sequence have been found in intertidal deposits (Marshall 1992).
4,200-contact	West Coast Culture Type	Single continuous culture type for the entire Nuu-chah-nulth territory. Characterized by ground stone, bone and shell technology, with a low abundance of stone tools (mainly abraders which were likely used for manufacturing bone and antler tools). Subsistence based mainly on maritime resources. Large, permanent villages established at least 2,000 years ago (Mitchell 1990).
4,000-?	Shoemaker Bay Culture Sequence	Known only from the Shoemaker Bay site in the Alberni Valley, the Little Beach site and sites in Barkley Sound (Brolley 1992; McMillan 1998, 1999). Characterized by flaked stone technology with some ground stone, microblades, and rectangular adzes, all similar to the Locarno Beach and Marpole culture types in the Strait of Georgia (McMillan and St. Claire 1982); later deposits exhibit traits similar to both Strait of Georgia and West Coast culture type assemblages (Mitchell 1990).

Archaeological deposits dating to the Early Period, as defined by Matson and Coupland (1995), have not been recorded in the Nuu-chah-nulth area. However, stone tools have been found in intertidal deposits that appear to belong to this period (Marshall 1992). The lack of knowledge of sites pre-dating 4,000 BP may be a result of changes to relative sea levels as sites located around the present day shoreline would have been affected by fluctuating sea levels. Sites dating to earlier than 5,000 BP are likely to be located on relict beach terraces several metres above the modern sea level (Mason et al. 1999; McMillan 1999).

Based on the excavations at Yuquot, Mitchell (1990) defined the West Coast Culture Type as a single continuous entity spanning the entire Nuu-chah-nulth territory and persisting for the 4,000 years prior to the current era. This culture type is characterized by sustainable lifeways employing appropriate technology during those millennia (Mitchell 1990). Suitable lithic raw materials for tool manufacture are limited on the west coast of Vancouver Island, so the Nuu-chah-nulth utilized wood, bone, antler and shell for that purpose. As such, the archaeological remains of ancient Nuu-chah-nulth are subject to relatively extreme preservation bias that favours technology made from stone (McMillan 1999; Mitchell 1990).

Deposits containing flake or chipped stone technology similar to those found in archaeological sites around the Strait of Georgia have been recorded at Shoemaker Bay in the Alberni Valley, and in the deeper strata of excavated sites to the south of Clayoquot Sound (Brolley 1992; McMillan 1996, 1998, 1999). The assemblages included chipped and ground slate projectile points, quartz crystal and obsidian microblades and a cairn burial (McMillan 1998, 1999). Similar finds have been noted at the Little Beach Site in Ucluelet and in surface collections from undated sites (Brolley 1992; McMillan 1998). While the assemblages at these sites are consistent with the Locarno Beach Culture Type, only deposits at the Ch'uumat'a Site in Barkley Sound have been dated to between 3,000 to 3,500 BP, which is consistent with the Locarno Beach Culture Type (McMillan 1998, 1999). With little affinity to the West Coast Culture Type assemblages, the Shoemaker Bay Culture Sequence is difficult to reconcile with the culture history of the Nuu-chah-nulth. Some researchers opine that these deposits are the result of earlier occupations of the area by Salishan peoples from the east side of Vancouver Island or the mainland (McMillan 1996, 1998, 1999).

By 2,000 years ago, people were occupying large, permanent villages for at least part of the year (Mitchell 1990). Radiocarbon dating of habitation sites throughout the Nuu-chah-nulth area indicates that several ethnographically recorded village sites were established by approximately 2,000 BP, with a marked expansion of such sites at approximately 1,200 BP. Occupation of these villages continued into the global era and some ultimately became Indian Reserves (McMillan 1999). Archaeological deposits indicate that by 2,000 BP the inhabitants of these villages were following a marine adaptation consistent with ethnographic descriptions (McMillan 1996, 1999; Mitchell 1990).

Archaeological evidence from Clayoquot Sound itself is more problematic than that from Yuquot and Barkley Sound. Excavations have been conducted in only two areas. At Hesquiat Harbour, intensive excavations began in 1971 and continued for more than a decade (e.g. Calvert 1980). A much smaller scale excavation took place at Tofino in the late 1980s during the course of mitigating an adverse impact to the site (Wilson et al. 1991). In contrast, however, there are abundant data collected during the course of surveys, including a project targeted at identifying culturally modified trees on Meares Island (Eldridge et al. 1984). More recent work includes a three phase archaeological inventory of all of Clayoquot Sound, except Meares Island, that was conducted between 1997 and 1998 (Mason et al. 1999). While the lack of excavations means that the chronology for the area is unknown, surface reconnaissance can contribute the spatial analysis that may make it known (Mackie 2001).

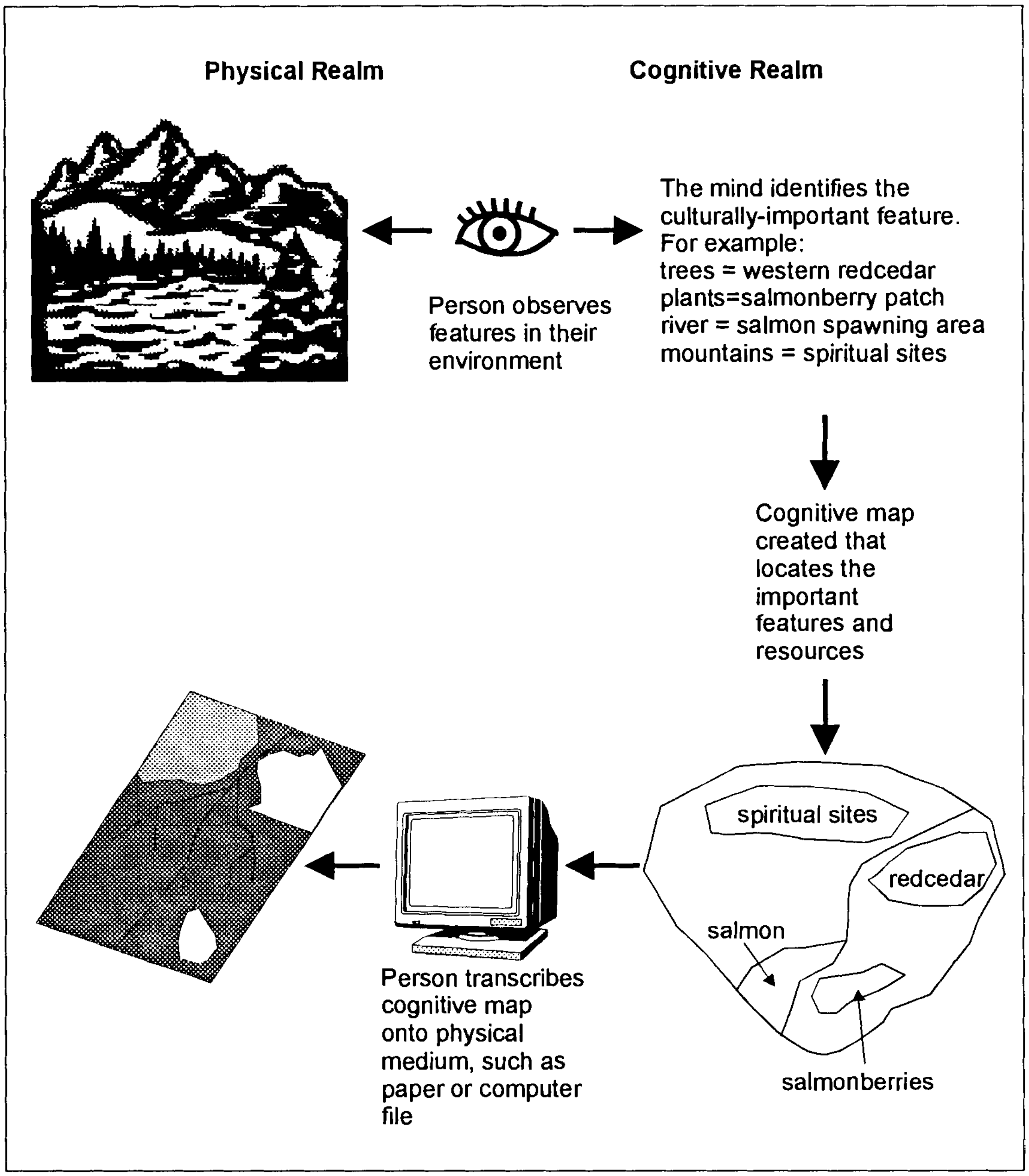


Figure 3. Cognitive Mapping and its Relationship to Physical Mapping.

THEORY

Cognitive Maps

Elucidating the nature of antiquity in Clayoquot Sound is possible by studying the historic record and archaeological site distribution. However, its details can also be discerned by examining cultural perceptions of the land. All people map their environment according to how they perceive it. When cognitive mapping, people utilize both consciously and subconsciously, distance, particularly in terms of travel time; location, which could include economic, social, symbolic and aesthetic factors; and both physical and social accessibility (Butzer 1993:254). Likewise, Aboriginal people perceive the landscape in terms of personal experiences and collective knowledge, which was communicated through oral traditions. Geographic elements formed the mnemonic elements that transformed memories into a cognitive map (Nabokov 2002; Yellowhorn 2000). Since they are subjective representations of reality, only information about the environment that is culturally relevant is stored in cognitive maps (Pentland 1975; Witcher 1999). If we, as researchers, could access such cognitive maps, we may be able to better understand the relationship of specific people to their land (Figure 3).

Oral traditions and traditional use information allow archaeologists to gain some insight into the "cognitive perspectives" and history of the people who actually used the landscape (Marquardt and Crumley 1987:3). Typically, the entire history of an Aboriginal group is recalled from features on the landscape of their homeland. The notable geographical features on the landscape act as locational markers, reminders of historical events and serve to validate oral traditions, legends, and myths (Budhwa 2002; Linklater 1994; McMillan 1999; Morris and Fondahl 2002; Nabokov 2002; Yellowhorn 2000). Any drastic alterations of the landscape can erode a group's collective knowledge of that landscape, and will thus affect the transmission of their histories (Brody 1988; Budhwa 2002; Linklater 1994; Sutton 2002).

While we may be able to access general cognitive perspectives through first hand accounts of Aboriginal people, transcribing these maps into readable forms using paper, or more recently on computer files, has proved challenging (Yellowhorn 2000). Throughout North America, government officials attempted to accurately map boundaries of tribal territories at the time that treaties were signed with, or land seized from, resident Aboriginal populations (Sutton 2002). Early ethnographers also recognized the importance of transcribing onto maps the places the informants deemed important (e.g., Drucker 1951). However, this mapping activity was limited to significant village sites in most instances. In the 1970s and 1980s, a number of land use and occupancy studies were undertaken in Canada to transcribe maps of Aboriginal use of particular landscapes, mostly in advance of large scale development projects (Brody 1988). These early attempts at documenting cognitive maps met with varying degrees of success (Sutton 2002).

However, the challenges around transcribing maps in a cross-cultural setting are partially overcome when Aboriginal groups transcribe their own cognitive maps. Contemporary traditional use studies have attempted to capture the intricate details of the perceived landscape. The paper maps document the toponymy, or place names, and can identify significant places on the landscape (Bouchard and Kennedy 1990; Clayoquot Sound Scientific Panel 1995). In recent years, there has been a dramatic increase in the number of Aboriginal groups that have been doing their own mapping (Hume 2000; Huu-ay-aht First Nations 2002; Nabokov 2002; Olive and Carruthers n.d.). Many of these maps have been, or will be, referred to during the course of Aboriginal land claims or treaty negotiations (Sutton 2002). As these activities continue, particularly in British Columbia, more and more First Nations will be transcribing their cognitive maps into visual media. This thesis contributes to that goal by anticipating the use of modern media in that project.

Locational or Land Use Models

Basic Concepts and Principles

In general, researchers develop models to find explanations for phenomena that they observe. All models share two fundamental qualities. First, models are "selective abstractions, which of necessity omit a great deal of the complexity of the real world" (Sebastian and Judge 1988:1). Secondly, models are by definition predictive. While this renders the common term 'predictive model' redundant, it is still a phrase used to refer to models that are designed to predict specific phenomena given the presence of specific factors (Sebastian and Judge 1988). If a correlation between variables can be identified, the model acts as a predictor (Moon 1993). In the case of locating undiscovered archaeological remains, the goal is to formulate a hypothesis about site locations that can be extrapolated across a wider area (Kohler and Parker 1986; Kvamme 1988a, 1990; Wheatley and Gillings 2002).

Predictive models of site locations are based on two assumptions: first, environmental factors influenced the settlement and movement of ancient people and, second, these same environmental factors exist in the modern landscape (Warren 1990; Warren and Asch 2000; Wheatley and Gillings 2002). Therefore, archaeological sites ought to be distributed in a non-random manner according to one or several variables (Brandt et al. 1992; Kvamme 1988a). The logical conclusion is that environmental variables, sometimes coupled with additional information, can be used to predict where sites may be found (Kohler and Parker 1986; Wheatley and Gillings 2002).

Early attempts at model building concentrated primarily on determining why ancient peoples chose to settle where they did given the specific environmental characteristics of a particular location. A parallel goal was to use this information to predict where sites would be found in an area that had not been subject to archaeological investigation (e.g., Green 1973). The practical benefits were quickly recognized because land managers responsible for protecting archaeological resources could apply the models to large pieces of unsurveyed land, and then factor the expected distributions into their land use planning (Warren and Asch 2000). Limits on funds and personnel made this type of modelling particularly attractive to budget conscious civil servants, land managers and consultants (Warren and Asch 2000).

In Clayoquot Sound, the competing interests of environmentalists, developers and First Nations have placed a sense of urgency on determining the extent and locations of archaeological sites (e.g., Mason et al. 1999). Land management officials, particularly in the forestry industry, rely on locational models for planning purposes (e.g., Arcas 1998b). In contrast, the Nuu-chah-nulth, like many other Aboriginal groups, rely on archaeological sites to buttress their land claims, thus their interest in modelling their traditional knowledge is to verify their claims (e.g., Clayoquot Sound Scientific Panel 1995; Hume 2000; Huu-ay-aht First Nations 2002; Olive and Carruthers n.d.). For these reasons, the Nuu-chah-nulth area is an ideal setting for locational modelling.

Types of Locational Models

The development of two schools of thought regarding locational modelling has resulted in two distinct types of locational models: those derived through inductive reasoning (e.g., Brandt et al. 1992; Green 1973; Kohler and Parker 1986; Kvamme 1985; Maschner and Stein 1995) and those based on deductive reasoning (e.g., Beattie 1996; Dalla Bona 2000; Dalla Bona and Larcombe 1996). While both approaches rely on the development of a decision rule that specifies the combination of variables with which one could accurately locate an archaeological site, they follow different approaches to arrive at their destinations (Table 4).

Table 4. Types of Locational Models.

Type of Locational Model	Reasoning		Variables Used		Result	
	Inductive	Deductive	Environ-mental	Cultural	Descriptive	Explanatory
Correlative	x		x	x	x	x
Explanatory		x		x		x

Inductively-derived models, also known as correlative models, identify and quantify relationships between site locations and environmental variables. Inferential methods, typically statistical, are used to determine which environmental variables are demonstrably correlated to observed site locations (Kohler and Parker 1986). Another key component is that the environmental data measured at site locations are contrasted to those measured where sites are absent, creating a comparative negative data set or "no archaeological evidence class" (Kvamme 1985,1990:268).

A correlative model is considered a success if it predicts both where sites may be found as well as where they are not found (Kvamme 1988a, 1990). Some models also purport to be successful at predicting the type of site that may be found, given the presence of one or several environmental variables, but this is a difficult task (Kvamme 1985). Simple to construct and cost-effective, correlative models are the most commonly used in archaeology, particularly in cultural resource management (Church et al. 2000). They appear to work reasonably well at predicting where sites may be found, which assists in land use planning (Church et al. 2000; Kohler and Parker 1986; Kvamme 1988b, 1990; Sebastian and Judge 1988). However, most projects where inductive models have been used report accuracy rates between 60% and 70% for predicting site locations, which some critics find too low to be considered successful (Ebert 2000).

Nonetheless, correlative models are observational and do not address causality; they only describe the characteristics of discovery. Indeed, a major criticism is that the very environmental variables used, typically water, slope and aspect, actually limit what can be learned of terrain features because there is no component that attempts to explain why these features may have been chosen as desirable (Church et al. 2000:137). A number of archaeologists insist that neither theory nor explanation are necessary in these studies, which limits the potential for correlative models to explain phenomena (Ebert 2000).

Deductively-derived models, also known as explanatory models, begin with some model of human land use and attempt to predict how particular patterns identified in the model will be reflected in the archaeological record. Typically, the model is developed from ethnographic and ethnohistoric literature rather than from previously recorded archaeological sites. Thus, they have the ability to explain phenomena and may provide insight into human spatial behaviour, culture change and adaptation (Kohler and Parker 1986; Sebastian and Judge 1988). Currently, these remain extremely difficult and time consuming to create. However, there remains much optimism that deductively-derived models are the future of locational modelling (Butzer 1993; Dalla Bona 2000; Dalla Bona and Larcombe 1996; Kohler and Parker 1986; Sebastian and Judge 1988).

Explanatory models are developed from assumptions of human behaviour in relation to the environment rather than only those variables identified at archaeological sites. There are numerous factors that complicate our understanding of how ancient peoples made decisions about where to locate themselves, especially when considering which environmental variables to include (Kohler and Parker 1986). A key consideration is that the environment as perceived by the researcher could be very different than that of the people who lived in that environment in the past (Butzer 1993; Ellen 1988). Further, concepts such as social accessibility and aesthetics, which are of great interest to archaeologists and would have been of great importance to the people being studied, are difficult to quantify for the purpose of modelling (Kohler and Parker 1986:439).

At first glance, the difference between correlative and explanatory models may not be obvious because they both rely on environmental variables and they both attempt to predict where sites might be found on the landscape. The key difference is in the level of specificity of their conclusions. Explaining why the phenomenon occurred rather than simply reporting on the observation distinguishes the explanatory from the correlative model (Church et al. 2000).

Regardless of which approach the researcher chooses, a significant hurdle is that the variables used in developing models exist in the present day. This is a good place to start, but a more useful model links the present to the past through explanation or by running multiple simulation models (Ebert 2000; Church et al. 2000; Kohler and Parker 1986; Kvamme 1985, 1988b). The researcher must also be wary of the impact of long term climatic variation and geomorphological processes as these could have had an impact on the environment at the time being studied, or may have caused subsequent alteration to the archaeological record (Butzer 1993; Church et al. 2000; Kvamme 1985). In addition, the scale of most environmental data is too coarse, and categories of information too broad, to be suitable for studies that focus on the unit of site (Allen 2000; Church et al. 2000). The uncritical use of existing mapped environmental data is a common criticism of the practice of predictive modelling (Berry 1984; Ebert 2000).

Landscape Archaeology and the Cultural Landscape Approach

The roots of both landscape archaeology and the cultural landscape approach are found in the theory of cultural ecology that recognizes the interaction of cultural and environmental systems. Cultural ecologists acknowledge that human behaviour is influenced as much by their unique histories as the physical environment (Bettinger 1980; Steward 1938; Trigger 1991, 1995). This perspective led to the more interdisciplinary ecological approach that incorporates anthropology, geography, biology and archaeology (Ellen 1988; Trigger 1995).

Fundamental to land use or locational modelling is the concept of the landscape, which can be defined as "the spatial manifestation of the relations between humans and their environments" (Marquardt and Crumley 1987:1). The delineated landscape represents both the physical region and the ancestral homeland of the people being studied (Ellen 1988). By combining ecological and cultural factors, a more complete picture of how humans interacted with their environments unfolds (Trigger 1991; 1995).

Landscape archaeology is where geographical and anthropological thought converge, thus it is the ideal perspective for proceeding with heritage studies in Clayoquot Sound. In landscape archaeology, the focus shifts away from individual sites as the unit of analysis, requiring the researcher to look at sites in terms of the roles they played within the larger social network or settlement strategy. Within this perspective, the natural environment, while important, is seen as only one of several factors that would have influenced human adaptation (Trigger 1991; 1995).

The major goal of landscape archaeology is to find evidence of human use on a landscape (Knapp and Ashmore 1999). Unfortunately, much of human activity is not persistent or repetitive enough to leave an enduring material record (Beattie 1996). For this reason, early studies concentrated on past societies that were large and complex and which left larger settlement sites in their wake (Marquardt and Crumley 1987). However, a perspective that incorporates combinations of resources that are available on a landscape is flexible enough to use for any level of society (Butzer 1993; Church et al. 2000).

There is a clear link between landscape archaeology and cognitive mapping. While sociohistorical structures of a society and the physical structures of the surrounding environment are important, the way these structures are perceived also defines the overarching landscape (Marquardt and Crumley 1987). As long as there is a disconnect between how researchers and the people they study perceive the landscape, concordance will not be realized. Therefore, additional information must be sought that enables the researcher to gain access to the Aboriginal perspective (Marquardt and Crumley 1987).

Although it follows in the same vein as landscape archaeology, the cultural landscape approach edges nearer toward a more inclusive approach (Buggey 1999). This approach does not rely entirely on archaeological evidence and eschews the focus on sites or features. Instead, it acknowledges that material remains on the land are just one portion of a much larger landscape used by a cultural group. Supporting evidence can include oral traditions, personal accounts, ethnographic and ethnohistorical sources, traditional ecological knowledge (TEK) and Aboriginal cognitive maps (Budhwa 2002; Buggey 1999; Linklater 1994; Sutton 2002; Yellowhorn 2000). Buggey (1999:27) offers the following definition of Aboriginal cultural landscapes:

> An Aboriginal cultural landscape is a place valued by an Aboriginal group (or groups) because of their long and complex relationship with that land. It expresses their unity with the natural and spiritual environment. It embodies their traditional knowledge of spirits, places, land uses, and ecology. Material remains of the association may be prominent, but will often be minimal or absent.

The probability of finding archaeological remains is further complicated by the fact that most landscapes are not pristine; post-depositional activities have led to the destruction of much of the material record, especially in the developed world. While we rely on the archaeological record as a physical record of past activities, the information from oral traditions, traditional use studies and personal accounts and memories can help to fill in the gaps where material remains are absent (Budhwa 2002; Buggey 1999; Linklater 1994; Sutton 2002; Yellowhorn 2000).

Considering the willingness of First Nations in British Columbia to adopt cartographic methods, they may soon be in a position to convey to others their concept of the cultural landscape. For example, the Ahousaht First Nation has concluded a project to document oral histories associated with actual locations on the map. The unmarked places on the map are not interpreted as "unused lands," but as part of "a more comprehensive picture indicating a strong historical presence and relationship with the land" (Olive and Carruthers n.d.:4). Several other First Nations, including the Gitxsan, Huu-ay-aht First Nations and Kwakiutl District Council, are conducting similar projects (Olive and Carruthers n.d.; Huu-ay-aht First Nations 2002).

A more thorough understanding of how a cultural group used, or continues to use, an entire landscape is best obtained by developing an explanatory model based on the concept of cultural landscapes. By taking this approach, one can augment what is known about use of the land by a cultural group by integrating information from archaeological, ethnographic, ethnohistorical, and traditional uses of specific places and extrapolating it to the entire landscape. Cognitive maps for the group being studied can also contribute, allowing the researcher to gain some level of understanding about places on a landscape that have not been visited or utilized by someone other than the extant culture.

SCRUTINY OF SOURCES OF DATA

Ethnohistoric and Ethnographic Data

There are copious amounts of ethnohistoric and ethnographic information regarding the Nuu-chah-nulth in general, and a considerable amount of data for the Nuu-chah-nulth of Clayoquot Sound in particular. These sources document Nuu-chah-nulth lifeways for a period spanning more than 200 years and can be divided into four distinct categories: early European trader and mariner accounts, federal government administrator accounts, ethnographer accounts, and accounts from memories. In this section, I provide a review and evaluation of the sources used to construct my models.

For reference, Table 2 presents a summary of significant events and changes in Nuu-chah-nulth lifeways during the global era.

European Trader and Mariner Accounts (1774-1803)

There is an abundance of valuable data on the early contact period found in the writings of the first Europeans to arrive in Nuu-chah-nulth territory. Captain Cook's journals (Beaglehole 1967) provide a detailed description of life at Yuquot in the late 1700s, and are considered to be the best glimpse of Nuu-chah-nulth life at that time. John Jewitt (1987) spent several years at Yuquot as captive of Chief Maquinna. His journal provides an excellent account of day to day life among the Nuu-chah-nulth in the early global era. Other sources of ethnohistoric data that coincide with this time frame include the accounts of Meares (1967), Menzies (1923), Moziño (1991), Bishop (Roe 1967), Tello (1930), Walker (1982). Howay (1941) compiled the accounts of two voyages of the Columbia in the late 1700s and Wagner (1933) synthesized the writings of early Spanish explorers.

In general, the main value of the ethnohistoric accounts of the early European visitors is that they are accurate and descriptive and they are the earliest documentation of Nuu-chah-nulth society. Of the ethnohistoric accounts from the maritime fur trade, the journals of Meares (1967) and Moziño (1991), and Howay's (1941) synthesis of the writings of Haswell, Hoskins and Boit are considered the most valuable for their detailed ethnographic content (Suttles 1990b; Suttles and Jonaitis 1990). However, the quality of the descriptions vary because most of the early observers were not scholars, nor did they speak the native language (Suttles 1990b).

Mariner accounts, however, represent only a partial and sometimes ambiguous view from the outside (Galois 2000; Inglis et al. 2000). The writers brought their own values and priorities to their writings (Inglis et al. 2000). First of all, their Eurocentric view was a reflection of the social milieu of the day. Europeans alternatingly viewed the Aboriginal inhabitants of the new world as rude savages in need of civilization or noble savages whose ways of life had to be protected (Brody 1988). Cook's journals (Beaglehole 1967) are treated as the ethnohistoric handbook of the day, but they are replete with biases, particularly in the way that Aboriginal groups throughout the world were compared to the indigenous peoples of the South Pacific that Cook and his crewman favoured (Inglis and Haggarty 2000). In addition, the observations provided by the mariners were also biased toward the people with whom they traded: powerful men. Another problem is that the accounts document relatively short periods of time. For example, Cook was at Yuquot for only a month (Beaglehole 1967), and this is the source that most researchers rely on (e.g., Haggarty and Inglis 2000). An exception to this is the writings of John Jewitt (1987) who experienced, and wrote, about daily life for an extended period of time.

