Putting Down Roots: The Emergence of Wild Plant Food Production on the Canadian Plateau

by

Sandra Leslie Peacock
B.A., University of Calgary, 1988
M.A., University of Calgary, 1992

A Dissertation Submitted in Partial Fulfilment of the Requirements for the Degree of

DOCTOR OF PHILOSOPHY

in the Interdisciplinary Degree Programme

We accept this dissertation as conforming to the required standard

Dr. N.J. Turner, Co-Supervisor (School of Environmental Studies)

Dr. M.C.R. Edgell, Co-Supervisor (Department of Geography)

Dr. P. Dearden, Departmental Member (Department of Geography)

Dr. D.H. Mitchell, Outside Member (Department of Anthropology)

Dr. D.L. Pokotylo, Outside Member (Department of Anthropology and Sociology, University of British Columbia)

Dr. R.I. Ford, External Examiner (Museum of Anthropology, University of Michigan)

Supervisors: Dr. Nancy J. Turner and Dr. Michael C.R. Edgell

ABSTRACT

This research traces the emergence of wild plant food production during the Late Prehistoric Period (4500 to 200 BP) on the Canadian Plateau. It builds upon ecological-evolutionary perspectives offered by theories of people-plant interactions and models of plant food production. From this, it derives a general model of wild plant food production outlining the components of such systems, the conditions favouring their development, and the consequences and correlates of these activities. This general model is expanded and made specific to the Canadian Plateau through ethnographic, ethnobotanical, ecological and archaeological evidence for root resource use by the Secwepemc (Shuswap) and other Interior Salish peoples. The implications of these findings for reconstructions of Late Prehistoric culture change are discussed.

The study has two components. It begins by demonstrating that historically, the Interior Salish peoples were not plant collectors, "adapting to" the environment, but plant food producers who "domesticated" the landscapes of the region. Ethnobotanical evidence indicates the Secwepemc managed, processed and stored a variety of plant resources to increase their productivity and availability. These actions ensured surpluses for overwintering, reducing the threat of recurrent seasonal resource stress.

Root foods were particularly important. At least 20 species were regularly harvested and stored. Practices associated with harvesting were essentially horticultural and acted at the species, population and landscape levels to increase the density and distribution of targeted species. The productivity of root resources was also increased through processing in earth ovens. An experimental reconstruction of an Interior Salish earth oven found pitcooking increased the energy value of balsamroot (***Balsamorhiza sagittata***), a former root staple, by 250 percent. Balsamroot contains inulin, a complex carbohydrate indigestible in its raw form.

The second component of this study traces the beginnings of these wild plant food production systems through the archaeology of earth ovens. The discussion begins with Komkanetkwa, a traditional root gathering ground of the Secwepemc located near Kamloops, British Columbia, where investigations identified the remains of 170 earth ovens, 11 of which were excavated. Similar data from four additional root processing locales, including the Upper Hat Creek Valley, Oregon Jack Creek and Potato Mountain on the Canadian Plateau and the Calispell Valley on the Columbia Plateau, are also presented.

Analysis of site types and distributions, the structure and content of earth ovens and radiocarbon age estimates associated with them reveals root food production began approximately 3100 years ago on the Canadian Plateau. The broad pattern of root resource use, consistent with ethnographic expectations, is well-developed after 2500 BP and persists until historic times. Radiocarbon age estimates (n=30) indicate a peak in activity developing between 2250 and 1750 BP.

A review of the paleoenvironmental and culture-historical context identified the conditions, consequences and correlates of these processes. The catalyst for the development of these strategies was a dramatic decline in temperatures approximately 3900 years ago. This ushered in a 2000-year period recognized as the coldest and wettest stage of the Holocene, one characterized by long, cold winters. Under these conditions, wild plant food production represents a risk reduction strategy developed by

peoples of the Canadian Plateau to cope with the uncertainty of seasonal and annual environmental variation and prolonged periods of resource scarcity.

In sum, earth ovens are the archaeological manifestations of fundamental shift in the processes of people-plant interactions -- the transition from foraging to wild plant food production which occurred on the Canadian Plateau at least 3100 years ago. This transition represents the adoption of strategies designed to ensure the productivity and availability of plant resources, particularly storable carbohydrates derived from roots, for overwintering.