Federal Government Representative Accounts (c.1870-1914)

Following the collapse of sea otter populations, fur traders had little reason to visit the west coast of Vancouver Island to trade with its inhabitants. Therefore few historical records document Nuu-chah-nulth life between the time of Jewitt's (1987) stay at Yuquot and the arrival of the Indian Superintendent and Indian Agents for Indian Affairs in the 1870s (Powell 1873, 1875, 1881). This represents a lacuna of approximately 70 years in the historical record, a period in which considerable social change occurred.

Dr. J.W. Powell, the first Superintendent of Indian Affairs for British Columbia, originally described the "Ahts," the name he used for the Nuu-chah-nulth, "as a nation of savages" (Powell 1873:7). His opinion softened quickly, and two years later, Powell (1875:50) was requesting that Indian Reserves be established with "justice and fair dealing." Further historical data was compiled by Commissioner O'Reilly who came to Clayoquot Sound in 1886 and 1889 to allot Indian Reserves to the area's inhabitants on behalf of the federal government (Indian and Northern Affairs Canada 1992; O'Reilly 1886, 1889). The records of Commissioner O'Reilly are of great value to researchers as they include maps showing the surveyed extent of the Indian Reserves, often accompanied with notes on the use of the land by the people to whom the land was allotted (O'Reilly 1886, 1889). In 1914, the Royal Commission on Indian Affairs for the Province of British Columbia arrived in Clayoquot Sound to reevaluate the allotments of Indian Reserves twenty-five years earlier. The significance of the report is that it contains *verbatim* testimony by the Aboriginal residents of Clayoquot Sound and their Indian Agent regarding the importance of any Indian Reserves under review (Canada and British Columbia 1914).

Similar to the accounts of early European traders, the records of employees of the federal government are extremely useful, but are also filled with biases. The value of these government records is in their descriptions of the people, including all aspects of their economic pursuits and use of the land. In addition, they offer records of changing populations and demographics. Again, these records must be used with caution and awareness of the inherent biases. First of all, the writers were often Eurocentric in their opinions, and were bureaucrats who had to conform to the assimilative policies of the *Indian Act* (e.g., Powell 1873). Additionally, similar to the European mariners, they spent short and sporadic periods of time among Aboriginal groups. Their visits to the Indian Reserves were often during the more temperate seasons, which may introduce a seasonal bias to their observations. Further, short visits may have provided a skewed picture of populations and demographics if the people living on the reserves were away pursuing resource activities.

Ethnographer Accounts (1860-1950)

In developing the models presented in this thesis, I relied on several ethnographic sources. The most comprehensive ethnographic data are found in Drucker's (1951) *The Northern and Central Nootkan Tribes*. Other sources of ethnographic data for the Nuu-chah-nulth include Arima (1983), Arima and Dewhirst (1990), Inglis and Haggarty (1986), Koppert (1930), Sapir and Swadesh (1978), and Sproat (1987).

While all of these ethnographies provide valuable information about the Nuu-chah-nulth, there use is quite limited for understanding the archaeological record. Most ethnographic research took place in the twentieth century (McMillan and Hutchinson 2000). The earliest of these accounts is Sproat's, which describes Nuu-chah-nulth cultural, settlement and subsistence practices as they were in the 1860s, which is more than three-quarters of a century after first contact. Koppert (1930) conducted his fieldwork among the Tla-o-qui-aht at their main village of Opitsat in the summers of 1923 and 1929. Drucker (1951:14) collected the data for his work in 1935 and 1936 and even he was critical of what his informants could tell him about precontact life: "Accurate accounts on which one can rely, are after all, those based on human first-hand knowledge, the things the informant saw himself."

Without long-term residence among the group he is observing, the ethnographer cannot move beyond his perspective as an outsider (Inglis et al. 2000). Aboriginal people maintain that their contributions are undervalued and their roles are reduced to that of advisor or informant (Inglis et al. 2000). In the selection of informants, the ethnographer runs the risk of introducing a gender or socioeconomic bias. Similar to the writings of the early maritime traders, most of the ethnographic accounts of the Nuu-chah-nulth date to the period where the focus was on males, particularly those with status and power.

Nonetheless, by looking at the value of ethnographies while being mindful of the biases, I decided that the ethnographic data was suitable for developing the models I present in this thesis. The ethnographic accounts of the Nuu-chah-nulth are detailed and comprehensive and provide excellent descriptions of material remains, settlement patterns and subsistence strategies during the ethnographic period (e.g., Drucker 1951). In addition, the ethnographers tended to stay among the Nuu-chah-nulth for longer periods of time than the early European visitors and the federal government representatives (e.g., Drucker 1951; Koppert 1930). Indeed, Sproat (1987) lived among the Nuu-chah-nulth groups of the Alberni Valley. The major problems with these ethnographies is that they can still be biased toward particular seasons (e.g., Koppert 1930), the male gender (e.g., Drucker 1951) and technology (e.g., Drucker 1951).

Reconstructions from Memory

First hand source of ethnographic data comes from the writings of Aboriginal elders, such as Peter Webster (1983). He offers his personal experiences and perspectives in *As Far as I Know: Reminiscences of an Ahousaht Elder*. A recently published volume on the Nuu-chah-nulth (Hoover 2000) includes contributions by Nuu-chah-nulth people of the Mowachaht-Muchalaht First Nations and Huu-ay-aht First Nation, and interviews with contemporary Nuu-chah-nulth artists.

In addition to first hand accounts written by elders, we can access memories and First Nation perspectives through traditional use studies (TUS). Traditional use studies document how people used and perceived the land in which they lived. Traditional ecological knowledge or TEK is the system of knowledge that grew from their long-term experience with a specific location, which is then transmitted generation to generation through oral traditions. Thus, it forms an integral component of TUS. Indeed, TUS are a means to gather and interpret TEK (Smith 1998; Markey 2001).

In conducting the research for this thesis, I relied heavily on *Clayoquot Sound Indian Land Use* (Bouchard and Kennedy 1990) and *First Nations' Perspectives Relating* *to Forest Practices Standards in Clayoquot Sound* (Clayoquot Sound Scientific Panel 1995). Both reports provide information about TEK specifically, as well as the overall use of the landscape. The latter is the result of extensive research by a panel consisting of four representatives of the Nuu-chah-nulth and one ethnobotanist. Their mandate was to examine the impacts of historic and modern-day timber harvesting practices on Nuu-chah-nulth ways of life in Clayoquot Sound. Both the Bouchard and Kennedy (1990) and the Clayoquot Sound Scientific Panel (1995) reports present the Aboriginal perspective of how the land and resources of Clayoquot Sound were used in the past.

Two other studies, *Native Settlements on Meares Island, B.C.* (Arcas 1988) and *Patterns of Settlement of the Ahousaht (Keltsomaht) and Clayoquot Bands* (Arcas 1989), relied on traditional use information collected through interviews. However, these studies looked only at settlement locations and contain limited information on the range of activities that occurred there. Nonetheless, the findings presented in these reports are consistent with those of Bouchard and Kennedy (1990) and the Clayoquot Sound Scientific Panel (1995), therefore the information contained in these reconstructions from memories attest to the accuracy of these sources of data.

At first glance, reconstructions from memories appear to counterbalance some of the biases found in the ethnohistorical accounts of the mariners and federal government representatives and ethnographers. They provide a way to balance the view from the outside with the view from within (Inglis et al. 2000). However, reconstructions from memories introduce different potential biases, such as the agenda of the informant or writer, and also must be used with caution. The benefits offered by memorates include a more inclusive approach to genders and societal ranking. In addition, they offer the first hand perspective, and who would know the history of a group as well as someone who is part of that group? Nonetheless, researchers should not treat these accounts the same as historical records because they tend not to document specific events. Instead, Aboriginal groups use oral histories to convey broader issues (McMillan and Hutchinson 2002). In addition, an ongoing debate questions their trustworthiness because they rely on memory and could be partly 'fictitious' (Echo-Hawk 2000; Mason 2000). However, this could be true of any historic documents. Another criticism is that they are as much a product of the present as they are the past because they evolve through time with each presentation (Inglis et al. 2000; Mason 2000).

Archaeological Data

Textual Data

Archaeological reconnaissance of Clayoquot Sound has motivated the majority of archaeological investigation there; as a result, very few archaeological excavations have been undertaken. Of these projects, most were sponsored by timber interests and development proponents and take the form of archaeological impact assessments, archaeological overviews, and archaeological inventory studies. Most studies have focussed on shoreline areas or on inland cutblock areas in advance of timber harvesting, resulting in a somewhat skewed coverage of the study area.

For this study, I relied on the 'grey literature' comprised of data gathered mainly by archaeological consultants. Of particular value is the report that presents the results of a three-phase archaeological inventory of Clayoquot Sound (Mason et al. 1999). The inventory, in which I participated, involved a rigorous examination of nearly one-hundred percent of the shoreline zone and a substantial sample of inland zones in the study area. However, only provincial crown lands were included in the mandate for this study, therefore Indian Reserves were excluded. Meares Island was also excluded from the inventory as it had been subjected to extensive examination in previous studies (Arcas 1988, 1989; Stryd and Eldridge 1993). By combining the data recorded during surface survey, I feel confident that coverage was sufficient for the purposes of my research.

I obtained supplementary information about the typical contents of archaeological deposits from archaeological reports and publications for other parts of the Nuu-chah-nulth area, including Nootka Sound (e.g., Arcas 1998b; Dewhirst 1978, 1980; Marshall 1993) and Barkley Sound (e.g., Arcas 1998a; Brolly 1992; McMillan 1996, 1999; McMillan and St. Claire 1982). This data contributed information only available through excavation, which is lacking from the Clayoquot Sound dataset.

A key criticism of the archaeological impact assessment and inventory studies conducted by archaeological consultants, particularly those of the 1970s and 1980s, is that they do not include an Aboriginal perspective (Markey 2001). While this is most certainly true of the early studies, this is not always the case for more recent projects because Aboriginal field assistants are typically employed by consultants while in the field. By making Aboriginal people an integral part of the field program, archaeologists can gain first-hand knowledge about any archaeological remains that are discovered (e.g., Mason et al. 1999). Unfortunately, in my experience, the Aboriginal perspective is limited even in cases where Aboriginal field assistants are present because they are rarely called upon to contribute to the final report. In my opinion, each report has to be evaluated on the extent to which the Aboriginal perspective is represented in the report by thoroughly reading the methodology section. However, I feel that this shortcoming does not affect my research as I did not rely on the textual data to create the models.

Another criticism is that contract archaeologists cannot be completely unbiased. Wickwire (1991:76-77) argues that the "financial bond between the consultant and the company leads to problems, however, as those who depend upon such work become influenced by the goals of their 'clients.'" Unfortunately, determining the validity of this statement is difficult when reading the reports of contract archaeologists. When there is little available beyond the grey literature, a researcher must assess the potential bias against not doing the research at all. Given that this is the state of the known archaeological record for most of the province, a researcher must find a way to get beyond this concern (Eldridge and Mackie 1993; Moon 1993). The best way to assess the validity of archaeological research is to consider complementary sources, be they historical, ethnographic, TEK or TUS.

The lack of chronological control for most archaeological sites in British Columbia can have consequences for regional analysis. This is certainly the case for Clayoquot Sound, however the study area is no different than most other regions of the province, or most of the New World. "It is normal that there are many more known sites of unknown age than there are of known age: site location is easier to ascertain than site chronology" (Mackie 2001:42). Similar to a regional study conducted by Thomas (1973:167), since my research "does not involve the construction of a chronology, the research design need not be restricted to stratified sites." Indeed, my research has practical implications for British Columbia archaeology. The west coast of Vancouver Island has received some archaeological attention, but sections of it are known only by their location. A detailed chronology of local cultural development remains elusive.

Digital Data

As the intent of this study is to model the cultural landscape of Clayoquot Sound from ethnographic and ethnohistoric sources and compare the models to the known archaeological record, I decided that a large dataset amassed through surface reconnaissance would be the most suitable. While chronology and seasonality could enhance model development, they are not critical components of the types of models that I developed. Therefore, a region that has been the subject of extensive reconnaissance activities rather than excavation, such as Clayoquot Sound, is sufficient. As described in the previous section, I found that the data for the study area are extensive and sufficiently detailed for this study, therefore no further fieldwork was necessary.

I obtained the digital archaeological data for Clayoquot Sound in ArcView GIS format from the Archaeology Branch of British Columbia's Ministry of Sustainable Resource Management. On the computerized map, archaeological sites are depicted as polygons drawn to scale and are linked to an attribute table that provides specific locational information. The Archaeology Branch also provided me with a Microsoft Excel database that includes all the information the Archaeology Branch requires archaeologists to record, including location, functional site type, archaeological features present, elevation, size of the site, amount of disturbance, potential for disturbance and detailed remarks. In combination, the maps, locational data, and Excel database, create a complete package of all known relevant archaeological data for the study area.

Nuu-chah-nulth cultural remains are particularly susceptible to preservation biases. The vast majority of artifacts were made of perishable materials such as wood, bone and shell. Even the most ubiquitous archaeological remains, culturally modified trees, have an extremely limited range of preservation.

In Clayoquot Sound, several factors may limit the utility of the dataset. First, there are numerous environmental factors that impact site preservation and potential for rediscovery. Contemporary environmental factors include dense vegetation, acidic soil and the wet climate. Environmental conditions of the past such as seismic waves, earthquakes and glaciation have contributed to site destruction.

In addition, cultural activities have contributed to the alteration or destruction of numerous archaeological sites in Clayoquot Sound. Small scale logging began in the 1940s and intensive logging was underway by the 1950s. Timber harvesting activities, such as logging and road building, can destroy surface and subsurface remains. Logging also removes CMTs. As the timber industry expanded to the west coast of Vancouver Island, a network of logging roads was built, which improved access to the area by the public. In 1971, the road to Tofino was paved and the federal government established the Long Beach Unit of Pacific Rim National Park Reserve (Smith 1997). Today, communities in Clayoquot Sound are dependent on resource procurement activities such as forestry, commercial fishing and aquaculture, as well as tourism. All of these activities have the potential to adversely impact archaeological sites (Mason et al. 1999).

In addition, the integrity of the dataset is only as good as the integrity of those who recorded the data, and this is an unknown variable. Confounding variables are difficult to control, but improving the state of archaeological data in British Columbia can only benefit the long term objective of elucidating the cultural sequences through regional studies (Eldridge and Mackie 1993).

While there may be limitations to the quality of archaeological information about Clayoquot Sound, I am confident that what exists is generally good. Even if archaeological investigations had been undertaken on every square inch of the study area, a complete picture would still be missing as most activities leave no material remains. Further, past disturbances of the landscape by both natural and cultural factors would have removed or obscured many of the cultural remains. However, I am confident that the existing archaeological data is sufficient to meet the needs of this research, which is to evaluate the models that I constructed from the ethnographic and ethnohistorical data.

Environmental Data

I obtained the base maps for this study from the Base Mapping and Geomatics Services Branch of British Columbia's Ministry of Sustainable Resource Management. Similar to the digital archaeological site data, the Terrain Resource Information Mapping (TRIM) maps are stored in ArcView GIS format. The consistent format used for both the digital maps of the archaeological data and the environmental data allows for direct comparison. The GIS map themes contained critical spatial information including shorelines, waterways, and elevation contours. The digital maps for the study area were joined together using the Xtools ArcView extension.

The scale of the environmental data is 1:20,000, which is a mapping standard for archaeological inventory studies in British Columbia (Resource Inventory Standards Committee 2000). I decided that this scale is suitable for a regional study the size of Clayoquot Sound. Further, I was familiar with the scale having personally utilized it during the Archaeological Inventory Study of Clayoquot Sound (Mason et al. 1999).

DESCRIPTION OF THE LAND USE MODELS

Model 1 - Cultural Landscape Model

I undertook a comprehensive review of the ethnographic, ethnohistoric, and traditional use literature regarding the people of Clayoquot Sound and the Nuu-chah-nulth in general, to determine how the people of the study area used their landscape. Specifically, I focussed on what types of activities they pursued and the locations of these activities. I then assembled a table to summarize the salient information regarding these activities, their locations and the season in which they occurred.

After I constructed the ethnographic and ethnohistoric synthesis, the next step was to consider which activities would result in some physical evidence on the landscape. The result was a table that included the ethnographic and ethnohistoric information about land use, and added predictions about the types of features and functional site types that would be expected in each environmental setting. This is the Cultural Landscape Model (Appendix B). In its tabular form, the Cultural Landscape Model is descriptive, but difficult to follow. The visual cues that best represent the Cultural Landscape Model, which combines the environmental settings themes, are created using ArcView GIS (Figure 10, Appendix C).

Model 2 - Habitation Site Model

While I espouse a cultural landscape perspective that includes all types of archaeological features, I decided to construct a model using a more commonly used approach as a basis of comparison. I believe this is a useful exercise, particularly when used as one in a series of steps to understanding Aboriginal use of the land. Typically, a number of environmental variables are identified that appear to correlate with habitation, or village, site locations. Sometimes these variables are gleaned from the ethnographic and ethnohistoric literature. In other cases, the variables are identified using statistical inference from data from known habitation site locations.

Using ethnographic data (e.g., Arima 1983; Drucker 1951), I constructed a multivariate model for habitation site location: the Habitation Site Model. I identified three environmental factors that were important to site location: proximity to water for transportation and drinking, relatively flat areas with suitable beaches for landing canoes and sheltered from prevailing winds. Maschner and Stein (1995) used similar environmental variables in developing a predictive model in Southeast Alaska. The Habitation Site Model predicts where habitation sites should be found given the combined presence of all three of these variables (Figure 11, Appendix C).

As season of use has not been determined for many archaeological sites in Clayoquot Sound through excavation, I chose to develop only one model using the more restrictive criteria that are consistent with the location of winter villages. My rationale was that the aggregation of the largest numbers of people occurred at winter villages, which would result in conspicuous signs of habitation sites in the archaeological record.

CONVERSION OF MODELS TO SPATIAL DATA

Division of Landscape into Physical Units

In the Nuu-chah-nulth area, past attempts at spatial analysis of site locations using divisions of the land into physical units have not been fruitful (e.g., Haggarty and Inglis 1983). In 1983, Haggarty and Inglis attempted a spatial analysis of known archaeological sites throughout the Nuu-chah-nulth territory and the macroenvironmental settings in which they were found. The authors subdivided the landscape into three macroenvironmental zones: the exposed or outer coast zone, the semi-exposed or transitional zone, and the protected or inner coast zone. Sites were distributed fairly evenly across the three zones even though the zones were very different in size (Haggarty and Inglis 1983).

My main criticism of the analysis was that the zones as defined were too coarse to be meaningful as my review suggested that land use was more environment-specific. Haggarty and Inglis' (1983) approach to dividing the landscape into physiographic units is biased toward the shoreline of their study area, and extrapolates the environments associated with the shorelines to the inland areas. To compensate for the shortcomings of Haggarty and Inglis' (1983) approach, Huu-ay-aht First Nations (2000) added two more environmental zones: an inland forested zone and a riverine zone.

However, even the Huu-ay-aht First Nations' (2000) taxonomy of five environmental zones seemed too general for my research. My experiences in the field indicated that there was too much diversity of resources, terrain and microclimate within the forested and riparian areas of Clayoquot Sound to rely on these generalizations. Instead, I began with the environmental settings defined by Arcas and Archeo Tech (1994) for Clayoquot Sound (also Arcas 1998). Each of the eight environmental settings is associated with distinct landforms and specific resources, which have implications for Aboriginal use of the landscape (Arcas and Archeo Tech 1994).

While Arcas and Archeo Tech's (1994) delineation of physiographic zones is more inclusive than previous attempts, it still does not account for the incredible diversity of the environment of Clayoquot Sound. For example, Hesquiat Harbour is considered to be part of the Inside Coast environmental setting, but is quite different than other areas of Clayoquot Sound that also fall within this category. For example, most areas of the Inside Coast are contiguous with the Inlets environmental setting, which facilitates mobility throughout the different environmental settings. Hesquiat Harbour, in contrast, is only contiguous with the Outside Coast environmental setting, and is separated by land from other environmental settings. Therefore, anomalies may still appear when using this approach to dividing the landscape into physiographic units; however, this classification appears to be appropriate for most of the study area.

I described the physical characteristics and resources of each environmental setting in chapter one. In chapter three, I present the implications for land use and the archaeological record in the ethnographic and ethnohistoric summary and the Cultural Landscape Model, respectively.

Geographic Information Systems (GIS)

Geographic information systems (GIS) greatly facilitated this study. The organizational, analytic and presentation capabilities that these software programs offer are particularly suitable for regional analysis. The ability to isolate the various categories of data that I used as layers, or themes, was a major contribution that GIS made to my research. This allowed me to organize my data and conduct visual comparisons of the models to the archaeological record.

The analytical capabilities, including the ability to combine layers to integrate new types of data, allowed me to construct each model based on existing environmental data. Using the presentation capabilities of GIS, I translated the Cultural Landscape Model and the Habitation Site Model onto maps that are simple to understand. For a detailed review of the potential of GIS for archaeological research, refer to Appendix A.

For this study, I used ArcView GIS, version 3.2, which Environmental Systems Research Institute (ESRI n.d., 1999) describes as their most popular software for GIS. ArcView GIS runs on the Microsoft Windows platform and can be operated on most personal computers. Several extensions are available, which enhance ArcView GIS' capabilities, including the 3D Analyst and Spatial Analyst that I used for this study (ESRI 1999).

GIS Mapping

Conversion of Digital Archaeological Data

While the archaeological database in Microsoft Excel contains copious information on inferred site function, and detailed descriptions of archaeological features, it is difficult to work with. Much of the information is buried in descriptive phrases that required me to switch back and forth between the mapped data in ArcView and the textual material in Excel. The first step in reclassifying the data involved adding fields for each type of archaeological feature to the ArcView attribute table to allow for simple Boolean queries for presence or absence (Table 9, Appendix C). The first series of fields, or columns, that I added to the table was for the features found in the study area. By adding information about the types of features recorded at each site to the ArcView table, descriptive attributes could be linked directly to the spatial data, allowing me to run quick queries identifying, for example, all sites that had middens.

I then added several Boolean fields to list the inferred function of each archaeological site to the ArcView attribute table. As site function is subjective and I did not record the sites personally, I relied on interpretations the recorders provided in the "Remarks" field of the Excel table. In the absence of a first hand interpretation, I made conservative interpretations of site function. For example, I concluded that sites with large middens and evidence of structural remains were habitation sites. Sites comprised solely of CMTs or fish traps were assigned to the resource procurement and processing field. Canoe skids recorded with no other features were assigned to the "Other" class, as were human remains.

Reclassifying the data into two sets of Boolean fields allows for two levels of analysis of the archaeological remains. For example, a designated site may consist of a large midden deposit with house depressions, several canoe skids and a fish trap. This site was classified in the database as a habitation, but if queried in terms of the features present, the database separates the site into its features: midden, structural remains, canoe skids, fish traps. This allows for the analysis of archaeological remains at either the level of site type or site feature. For this study, I chose to focus on features rather than site types as the latter can introduce subjectivity and ambiguity from the person who recorded the site.

Digitization of Other Data

Traditional Use Data

I obtained locational information on traditional use sites primarily from Bouchard and Kennedy (1990). I found additional information in studies conducted by Arcas (1988b and 1989). In these reports, the locational data for the sites are presented as points on paper maps with identification numbers that link the points to the textual descriptions. From the paper maps in Bouchard and Kennedy (1990), I digitized into ArcView GIS all the traditional use site locations as point locations with their number assignment. I then entered all relevant non-spatial information including use, season of use, Nuu-chah-nulth name, and tribe into a linked attribute table (Table 10, Appendix C). I then repeated the same process with the maps and information provided by Arcas (1988b and 1989). As there is some data overlap in the Bouchard and Kennedy (1990) and Arcas (1988b and 1989) reports, I cross referenced them to avoid entering redundant data. Where there was repetition, I chose to use the Bouchard and Kennedy (1990) site number and data, and supplement the descriptive information with any additional data I found in Arcas (1988b and 1989). I then set up Boolean fields for traditional uses, such as hunting, fishing, and spiritual pursuits, for ease of analysis. These fields are consistent with those set up for the archaeological sites theme to facilitate their comparison.

Environmental Settings

I relied on the environmental settings identified by Arcas and Archaeo Tech (1994) for Clayoquot Sound to create the Cultural Landscape Model. Meaningful comparison of the model to the known archaeological data could only be undertaken if the settings were added to the ArcView database. I interpreted the locations and extent of each setting from the textual descriptions provided by Arcas and Archeo Tech (1994), then drew polygons directly into eight separate ArcView themes to represent each environmental setting (Figure 10, Appendix C).

Creation of New Themes for Analysis

As noted previously, my review of the ethnographic literature revealed that three environmental variables appear to have influenced the choice of locations for habitations during the ethnographic period. For the people of Clayoquot Sound, and the Nuu-chah-nulth in general, distance to water (fresh for drinking and fresh or salt for transportation), slope and aspect appear to have been the main environmental variables (Arima and Dewhirst 1990; Drucker 1951).

As the set of environmental data was too large for my personal computer to run many of the following operations, I chose a non-random sample that was representative of the study area. To choose the sample, I drew a rectangle across the centre of the study area, creating a rectangular cut out of all the themes that I had in my project set.

To create a model for locating habitation sites that relies on the environmental variables of distance to water, slope and aspect, I created new themes by manipulating the existing data. To model for distance to water, I created buffers of 100 metres around the shoreline, lakes and rivers (Figure 12, Appendix C). I employed the Spatial Analyst and 3D Analyst extensions for ArcView GIS (ESRI 1999) for the more complex data manipulation. The first step was to convert the theme that contains elevation contours to a triangular irregular network (TIN) using 3D Analyst before converting the data to an elevation grid. The TIN interpolated elevations between the contours to close the data gaps. It was then used to create an elevation grid with elevation values for every point of the map. From the elevation grid, a slope grid was generated in Spatial Analyst. Following the Arcas (1998) model, the data were then reclassified to reflect potential for finding archaeological sites: slopes of 0% to 20% were considered high, 20% to 50% are medium, and anything greater than 50% is classified as low (Figure 13, Appendix C).

The next step was to extrapolate an aspect grid from the elevation grid (Figure 14, Appendix C). The logic is that the highest potential for finding archaeological sites is in areas with southern exposures based on the assumption that southern exposures offer the most shelter and warmth, particularly during the stormy winter months. In Clayoquot Sound, winter storms tend to track from the southeast, therefore southwest exposures would likely have been the most desired aspect. To simplify the grid, I grouped aspects into areas of high potential (southern to western aspects 180° to 270°), medium potential (eastern to southern 90° to 180°), low potential (Northwestern, northern, and northeastern aspects 270° to 360° and 0° to 90°).

To translate the Habitation Site Model into a computerized map, I reclassified the slope and aspect themes in ArcView GIS into three classes of high, medium and low potential with values of 3, 2 and 1 respectively. I then used the Map Calculator command to identify the combined zones of high potential for both themes, which produced the Combined Slope and Aspect. The theme with the 100 metre buffer from water was then added to the view and the command to Map Calculator to highlight where the buffers and the Combined Slope and Aspect theme coincided. In this manner, I developed the Habitation Site Model. The theme containing the archaeological sites was added to the map as a comparison of the model against the archaeological record (Figure 11, Appendix C).

COMPARISON OF MODELS TO THE ARCHAEOLOGICAL RECORD

Inventory of Archaeological Sites and Features

The first step in the evaluation of the archaeological site data was to inventory all sites and features that have been recorded in the study area. First, I tallied the archaeological sites that have been assigned Borden numbers. I then inventoried the archaeological features recorded at these sites.

To conduct the inventory, I used the attribute database in ArcView GIS, particularly the Boolean fields I had created for features and inferred site function. From the attribute table, I summarized and exported the data to Microsoft Excel. I chose Microsoft Excel to generate the histograms I present in chapter three simply because it is easier to transfer these figures into word processing programs.

Comparison of Site Locations to Models

Model 1 - Cultural Landscape Model

Creating the separate themes for each environmental setting allowed me to select subsets of the archaeological site theme that coincide with a particular environmental setting. The ability to directly compare the archaeological data to a specific environmental setting greatly facilitated the process of evaluating the model.

To compare the Cultural Landscape Model to the known archaeological record, I used the themes I had created for each environmental setting for the study area (Arcas and Archeo Tech 1994). The comparison entailed selecting all sites within each environmental setting as a separate set, and then determining what types of features have been recorded in each, and their relative frequency. I then exported the data to Microsoft Excel to generate the histograms I present in chapter three. The results were then compared to the Cultural Landscape Model for consistency.

Model 2 - Habitation Site Model

To compare the Habitation Site Model to the known archaeological record, I used ArcView GIS to select all the archaeological sites that coincide with areas identified as suitable for habitation sites as a separate set. As I did with the Cultural Landscape Model, I determined which types of archaeological sites and features coincided with the areas identified as suitable for locating habitation sites. Similar to the Cultural Landscape Model, I created histograms for presentation using Microsoft Excel.

CHAPTER SUMMARY

This chapter introduced the theory and methods I used to build and test the land use models that are central to my research. By employing a cultural landscape perspective, I was able to shift focus away from specific locations to general use of the overarching landscape, thus coming closer to accessing the cognitive maps of the people who used the land. I then scrutinized my sources of data to assess their validity and relevance to the context of my research. These data were critical to the building of the models as described in this chapter. ArcView GIS allowed me to organize, manipulate, analyse and present the data used in the model building. GIS also figured prominently in the testing of the models, the results of which are presented in the next chapter.

CHAPTER THREE:

NUU-CHAH-NULTH LAND USE

The contemporary physical environment of Clayoquot Sound, while relatively unchanged for the last 2,000 years, is a product of long-term climatic and geomorphological processes. Aboriginal groups residing in the study area have successfully adapted to this environment over the millennia by developing appropriate technologies and subsistence strategies. Over time, the Nuu-chah-nulth developed systems of land use and land tenure that allowed them to effectively utilize geographically and seasonally dispersed resources. Interaction with the larger world in the late eighteenth and early nineteenth centuries through the maritime fur trade did affect their traditional lifeways, but their resilience allowed them to maintain considerable control over trade and to accept the change on their own terms.

In this chapter, I present the results of the research and model building I undertook regarding Nuu-chah-nulth land use. I also describe the ethnographic summary and the land use models that form the core of this thesis. In the first section of this chapter, I review ethnographically and ethnohistorically documented patterns of land tenure and land use among the Nuu-chah-nulth, and how these patterns figured into their societal structure. Based on this information, I derived a summary of extant knowledge of Nuu-chah-nulth land use. The first of the two land use models, the Cultural Landscape Model, is a direct grafting of the ethnographic pattern of land use onto the physical landscape of Clayoquot Sound. It predicts archaeological correlates for the activities described in the ethnographic and ethnohistoric literature. The second model, the Habitation Site Model, is a reworking of traditional locational models developed for the Northwest Coast.

The chapter closes with my evaluation of how well the Cultural Landscape Model and the Habitation Site Model explain the archaeological record. The evaluation begins with an inventory of archaeological remains and traditional use sites as a basis of comparison. I follow the inventory with my comparisons of the predictions of the land use models against what is known about the archaeological record.

ETHNOGRAPHIC AND ETHNOHISTORIC SUMMARY OF LAND USE AND TENURE

Nuu-chah-nulth society was organized along three sociopolitical levels: the local group, family group and tribe (Drucker 1951). The fundamental unit, the local group, consisted of a group of chiefs, and their families, who shared common ancestry and who owned territorial rights, houses, and other privileges (Drucker 1951, 1983; Bouchard and Kennedy 1990; Wike 1958; Wilson et al. 1991). Local groups had names that were usually taken from a place, such as an important fishing grounds, to which they could trace their ancestry (Drucker 1951). Larger political entities could be accommodated in Nuu-chah-nulth society, especially through amalgamations of local groups into tribes (Drucker 1951). Political power rested in the *Hawiilh*, or group of hereditary chiefs (Clayoquot Sound Scientific Panel 1995; Drucker 1951).

Within Nuu-chah-nulth society, political power was distributed among the local groups or tribes in a system of fixed ranking of their chiefs based on proximity to their ancestors (Drucker 1951, 1983). In Clayoquot Sound, tribal organization was uncommon in precontact times, but emphasized local autonomy where it did occur. In Hesquiat Harbour, for example, there were several autonomous local groups who operated independently of one another. The Tla-o-qui-aht was the most powerful political unit at time of contact. It consisted of a single local group from Kennedy Lake (Drucker 1951). Early Spanish explorers in Nuu-chah-nulth territory noted that three chiefs controlled Clayoquot Sound, with Chief Wickanninish occupying the senior position (e.g., Tello 1930;

Wagner 1933). Each head chief controlled seasonal villages, fishing stations and resource camps, with some responsibilities delegated to his subchiefs. In winter, all the people under the protection of a chief would assemble in one winter village (Wike 1951:56-57). In the case of Chief Wickanninish, the leader of the dominant and warring Tla-o-qui-aht, power was obtained by conquest (Drucker 1951).

The physical landscape of Clayoquot Sound had clear implications on the cultural development of its Nuu-chah-nulth inhabitants. The sea offered the most abundant, diverse and reliable food resources, as well as raw materials for tool manufacture. The main contribution of the terrestrial environment was plant resources for both food, mainly berries and rhizomes, and technology, particularly from the western redcedar. These resources where seasonally and geographically dispersed, therefore considerable mobility was required for people to effectively exploit these resources (Drucker 1951, 1983).

The seasonal round followed by the people of Clayoquot Sound developed over many centuries through observation, deduction, and trial and error. Thus, they accrued their collective traditional ecological knowledge. According to the Clayoquot Sound Scientific Panel report (1995:14 and Appendix V), the Nuu-chah-nulth people of Clayoquot Sound have specific knowledge of 270 species that exist in their area, including 20 species of trees, more than 30 species of shrubs, 20 species of marine and terrestrial mammals and 35 species of fish. Impressive as it is, this list is considered incomplete (Clayoquot Sound Scientific Panel 1995).

The local group was the most effective unit for exploiting these dispersed resources (Drucker 1983). In general, the carrying capacity of the environment prevented larger amalgamations, while the need for a large enough labour pool to gather and process resources during limited harvest seasons encouraged groupings larger than the basic family unit (Drucker 1983). Efficient exploitation of salmon runs is only one example of where this strategy works well. Nuu-chah-nulth people adapted strategies such as movement of local groups to fishing stations at the appropriate time of year, development of technology to maximize efficiency in harvesting the resource, and preservation techniques that allowed people to build up their stores to bridge the lean seasons (Wike 1951).

Seasonally available resources dispersed across the landscape demanded the efficient movement and timing of local groups to effectively exploit these resources (Drucker 1951, 1983). Therefore, scheduling was indispensable for effective resource exploitation, as reflected by the names of the thirteen moons. Twelve and one third lunar cycles occur each solar year, thus explaining the apparent identification of thirteen moons. The intercalary moon corrected the lunar calendar with the solar year every three years (Yellowhorn pers. comm. 2003). The Tla-o-qui-aht calendar is one example of calendars developed by several Nuu-chah-nulth groups to reckon time (Table 5) (Drucker 1951; Moziño 1991; Sproat 1987).

Table 5. Tla-o-qui-aht calendar (from Drucker 1951).

Month	Moon Name	Meaning (approximate)
November	*ma'miqsu*	Elder sibling moon
December	*qalatik*	Younger sibling moon
January	*wiyaqhaml*	No food getting for long time moon
February	*axhaml*	Bad weather moon
February	*ai'tamil*	False spawning moon
March	*aiyakamil*	Herring spawn moon
April	*ho'ukaml*	Geese moon
May	*inihitckmil*	Getting ready (for whaling)
June	*qawccamil*	Salmonberries moon
July	*ta'atokamil*	Drifting moon (canoe drifts away because the whales swim rapidly)
August	*satsamil*	Spring salmon (run) moon
September	*heniqocasamil*	Dog salmon moon
October	*etsosimil*	Rough sea moon

Hahuulhi

Particularly germane for developing models of land use is the Nuu-chah-nulth conception of land tenure. This is defined in *hahuulhi*, which is "the Nuu-chah-nulth system of hereditary ownership and control of traditional territories" (Clayoquot Sound Scientific Panel 1995:vii). Hahuulhi developed over centuries of resource use and management, and is still observed by Nuu-chah-nulth groups. Hahuulhi is linked to the Nuu-chah-nulth approach to resource stewardship, *hishuk ish ts'awalk*. With ownership of land and resources came an obligation of respect for all life forms, and this required an intimate knowledge of these resources that could only develop through many years of relying on the land (Clayoquot Sound Scientific Panel 1995; Turner and Atleo 1998). Searching for traces of a system such as *hahuulhi* has proved elusive for archaeology. It may yet be discernible in the landscape and spatial analysis of archaeological sites may be a promising method for finding its signature.

Each local group is tied to a specific piece of land (Clayoquot Sound Scientific Report 1995). At the apex of the local groups were the chiefs, then commoners and slaves. Hereditary chiefs were responsible for taking care of their *muschum*, or members of their local group (Clayoquot Sound Scientific Panel 1995). Whether a man was a chief or a commoner depended solely on birthright. Close male relatives of the chief often took positions as subchiefs who were responsible for specific areas of land or particular resources. The chiefs, as representatives of each local group, owned territorial rights to houses, privileges and resource procurement areas. Rights to harvest resources filtered down to subchiefs. Commoners and slaves owned nothing, but lived with chiefs and exchanged their labour and loyalty for opportunities to use resource areas (Drucker 1951).

Commoners, while related to the chiefs with whom they resided, had virtually no economic or political power (Lane 1991). Their implicit social contract was activated when chiefs demanded tribute before dispensing the right to harvest resources, or expected a portion of a harvest as tribute after the resources had been obtained and preserved (Drucker 1951; Bouchard and Kennedy 1990; Wike 1951, 1958). Most people gave tribute willingly as they knew the chief would reciprocate with a feast of the surpluses (Drucker 1951; Turner and Atleo 1998; Turner and Jones 2000). Depending on the personality of a specific chief, his relationship with his sub-chiefs and commoners could take one of two forms: a balance of mutual obligations or an "autocratic and exploitive relationship" between the chief and his subordinates (Wike 1958:5). Drucker (1951) saw the relationship between chief and commoners as more of a balance because without the support of his people, a chief would be unable to live up to his inherited name and position. Effective control of resources and surplus was also largely dependent on the coercive power of the military force a chief could wield (Wike 1951).

Relative power among the chiefs could only be enhanced through marriage or conquest (Drucker 1951; Wike 1951). The history of warfare and conquest in Clayoquot Sound, and throughout Nuu-chah-nulth territory, is well documented (e.g.,Arima 1983; Drucker 1951; Bouchard and Kennedy 1990; Sapir and Swadesh 1978; and Webster 1983). By the late eighteenth and early nineteenth centuries, the balance of power in Nuu-chah-nulth territory had crystallized around three or four chiefs (Wike 1951). Economic relations, coupled with military power, extended to the commercial trade in sea otter furs with European and American sailors and led to enhanced powers for the chiefs who controlled the trade, which further entrenched their domination (Morgan 1981). However, the social structure of the Nuu-chah-nulth prevented upward mobility of the commoners, including the subchiefs, and especially slaves (Wike 1951). Rights, land and resources obtained through warfare were considered less noble than those received through inheritance (Drucker 1951).

Within his territory, a chief owned all resources and the lands on which these resources were located. Chiefs controlled access to proximal rivers and fishing places, coves where herring spawned, and berry patches, especially salmonberry. They even asserted ownership of the waters of the sea for miles offshore from their villages, to control access to whaling and other marine resources (Drucker 1951). The land under the sea was the location of dentalium beds that supported the lucrative trade in this commodity, of which the Nuu-chah-nulth were widely known (Barton 1994; Drucker 1951). Ownership extended to these sea beds and all that was found there. Chiefs owned rights to anything that drifted ashore within their territory, including beached whales. They also owned the houses, land and entire villages as well as names, songs, dances, rituals and so on. Significant salmon streams were the most important possession of a chief

(Clayoquot Sound Scientific Panel 1995; Drucker 1951; Lane 1991; Turner and Jones 2000; Wike 1951). This concept of ownership encouraged a central management protocol, emanating from a paramount chief delegating rights to regional subchiefs. In fact, the root cause of many of the wars documented throughout the history of the Nuu-chah-nulth was competition for resources such as productive salmon streams, which resulted in ever-changing boundaries between local group territories (Wike 1951).

The concept of ownership among the Nuu-chah-nulth was so formalized that Captain Cook (Beaglehole 1967:306) noted in his journal that "I have no were [sic] met with Indians who had such high notions of every thing the Country produced being their exclusive property." The strict code of ownership among the Nuu-chah-nulth was also observed by the Indian Commissioner for British Columbia in 1875. In his visit to Nuu-chah-nulth territory, Powell observed that they "have strict customs in regards to their exclusive right to everything their country produces" (Powell 1875:46). A century later, Drucker (1951:247) reiterated that they "carried the concept of ownership to an incredible extreme." Ahousaht elder Peter Webster (1983:17), who was born in the Ahousaht village of O-in-mi-tis in 1908, believed that this concept of property rights had existed for centuries.

Certain natural landmarks defined the boundaries between the land and resources of neighbouring chiefs. Indian Commissioner Powell (1875:46) noted that "the limits of tribal [local group] properties, or tribal claims to land are clearly defined," and that the Nuu-chah-nulth established "distinct boundary posts by which the lines of each locality are distinctly defined and respected by neighbouring tribes." Consistent with a culture oriented toward marine resources, shoreline boundaries were the most clearly defined (Bouchard and Kennedy 1990). Offshore boundaries were located as far out as a person could go and still see the mountains of their territory (Turner and Jones 2000). Interestingly, their concept of ownership was not observed as strictly in the remote inland areas (Drucker 1951; Wilson et al. 1991). Instead, the inland limits of their territories were fluid and defined as the distance inland that the salmon swam or as far inland as necessary to go to obtain cedar. Few mountains were named, except those that were used to locate offshore fishing banks or for navigation (Bouchard and Kennedy 1990; Turner and Jones 2000; Wilson et al. 1991).

While these boundaries are not as well-defined today, contemporary Nuu-chah-nulth people still know their approximate locations (Bouchard and Kennedy 1990). Ahousaht Elder Stanley Sam stated that these "boundary lines are very important in the same way that the government is with their boundary lines with the USA and Canada" (Clayoquot Sound Scientific Panel 1995:8). Boundaries were known to all and this knowledge transcended the generation by means of their oral traditions (Clayoquot Sound Scientific Panel 1995). Trespass into another chief's territory was considered the same as theft, a very serious crime (Lane 1991; Turner and Jones 2000).

Within the territories, patches of productive plant resources were also owned and were often distinctly marked out (Deur 2002; Turner and Jones 2000). Of particular importance were berry patches and stands of good cedar. Some plants, such as clover and silverweed, were subject to intensive management practices that perpetuated distinct ownership (Deur 2002; Turner and Jones 2000).

While boundaries were rigidly defined, there was considerable flexibility in terms of which resources were included in the territory. For example, territorial rights were quickly adapted to the maritime fur trade when foreign traders arrived. When a trading ship anchored within a chief's territory, he controlled other chiefs' access to the ship. Some chiefs prohibited access completely, while others were willing to allow limited access according to some prior arrangement between the chiefs. In 1788, Captain Meares observed a contract between two chiefs and Wickanninish, who acted as a middleman in the trade negotiations in return for a pre-arranged payment (Wike 1951:18).

Hahuulhi can be described as elastic: it was flexible enough to incorporate new resources when they became available, but resilient enough to rebound to its previous dimensions when those resources disappeared or a particular season ended. For example, commodities, such as sea otter pelts, were vulnerable to ownership, and the chiefs who controlled them dominated the fur trade. However, commercial trade in furs did not affect the economic fortunes of the chiefs, nor was it a vehicle for social mobility among commoners or slaves who wished to improve their positions. Indeed, after the fur trade ceased, life among the Nuu-chah-nulth continued much as it did before the arrival of non-Aboriginal people (Wike 1951).

Ethnographic and Ethnohistoric Summary of Nuu-chah-nulth Land Use

Based on a review of the ethnographic and ethnohistoric literature, I have constructed a synthesis of Nuu-chah-nulth land use. This section begins with a discussion of the seasonal round and salient aspects of the society related to land use that I have gleaned from ethnographic and ethnohistoric accounts (Arima 1983; Arima and Dewhirst 1990; Beaglehole 1967; Dewhirst 1978; Drucker 1951; Howay 1941; Jewitt 1987; Koppert 1930; McFie 1865; Moziño 1991; Sapir and Swadesh 1978; Turner and Jones 2000). An idealized depiction of the seasonal round is provided in Figure 4. I derived specific information for Clayoquot Sound largely from Arcas Associates (1988 and 1989), Bouchard and Kennedy (1990), the Clayoquot Sound Scientific Panel (1995) and the first hand account of an Ahousaht Elder, Peter Webster (1983).

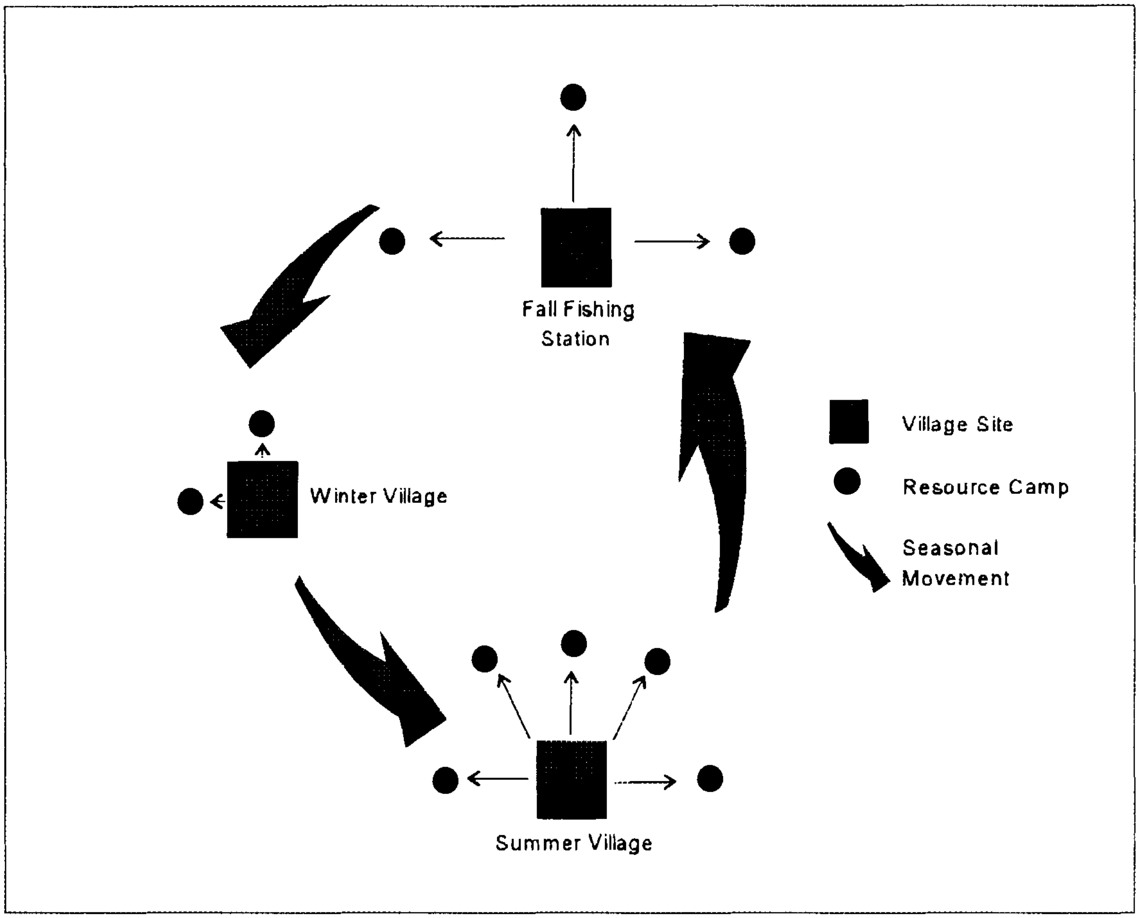


Figure 4. Idealized Nuu-chah-nulth Seasonal Round.

The new year began in November when constant rain and frequent storms kept people settled in villages on the sheltered inside coast. When weather was good, which was rare, men fished for cod and trapped deer, elk and bear, and women gathered shellfish and winter huckleberries. Drift whales most commonly came ashore at this time of year, and were a coveted delicacy. In Hesquiat Harbour and other parts of Clayoquot Sound, ducks were known to winter and were occasionally netted. During the winter, the ceremonial life of the people took precedent over subsistence activities, which were only occasionally pursued to add some variety to their diet of dried salmon.

Herring season began in early February and continued through March. The small fish were caught in nets or with rakes along the outside and inside coasts and as they entered the inlets. Herring were eaten fresh, or smoked for future consumption. Spring salmon could also be caught at this time of year as they followed the herring inland. Weather began to improve just as food stores shrank, thus encouraging dispersion of smaller family groups in search of fresh food resources. People began to move along the inlets to their spring camps, where there were permanent house frames. By March, spawning herring had reached the inland waters, where they remained for several weeks. Herring spawn was collected on boughs or kelp. The eggs were dried in the air while still attached to the substrate on which they were collected. Much of the month of March was devoted to intensive harvesting and processing of herring spawn.

Spring found the Nuu-chah-nulth settled in their spring villages, when food procurement activities expanded. As waterfowl migrated north up the coast, they were trapped in deep coves where they sought shelter during storms. The focus on foods obtained from the sea also continued.

Halibut fishing and whaling began in April, when people moved to the outside coast because by then the weather had improved. The Ahousaht, Tla-o-qui-aht and Otsosaht were known to be great whalers. Late spring and summer were the best time for hunting sea mammals, especially the popular hair seal. In Clayoquot Sound, congregations of sea lions were also exploited. In addition, low spring tides facilitated gathering of shellfish such as giant red sea urchins, black katy chitons, razor clams, black turban snails and blue mussels.

While fishing had scarcely abated, the gathering season began. May was known locally as the beginning of the season of abundance. Early berries, young stalks and leaf stems, rhizomes and fiddleheads and cambium from hemlocks added a much desired variety to the diet. The people of Clayoquot Sound ate shoots of salmonberry, thimbleberry, horsetail and cow parsnip and gathered the roots of eelgrass through April and May, and by early May, salmonberries began to ripen. This was also the best time for stripping bark from redcedars, which was used in the manufacture of many household goods and clothing. Using their spring and summer village as a base, people would move out to a number of temporary resource camps or make day trips to collect their country foods.

While residing on the outside coast, the people of Clayoquot Sound fished for Pacific cod, lingcod, halibut, rockfish and groundfish such as flounder midshipman and skate. Perch were caught close to shore and come summer, dogfish joined the edible menu.

Summer was a time of gathering foods to eat fresh and preserve for winter. A large variety of berries, such as salal berries, red elderberries, blueberries and blackberries, were collected as they ripened. Women used digging sticks to gather available roots and bulbs. Intensive shellfish gathering continued through summer, when barnacles and butter clams were considered to be at their best.