TABLE OF CONTENTS

List of Tables

Table	Title	Page
7.9	Summary of surface measurements from earth ovens in the Upper Hat Creek Valley (from Pokotylo and Froese 1983)	216
7.10	Summary data for excavated earth ovens in the Upper Hat Creek Valley (from Pokotylo and Froese 1983)	219
7.11	Summary data for excavated earth ovens at Potato Mountain (from Alexander and Matson 1987)	233
7.12	Summary data for excavated earth ovens from the Calispell Valley (from Thoms 1989)	240
7.13	Summary of archaeologically-investigated root processing locales discussed in the study	248
7.14	Average rim crest diameters and subsurface basin lengths for earth ovens at root processing locales	252
7.15	Results of the two-way comparison of average rim crest diameters from the four Canadian Plateau root processing locales	261

List of Figures

ACKNOWLEDGEMENTS

Ah, the last blank page. The final challenge -- to find the words to adequately express my gratitude to family, friends, colleagues and companions who have assisted in innumerable ways throughout this adventure. So, without further ado, I offer many, many thanks to:

The "Academic" Team:

- Nancy Turner, for her vision, quiet resolve and endless enthusiasm for all things ethnobotanical. This is for her.

- Mike Edgell, for helping me navigate the uncharted waters of the Interdisciplinary Ph.D. programme.

- The dynamic duo of Drs. Duffus & Dearden (or was that Dearden & Duffus?), for their exasperating ability to ask all the right questions at all the wrong times!

- Don Mitchell and David Pokotylo, for their careful reading of my lengthy tome and the thoughtful comments which did much to improve the final product.

- Richard Ford, who served, via satellite from Sante Fe, as the external examiner. His work, wit and wisdom have influenced and inspired me and will continue to do so.

The "Research" Team:

- The Tk'emlupsemc, "the People of Kamloops", especially the elders who shared their stories. Thanks also to Chief Manny Jules and Council of the Kamloops Indian Band, as well as to John Jules, Cultural Resources Management Department, KIB, for supporting my research.

- The 1996 "Pit" Crew, particularly my field assistant, the perpetually-cheerful Sharnelle Casimir, who can move dirt with the best of them! My mother, Margaret Peacock, herself an archaeologist, assisted in the excavations of the earth ovens, as did long-time friend and confidante, Linda Armstrong.

- The Cooking Crew -- Dawn Loewen, Kelly Bannister, Nancy Turner, Darrell Eustache, Michele Wollstonecroft, Lee McNabb and the folks at Wells Gray, who dug pits, gathered rocks, hauled water, hewed wood, collected plants, prepared roots, stoked fires, and monitored temperature probes well into the wee hours of the night! (NB: Many of these people served double-duty as balsamroot counters.)

- The Chemistry Crew, Dr. John Mullin, Agriculture Canada, for his eager assistance with the inulin analysis and the crash course in the chemistry of carbohydrates.

- The Scheidam Flats Crew, led by Bjorn Simonsen and field director Steve Lawhead. This basis of this work is derived from our 1992 field season of cheap prawns, Tim Horton's donuts and the Acadian Motor Hotel. Special thanks to Kevin Twohig.

- The Archeobotanical Crew -- Dana Lepofsky, Michele Wollstonecroft and Tasha Lyons -- for sharing floatation tips and techniques.

- The Artistic Crew, Ken Josephson, Department of Geography, for turning sketches and sticky notes into wonderful figures and illustrations.

The "Funding" Team:

- The Social Sciences and Humanities Research Council of Canada for the Doctoral Fellowship, as well as the promise of a PostDoc which fueled the push to the finish line. My doctoral program was funded, too, by a Sir James Lougheed Award of Distinction from the Government of Alberta and by a Charles Borden Scholarship from the British Columbia Heritage Trust. The University of Victoria also provided support through a number of scholarships and awards.

The "Home" Team:

- My "seester", Diane Peacock, who weathered the trials and tribulations of a sister (and housemate!) in the throes of dissertation writing. She, more than anyone, is overjoyed that this chapter of my life has drawn to a close (it's safe to come home now, Di).