Salmon season began in the summer and lasted into the fall. In the Megin River and at Hisnit in Clayoquot Sound, an early run of sockeye salmon arrives in April, which is two months earlier than in any other stream in Clayoquot Sound. By June, spring salmon were taken in abundance. Springs were considered to be the most desirable of the salmon species because they were the most nutritious. Mid-summer salmon fisheries focussed on pink and sockeye, then spring and early coho. In Clayoquot Sound, the sockeye run began by August, followed in quick succession by spring, coho, pink and chum salmon. Chum salmon, also known as dog or humpback, were the most important salmon of the fall as this species is abundant and well-suited to drying or smoking. Their shelf life lasted into the late winter.

Fall found most people of Clayoquot Sound congregated at salmon fishing stations to prepare their winter store of fish. Evergreen huckleberries and bog cranberries were picked during the autumn and people dug the roots of wild clover and bracken fern. Some people would also hunt or trap land mammals such as martin, otter and black bear around their fishing stations. Throughout the year, coast deer, elk and black bear were hunted or trapped. With the onset of the storms of winter in November, people returned to their winter villages.

Given the rigidity of ownership and the need for large scale movement of groups, archaeological site locations should reflect this pattern. Table 6 summarizes the ethnographic and ethnohistoric information regarding the seasonal round and places it in the context of the environmental settings present in Clayoquot Sound (Table 6).

Table 6. Ethnographic and Ethnohistorical Summary of Land Use.

		Environmental Setting	
Season/ Months	**Resources Exploited**	**Settlement Location**	**Location of Resource Procurement**
Late Fall & Winter: November through January	Subsistence mainly based on food stores. Hunting of land mammals, gathering of evergreen huckleberries and fishing for cod in good weather; occasional drift whale.	Inland villages located on sheltered Inside Coast	Along the Inside Coast, in close proximity to villages, with some forays to Outside Coast.
Late Winter & Early Spring: February through March	Herring then spring salmon caught; herring spawn obtained on hemlock boughs; migrating waterfowl trapped; plant gathering included fiddleheads, young stalks and stems; redcedar use (bark and logging)	Temporary spring camps along the lower Inlets and Inside Coast	Concentrated along the shorelines of the Inside Coast and Inlets.
Spring: Late March/April	Expansion of food and resource procurement; focus shifts to open ocean resources such as halibut, whales and salmon.	Summer villages on Outside Coast	Concentrated on the shoreline of the Outside Coast and offshore.
Spring & Summer: May through August	Gathering season: plants (berries, rhizomes, roots and bulbs, cambium from hemlock) and shellfish; redcedar use (bark and logging); continued focus on ocean fish and marine mammals.	Summer villages on Outside Coast	Expansion of movement but still close to Outside Coast: resource areas mostly within a day's travel of village using small temporary camps.

Season/ Months	Resources Exploited	Environmental Setting: Settlement Location	Environmental Setting: Location of Resource Procurement
Late Summer: August	Salmon begin to spawn. Continued focus on outside coast fish and marine mammal resources.	Most remain in summer villages on Outside Coast	Small groups sent to salmon streams for early runs. Population still concentrated on Outside Coast.
Late Summer & Early Fall: September through mid-November	Salmon season: successive runs of sockeye, chinook, coho, chum and pink as well as steelhead. Intensive activities: procuring and processing salmon for winter storage.	Fall fishing stations on Estuaries and major fishing streams or on Kennedy Lake (Tla-o-qui-aht)	Concentrated around salmon streams. Some movements to obtain animal and plant resources around Estuaries, River Valleys and into the mountains using small temporary camps.
Late Fall: late November	Winter season begins.	Return to villages on Inside Coast.	Limited movement around villages on Inside Coast.

In general, cultural activities concentrated in areas along the shoreline or close to it. According to Drucker (1951), Nuu-chah-nulth people focussed relatively little attention on the inland areas due to the ruggedness of the terrain and the dense, almost impenetrable vegetation. While terrestrial mammal resources were rich, their abundance and diversity paled in comparison to what was available from marine sources. This is not to say that the Nuu-chah-nulth did not venture inland because this is clearly not the case; trails have been documented through many inland areas in Nuu-chah-nulth territory (Lane 1991). It simply means that land use was much more intensive in shoreline areas, which has clear implications for modelling land use.

However, the time depth of the fully developed ethnographic seasonal round as I have described remains a topic of debate. As the evidence from Yuquot was generally consistent with the ethnographic pattern of a maritime focus, exhibiting remarkable continuity for over 4,000 years, several researchers concluded that aspects of the Nuu-chah-nulth seasonal round have antecedents in the archaeological record (Dewhirst 1978, 1980; Mitchell 1990). However, limited archaeological evidence from Clayoquot Sound suggests an alternative explanation. Based on excavations and surface reconnaissance at Hesquiat Harbour, Calvert (1980) and Haggarty (1982) found evidence that independent local groups were residing and exploiting resources within small constrained territories. This pattern of independent local groups coexisting side by side was also documented during the post contact period (Drucker 1951). However, Hesquiat Harbour may represent a unique circumstance as it differs physiographically from the rest of Clayoquot Sound, but we will not know whether this is the case until more excavations are completed in the study area.

Interpretations of ethnohistoric sources and site distributions have also revealed an alternate interpretation that the ethnographic pattern for land use is an entirely recent phenomenon (Inglis and Haggarty 2000; McMillan 1996, 1999). The interpretation is based on the idea that the sudden decimation of large portions of the population due to warfare and the appearance of epidemic diseases led people to adopt a pattern of large-scale movement to effectively exploit seasonally and geographically dispersed resources. However, little is known about the impact of intergroup warfare on the populations of the groups in Clayoquot Sound (Drucker 1951). In addition, signs of epidemic diseases, such as scars from smallpox, went unrecorded in the journals of visiting sailors although they had written about visual evidence of disease amongst Aboriginal populations in other areas (Boyd 1990, 1994; Beaglehole 1967; Jewitt 1987; Menzies 1923; Moziño 1993; Roe 1967; Sproat 1987). The first smallpox epidemic to appear on the Northwest Coast in the 1770s actually missed much of the west coast of Vancouver Island (Wike 1951:58). Although this proposal was then disputed rigourously by other researchers (e.g., McMillan 1999). While smallpox was not documented among the central and northern Nuu-chah-nulth until 1852 (Drucker 1951; Morgan 1981), the conclusion that it was absent would be erroneous. Therefore, populations are difficult to extrapolate based on the mid-nineteenth century observations. Spanish explorers at Clayoquot in 1791 wrote about large populations of 1,500 to 2,500 people in each of the villages (Wagner 1933:145-146), however these rough estimates for central and northern Nuu-chah-nulth groups reveal nothing about the arrival of epidemic diseases.

McMillan (1996; 1999) and Inglis and Haggarty (2000) describe a prior settlement pattern that differs considerably from the ethnographic pattern. Their interpreted settlement pattern was characterized by independent local groups exploiting a "relatively small, culturally constrained territory from a year-round base" (McMillan 1996:279). As populations declined or, as in the case of some groups, disappeared, many permanently occupied villages were reduced to seasonal camps. Amalgamations of several local groups resulted in larger territories that could not be managed effectively from a single location, thus the ethnographic pattern of seasonal movement arose. Inglis and Haggarty (2000:93) suggest that "the archaeological pattern of numerous, large, recently-abandoned village sites located in close geographic proximity" observed during their intensive archaeological survey of the Nuu-chah-nulth area were inconsistent with a subsistence strategy that involved seasonal movements. They found additional support for their interpretation in the journal of Captain James Cook from his 1778 expedition: "[the people of] Nootka Sound were established in a number of relatively small, independent groups that operated from single villages within socially constrained, geographically limited resource territories" (Beaglehole 1967:93).

However, my review of the ethnohistoric literature revealed that the Nuu-chah-nulth were following a seasonal round at least as early as the 1790s. Tello (1930) made note of the seasonal round in 1792 and Bishop (Roe 1967), who visited Yuquot in 1795, observed that most people were living up in Nootka Sound during September, presumably at a fishing camp. In addition, assuming the absence of a major decrease in population, contact with traders would disrupt a seasonal round by compelling people to live near the shipping routes, rather than dispersing about their territories. This was certainly the case in the 1860s (Morgan 1981). Further, Cook only stayed at Yuquot, a winter village site, during late winter, which would have yielded a biased perspective (Beaglehole 1967). Limited travel and activity around a village is consistent with the ethnographic pattern of land use during the winter months.

The Nuu-chah-nulth, like many other Northwest Coast Aboriginal groups, appear to have experienced more of an intensification or modification of their established lifeways, rather than a significant change, immediately following contact (Wike 1951). Indeed, Wike (1951) found that the trade in sea otter furs was conducted on the terms put forth by the Aboriginal people, allowing them to maintain their established practices and demand of the traders the best technology to do so.

Oral traditions, while few in number, further support the argument that the seasonal round as described in the ethnographies was well-developed at time of contact. For example, Peter Webster (1983:17), an Ahousaht elder, in his descriptions of the seasonal movement that his family followed, states that "my people still lived a life much like that which existed before contact with the Europeans."

The ethnographic and oral histories provide support to the argument that the ethnographic pattern for land use has considerable time-depth. Spatial analysis, as conducted for this study, also suggests that the ethnographic pattern may have been present in ancient times. However, conclusive evidence will remain elusive until further archaeological excavations and radiocarbon dating allow us to construct a detailed chronology of sites in the Nuu-chah-nulth area.

LAND USE MODELS

The Aboriginal inhabitants of Clayoquot Sound saw sufficient benefits to living in a land with such diverse and abundant resources that they adopted strategies to optimize living in this environment. So firmly established were these general lifeways that they were present by at least 2,000 years ago when large, permanent villages started to appear throughout the Nuu-chah-nulth area, and persisted well into the global era (Mitchell 1990). Their connection to, and knowledge of, the landscape was so strong that by the time Europeans arrived on their shores in the late eighteenth century, they had developed complex systems of land use and land tenure to most optimally exploit their environment while maintaining a balance to prevent overexploitation. The antiquity of the seasonal round as described in the ethnographies is an outstanding question. The two land use models that I present in this section represent steps toward resolving this question.

Model 1 - Cultural Landscape Model

The Cultural Landscape Model is based on the seasonal movement detailed in the ethnographic and ethnohistorical summary, which exploited a variety of environments in the study area. Each environmental setting within the study area possessed unique qualities. Depending on the qualities present, the landscape would have been used for different activities at different times of year. I described the environmental settings found in Clayoquot Sound in chapter one.

Fundamentally, the Cultural Landscape Model is a translation of the ethnographic land use pattern into spatial data. By converting the more abstract and descriptive information into a spatial medium, I was able to predict the types of sites and features for each setting and the areas in which these would be found (Appendix B). Figure 10 (Appendix C) is a visual representation of the model.

Model 2 - The Habitation Site Model

A more common approach to modelling land use, particularly if the purpose of the study is to develop predictions about site location, is to model for the location of habitation, or village, sites (e.g., Maschner and Stein 1995). There are advantages and disadvantages to using such an approach. The main advantages are that habitation sites are the most studied of archaeological site type and they are often the most visible during surface survey. The major disadvantage is that they account for a relatively small percentage of archaeological features that exist in the real world. Nonetheless, the second model presented here is intended to predict the locations of habitation sites in Clayoquot Sound based on the ethnographic review (Figure 11, Appendix C). Locating significant habitation sites is a critical step in finding the archaeological signature of the seasonal round. Habitation sites also represent the starting point when looking for archaeological evidence of the land tenure system described in ethnographic and ethnohistoric accounts.

The seasonal round pursued by the people of Clayoquot Sound demanded seasonal mobility. People congregated in large villages for the winter, then dispersed to smaller villages for the summer to pursue a variety of fisheries and sea mammal hunting. In the fall, people congregated again at fall fishing stations where they harvested large amounts of salmon and preserved them for the winter.

For winter villages, shelter was likely the key consideration when deciding on a location. Most were located in sheltered areas away from the prevailing southeasterly winds that brought the storms in winter. Other desirable features would have included a level area above the shore that was out of the reach of storm tides, but with an open sand or gravel beach across which they could haul their canoes. Proximity to freshwater was less of an issue in the winter because freshets and streams were numerous and rainwater was easily obtained (Drucker 1951). In Clayoquot Sound, some winter villages were located along the inlets, while some were in the sheltered inside coast areas such as those on Meares Island (Lane 1991). Peter Webster's (1983) Ahousaht family, for example, traditionally used Cloolthpich on the west side of Meares Island. The Tla-o-qui-aht also had their main winter village on Meares Island at Opitsat. Opitsat is sheltered from the storms that track from the southeast and has a variety of good shore zone resources in its immediate vicinity (Lane 1991).

Summer villages were located on, or very near, the outside coast and beaches. As weather is calm and there is relatively little rain, shelter was far less of a concern than proximity to a source of freshwater. As many springs and smaller streams are dry at this time of year, water was likely a key consideration for village location. A level site with suitable beach access was just as important in the summer as it was in the winter. Most of the modern Indian Reserves that are contemporary settlements were ancient summer habitations as they were the most convenient of their traditional villages to shipping routes and European goods and settlements (Drucker 1951). The Tla-o-qui-aht who wintered at Opitsat moved to Ichachis on the open ocean for spring and summer (Lane 1991). Peter Webster's (1983) family summered at Yarksis on Vargas Island, which was formerly a Keltsomaht village.

The Nuu-chah-nulth located their fishing stations at their most productive fishing grounds. Summer villages are also considered fishing stations as they were situated near their offshore fishing and sea mammal hunting waters. Fall fishing stations were situated at their main salmon streams, normally at the heads of inlets and along the estuaries where the rivers drained into the inlets. Level ground was also a consideration, but not difficult to find along river mouths and estuaries (Drucker 1951). The Tla-o-qui-at of Opitsat used Okerminna on the Kennedy River as their main fall fishing station, but also spent some time at Inistuck on Indian Island before moving to their fall fishing station (Lane 1991). Peter Webster's (1983) family harvested and preserved their winter stores of dog salmon at O-in-mi-tis on the Bear River at the head of Bedwell Sound.

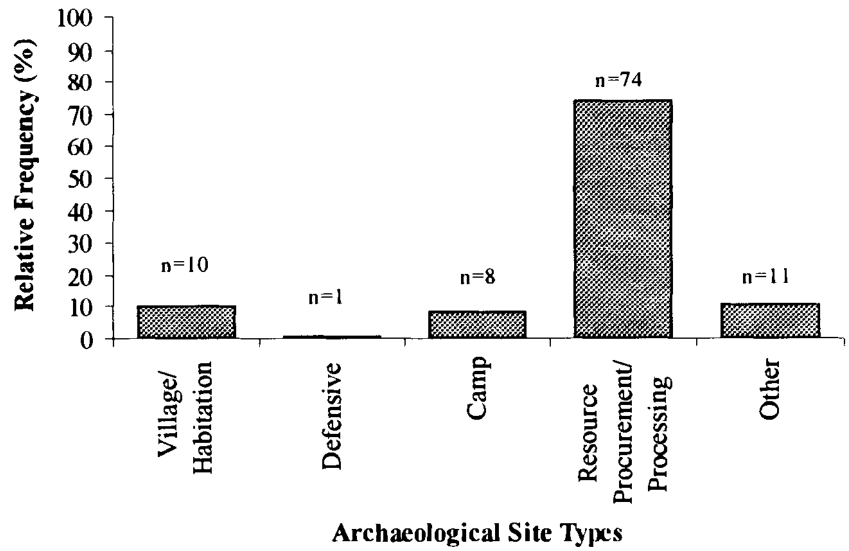
Another type of habitation site was the defensive, or war refuge, site. These were typically small islands with steep sides that were difficult for warriors to ambush without being spotted. These sites could not be occupied for the long term as there was normally a limited supply of water, food and other resources. In places where natural defensive sites were not available, residents would build stockades around their villages (Drucker 1951).

At winter and summer villages, and major fishing stations, inhabitants built permanent shed roof house frames. The planks that comprised the roofing and siding were easily removed and transported by canoe from one habitation site to another as people moved seasonally. Smaller dwellings were erected at short-term resource procurement camps using the planks, but with no permanent frame (Drucker 1951; Koppert 1930).

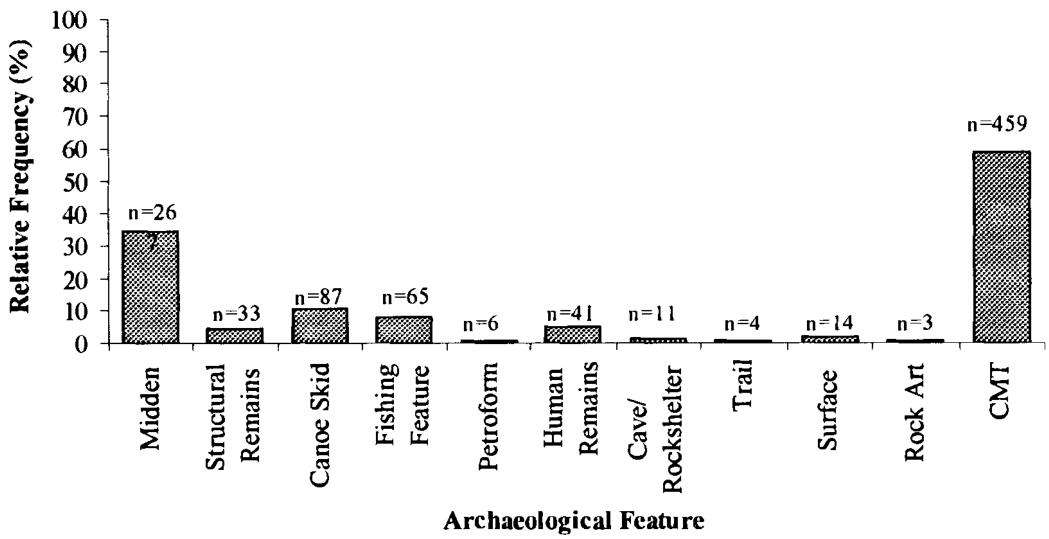
INVENTORY OF ARCHAEOLOGICAL REMAINS

Archaeological Sites and Features

As of autumn 2002, there were 876 recorded archaeological sites in Clayoquot Sound. Of those, 783 had some Aboriginal component, 723 contained strictly Aboriginal remains, 60 were comprised of both Aboriginal and historic remains, and 93 contained solely historic remains. As my study focuses on Aboriginal sites alone, the strictly historic sites were removed from the GIS database. Within the 783 archaeological sites with Aboriginal components, a total of 1,094 features, or groups of features, have been recorded. In this section I provide an inventory of the Aboriginal archaeological sites within the study area (Figure 5a), followed by an inventory of archaeological features recorded at the sites (Figure 5b).



a.



b.

Figure 5. Inventory of Archaeological Remains Recorded in Clayoquot Sound. (a) Archaeological Site Types; (b) Archaeological Features.

Site Types

In Clayoquot Sound, archaeologists have recorded eighty habitation/village sites, which is approximately 10% of all sites in the study area. All of these sites contain relatively large shell midden deposits, but investigators observed evidence of structural remains at only 34 of these sites. Fifteen of the eighty sites also contained canoe runs, and only three of the habitation sites contained a fish trap or fish weir. Investigators recorded only four defensive sites, or 0.5% in the study area. All four sites appear to be associated with village or habitation sites and both shell midden deposits and structural remains were present.

Site recorders interpreted 64 sites, or about 8%, as campsites. Twenty-two of these sites were explicitly listed as resource camps. Relatively small shell middens were recorded at 58 of the campsites, ten of which had canoe skids. Fish traps or weirs were only recorded at four of the campsites, while CMTs were noted at 15 of the sites.

By far the most ubiquitous, 577 of the 783 Aboriginal sites in Clayoquot Sound, or 73.7%, were interpreted as resource procurement and processing sites. Twenty-two of these sites were interpreted as campsites and three sites had evidence of habitations within the site boundary. Approximately 72% of all the sites in the study area were considered by the site recorders to be primarily resource procurement and processing sites. The most numerous of resource sites are CMT sites (n=436). Three hundred and ninety resource sites are comprised solely of CMTs and four sites are comprised of CMTs and canoe skids, suggesting that the sole purpose of 394 sites, or 50.3% of all sites in Clayoquot Sound, was for forest utilization. At 128 of the resource sites, investigators recorded shell midden deposits. Only two of these sites yielded structural remains. At seventeen of these sites, shell midden deposits were recorded in association with fish traps or weirs, suggesting that these were fish processing sites. Five of these fish processing sites also contained canoe skids. Fish traps or weirs were recorded at 59 of the resource sites. Twenty-seven of these sites contain no other features besides the fish traps or weirs, suggesting that the use of the site was procurement, with little to no processing and no site occupation.

Less common site types in the study area were consolidated into an "Other" category that is comprised of 85 sites, or 10.9%. These include human remains (n=32), canoe skids unassociated with other features (n=21), unknown petroforms (n=3), rock art (n=3), and evidence of Aboriginal trails (n=2). The remaining sites (n=24) contain ephemeral remains or culturally-modified trees that appear to be recent modifications.

Archaeological Features

Shell midden deposits were recorded at 268 sites in Clayoquot Sound. Of these, 34 also have evidence of structural remains such as berms and ridges, suggesting that they were once used as village or habitation sites. Several of these sites contained additional features such as canoe skids (n=6), fish traps or weirs (n=2), human remains (n=2), or CMTs (n=5). Only 29 of the 34 sites with associated structural remains were interpreted as village or habitation sites by the original recorder. At the 234 sites with shell midden deposits where no evidence for structural features was noted, 87 also had canoe skids present and 19 had both canoe skids and fish weirs or traps. Twenty-one sites contained shell midden deposits and fish weirs or traps. Archaeologists inferred that these sites were resource sites, campsites and habitation/village sites.

A total of 11 sites were caves or rockshelters that contained evidence of human use. Three of these included subsurface or eroding shell midden deposits and two had visible refuse on the surface. Caves and rockshelters were inferred as camps, burial places, and one was recorded as a habitation site.

Investigators recorded canoe skids at 87 sites in the study area. At fifteen sites, canoe skids were recorded as part of a complex of features that was interpreted as a habitation or village site. Canoe skids were present at 22 sites that were inferred as resource camps. At four campsites, canoe skids were noted, while at 46 resource procurement and processing sites, canoe skids were found. At 24 sites that fall into the "Other" classification for site types, investigators recorded canoe skids; 20 of these sites are comprised solely of canoe skids.

Sixty-five sites include fish traps or weirs. At 28 of these sites, fish traps and weirs are the only features present, thus archaeologists interpreted them as resource procurement sites. Fish traps were recorded at three habitation or village sites, four campsites and 58 resource sites.

A total of 41 sites contained human remains. Thirty-three of these sites are comprised solely of human remains.

Researchers have recorded and described a total of 4,356 CMTs at 459 sites within the study area. Of these, 203 sites contained trees with scars from bark-stripping, 289 sites had Aboriginally-logged CMTs and 73 sites contained trees with other types of modifications. At 11 sites, no descriptions or counts of CMTs were recorded. Numbers of CMTs recorded at a site range from a single CMT (n=150) to 441 (n=1). The mean number of CMTs per site is ten, but this number is heavily skewed to lower numbers as the majority of sites contain three or fewer CMTs (n=246).

Due to their sparseness, I chose to group the remaining features into the 'other' class. Rock art was found at three sites in the study area. At all three sites, petroglyphs were the type of rock art recorded, and they were found unassociated with any other features. Researchers noted uninterpreted petroform features at six sites in Clayoquot Sound. The recorders stated they could not infer the purposes of these petroforms, but felt they were anthropogenic. Archaeologists noted surface refuse at 15 sites in the study area. At four of these sites, surface refuse was the only archaeological feature present.

Traditional Use Sites

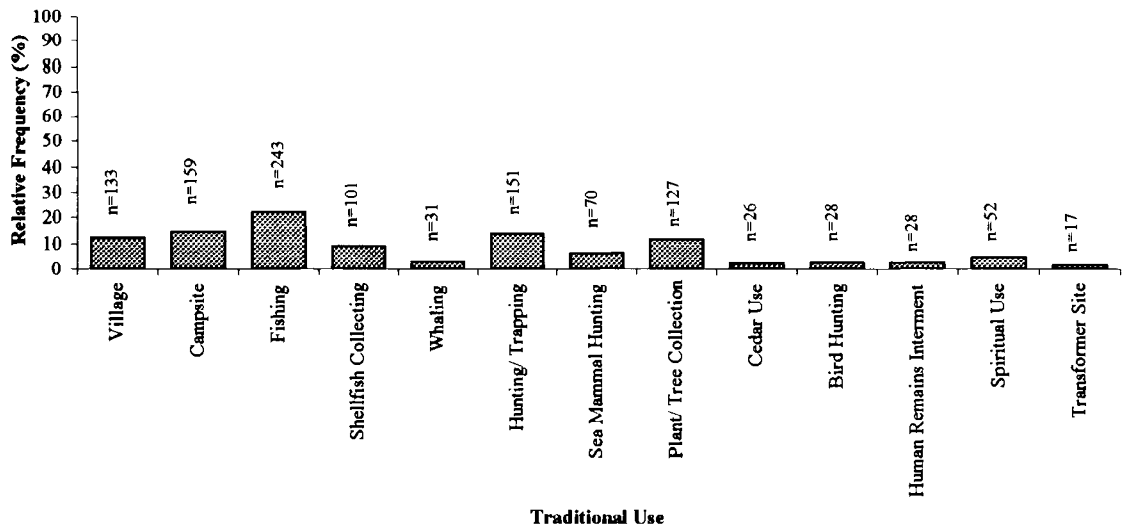
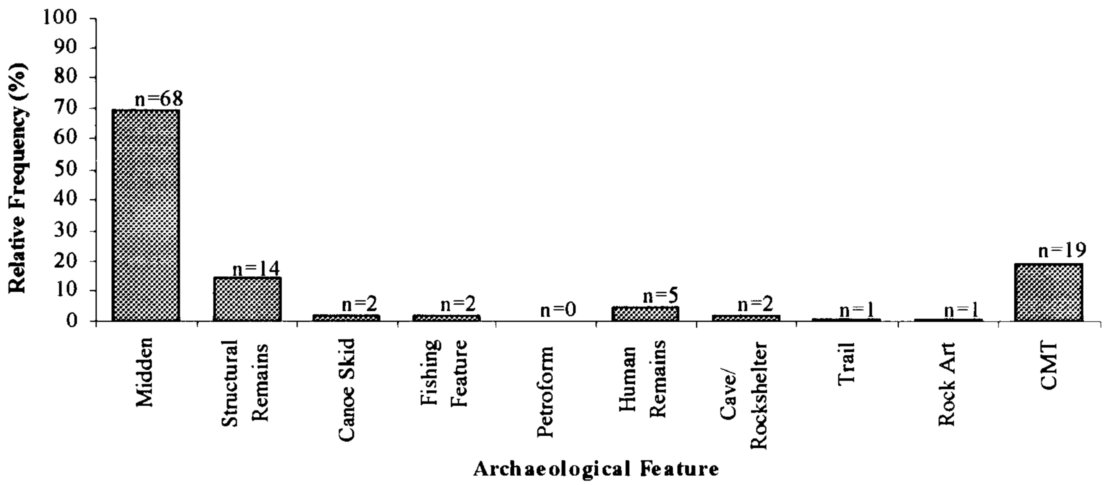


Figure 6. Inventory of Traditional Use Sites Recorded in Clayoquot Sound.

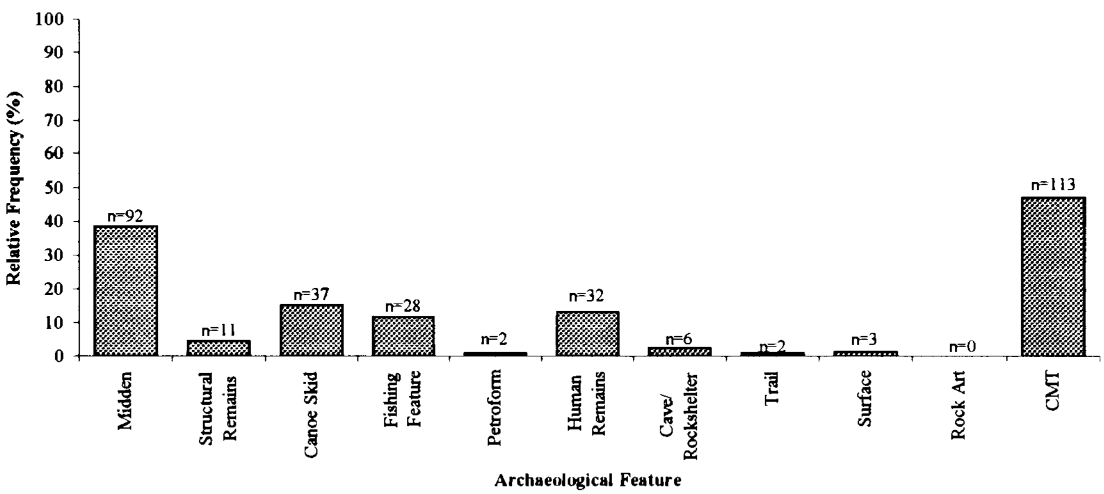
A total of 1,079 traditional use sites have been recorded and mapped in the study area (Figure 6). Ninety-nine sites are considered former village sites and 125 were noted as campsites. Informants stated that 34 sites were used as both villages and campsites. Resource procurement and processing activities were also recorded for many of these sites.

Burials were known to exist at 28 locations, but only 11 sites were used solely for this purpose and three burial sites also had spiritual connections. Twenty four sites were known as spiritual places, many of which were used for spiritual training. Nine sites are transformer sites. The remaining 746 recorded sites were used primarily for resource procurement or processing.

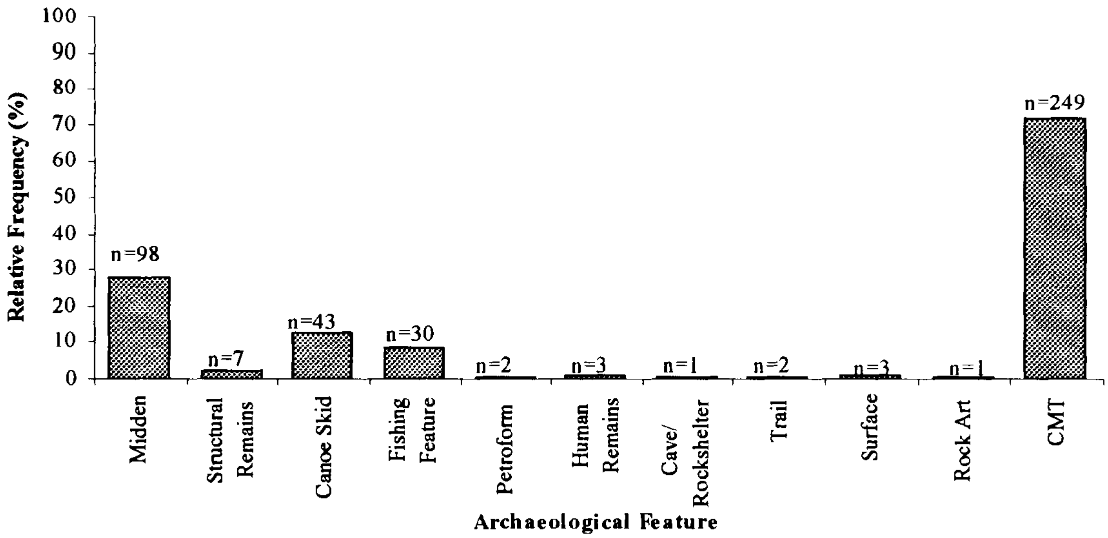
Figure 7. Archaeological Features Recorded within each Environmental Setting.



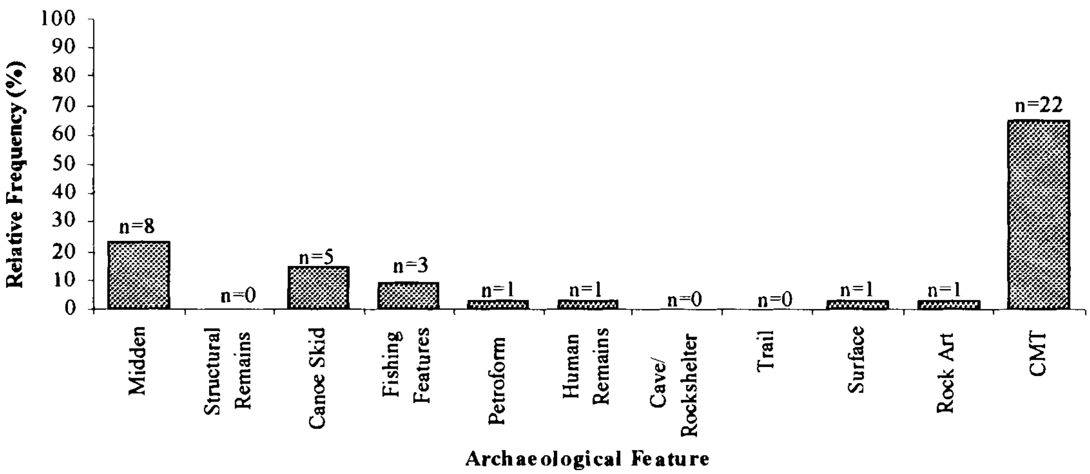
a. Outside Coast Environmental Setting.



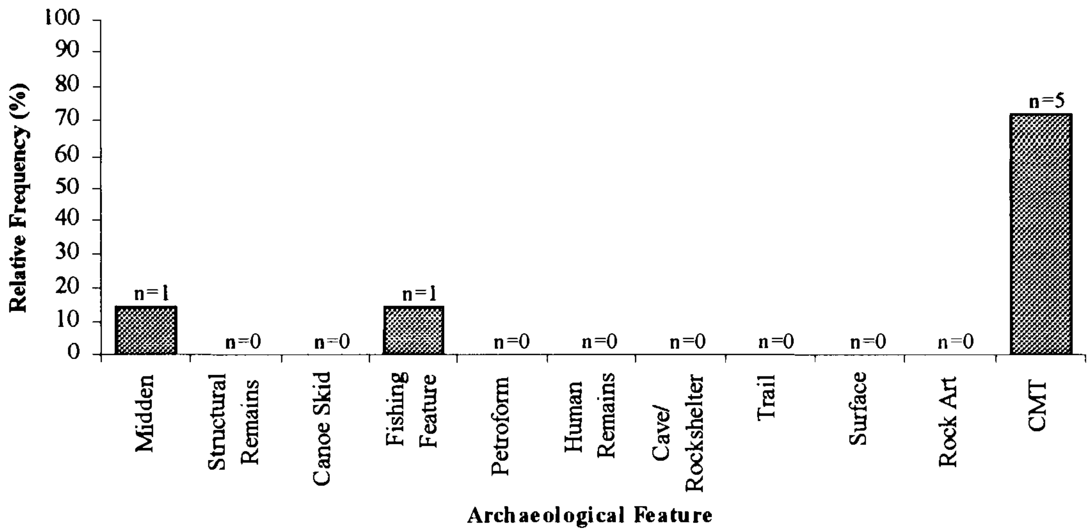
b. Inside Coast Environmental Setting.



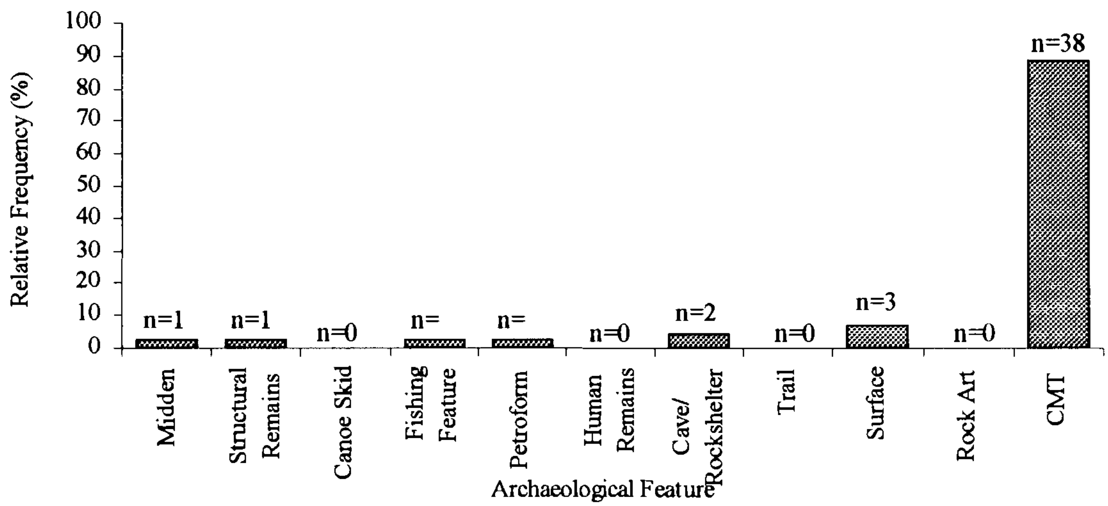
c. Inlets Environmental Setting.



d. Estuaries Environmental Setting.



e. River Valleys Environmental Setting.



f. Kennedy Lake Environmental Setting.

COMPARISON OF MODELS TO THE ARCHAEOLOGICAL DATA

Model 1 - Cultural Landscape Model

In this section I provide the results of the comparison of the Cultural Landscape Model to the recorded archaeological remains in each environmental setting of the study area. The process of comparison acts as a test of how adequately the Cultural Landscape Model describes the archaeological landscape of Clayoquot Sound. To allow for direct comparison of the remains in each environmental setting, I constructed histograms based on the relative frequency of the occurrence of each feature type (Figure 7). By converting the number of features, or groups of features, to percentages, I standardized the data to facilitate direct visual comparison. For reference, I have also included the actual numbers.

I also offer a brief summary of the traditional use sites found in each environmental setting as a basis of comparison. However, the distribution of traditional use sites was expected to be consistent with the Cultural Landscape Model as both are derived from the same sources of information. Therefore, I have excluded the traditional use site data from the concluding remarks for this section.

Outside Coast

A total of 98 archaeological sites were recorded within the Outside Coast environmental setting. This represents 12.5% of all known archaeological sites in the study area. The most common feature recorded in this setting are shell midden deposits. At fourteen of the shell midden sites, evidence of structural remains were also recorded. Canoe runs were recorded at two of the sites where shell middens and structural remains were recorded. These were interpreted as village sites, one of which was the Ahous whaling village that was occupied during the ethnographic period.

CMTs are the second most common feature: 91 modified trees were recorded at 19 sites. Nine sites contained only bark-stripped trees, nine contained only aboriginally-logged CMTs, one site contained both bark-stripped and aboriginally-logged trees, while one site contained another type of modification. Fish traps or weirs were recorded at two sites, and were found unassociated with other archaeological remains. Researchers observed human remains at five sites. Archaeologists inferred that two caves or rockshelters in this environmental setting were used as temporary habitations. Only one petroglyph has been recorded in the Outside Coast.

A total of 306 traditional use sites have been documented within this environmental setting. Twenty are village sites and 24 are campsites, and ten sites were used as both villages and campsites. Three sites were used for exclusively spiritual purposes, one was used for burials and had spiritual significance and one was considered a transformer site. Sixty four sites have been assigned place names, but the function of the sites are unknown. The remaining 183 sites are considered resource procurement areas. The following activities were known to take place at these sites: fishing, shellfish gathering, sea mammal hunting, plant use, hunting and trapping, whaling, bird hunting, and cedar use.

Inside Coast

A total of 240 archaeological sites have been recorded within the Inside Coast environmental setting. This is 30.65% of the total for Aboriginal sites recorded in Clayoquot Sound. CMTs are the most common feature in this environmental setting. A total of 1,678 CMTs were recorded at 145 sites. Forty two contained only bark-stripped trees, 45 contained only aboriginally-logged trees, 23 contained both aboriginally-logged and bark-stripped trees, 28 contained other types of modifications, and seven were comprised of both aboriginally-logged and other types of modifications.

In the Inside Coast environmental setting, shell midden deposits are the second most commonly recorded feature, which were recorded at 92 of the sites. Researchers also noted evidence of structural remains at 11 of these sites. Thirty-seven sites contained canoe runs, 32 sites contained human remains, 28 had fish traps or weirs, six sites were caves or rockshelters with evidence of limited occupation. No rock art was found in this environmental setting.

A total of 340 traditional use sites coincide with this environmental setting. Thirty-eight sites were described as village sites, 37 were campsites and nine were described as both. Eleven sites had strictly spiritual significance and two are transformer sites. Ten sites were used solely for burials and one was a spiritual site where burials were also present. Sixty six traditional use sites have place names, but the functions of those sites is not known. The remaining 166 sites were used exclusively for resource procurement. The following activities took place at these sites: fishing, shellfish gathering, hunting and trapping, plant use, sea mammal hunting, bird hunting, cedar use, and whaling.

Inlets

Archaeologists have recorded a total of 349 archaeological sites in the Inlets environmental setting, representing 44.6% of the total recorded for Clayoquot Sound. CMTs are the most ubiquitous feature in this setting, which were recorded at 243 sites and total 2,184 trees. One hundred and eleven sites were comprised solely of aboriginally-logged trees, 71 sites contained only trees with bark-stripping scars, and 43 sites contained trees exhibiting both aboriginal logging modification and bark-stripping scars. At 21 sites, CMTs with other modifications or with unknown modifications were recorded.

Shell midden deposits are the second most commonly recorded feature in the Inlets environmental setting. Researchers noted structural remains at seven of the sites containing shell middens. Forty-three sites included canoe runs, 30 sites had fish traps or weirs, and three sites contained human remains. Only one rockshelter or cave was recorded with evidence of use. Rock art was recorded at one site in this environmental setting.

A total of 291 traditional use sites coincide with the Inlets environmental setting. Forty-three sites were recorded as campsites, 25 sites were used as villages and nine sites were considered both. Only one site was used strictly as a burial site, another was a spiritual site with burials and another burial site was associated with a transformer legend. Five sites were strictly transformer sites and five sites were recorded as spiritual sites. Sixty two sites had place names, but the informants did not recall the function of these sites. The remaining 139 sites were used for obtaining resources. The following activities took place at these sites: fishing, hunting and trapping, plant use, shellfish gathering, sea mammal hunting, cedar tree use, and whaling.

Estuaries

In the Estuaries environmental setting, archaeologists have recorded only 34 archaeological sites. Again, CMTs are the most abundant site type: 22 sites contain a total of 93 CMTs. Of these 22 sites, three sites are comprised entirely of bark-stripped trees, while 13 sites contain only aboriginally-logged trees. Three sites contained both types. In addition, seven sites contained trees with other modifications.

The second most commonly recorded feature in this environmental setting were shell midden deposits, none of which had evidence of structural remains. Canoe skids were recorded at five sites, fish traps or weirs at three sites, human remains at one site, an unidentifiable petroform at one site and one site had limited surface remains.

Fifty four traditional use sites fall within the estuaries environmental setting. Eight sites were recorded as villages, six were campsites and three were recorded as both villages and campsites. One transformer site, one burial site and two spiritual sites were also recorded in the Estuaries environmental setting. Place names were known for nine locations, but their use was no longer remembered. The remaining 24 sites were used for resource procurement or processing. The following activities took place at these sites: fishing, hunting and trapping, plant use, bird hunting, sea mammal hunting and shellfish gathering.

River Valleys

Only seven archaeological sites have been recorded in the River Valleys environmental setting. Researchers have recorded a total of 63 CMTs at five of the sites: three comprised of aboriginally-logged trees and two with both bark-stripped and aboriginally-logged trees. One site contained shell midden deposits and another had a fish trap or weir.

A total of 31 traditional use sites coincide with the River Valleys environmental setting. Informants stated that three sites were former village or habitation sites, two were campsites and one was recorded as both. Five sites are spiritual sites, and one is a transformer site. Nine sites had place names, but informants did not recall any function for the locations.

aboriginally-logged trees were recorded. One site was comprised of a single CMT with a kindling removal scar. Archaeologists have recorded shell midden deposits at one site, where structural remains were also present. Other archaeological features recorded include: three surface scatters of refuse, two rockshelters with evidence of limited use, a fish trap, and an unidentified petroform.

Informants recalled thirty traditional use sites for this environmental setting. Thirteen sites were used as camps, three were village or habitation sites and two were considered camps or villages. Only one spiritual site is known in this setting. Informants recalled place names for two sites, but did not know function of these locations. The remaining nine sites were for resource procurement or processing. Activities pursued at these locations include: fishing, hunting and trapping, plant use , cedar use, bird hunting, and sea mammal (hair seal) hunting.

Coastal Mountains

Only two archaeological sites have been recorded in the Coastal Mountains environmental setting. Both sites are comprised entirely of bark-stripped CMTs. Investigators have recorded a total of 18 trees in this setting.

Only seven traditional use sites coincide with this environmental setting. Two sites are associated with a key Ahousaht village located in the Inside Coast environmental setting, but informants did not specify the use of these locations. One site is a spiritual site and one is a known location for hunting and trapping. The other two sites are place name sites of unknown function.

Inland Mountains

Only two archaeological sites have been recorded in the Inland Mountains environmental setting. A total of 21 bark stripped CMTs were recorded at the two sites. A total of four traditional use sites were noted in this environmental setting. Three are spiritual sites and one is a place name of unknown function.

Discussion

In general, the Cultural Landscape Model is a good predictor of the types of archaeological remains that exist in the environmental settings of Clayoquot Sound. Table 7 provides a comparison of the predictions of the Cultural Landscape Model to the archaeological record as it is currently known.

Table 7. Comparison of the Cultural Landscape Model to the Known Archaeological Record.

Environ-mental Setting	Predicted Features and Relative Quantities	Observed Features and Relative Quantities	Assessment of Fit
Outside Coast	• mostly shell middens (some with structural remains) • CMTs (mostly bark-stripped, but also other types) • human remains in areas where caves/rockshelters are present • other features expected, but not in low quantities	• shell middens the most common feature, some with structural remains • CMTs (bark-stripped and aboriginally-logged) are second most common • human remains present • other features present in low relative quantity	Good fit. Observed features appear in same relative quantity as predicted by the model.
Inside Coast	• CMTs (all types) expected to be most common • shell middens should also be numerous, some with structural remains • human remains in areas where caves/rockshelters are present • canoe skids and fishing features expected in higher relative quantity than in Outside Coast Setting • other features expected to be few in number	• CMTs are most common feature; all types present • second most common are shell middens, some with structural remains • canoe skids at many sites • largest number of sites containing human remains found in this setting • fishing features also common • all other features present except rock art	Good fit. Observed features appear in same relative quantity as predicted by the model.
Inlets	• CMTs expected to be most common feature • bark-stripped trees predicted to be most common CMT type, but other types are expected • surface refuse and middens as evidence of resource camps • canoe skids expected to be few in number as most shorelines are steep sided	• CMTs most common feature type • bark-stripped trees are common, but aboriginally-logged trees most common • many shell middens present, some with structural remains • numerous canoe skids • fishing features fourth most common feature	Poor fit. CMTs most common as predicted. Middens, canoe skids and fishing features more numerous than expected.
Estuaries	• CMTs (all types) most common feature • middens with structural remains • fishing features and canoe skids expected to be numerous	• CMTs are the most numerous feature • relatively few middens, no structural remains • canoe skids and fishing features present, but in low quantities	Moderate fit. CMTs most common as predicted, but few middens, canoe skids and fishing features observed.

Environ-mental Setting	Predicted Features and Relative Quantities	Observed Features and Relative Quantities	Assessment of Fit
River Valleys	• CMTs (all types) expected to be most common feature • middens expected in low quantities • fishing features expected in low quantities • trails could be present	• CMTs (aboriginally-logged and bark-stripped) are the most numerous • one midden recorded • one fishing feature observed	Good fit.
Kennedy Lake	• CMTs (all types) expected to be most common feature • middens expected to be present, some with structural remains • fishing features expected • surface refuse and canoe skids may also be present	• CMTs of all types are the most numerous feature • surface refuse second most common feature followed by evidence of use of rockshelters • only one midden with structural remains observed • fishing feature observed	Moderate fit. As expected, except fewer middens and fish features were recorded.
Coastal Mountains	• CMTs, mostly bark-stripped	• CMTs are only recorded feature, all are bark-stripped	Good fit
Inland Mountains	• CMTs, entirely bark-stripped trees • small animal bones (marmot hunting)	• CMTs are only recorded feature, all are bark-stripped	Good fit

Archaeological remains recorded in the Outside Coast environmental setting have strong parallels to the Cultural Landscape Model. As predicted in the model, remains consistent with large village sites and open ocean resource procurement and processing, such as large shell middens and structural remains, were present. In addition, as predicted, CMTs made up a large part of the archaeological record in the Outside Coast environmental setting.

Within the Inside Coast, the model predicts that the major archaeological features would be shell middens, some would be part of a complex of remains indicative of village sites, and CMTs. CMTs would be in greater relative abundance than the Outside Coast as suitable trees are more numerous. People would also utilize the redcedar trees in this environment in spring and summer due to its proximity to summer village locations on the Outside Coast and the relatively high quality of the redcedar in the Inside Coast. This is also true for other plant resources, but archaeological evidence for plant collection other than cedar resources is not expected. These predictions are consistent with what has been recorded during archaeological investigations.

The model predicts that archaeological features within the Inlets environmental setting would be limited to smaller midden deposits indicative of campsite locations and CMTs. As people were not generally resident in this setting for long periods of time, CMTs would be the most abundant archaeological feature. Rockshelters or caves with evidence of human use might also be found in this setting. CMTs are the most common archaeological feature recorded in this environment, with more sites containing Aboriginally-logged trees than bark-stripped trees. Oddly, more sites with middens and structural features that have been interpreted as villages are present than the model predicted. In addition, canoe skids and fishing features were not expected to be a prominent type of feature as most inlets are steep sided with few areas for beaching canoes and few productive salmon streams.

For the Estuaries environmental setting, the model predicts that substantial evidence of habitation as well as procurement and processing of fish would be found in this setting. In addition, CMTs should be numerous as there is high quality cedar found around the mouths of rivers in the study area. CMTs make up the majority of feature types found in this environment. However, fewer substantial midden deposits have been recorded and described than would be expected at the locales of fishing stations.

The model predicts that within the River Valleys, shell midden deposits associated with both village sites and campsites, would be found. As the focus of activities in this setting would be on resource procurement, including fishing, subsistence features such as fish traps or weirs might also be present. In addition, trails leading inland and into the mountains might also be found. However, the most common feature would likely be

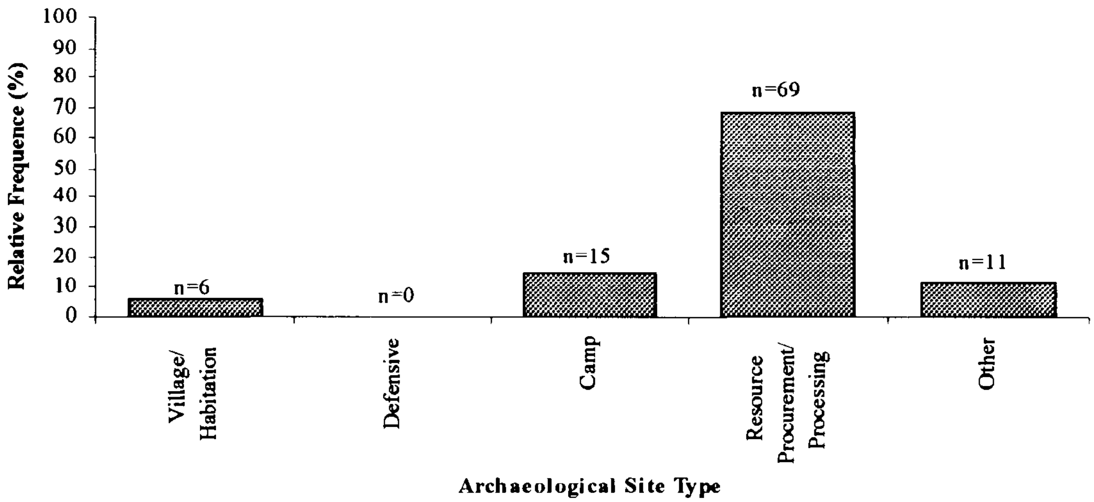
CMTs as river valleys host numerous stands of good quality timber. The features recorded, though few in number, are consistent with the model.