- My parents, for their love and support (financial and otherwise).

- Long-time friends and collaborators, Suzanne Twelker and Noreen Willows, who started this journey with me over a decade ago. Our paths now lead us in different directions, but I am eternally grateful for the love & laughs we've had along the way!

- More long-time friends and colleagues: Warren Hill, a member of the U of Calgary cohort, currently enjoying fame and fortune on the MesoAmerican ballcourt lecture circuit; Brian Vivian, who introduced me to the Plateau, roasting pits and the funding potential of bottle returns; Heather Moon, whose timing with bonbons, bubble bath and brain candy was impeccable; and Quentin Mackie, who provided the proper words at a critical point in my argument and shared the joys of conference planning and dissertation angst.

- The members of the "Turnerettes" -- Kelly Bannister, Dawn Loewen, Juliette Craig and Brenda Beckwith, for many enjoyable hours spent ethnobotanizing.

- The crew of the Light Horse -- Duff, Anna, Scotty, Chris, Christina and Sonya -- for close encounters of a cetacean kind. Thanks for that!

And with that, and apologies to Bob Dylan, I'm ready to:

Dance beneath the diamond sky with one hand waving free,
(in the other my Ph.D),
silhouetted by the sea,
circled by the circus sands,
with all memory and fate,
driven deep beneath the waves,
and to forget about today until tomorrow . . .

≈≈≈≈≈

Chapter 1: The Research Question

1.1 Introduction

It is known to the Secwepemc (Shuswap) peoples as "*xk'emkenátkwa*" or "Komkanetkwa," "the place where the waters meet" (Turner and Peacock 1995). It is a broad, upland valley characteristic of the arid portions of the southern interior Canadian Plateau in British Columbia (Figure 1.1). Bunchgrass and sagebrush communities cover the valley bottom and lower slopes, open stands of ponderosa pine (*Pinus ponderosa*) occur at mid elevations, and the highest ridges bordering the valley are dominated by stands of aspen (*Populus tremuloides*) and forests of Interior Douglas-fir (*Pseudotsuga menziesii*). Two creeks converge at the head of the valley and flow westward, descending towards the confluence of the North and South Thompson Rivers, approximately 10 kilometers away.

Oral traditions of the Secwepemc peoples speak of the importance of Komkanetkwa as a traditional root harvesting and processing locale. Even today, the hillsides are blanketed in an array of edible root species. In fact, ethnobotanical studies of Komkanetkwa identified 17 species of root foods, some growing in considerable densities, and more than 70 culturally important plant resources in the valley (Turner and Peacock 1995). Balsamroot (*Balsamorhiza sagittata*), wild onion (*Allium cernuum*), spring beauty (*Claytonia lanceolata*), mariposa lily (*Calochortus macrocarpus*) and several species of desert parsley (*Lomatium* spp.) are abundant. The density and diversity of these former root food staples hint at generations of use and management by the Indigenous peoples of the region (Peacock and Turner, in press).

Further clues to the significance and duration of the relationship between the

Figure 1.1: View from the upper slopes of Komkanetkwa, looking south towards the valley bottom. The ribbon of trees, winding east-west, marks the location of Paul Creek and the concentration of root processing sites. In the foreground, researchers record the density of balsamroot.

people and plants at Komkanetkwa are concentrated along the valley floor. Here, the low terraces bordering the creek are dotted with the archaeological remains of at least 170 earth ovens or roasting pits (Schurmann 1969; Rousseau and Howe 1987; Arcas 1990, 1995; Simonsen 1994; Peacock 1996, 1998, in press). Historically, earth ovens were used by the Secwepemc and other Interior Salish peoples to process large quantities of edible roots. The construction and repeated use of earth ovens created permanent features on the landscape, massive rock-filled basins and mounds up to eight meters in diameter, still visible today in traditional root gathering grounds (Figure 1.2). Radiocarbon age estimates from a sample of the earth ovens at Komkanetwka suggest the continued use of these features throughout the last 2,500 years (Simonsen 1994; Stryd 1995; Peacock 1996, 1998, in press.). The archaeological remains of earth ovens, then, represent a tangible, direct link between past subsistence strategies and present ethnobotanical knowledge. Thus, the investigation of these features has much to contribute to our understandings of Plateau prehistory and the emergence of systems of wild plant food utilization in the region.