Kennedy Lake, according to the ethnohistorical and traditional literature, was a main locus for procurement of plant resources, particularly from redcedars, and salmon fishing. Therefore, one would expect to find numerous CMTs of all types, midden deposits, and fish traps or weirs. The archaeological features recorded in this environmental setting are consistent with the model.

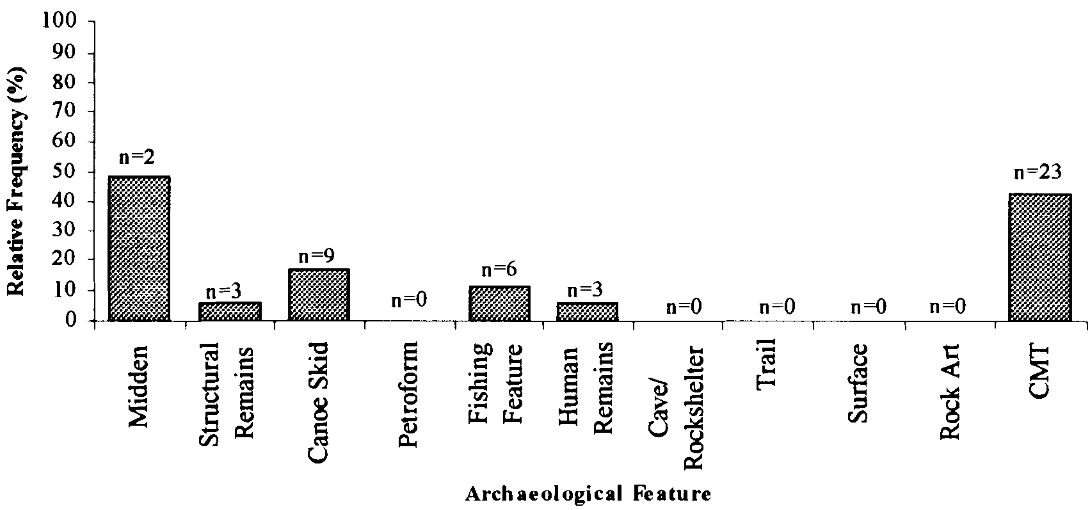
The model predicted that limited archaeological remains would be found in both the Coastal Mountains and Inland Mountains environmental settings. CMT sites were the only features recorded in these areas, which was expected for Coastal Mountains but not the Inland Mountains. The presence of CMTs confirms that people used the Inland Mountains, but I doubt that people would have travelled such a great distance just for cedar bark. I suspect that the bark collection was combined with spiritual pursuits or hunting.

Overall, the archaeological remains that have been recorded in the study area are consistent with the model, but there are some discrepancies. For example, in the Estuaries environmental setting archaeological features that one would expect at fishing stations, such as middens and structural remains, are few in number. However, I believe that this is at least partially explained by the fact that Indian Reserves were not included in the inventory conducted by Golder Associates (Mason et al. 1999). Most major fishing stations were designated as Indian Reserves in the nineteenth century. There is also a lack of concordance between the model and the archaeological record in the River Valleys, Coastal Mountains and Inland Mountains environmental settings. However, I believe that this is due to sample size as these environmental settings have received relatively little archaeological attention and few remains have been recorded.

In areas with excellent archaeological coverage, the poorest fit between the predictions of the model and what has actually been recorded occurs in the Inlets environmental setting. Shell middens with structural remains, canoe skids and fishing features have been recorded in greater abundance than was predicted by the model. The Inlets environmental setting as described in Table 1 consists of steep rocky shorelines and contains limited resources aside from good quality timber. The Inlets environmental setting as defined would not contain physiographic features that would accommodate village locations and shorelines suitable for hauling canoes ashore. In addition, fishing features would not be anticipated as productive salmon streams are not expected to be numerous in this setting. Such features - middens, fishing features and canoe skids - are, however, consistent with the Estuaries environmental setting. I suspect that either the definition of the environmental setting is too restrictive or my transcription of the setting into the GIS was inadequate, and that there are numerous small estuaries situated within the Inlets environmental setting.



a.



b.

Figure 8. (a) Archaeological Site Types and (b) Archaeological Features that Coincide with Areas Identified by the Habitation Site Model as Favourable.

Model 2 - Habitation Site Model

In this section, I provide the results of the comparison of the Habitation Site Model to the recorded archaeological remains in the sample of the study area. Similar to the Cultural Landscape Model, the comparison takes the place of ground truthing to test how well the Habitation Site Model predicts where habitation sites may be found. Again, to allow for direct comparison of the remains in each environmental setting, I constructed histograms based on the relative frequency of the occurrence of each site type and archaeological feature in areas identified by the model as suitable for locating habitation sites (Figure 8).

Of the 342 archaeological sites located within the sample area, a total of 54 sites coincided with areas identified as suitable for habitation site location. This represents only 16% of sites in the area. Of the 54 sites, only three, or 6%, were inferred as village/habitation sites. The most common site type was resource procurement or processing sites, followed by campsites and other site types. No defensive sites coincide with the areas identified by the models.

Shell midden deposits are the most common archaeological feature found in the locations that the Habitation Site Model identified as favourable for site location. Investigators recorded structural remains at three of these sites, but the majority of these deposits were too small to be considered part of a village or habitation site. CMTs are the second most common features that coincide with the selected areas: 210 CMTs were distributed across 23 sites. Canoe skids were recorded at nine sites, fish traps or weirs were found at six sites and human remains were noted at three sites.

The comparison of the Habitation Site Model to the known archaeological record revealed that there is little concordance between the model and reality. Significantly, the location of very few archaeological features coincides with areas identified by the model as suitable for habitation sites, therefore the model requires further refinement.

Determining the weakness of this approach is difficult as the spatial data do not conform to the model, which means there is a disconnect between the ethnographic data and the archaeological data. My scrutiny of the data sources I used in this research did not reveal any weak areas or data gaps that could easily explain the lack of concordance between the model and reality. Instead, my first instinct is that the scale of the digital data is too coarse for this type of model development. At 1:20,000, the environmental data may be digitized in broad zones that do not conform well to predicting site locations that would normally be no more than 100 to 200 metres in length. This is something that I had not anticipated when I built the Habitation Site Model. However, an issue of scale would be particularly problematic because this is the typical scale used in developing predictive models for regional overviews. Alternate reasons for the lack of concordance between the model and the archaeological record may be that the model is too restrictive or that the ethnographic pattern and the ancient pattern for habitation site locations may be different. Locating habitation sites could also be a result of idiosyncratic human behaviour, which cannot be modelled for using environmental variables.

Whatever the reason for the lack of agreement between the model and the archaeological record, I was very concerned with the results. Land managers rely on these types of models when planning their regional land use strategies. If the model is unsuccessful at predicting where remains might be found, it could endanger undiscovered archaeological remains or focus archaeological attention on the wrong areas. While I believe that as part of a larger field program, predictive models can be powerful tools, the Habitation Site Model demonstrates that they cannot replace fieldwork. Instead, I recommend that they should be used more for guidance than as a short cut to finding archaeological remains.

CHAPTER SUMMARY

Following my evaluation of the data sources I used in this study, I felt confident that they were sufficient in quantity and generally of high enough quality for the purposes of this research. While the comparison of the Cultural Landscape Model to the archaeological record confirmed that the data was, in general, adequate and consistent for such a study, the testing of Habitation Site Model revealed that there was discordance between what the model predicted and reality.

Overall, the known archaeological record is consistent with the predictions of the Cultural Landscape Model. Significantly, this exercise has highlighted that there are gaps in the archaeological data, which is most likely the result of uneven coverage of the study area. For example, the quantity of sites and features recorded in the Estuaries, Coastal Mountains and Inland Mountains Environmental Settings indicates that few archaeological investigations have concentrated on these areas. By revealing where gaps in the data appear to be, models can be used to inform future archaeological investigations. In addition, there also appears to be a problem with the definition of the Inlets environmental setting. By comparing the discrepency - presence of middens, fishing features and canoe skids - to the model, a possible explanation emerges. These features are consistent with another environmental setting, Estuaries, which could be interspersed throughout the Inlets environmental setting.

The analysis of the Habitation Site Model lends considerably less optimism. Few archaeological sites interpreted as village/habitation sites coincide with areas identified by the model as suitable locations for habitation sites. Indeed, there was little correlation between suitable areas and any recorded archaeological features. While it is difficult to determine why this discordance exists, the results could also be used to inform future research. For example, to determine if the environmental data is insufficient, future research could contemplate using environmental data at a larger scale or collecting environmental data in the field ourselves. To test whether the lack of concordance is between the ethnographic and archaeological data, it may be useful to construct another model using the archaeological data and comparing this to the Habitation Site Model.

CHAPTER FOUR:

DISCUSSION

This chapter revisits the goals that motivated the research presented in this volume. A review of the cultural traits described in the ethnographic and ethnohistoric literature contributed to a synthesis of Nuu-chah-nulth land use and land tenure in Clayoquot Sound and were critical to the development of the models I present in this thesis. The archaeological record, as recorded by archaeologists who have worked in Clayoquot Sound for decades, contributed to my evaluation of the efficacy of the models. While land tenure is an integral component of the ethnographic pattern of Nuu-chah-nulth land use, I was not able to develop models from the existing data that could predict how the land tenure system may be inscribed in the archaeological record. In this chapter, I share my thoughts on how this may be accomplished in the future.

Geographic information systems (GIS) made a substantial contribution to this particular study. While I treated it solely as a tool and not as the central theme of this study, without it, I would not have been able to build and evaluate the models as I describe in chapters two and three. In this chapter, I offer thoughts on other possible avenues of research where GIS may prove useful.

I also provide my thoughts on the impact of contact with non-Aboriginal peoples on Nuu-chah-nulth land use and tenure, particularly in terms of what it means for the archaeological record of the future. The chapter, and the thesis, concludes with some considerations for future research.

THE ETHNOGRAPHIC PATTERN AND ARCHAEOLOGICAL REMAINS

In this thesis, I provided a synthesis of Nuu-chah-nulth land use as found in the ethnographic and ethnohistoric literature. While most of the sources I used documented land use among the Nuu-chah-nulth in general, several sources (e.g., Bouchard and Kennedy 1990; Clayoquot Sound Scientific Panel 1995; Turner and Jones 2000; Webster 1983) confirm that this pattern was also well-established in Clayoquot Sound during the ethnographic period. From this synthesis, I summarized the land use pattern in terms of the physical areas in which each of these activities would have taken place. To do so, I used the eight environmental settings defined by Arcas and Archeo Tech (1994) for Clayoquot Sound.

The next step in examining Nuu-chah-nulth land use was to test whether the archaeological record conformed with the ethnographic pattern. To test for the antiquity of the ethnographic pattern, I developed and evaluated two land use models: the Cultural Landscape Model, which was a direct translation of the ethnographic and ethnohistoric summary of land use onto the archaeological landscape, and the Habitation Site Model, that sought to predict where habitation sites might be located, based on data found in the ethnographies.

In general terms, the known archaeological record confirmed the predictions of the Cultural Landscape Model, indicating there may be considerable antiquity for the ethnographic land use system in the archaeological record. However, these results must be viewed with caution, as few excavations have been done in the study area and little is known about the temporality or seasonality of the recorded archaeological sites. Furthermore, the variables used here can yield more than one explanation, including the alternate settlement pattern as proposed by other researchers. Hence, ongoing research will help to refine the models.

In contrast, the archaeological record showed little conformity to what the Habitation Site Model predicted. Few archaeological sites inferred as former habitations coincide with areas that the Habitation Site Model identified as favourable, based on information contained in the ethnographies. While disturbing, I feel that the results should also be used to inform future research. My instinct, in hindsight, is that the environmental data exists at too small a scale to be used for this sort of modelling exercise. In the future, researchers could gather more data related to the environmental conditions adjacent to sites, or at a larger scale, to further refine the model.

MODELLING LAND TENURE

Among the Nuu-chah-nulth in the ethnographic period, land tenure was an important part of their relationship to the land. The principles of *haḫuulhi* and *hishuk ish ts'awalk,* as described in chapter three, define how people own specific territories and use the land and resources within those territories (Clayoquot Sound Scientific Panel 1995:vii). Modelling land tenure practices of the past is difficult as the associated concepts are too abstract for present day researchers to operationalize easily. Nevertheless, archaeologists are very interested in the antiquity of the Nuu-chah-nulth land tenure system and we should look for ways to find its signature. The models I developed in my research can contribute to such a research program.

The ability to create location-allocation models in GIS may be our best approach to look for territorial limits (Burrough and McDonnell 1998; Demers 2000; Wheatley and Gillings 2002). To model for regions of influence or ownership, the researcher could start with contemporaneous major village sites and construct areas around the sites based on natural geographic divisions or impedance to travel. The models could then be compared to the archaeological record or ground truthed, then further refined. With a strong understanding of the temporality of the sites, location-allocation models could be constructed for various time periods to model for changes to the territorial boundaries through time. Unfortunately, very few controlled excavations have been undertaken in the study area, therefore the archaeological dataset has no temporal controls and we cannot know in which seasons these sites were used. Therefore, the archaeological data, as they are known today, are insufficient for constructing high-resolution models to predict correlates of Nuu-chah-nulth land use in the past.

GEOGRAPHIC INFORMATION SYSTEMS AND ARCHAEOLOGICAL RESEARCH

This study would have been nearly impossible without the use of geographical information systems (GIS). GIS provided a means of organizing, standardizing and presenting the vast amount of complex data for this research. While it required a substantial time commitment initially, it greatly facilitated the summarizing, comparison, analysis and presentation of the data.

While my research confirms the efficacy of GIS in archaeological research, its ancillary benefits are also very interesting. The next step, which is well-underway in many Nuu-chah-nulth communities, is to create thematic maps that document use, tenure and toponymy of their cultural landscapes (Olive and Carruthers n.d.). The mapping standard for land managers employed by the province of British Columbia is at the 1:50,000 or 1:20,000 scale, which is the scale of the maps utilized in this study (Ministry of Sustainable Resource Management n.d.). The results of the Habitation Site Model suggest that this scale might be too coarse for such mapping. First Nations, who would be focussing on much smaller areas, would probably benefit from using a larger scale, such as 1:10,000 or 1:5,000.

While paper maps are suitable for documenting traditional use and knowledge, GIS would facilitate this work and, at the same time, preserve the information in a medium that allows for a variety of presentation options to future audiences. Only through GIS could they create the kinds of three-dimensional virtual landscapes that will provide a new perspective of their traditional territories (e.g., Huu-ay-aht First Nations 2002). In addition, GIS offers a means of creating atlases that can readily compare official government maps with those created by Nuu-chah-nulth groups. Atlases are suitable for documenting Aboriginal past, present and future use of the land, including resource management (Sutton 2002).

POST CONTACT CULTURE CHANGE AND THE ARCHAEOLOGICAL RECORD

The Nuu-chah-nulth maintained some level of autonomy throughout the era of the maritime fur trade and in the immediate decades following the cessation of trade. However, Canada's federal policies regarding Indian Affairs and the arrival of the market economy and non-Aboriginal residents to the west coast of Vancouver Island have had a major impact on Nuu-chah-nulth lifeways. These changes will be reflected in archaeological deposits of the future.

The restriction of Aboriginal groups to their Indian Reserves severely limited their access to their traditional territories, and the Nuu-chah-nulth system of land tenure was effectively alienated (Morgan 1981). Small Indian Reserves were established based on the Nuu-chah-nulth system of land use (Appendix D). The constrained territories and restricted mobility also had a detrimental impact on the collective cognitive mapping of the groups which probably caused the loss of some oral traditions and traditional knowledge.

In recent decades, there has been a resurgence of interest in reconstructing traditional culture among many Aboriginal groups. In British Columbia, treaty negotiations have become a locus for finding a means to reestablish traditional lifeways within traditional territories (British Columbia Treaty Commission n.d.). The Nuu-chah-nulth are no exception (e.g., Maa-nulth First Nations Agreement-in-Principle 2003). In Clayoquot

Sound, the Hesquiaht, Ahousaht and Tla-o-qui-aht have undertaken several projects to document their use of the land for land claim purposes and transcribe cognitive maps and toponyms for future educational purposes (e.g., Bouchard and Kennedy 1990; Clayoquot Sound Scientific Panel 1995; Olive and Carruthers n.d.). Treaties will allow Nuu-chah-nulth people to gain more control of their traditional lands and have an influence on how others use their traditional territories (British Columbia Treaty Commission n.d.). The Nuu-chah-nulth will also have an opportunity to reestablish their traditional resource management and land tenure system. Such information could be contained in atlases.

The Nuu-chah-nulth of Clayoquot Sound have developed an intimate relationship with their environments over the millennia that remains relevant today. In spite of the outside influences they have faced throughout the global era, the land and its resources are still of great significance. Use of the land has changed considerably throughout this period, but the underlying principles of *iisaak* (respect) and *hishuk ish ts'awalk* (resource stewardship) remain fully intact (Clayoquot Sound Scientific Panel 1995; Turner and Atleo 1998). The archaeological signature of modern land use may be very different from the archaeological signature at pre-contact sites, but if the underlying principles and cognitive maps of that landscape have persisted, researchers of the future will arrive at similar explanations.

IMPLICATIONS OF THIS RESEARCH FOR OTHER AREAS

This thesis demonstrates that building land use models from data gathered in recent history is worthwhile for gaining a better understanding of land use in ancient times. However, the true value of model building is realized when it is part of a multi-stepped program. The general methodology I followed during my study, not the models themselves, could be used to build land use models in other areas of the Northwest Coast where there are rich descriptions of land use in the ethnographic and ethnohistorical literature. GIS should be used to organize, analyse and present the complex and numerous data that would amass during such a research program.

The first step in the methodology I have presented in this volume is to review all available ethnographic and ethnohistoric sources to reconstruct ethnographic land use patterns. The next step is to translate this information into concrete predictions of what may exist in the archaeological record (the Cultural Landscape Model). Ground truthing can be used to confirm the predictions of the Cultural Landscape Model and test the time depth of the ethnographic pattern. If the focus of the research program is to find significant village sites, the next step would be to build a Habitation Site Model.

As part of a larger regional study on land use, the researcher may select several habitation sites and excavate to determine temporality and seasonality. Once a sample of contemporaneous sites is selected, the researcher can then compare it to the Cultural Landscape Model, refine the model, if necessary, and then use it to understand changes in land use through time. If the researcher is interested in reconstructing land tenure, they would develop a location-allocation model at this stage, to model for the regions of influence or ownership around each contemporaneous village site.

Significantly, models should never take the place of archaeological field work. The land use modelling approach that I present in this thesis is no exception. Models should only be used to provide general guidance to researchers when planning and undertaking their research. Models are simplifications of reality, as described in chapter two, so they cannot be relied on to provide the definitive answers to our research questions. Indeed, modelling and fieldwork should go hand in hand and the results of each should be used to inform and refine the other.

While GIS made a substantial contribution to my research, it is within the context of accessing the cognitive maps of the people we study that the full potential of GIS can be realized. In recent years, there has been a huge resurgence of interest in culture and language among Aboriginal groups. This comes at a time when Elders who have first hand knowledge of a pristine traditional territory are passing on. The Elders are passing down much of their knowledge to younger generations using the physical landscape, but as this landscape becomes increasingly modified, there is a very real threat that information might be lost. GIS could assist by offering the option of creating a virtual pristine landscape on which this knowledge can be recorded in full. Using a multi-media approach would allow for the simultaneous recording of the voices of the Elders, thus preserving this primary knowledge for future generations. The result would be an electronic atlas of Nuu-chah-nulth cognitive geography that can be continuously updated in the future.

The future of archaeological research will also rely on innovative technological initiatives. Therefore, archaeologists of the future will benefit from proactive research that seeks to preserve traditional knowledge. However, the archaeological record itself is equally vulnerable as resource development encroaches on the pristine landscape. Archaeologists should also be thinking about how to preserve today's known archaeological record for future researchers. GIS could facilitate preserving this knowledge in the form of detailed regional and site maps and attribute tables. The ability to link to a variety of other software programs would also allow archaeologists to keep in one project file any additional information that could potentially be significant, including photographs, artifact drawings, and statistical analyses. The possibilities are limited only by the imaginations of archaeologists, and their willingness to explore new methods to answer old questions.

APPENDIX A:

REVIEW OF GEOGRAPHIC INFORMATION SYSTEMS (GIS)

GEOGRAPHIC INFORMATION SYSTEMS (GIS)

Geographic, or spatial, phenomena in the real world can be described in two ways: what is present at a specific location or where a particular object is found. In general, there are two conceptual models that conform to how humans perceive space. The first is an object-oriented view where space is occupied by discrete objects or entities. The second model is the continuous field where an attribute is assumed to vary continuously across space. The choice of model dictates how data are to be collected and what types of analyses are possible. The introduction of geographic information systems (GIS) has dramatically increased the number of options available to the researcher studying spatial phenomena (Burrough and McDonnell 1998; Demers 2000).

While there is no universally accepted definition of what constitutes a GIS, most acknowledge that a GIS is a computer system, composed of both hardware and software, that is able to capture, store, manipulate and display spatially referenced or geographic data. It is comprised of two parts, the relational or non-spatial database and the mapping or spatial database. Together, they allow for the simultaneous evaluation of space, time and form (Burrough and McDonnell 1998; Demers 2000; Madry 1990; Wheatley 1995; Wheatley and Gillings 2002). Through manipulation and analysis of data, GIS can create new information, taking it well beyond the capabilities of computer aided drafting or mapping software (Demers 2000; Kvamme 1990; Wheatley and Gillings 2002).

In a GIS, maps and other data are stored as categorical or classed themes or layers. Each of these themes is analogous to a sheet of clear plastic, depicting a different aspect of the spatial environment, which can be stacked one above the other to reveal relationships across themes (Figure 9). Each layer represents a variable and typically include geographical features such as hydrology, topography, elevation,

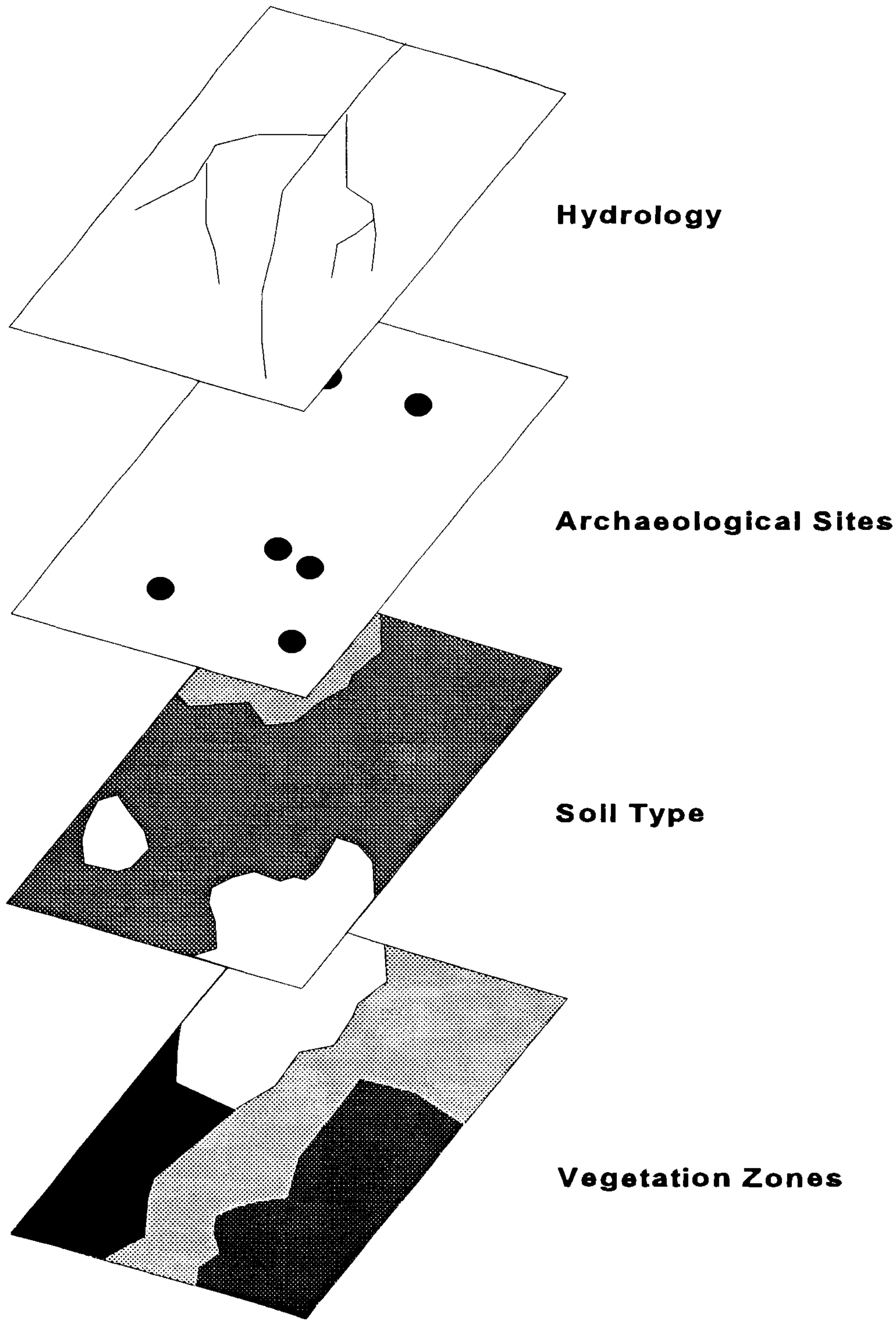


Figure 9. Thematic Layers in a GIS.

pedology or vegetation types (Burrough and McDonnell 1998; Demers 2000; Kvamme 1990, 1999; Wheatley and Gillings 2002). In archaeological applications, known site locations, features, and land ownership are commonly used thematic layers (Brandt et al. 1992; Kvamme 1992). Features on these layers are georeferenced to a coordinate system, such as latitude-longitude, that links them to features in the real world and across the layers (Burrough and McDonnell 1998; Kvamme 1999; Wheatley and Gillings 2002).