1.2 Current Interpretations

Komkanetkwa is one of only a handful of upland root collecting and processing locales identified on the Canadian Plateau (Figure 1.3) and thought to represent a period of root resource "intensification" during the Late Prehistoric Period (4500 to 200 BP), particularly after 2500 BP (Pokotylo and Froese 1983; Richards and Rousseau 1987). While I concur very generally with these interpretations, previous discussions have not defined what is meant by "intensification" or fully articulated the

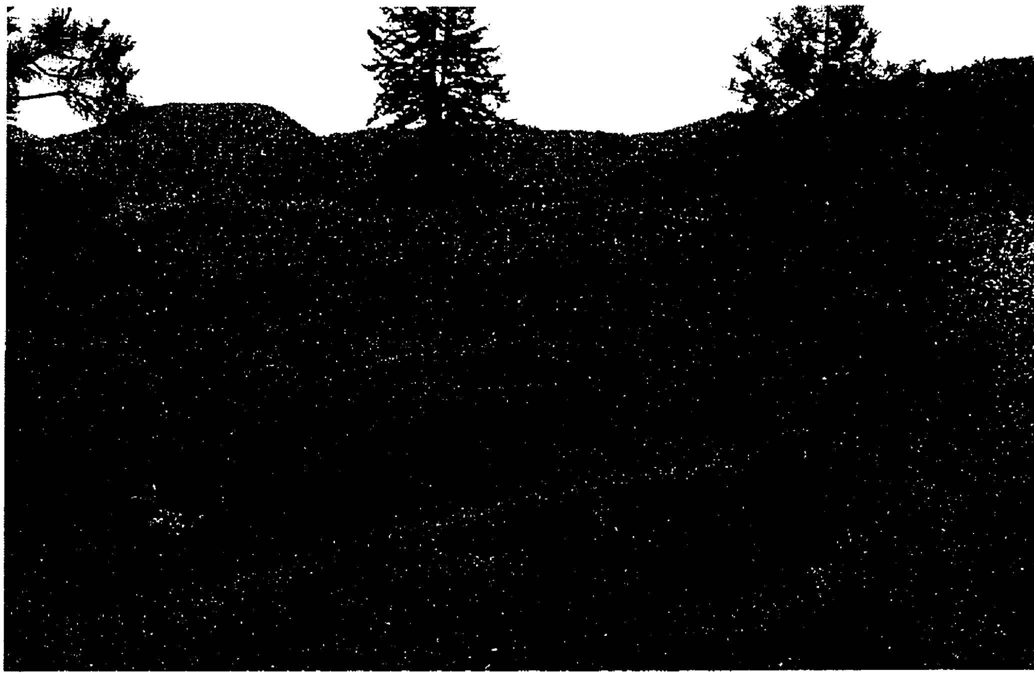

Figure 1.2: The archaeological remains of an earth oven (EeRb 89-1) from Komkanetkwa. A radiocarbon age estimate obtained from this feature during excavations yielded an age of 1830 ± 60 BP.