Although there are numerous GIS packages, there are two basic types of data models: vector and raster. Vector systems use a structure of points, lines and polygons to represent spatial phenomena in terms of xy coordinates that are linked to attribute information by a unique identifier code (Burrough and McDonnell 1998; Demers 2000; Savage 1990; Wheatley and Gillings 2002). In archaeological applications, points may be artifact find-spots, lines may represent rivers, and polygons would be used for discrete areas of the same data value such as an area of a particular soil type (Lock and Harris 1992).

Much simpler structures than vector models, raster data models are comprised of a matrix of grid cells in rows and columns. The size of the cell depends on the resolution required for the specific project; it should be as small as the smallest unit area of interest (Allen 2000; Burrough and McDonnell 1998). Each grid cell is characterized by its x and y coordinates with an assigned z-value, which is the numeric representation of a specific characteristic of the area in the real world such as elevation (Demers 2000; Savage 1990; Wheatley and Gillings 2002). The study area of interest is covered with a sheet of continuous grid cells and each cell is coded for whether or not it coincides with the feature of interest. Using the same examples above, artifact find-spots would be represented by one or several adjacent grid cells, depending on the resolution or scale used, rivers would be displayed as a series of connected, but linear, cells and blocks of contiguous cells would represent areas or zones of the same soil type (Wheatley and Gillings 2002).

While each type of GIS has its own distinct advantages and disadvantages, choosing a data model appears to be more a matter of preference. Many GIS users prefer vector models because they maintain spatial detail and are better for working with objects that have clear boundaries and precise location information (Burrough and McDonnell 1998; Kvamme 1999). Vector systems also require relatively little computer storage space (Wheatley and Gillings 2002). Another advantage is that vector systems produce maps that resemble the paper maps to which people are accustomed (Savage 1990). These factors make vector models ideal for regional data management.

Unlike the vector model where spatial and non-spatial data are kept in separate, but linked databases, the raster model keeps all the data in the same thematic layer. Each cell has a value assigned to it, thus raster systems require much more storage space. However, the simplicity of the grid system allows for simple overlay and comparison across multiple thematic layers. In addition, this model is well suited for continuous phenomenon that have no discrete boundaries, such as elevation (Wheatley and Gillings 2002). A critical strength is the numerical processing capability of the raster system for predictive modelling (Kvamme 1999). These factors suggest that raster models are also suitable for regional data management, but the modelling and analytical capabilities found in raster systems may make it the model of preference for many academic researchers.

A typical GIS offers several categories of operations for spatial data, all of which can be used separately or in combination (Demers 2000; Kvamme 1999). They include:

- *Map reclassification,* which can be used to reorganize and display your data in as many categories as necessary;
- *Map overlay*, which combines categories from multiple map layers;
- *Map algebra*, which is only available in raster applications and allows the researcher to run a variety of mathematical operations across map layers;
- *Boolean operations* to facilitate querying of data;

- *Distance operations* that can be used to calculate distances from a locus using linear distance or some sort of friction surface based on elevation changes, ground cover or other impedance variables and would include such analysis as site catchments or buffers;
- *Terrain processing*, which allows the creation of digital terrain or digital elevation models through interpolation from point or contour elevation data; and,
- *Image processing*, which allows for the incorporation of images such as satellite photographs.

While they may be more visually appealing, the maps produced by GIS are not significantly different than those produced before the advent of GIS. However, the database component allows the archaeologist to store a huge amount of data about the site including size, elevation, function, archaeological features and artifacts, locational coordinates, soil type and radiocarbon dates behind the map. Before GIS became available, a series of paper maps with a variety of symbols and legends would be required to display such data, and meaningful comparison would be difficult. GIS provides the kind of environment that allows the researcher to integrate a lot of information and explore how this information may fit together (Burrough and McDonnell 1998; Wheatley and Gillings 2002). In addition, GIS allows the researcher to access the underlying database while looking at the map, link between multiple views, redraw maps as needed and run animated simulations (Burrough and McDonnell 1998; Fisher 1999).

THE CONTRIBUTION OF GIS TO EXISTING METHODS OF SPATIAL ANALYSIS IN ARCHAEOLOGY

The use of GIS in archaeology began in the early 1980s in the United States and Europe, and then spread widely throughout the discipline during the 1990s. Since its early days, GIS has appealed to academic researchers and cultural resource managers alike. Current applications of GIS can be divided into two categories: research and management (see Figure 12.4 in Wheatley and Gillings 2002:234). Several edited volumes have been published, beginning in the 1990s, that showcase how archaeological studies have benefitted from the use of GIS (e.g., Aldenderfer and Maschner 1996; Allen et al. 1990; Ashmore and Knapp 1999; Gillings et al. 1999; Maschner 1996; Westcott and Brandon 2000). For a detailed critique and review of the use of GIS in archaeology, refer to Kvamme (1999). GIS has, and likely will continue, to have an effect on archaeology as a powerful research tool (Westcott 2000).

Following is a discussion of how archaeologists have incorporated GIS applications into their projects. Most GIS applications in archaeology, regardless of whether the purpose is research or management, fall into three general themes: inventory (survey and excavation), spatial analysis and publication (Fisher 1999).

Inventory Applications

The focus of an archaeological survey is to create an inventory of all known sites within an area and collect as much information as possible about those sites. A logical product of an inventory project is a map showing where sites are located and a database, whether electronic or on paper, that contains the details of what was recorded. Archaeological excavation is also concerned with inventory and mapping, but with a focus on a much smaller area (Fisher 1999). The amount of spatial data collected in the course of a single project can be enormous, making it difficult to analyse in any meaningful way. In its most basic form, as a database with a mapping output system, GIS can make a significant contribution to an archaeologist's work (Burrough and McDonnell 1998; Wheatley and Gillings 2002).

Early applications were limited to strictly cartographic uses or to organize and maintain regional archaeological databases. As data have accrued, GIS has facilitated the jobs of many people responsible for managing archaeological resources across large areas of land and this is a key reason for its popularity (Church et al. 2000). Both GIS and archaeological survey rely heavily on classification of environmental variables, which generates enormous amounts of data. At a regional scale, relationships are made clear that might not be immediately obvious from only a few sites. The visual product of a survey is normally little more than a map of dots, but coupled with GIS, the environmental data can be recorded to capture detailed information about those dots and the landscape that hosts them (Witcher 1999).

The ability to search through a huge volume of data is the most basic of operations that are available with GIS. A researcher is able to conduct searches for particular spatial criteria, attribute criteria or both. Most GIS packages offer some means of querying the data. Queries can be as simple as requesting the record for a site, for example at DgSn-2, or as complex as asking the computer to display all sites within one-hundred metres of all streams (Burrough and McDonnell 1998; Demers 2000; Wheatley and Gillings 2002). The link between the visual data and the database allows the user greater flexibility and speed in organizing and querying of archaeological site data (Kvamme 1990, 1999; Westcott 2000; Wheatley and Gillings 2002).

Most GIS packages, including ArcView, offer "theme-on-theme" selection, which allows the researcher to select items found in one theme based on criteria identified in another theme (ESRI 1999:17-2). For example, the user could define parameters to identify all village sites in the archaeological site theme that are located within 50 metres of a class two stream, which would be found in the hydrology theme. Such cross-referencing would be difficult to undertake without computers and GIS software.

A more complex operation available through GIS is the ability to summarize information in a large data set. Summaries can be basic statistics on an attribute value based on a single data theme, such as average elevation of an area, or they may require information from two data themes, such as number of archaeological sites that occur on a particular soil type. The output from such operations can be numerical or graphical summaries (Burrough and McDonnell 1998; Wheatley and Gillings 2002).

GIS also facilitates data transformation in a single theme. The most basic transformation is reclassification, which allows the user to convert abstract measures to something that conveys some meaning. For example, a map of soil types may have names assigned to each discrete type. This would not allow the researcher to conduct any meaningful analysis, but this would be possible if the user first reclassified the soil types into some rank order such as dry, moist or waterlogged (Wheatley and Gillings 2002). The researcher must always be aware that how the data are classified and reclassified will affect data analysis and ultimately the conclusions that result (Demers 2000).

The map overlay function allows the research to compare variables across multiple themes or layers. This is one of the most frequently used features of GIS, and has evolved from the long used process of stacking maps drawn on paper or Mylar for comparison. Generally, the goal of such operations is to look for correspondences across themes (Demers 2000). For example a researcher may overlay maps of elevation, hydrology and soil types to look for areas with level terrain, good drainage and good agricultural soil on which one might expect to find the remains of a village site.

Spatial data can also be transformed across multiple layers or themes. Such applications are referred to as map algebra, which is only available using the raster data model. As the name suggests, this form of data modelling relies on the ability of the GIS to add, subtract, multiply or divide one theme from another. A common example from archaeology is the method used to divide up a region into areas of potential for site location using environmental variables such as elevation, distance to water and slope. Each grid cell would then be reclassified according what would be considered high (3), medium (2) and low (1) potential. When the themes are overlaid, the software program adds the numbers across the layers to find areas of combined high, medium and low potential (Wheatley and Gillings 2002).

The earliest major application of GIS in regional analyses continues to be the most common type of analysis: that is, correlation of site location with environmental variables (e.g., Brandt et al. 1992; Dalla Bona 2000; Dalla Bona and Larcombe 1996; Hasenstab 1996). Many of these studies emerged from regional archaeological database managers, particularly government agencies responsible for land use decisions in Canada and the United States (Church et al. 2000). The focus of these studies is to identify patterns and correlations based on observations at known archaeological site locations within a particular region, and develop models that can be used to predict the location of undiscovered sites within the same region (Church et al. 2000; Kvamme 1999; Wheatley and Gillings 2002). The most straight forward way a researcher can use a GIS to build a predictive model is through the development of a decision rule: a particular combination of factors that creates conditions under which one would expect that a specific location is likely to contain an archaeological site. The decision rule can be developed using deductive or inductive reasoning and can be based on one to several variables (Church et al. 2000; Kvamme 1990; Wheatley and Gillings 2002). Using a deductive approach, the researcher must arbitrarily assign weighted values, typically based on some form of ethnohistorical research, that represent the importance of each class of variables for site location (e.g., Dalla Bona 2000). In an inductively-based approach, an existing set of data are used to determine which variables appear to correlate with site location and then use these to assign weights to each class of variables (Church et al. 2000; Wheatley and Gillings 2002; Witcher 1999). When multiple thematic layers are involved, map algebra is utilized to produce a map with zones of high, medium and low potential for finding archaeological remains (Wheatley and Gillings 2002).

To maximize spatial analysis capabilities, continuous data, such as elevation, require different approaches to storage and display that assign values to every part of the theme layer. In GIS, this is accomplished through the digital elevation model (DEM), which is ideally suited for elevation data, but can be used for any variable that varies continuously across a surface, such as artifact density or climatological data. Once the discrete data, such as spot elevations, are digitized, a DEM can be created from the known values and the process of interpolation to estimate unknown values in between (Burrough and McDonnell 1998; Wheatley and Gillings 2002).

Typically, DEMs take one of two forms. First, the grid-based DEM, is a regular grid of cells where each cell is assigned a value according to the value for that phenomena in the real world. The elevation grid DEM can easily be manipulated to create new themes such as slope, aspect, direction of drainage, viewshed, and irradiance or amount of solar energy received per unit area (Burrough and McDonnell 1998; Demers 2000; Wheatley and Gillings 2002). The main problem with the grid-based DEM is that values are assigned to each and every cell, which results in data redundancy in areas of uniform elevations, and an inability to account for sudden changes of elevation where they do not correspond to the grid lines (Burrough and McDonnell 1998).

The second form of DEM is the triangular irregular network, or TIN. The TIN is a vector based data model that consists of a sheet of connected triangular faces, based on a Delauney triangulation of irregularly spaced nodes, or points that represent changes in the data values (Burrough and McDonnell 1998). The result is a three-dimensional representation of the terrain being modelled (Demers 2000). The major advantage of the TIN over the grid-based DEM, is that it only stores the points required to draw the triangles; thus the storage requirements are significantly lower than that for grid DEMs (Wheatley and Gillings 2002). Like the grid-based DEM, the TIN can be used to derive themes including slope, aspect, hillshading and viewsheds from the elevation data (Burrough and McDonnell 1998; Demers 2000).

Spatial Analysis Applications

While the ability to conduct spatial analysis is what GIS is all about, there are limitations to the software's capabilities. The following section describes what is possible using GIS. Anything more complex or sophisticated, such as multivariate statistical analysis would require the combination of GIS with additional analytical tools such as statistical software and mathematical modelling packages (Demers 2000).

When using the object-oriented model, the researcher is concerned with the attributes, location, connectivity and distribution of those objects. If the researcher is working with continuous fields, analysis focuses on the spatial properties of the fields (Burrough and McDonnell 1998). All of the capabilities described above allow a researcher to create models to describe or explain the spatial distribution of phenomena in the real world.

As distance between the elements is the most fundamental spatial relationship, questions about proximity comprise the basis of many spatial archaeology studies, and GIS is well-suited for modelling scenarios that test archaeological hypotheses. Distance can be measures of a straight line, using the Pythagorean theorem, or can account for factors that would inhibit straight line measurement. Neighbourhood functions allow the researcher to compare the attributes of an object with those of its neighbours within a specified distance. Nearest neighbour analysis is a common approach to analysing point spacing to determine whether they exhibit regular, random or clustered patterning (Demers 2000).

Another approach utilizes some sort of modelled surface area, or spatial allocation (Burrough and McDonnell 1998). The most basic approach that is available through GIS involves constructing buffers or corridors. These are created by simply instructing the software program to create an area of a specified distance around a particular element on a theme layer (Burrough and McDonnell 1998; Demers 2000; Wheatley and Gillings

2002). In a vector system, points would be surrounded by circular buffers, lines would look more like corridors, and polygons would have irregular-shaped buffers. Within a raster system, the buffer would follow the outline of the original element. Other methods of spatial allocation include tessellations such as Thiessen polygons where a polygon is drawn around a point to model the "region of influence" that the entity represented by the point had over other entities (Demers 2000:30). This is a variation on Central Place Theory that uses hexagons to model the hierarchy of archaeological sites across a landscape (Butzer 1993). The main problem with buffers, corridors and tessellations is that they are strictly geometric operations that do not account for any social or geographic features that would impact the use of space in the real world (Wheatley and Gillings 2002).

Location-allocation modelling analyses the configurations and spatial interaction of archaeological sites without relying on geometric regularity. Location-allocation assumes that there is some flow of people, goods or information between the points on the map (Mackie 2001). To determine the ease and direction of flow, the researcher assigns relative weights to particular criteria that are considered to have been important to the people being studied (Butzer 1993). In the GIS, this is accomplished through the creation of cost surfaces. In archaeological applications, cost surfaces typically model ease of movement across an area from an archaeological site, and are normally created using the raster data model. This particular type of cost surface is called a friction surface. Once a friction surface has been created, the researcher can also ask the GIS to display least-cost pathways using this data, which models the easiest route to travel from one point to another (Burrough and McDonnell 1998; Demers 2000; Wheatley and Gillings 2002).

Location-allocation modelling fits very well with site catchment analysis (e.g., Gaffney and Stancic 1991; Hunt 1992). By using friction surface modelling, the researcher is able to build catchment areas that accurately reflect how people would have moved across an area to collect resources, and produce realistic catchment areas. Once the catchment area is defined, the researcher is able to examine the sites located within the catchment separately from all other sites on the layer (Demers 2000; Gaffney and Stancic 1991; Hunt 1992; Kvamme 1999; Wheatley and Gillings 2002).

Some researchers are also using GIS to conduct spatial analysis at the site level (e.g., Potts et al. 1996). Unfortunately, most of these studies use the GIS as a strictly cartographic tool, while overlooking the powerful analytic capabilities offered by the database component (Kvamme 1999). For example, if a researcher was to input into the database the kind of information normally recorded for artifacts and features at a site, such as location, dimensions, or raw material, they could instruct the GIS to create a statistical surface based on artifact density gradients. If done for each stratum, the researcher can visually compare these gradients and identify patterns for the use of space through time (Kvamme 1999).

New studies made possible by the use of GIS include viewshed studies that determine what would be visible from any point on the landscape, as well as intervisibility between points. With a grid-based DEM, the researcher can calculate cell by cell whether the topography would obstruct the line-of-sight. The product is a map that displays all that is visible from the chosen site. A secondary product of viewshed analysis that is of great interest to archaeologists is intervisibility between sites (Burrough and McDonnell 1998; Demers 2000; Gaffney and Stancic 1991; Mitcham 2002; Wheatley and Gillings 2002). While studies of intervisibility would be possible with paper maps and field survey, the use of GIS saves enormous amounts of time and allows the researcher to examine the topography itself with modern features and vegetation stripped away (Mitcham 2002). Other new areas of research include simulation studies and interfacing GIS with remotely sensed data (Fisher 1999; Kvamme 1999).

Publication Applications

As archaeological investigations have become more sophisticated and complex, archaeologists have experienced difficulty in finding ways to publish the results of their research that capture the complexity, without confusing their audiences. Some archaeologists recognize that they could garner public support more easily if they could share their results in a way that appeals to the general public (Spurling 1982). However, publishing the amount of data generated from a single project is not feasible, particularly when considering the costs of reproduction. Electronic publication can help overcome these limitations as it is a cost-effective way of publishing large amounts of data. In addition, multi-media presentations can organize the different types of information such as site maps, profiles, photographs, GIS maps and the written reports in a user friendly format (Wolle 2002).

GIS can make a great contribution to the electronic publication of archaeological research. The GIS can be used to link the visual map to the site report, photographs, and graphics. Interactive software and multi-media presentations that include some element of spatial data that have been modified and presented using GIS are becoming more common (Demers 2000; Fisher 1999; Preysler et al. 1999). The Hot Link feature available in ArcView GIS links points on a map to any other medium including internet sites (ESRI 1999). An excellent example of the potential of GIS for multi-media publication is a CD-ROM produced by Huu-ay-aht First Nations of the west coast of Vancouver Island. The highlight of the CD-ROM is a GIS produced animated fly-over of a DEM of the traditional territory of the Huu-ay-aht First Nations. It shows their main traditional villages and sites and is accompanied by music and a voiceover. The three-dimensional DEM provides the viewer with a true perspective of the landscape that comprises their traditional territory (Huu-ay-aht First Nations 2002).

GIS IN BRITISH COLUMBIA ARCHAEOLOGY

Archaeologists in British Columbia, particularly archaeological consultants, have been utilizing GIS for their research for quite some time. Much of this research has focussed on using the software for predictive modelling. In the early 1990s, the provincial government sponsored reviews of the potential of predictive modelling of archaeological site location in British Columbia by Moon (1993) and Eldridge and Mackie (1993). Moon (1993) conducted a thorough review of the literature related to this subject and found that the most valuable contribution of modelling is in the area of resource management and land-use planning. GIS could facilitate this process because they can be used to produce maps displaying the spatial arrangement of the data, such as the regional distribution of archaeological sites (Moon 1993).

Eldridge and Mackie's (1993) review of the use of GIS in predictive modelling revealed that the practice had not yielded acceptable levels of accuracy. It appears that the major limitation comes from deficiencies in mapped environmental data at a large enough scale to be useful for archaeological planning purposes (they should be at least 1:20,000, not 1:250,000). In the last decade British Columbia has made great strides to correct this through the development of standards for all aspects of resource management, including map data (Resource Inventory Standards Committee n.d.).

In his dissertation, Mackie (2001) took an innovative approach to looking at the spatial distribution of sites in coastal environments with the west coast of Vancouver Island as his case study. Mackie (2001) utilized GIS to construct mobility networks between over 200 habitation zones within his study area. The value of this study is that it can contribute to a better understanding of how people move about their environments (Mackie 2001).

In the final report for a three-year archaeological site inventory in Clayoquot Sound, Mason et al. (1999) used GIS for basic spatial analysis. GIS was used to obtain descriptive statistics on slope, aspect, and distance to freshwater and saltwater for several different site types. In addition, the project attempted to examine site distributions in terms of local and family group use of the landscape using difficulty of travel as an impedance variable, but the results did not correspond with ethnographically documented group boundaries. This lack of correspondence between the ethnographic data and modern-day interpretations of movement on the landscape indicate that further research is necessary (Mason et al. 1999).

In 1997 and 1998, Arcas (1998) conducted the first GIS overview of a coastal landscape. In partnership with six northern Nuu-chah-nulth First Nations, they undertook a study to assess and map archaeological potential of their combined traditional territories. The modelling exercise involved identifying traditional activities that would leave physical evidence, the types of archaeological sites and associated archaeological evidence resulting from these activities, and the locations for each site type, including the mappable biophysical variables associated with these locations (Arcas 1998:iii). The focus of the study was on "the capability of the landscape to support the types of traditional First Nations activities which resulted in physical evidence" rather than predicting specific site locations (Arcas 1998:iii). Arcas (1998) presented two models. The non-CMT model classified the study area into three classes of potential (Classes 1 through 3), while the CMT model resulted in two classes of Low or Moderate-to-High potential. While the study was hindered by data gaps in the archaeological inventory and limitations of the digital spatial data, it stands as a good example of how suitable GIS is for a detailed examination of such a large area.

The legal and political landscape in British Columbia has encouraged several First Nations to conduct community level mapping to meet the demands of traditional use studies, treaty negotiations and land and resource management planning (LRMP). All three initiatives rely on the translation of traditional ecological knowledge (TEK) onto maps, preferably digital maps through GIS. The significance for BC land use planning is the recognition of the connection of First Nations to the land and its resources (Olive and Carruthers n.d.). The significance for archaeologists is that digital data on TEK are becoming more widely available and the involvement of the provincial agencies and First Nations ensures that this data are compatible with existing biophysical spatial data.

LIMITATIONS

GIS was developed over several decades mainly within the discipline of geography. Well-established methodologies were borrowed by archaeologists and applied to archaeological research problems. Some archaeologists feel that early applications were driven more by the technology than well-defined research questions (Witcher 1999), resulting in studies that promote "technological determinism" (Mackie 2001:43). The often uncritical incorporation of techniques developed in geography has been a common exercise among anthropologists and archaeologists, and little collaboration has occurred (Ellen 1988). Even after two decades of widespread use of GIS in archaeological applications, it is still very much a 'method in search of theory' (Church et al. 2000). The problem is not that archaeology has borrowed a method from another discipline, it is simply that it has been borrowed without a sound knowledge of the theoretical underpinnings that allow geographers to use it to aid in explanation (Ellen 1988). Fortunately, there is a renewed focus on parallel development of theory and methodology within the discipline (Witcher 1999; Church et al. 2000).

The major criticism of the use GIS to archaeology is that the displays are nothing more than nice graphics and that spatial analysis is better done through formal statistical analysis (Kvamme 1999). There is also concern that the visual products of GIS can provide legitimacy to a published article or report as a representation of evidence even when an assessment of the quality of the data is not included (Mackie 2001; Preysler et al. 1999; Wheatley and Gillings 2002). In ethnographic research in particular, the ease of producing graphically sophisticated maps in a GIS introduces a danger that the representation "may become an end in itself" Ellen (1988:237).

Archaeologists have had minimal success with GIS in intra-site studies. Wheatley and Gillings (2002) suggest that the major shortcoming of GIS in contributing to such studies is that while GIS can handle three-dimensional data, it has difficulty incorporating an additional variable such as temporality. Therefore, chronology can only be considered as an attribute which limits the amount of analysis and modelling a researcher can conduct (Fisher 1999; Mackie 2001; Wheatley and Gillings 2002).

A general criticism is that the use of GIS promotes environmental determinism as only environmental variables can be easily considered (Fisher 1999; Wheatley and Gillings 2002). Of course, the root of the problem is not the software itself, but misuse of it. The quality and relevance of a research project is the research question, the data and the analytic design, not the technology the researcher utilizes. If the use of GIS perpetuates past mistakes, the researchers are to blame (Fisher 1999). New directions in development of theory should help to inhibit tendencies toward determinism (Witcher 1999).

Finally, GIS, with its specialized hardware and software demands, can be a significant expense for many archaeologists (Preysler et al. 1999). Training can be costly, and skilled personnel may be difficult to find. Further, the acquisition of existing digital data, or the digitizing or conversion of existing data, is another major expense that a researcher must consider when deciding whether to use GIS in their research (Mackie 2001; Wheatley and Gillings 2002).

APPENDIX B:

THE CULTURAL LANDSCAPE MODEL - TABULAR FORMAT

Table 8. The Cultural Landscape Model.