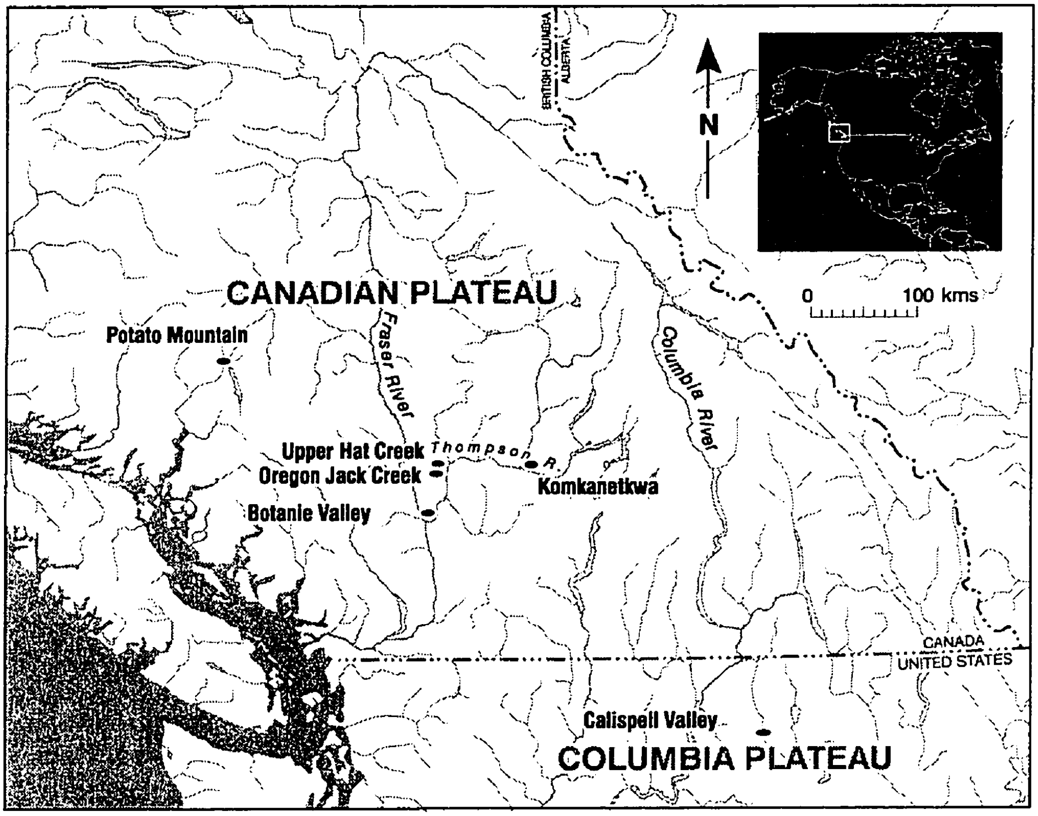

Figure 1.3: A map of the Canadian Plateau showing the location of Komkanetkwa and the other root processing locales discussed in the study.

ecological and cultural processes by which root resource "intensification" might have occurred. Consequently, they have not recognized the full significance of these sites and the activities they represent. For these reasons, the appearance of root collecting and processing locales on the Canadian Plateau is perhaps best understood when viewed from the broader ecological and evolutionary perspective offered by theoretical models of plant food production.

A growing body of ethnobotanical evidence indicates the Interior Salish-speaking peoples of the Plateau, including the Secwepemc, employed a wide variety of strategies to enhance and maintain the productivity and availability of culturally important plant species (Turner 1978, 1992; Turner and Peacock 1995; Turner et al. 1980; Turner et al. 1990; Peacock and Turner, in press). These practices included the "cultivation" or management of plants through techniques such as selective harvesting, weeding and tilling, and landscape burning; the innovation and adoption of plant processing technologies, such as pitcooking; and the development of storage technologies and facilities. Each of these may be considered a component of a system of wild plant food production.

In models of people-plant interactions (Ford 1985; Harris 1989), wild plant food production represents an intermediate point between foraging and farming. These models, based upon the notion of a continuum of people-plant interactions, stress that similar ecological dynamics underlie differing cultural practices of plant food production (Rindos 1984). In other words, differences between one end of the spectrum and the other are largely ones of degree (scale and intensity), not kind. This view has done much to dissolve the dichotomy between hunter-gatherer and agriculturalist.

The distinction drawn here between wild plant food *foraging* and wild plant food *production* is subtle, but significant. By positioning the plant use activities of Plateau peoples -- both past and present -- within the broader context of the processes of plant food production, we can view the "hunter-gatherers" of the region in a new light. From this perspective, Indigenous peoples of the Canadian Plateau are no longer passive plant gatherers "adapting to" their surroundings, but active resource managers modifying the landscape, and in essence, "domesticating" the environment (Ucko 1989; Blackburn and Anderson 1993).