Environmental Setting[1]	Significance/ Resources	Functional Site Type Expected	Archaeological Features Expected
Outside Coast	Summer village location	village	Large shell midden, house depressions or structural remains, defensive/lookout sites on high, steep rocks, canoe skids
	Marine mammal, offshore and inshore fish, shellfish onshore	midden	Evidence of processing found in main midden deposit for the village or in small midden deposits away from village
	Terrestrial mammal	midden	Bones in middens.
	Plant resources, including trees suitable for bark stripping, but few trees suitable for logging or planking	CMT	A variety of CMT types but mostly bark-stripped trees, no evidence expected for other plant resource procurement activities
	Burials	burial sites: cave, rockshelter, surface	Human remains interred in caves, rock shelters or on rocky islet and promontories, sometimes with remains of bentwood boxes
Inside Coast	Winter village location (and stopover on way to fall fishing station)	village	Large shell midden, house depressions, canoe skids
	Marine mammal, offshore fish, shellfish, waterfowl	midden	Evidence of processing found in main midden deposit for the village or in small midden deposits away from village
	Terrestrial mammal	midden	Bones in middens.
	Abundant plant resources, including excellent trees for logging or bark-stripping	CMT	A variety of CMT types including stumps, planked and bark-stripped trees, likely more abundant than on outside coast, no evidence expected for other plant resource procurement activities
	Burials	burial sites: cave, rockshelter, surface	Human remains interred in caves, rock shelters or on rocky islet and promontories, often with remains of bentwood boxes

Environmental Setting[1]	Significance/ Resources	Functional Site Type Expected	Archaeological Features Expected
Inlets	Travel corridors between coast and salmon-rich estuaries	camps	Small temporary camps used as stopovers or for resource procurement (e.g., rockshelters, hearths), cultural material on surface
	Excellent trees for logging or bark-stripping found inland	CMT	A variety of CMT types, but given distance from shore and transport distances to habitation sites, likely to be predominantly bark-stripped trees.
Estuaries	Salmon fishing stations	village/habitation	Midden deposits, small house depressions or structural remains, canoe skids, stone wall fish traps or the remains of wooden fishing weirs
	Waterfowl, terrestrial mammals	midden	Some bones may be found in middens.
	Abundant plant resources, including excellent trees for logging or bark-stripping	CMT	A variety of CMT types including stumps, planked and bark-stripped trees, likely more abundant than on outside coast, no evidence expected for other plant resource procurement activities
River Valleys	Resource camps for procuring resources to support fishing stations	camps	Cultural material on surface, small midden deposits.
	Upriver villages for hunting, fishing or resource collecting	village/habitation	Cultural material on surface, middens, structural remains or house depressions
	Excellent source of quality timber and bark, as well as plant foods	CMT	A variety of CMT types including stumps, planked and bark-stripped trees, no evidence expected for other plant resource procurement activities
	Access routes to the mountains and for contact with other First Nations	trails	Well-worn trails, cultural material on surface

Environmental Setting[1]	Significance/ Resources	Functional Site Type Expected	Archaeological Features Expected
Kennedy Lake	Salmon fishing stations	village/habitation	Midden deposits, cultural material on surface, house depressions, canoe skids, stone wall fish traps or the remains of a wooden fishing weir
	Abundant plant resources, including excellent trees for logging or bark-stripping	CMT	A variety of CMT types including stumps, planked and bark-stripped trees, likely more abundant than on outside coast, no evidence expected for other plant resource procurement activities
Coastal Mountains	Best source for quality timber and bark, main source area for yellow cedar	CMT	A variety of CMT types including stumps, planked and bark-stripped trees. May be more plentiful along streams as people ascended mountains this way.
	Spiritual place	none	No archaeological evidence expected
Inland Mountains	Spiritual place	none	No archaeological evidence expected
	Small terrestrial mammals (e.g., marmots)	none	No archaeological evidence expected

APPENDIX C:

GIS MAPS AND ATTRIBUTE TABLES

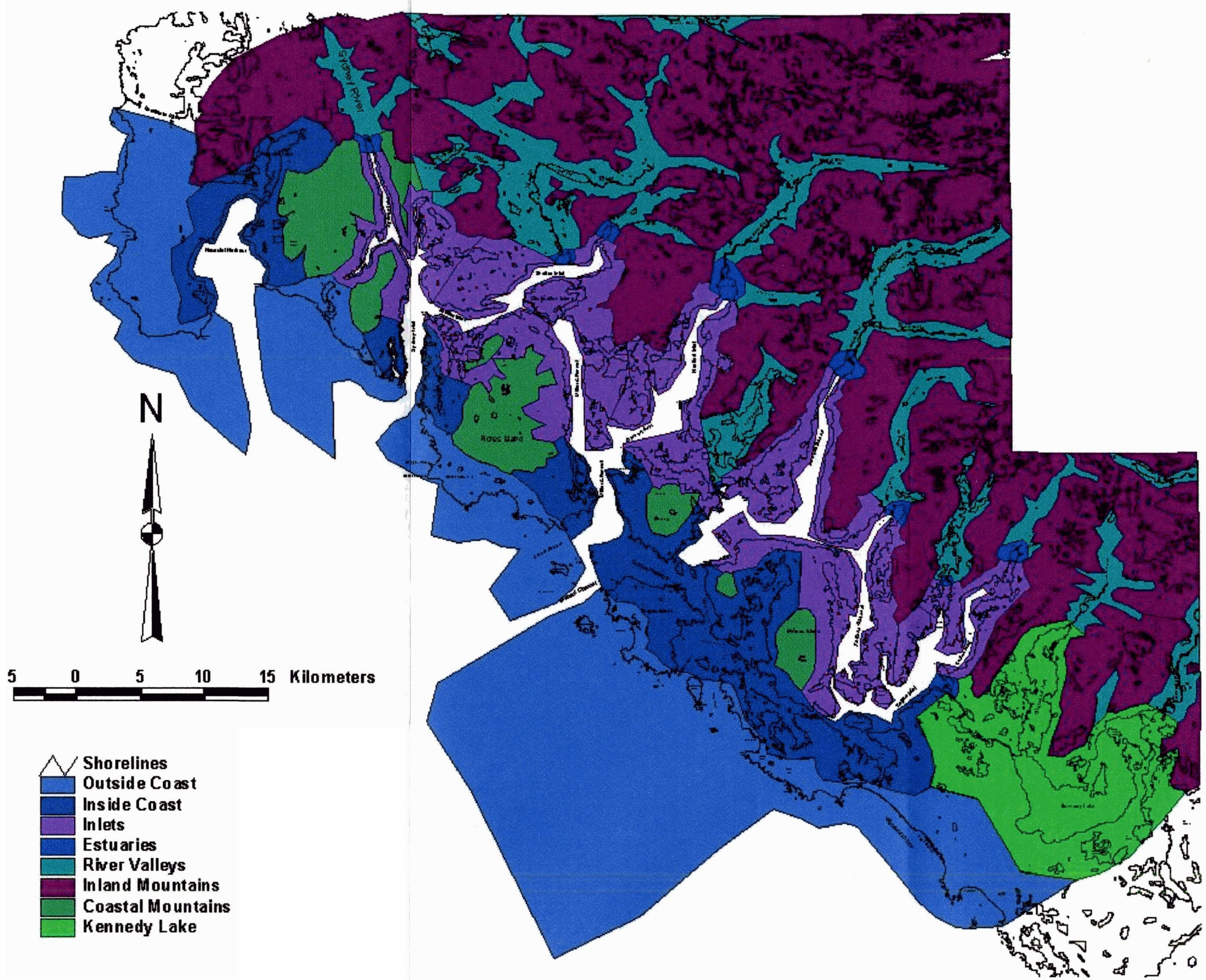


Figure 10. The Cultural Landscape Model.

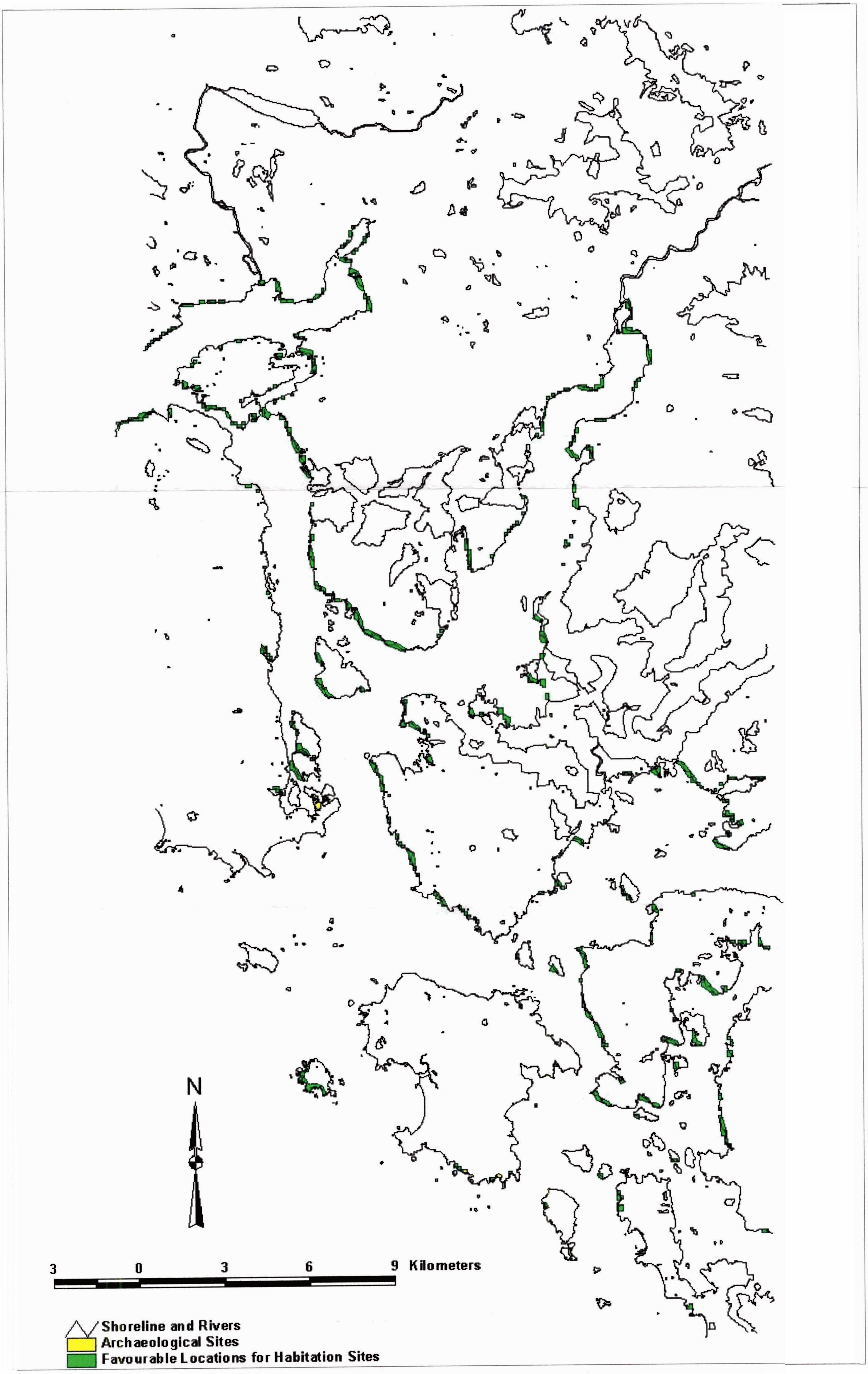


Figure 11. The Habitation Site Model.

Table 9. Example from the Archaeological Site Attribute Table.

BORDENNUMB	HISTORIC	PRECONTACT	VILL_HAB	DEFENSIVE	CAMP	RESOURCE	OTHER	MIDDEN	STRUCTURAL	CANOE_SKID	FISHFEAT	PETROFORM_	BURIAL_HR	CAV_ROCK	TRAIL	SURFACE	ROCK_ART	CMT_BS	CMT_AL	CMT_OM	CMT__	NO__CMTS
DgSj-001		T	T					T	T			T										0
DgSj-003	T	T	T					T		T												0
DgSj-004		T			T									T		T						0
DgSj-005		T				T					T		T						T			1
DgSj-006		T				T					T											0
DgSj-010		T				T													T			1
DgSj-013		T			T			T														0
DgSj-016		T				T												T				2
DgSj-017		T				T												T	T			5
DgSj-018		T				T													T			2
DgSj-019		T				T													T			17
DgSj-020		T				T													T			2
DgSj-021		T				T												T	T			19
DgSj-022		T				T													T			2
DgSj-023		T				T													T			1
DgSj-024		T				T													T			2
DgSj-025		T				T													T			1
DgSj-026		T				T													T			3
DgSj-027		T				T													T			2
DgSj-028		T				T													T			1
DgSj-029		T				T													T			1
DgSj-030		T				T													T			10

Table 10. Example from the Traditional Use Site Attribute Table.

ID	VILLAGE	FISHING	CAMPSITE	SHELLFSH	WHALING	HUNT_TRAP	SEAMAML	PLANT	CEDARUSE	BIRDS	BURIALS	SPIRTUAL	TRNSFRMR	SEASON	NCN_NAME	TRIBE	IR_NAME
1										T				summer	huhkii	Hesquiaht	
2					T										7aakmakhsis	Hesquiaht	
3															wihatis	Hesquiaht	
4		T													iihata	Hesquiaht	
5		T	T												paats'ista	Hesquiaht	
6		T													t'ukwis	Hesquiaht	
7		T													huumiilh	Hesquiaht	
8							T						T		kakatsts'ista	Hesquiaht	
9															p'aa7aknit	Hesquiaht	
10			T					T						spring	7aahuus	Hesquiaht	
11								T						spring	shishp'ika	Hesquiaht	
12															ts'aakwuu	Hesquiaht	
13															mushuwas	Hesquiaht	
14													T		a7uutuu7a	Hesquiaht	
15	T	T					T			T	T			summer	hum7is	Hesquiaht	Homais IR #2
16						T									yachnit	Hesquiaht	
17															chaachaak	Hesquiaht	
18															maakiyu	Hesquiaht	
19				T			T								mukwakis	Hesquiaht	

Figure 12. Distance to Water - Sample Grid.

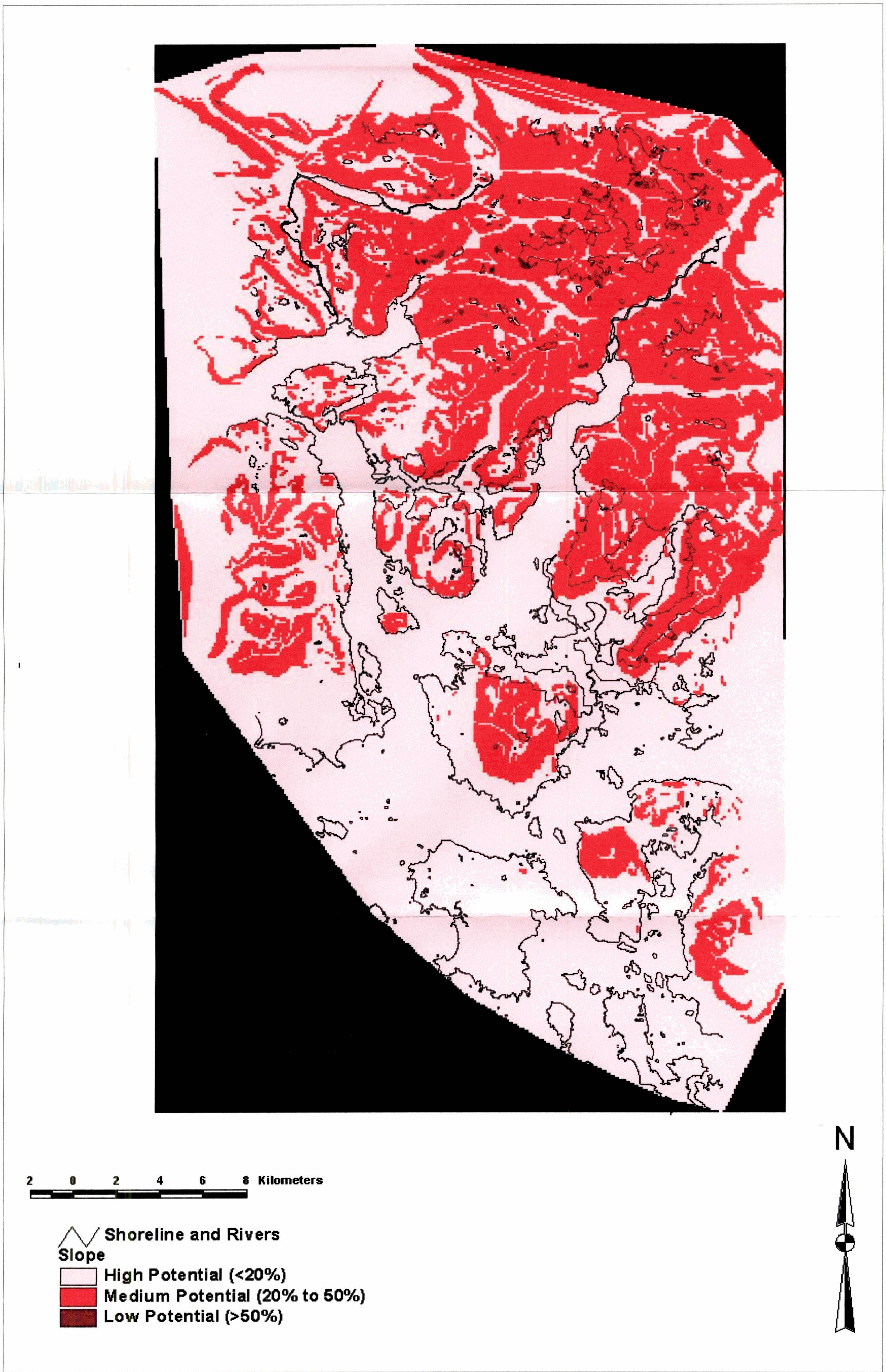


Figure 13. Slope Grid - Sample Area.

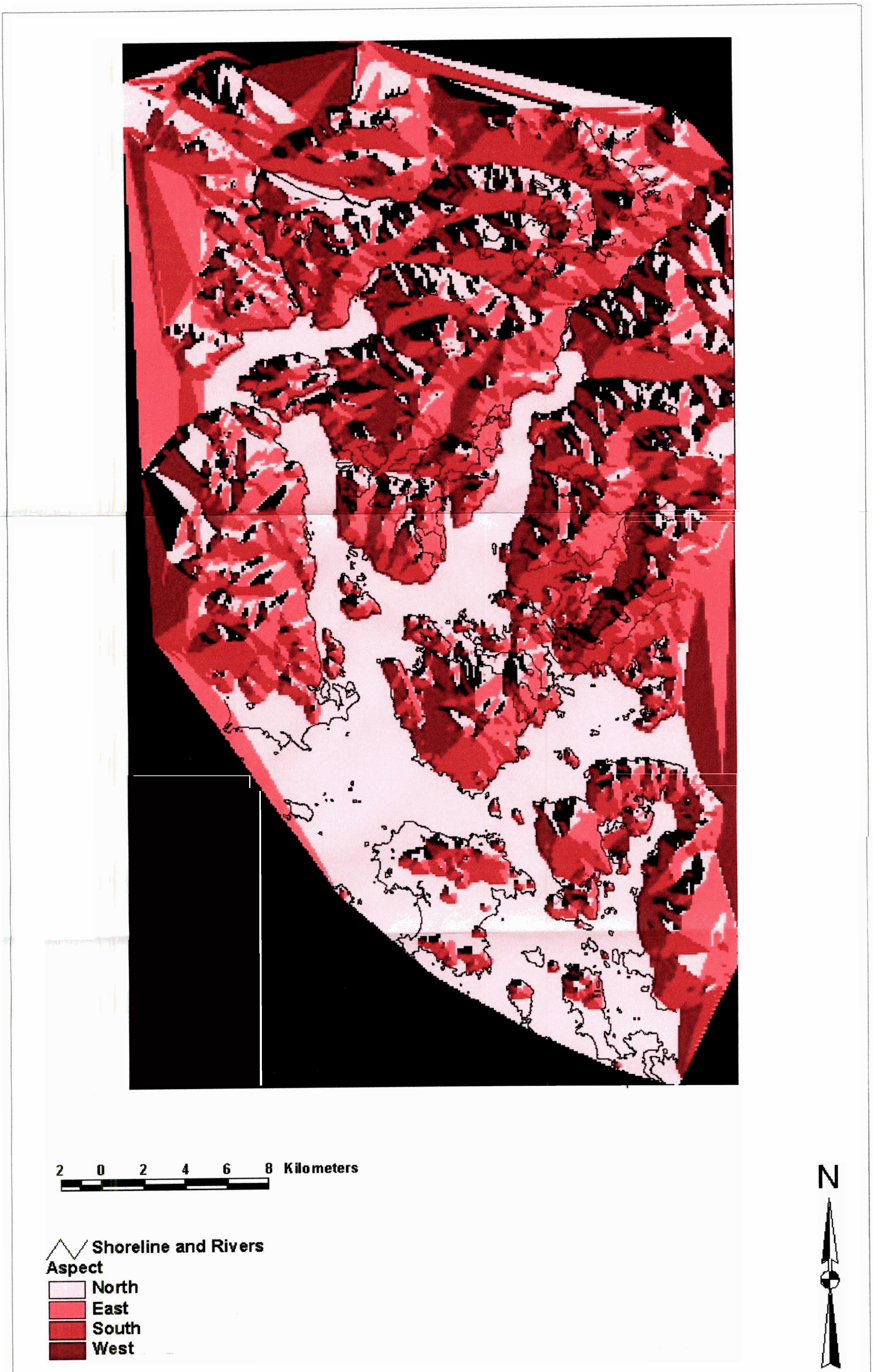


Figure 14. Aspect Grid - Sample Area.

APPENDIX D:
SEASONALITY AND USE OF INDIAN RESERVES IN CLAYOQUOT SOUND

Table 11. Seasonality and use of Indian Reserves in Clayoquot Sound.

IR Name[2]	Modern First Nation[1]	Pre-amalgamation[2]	Traditional Use[3]	Season of use[4]
Hesquiaht #1	Hesquiaht	Hesquiaht	main village	winter
Homais #2	Hesquiaht	Hesquiaht	for halibut and sealing	summer
Teahmit #3	Hesquiaht	Hesquiaht	limited fishing, poor timber	?
Maahpe #4	Hesquiaht	Hesquiaht	principal winter village and principal place for catching dog salmon	fall and winter
Iusuk #5	Hesquiaht	Hesquiaht	salmon fishing station	late summer and fall
Refuge Cove #6	Hesquiaht	Manhousaht	not a traditional Hesquiaht site	n/a
Opitsat #1	Tla-o-qui-aht	Tla-o-qui-aht	principal village site	winter
Echachis #2	Tla-o-qui-aht	Tla-o-qui-aht	fishing place and base for sealing	spring and summer
Esowista #3	Tla-o-qui-aht	Tla-o-qui-aht	fishing place/campsite	summer
Kootowis #4	Tla-o-qui-aht	Tla-o-qui-aht	fishing station for dog salmon	fall
Okeamin #5	Tla-o-qui-aht	Tla-o-qui-aht	fishing station	fall and early winter
Clayoqua #6	Tla-o-qui-aht	Tla-o-qui-aht	fishing station	fall
Winche #7	Tla-o-qui-aht	Tla-o-qui-aht	fishing station	fall
Ilthpaya #8	Tla-o-qui-aht	Tla-o-qui-aht	sockeye fishing station, close to Kennedy Lake	summer (August)
Onadsilth #9	Tla-o-qui-aht	Tla-o-qui-aht	fishing station for dog salmon, good timber	fall
Eelseuklis #10	Tla-o-qui-aht	Tla-o-qui-aht	salmon fishing station	summer and early fall
Tin-Wis #11	Tla-o-qui-aht	Tla-o-qui-aht	fishing camp	summer

[1] Indian and Northern Affairs Canada
[2] Canada and British Columbia 1914
[3] Bouchard and Kennedy 1990
[4] Canada and British Columbia 1914

IR Name[2]	Modern First Nation[1]	Pre-amalgamation[2]	Traditional Use[3]	Season of use[4]
Yarksis #11	Ahousaht	Kelsemaht	principal village site for fishing and whaling; good timber	spring and summer
Cloolthpich #12	Ahousaht	Kelsemaht	winter village	winter and spring
Quortsowe #13	Ahousaht	Quatsweaht/ Kelsemaht	fishing station for dog salmon	fall
Oinimitis #14	Ahousaht	Owinmitisaht/ Kelsemaht	fishing station for dog salmon and coho	late summer/fall
Marktosis #15	Ahousaht	Otsosaht	principal village	winter
Ahous #16	Ahousaht	Ahousaht	fishing and sealing station	summer
Chetarpe #17	Ahousaht	Ahousaht	fishing and sealing station	spring
Sutaquis #18	Ahousaht	Ahousaht	village and fishing station	fall and winter
Wahous #19 (fishing)	Ahousaht	Ahousaht	fishing station for dog salmon	late summer into winter
Wahous #20 (village)	Ahousaht	Ahousaht	principal village; good timber	late summer into winter
Tequa #21	Ahousaht	Otsosaht	small fishing station	spring?
Peneetle #22	Ahousaht	Otsosaht	fishing station	summer
Moyehai #23	Ahousaht	Otsosaht	important fishing station for dog salmon	fall
Seektukis #24	Ahousaht	Otsosaht	fishing station	fall with some winter use
Watta #25	Ahousaht	Otsosaht	small fishing station	fall
Wappook #26	Ahousaht	Otsosaht	fishing station; some timber	spring through fall
Openit #27	Ahousaht	Manhousaht	major village site	spring and summer
Tootoowiltena #28	Ahousaht	Manhousaht	salmon creek	summer?

[1] Indian and Northern Affairs Canada
[2] Canada and British Columbia 1914
[3] Bouchard and Kennedy 1990
[4] Canada and British Columbia 1914

IR Name[2]	Modern First Nation[1]	Pre-amalgamation[2]	Traditional Use[3]	Season of use[4]
Kishnacous #29	Ahousaht	Manhousaht	important fishing station	summer and fall
Indian Island #30	Tla-o-qui-aht	Tla-o-qui-aht	habitation site	?
Vargas Island #31	Ahousaht	Keltsomaht	historic village for fishing and sealing	spring and summer
Bartlett Island #32	Ahousaht	Otsosaht	summer villages	summer
Kutcous Point #33	Ahousaht	Otsosaht	village for fishing and sealing	summer
Hisnit Fishery #34	Ahousaht	Manhousaht	key village/fishing station for salmon	summer and fall
Swan #35	Ahousaht	Manhousaht	village	summer and winter?

[1] Indian and Northern Affairs Canada
[2] Canada and British Columbia 1914
[3] Bouchard and Kennedy 1990
[4] Canada and British Columbia 1914

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