One of the keys to understanding the emergence of systems of wild plant food production on the Canadian Plateau is to appreciate the properties of the plant resources being managed, processed and stored. Subsistence strategies of Plateau peoples emphasized the production and storage of carbohydrates as a means of coping with the seasonal resource stress characteristic of northern temperate regions (Speth and Spielmann 1983). These carbohydrates were obtained, in large part, through edible root resources. Further, plant processing technologies, such as pitcooking in earth ovens, were essential to these plant food production systems because they transformed the often inedible raw roots into highly digestible, readily stored sources of carbohydrate energy.

My thesis, then, is as follows. Earth ovens are not simply the camp kitchens of "foragers," or the task sites of logistically-organized "collectors." They are the archaeological manifestation of a fundamental shift in the processes of people-plant interactions -- the transition from foraging to wild plant food production which occurred on the Canadian Plateau during the Late Prehistoric Period (4500 to 200 BP). This transition represents the adoption of plant management and processing strategies designed to ensure the productivity and availability of plant resources, particularly storable carbohydrates derived from roots, for overwintering. The catalyst for the development of these strategies was, I suggest, a dramatic decrease in temperatures approximately 3900 years ago. This abrupt transition ushered in a 2000-year period now recognized as the coldest and wettest stage of the Holocene, a period characterized by moist summers and long, cold winters. Under these conditions, the beginning of plant food production represents the risk reduction strategy adopted by the hunter-gatherers of the Canadian Plateau to cope with the uncertainty of seasonal and annual environmental variations and resource stress typical of temperate regions. This shift to wild plant food production on the Canadian Plateau parallels a world-wide trend towards plant food production during the Holocene, a trends which is linked with increasing population densities, increasing sedentism, and increasing social complexity.

1.3 Research Context and Contributions

The intensification of reliable, abundant and storable resources has been linked to increasing sedentism and social complexity amongst prehistoric hunter-gatherers (Price and Brown 1985a). However, few archaeologists on the Canadian Plateau have considered plants as players in this scenario. Instead, fluctuations in the availability and utilization of salmon continue to play a major explanatory role in discussions of Late Prehistoric culture change and the emergence of the ethnographic pattern (Fladmark 1975, 1982; Hayden 1992; Hayden et al. 1985; Richards and Rousseau 1987; Kuijt 1989; Stryd and Rousseau 1996).

Several have challenged these explanations. Ames and Marshall (1980), pointing to the paucity of archaeological evidence for salmon intensification, propose *roots* may have been the intensified resource which promoted an increase in community sedentism on the Columbia Plateau. Similarly, Pokotylo and Froese (1983), based upon their investigations in the Upper Hat Creek Valley, suggested root resources may have played a supporting role in the development of winter villages on the Canadian Plateau. More recently, Thoms' (1989) comprehensive study of camas intensification in the Pacific Northwest points to the need to consider root resources as integral components of subsistence economies.

Unfortunately, few have taken up this challenge and archaeologists, in large part, continue to ignore and/or undervalue root foods (and plant resources generally) in their reconstructions of culture change on the Canadian Plateau (see Lepofsky et al. 1996 for a notable exception). For example, Stryd and Rousseau (1988:20) dismiss plant resources altogether, stating:

> the fact the people were living in pithouse villages [for the last 3500 years] suggests that subsistence . . . was based on intensive salmon exploitation for, Ames and Marshall (1980) notwithstanding, it is only this resource which could have supported sedentary winter populations in the Mid Fraser-Thompson Rivers area.

Equally dismaying is Driver's (1993:78) suggestion that "the lack of abundant wild plants with significant protein and carbohydrates in most of British Columbia means that animals were the main source of food in prehistoric times."

In light of these somewhat incomplete and inaccurate statements about Plateau lifeways, this study of the emergence of wild plant food production systems can make several important contributions to our understanding of Plateau prehistory. First, by synthesizing the extensive body of ethnographic, ethnobotanical and archaeological evidence, this research emphasizes that plant resources, and root foods in particular, have been important components of prehistoric economies for thousands of years. Therefore, it provides a modified and in many ways more complete picture of past lifeways.

Second, this work demonstrates that Plateau peoples were not "passive" food procurers, but active plant managers "cultivating" a wide range of plants and in doing so, cultivating the landscape. This perspective encourages us to reconsider the ways in which we perceive "hunter-gatherers" and their interactions with the environment. Plant resource utilization may no longer be tacked onto existing models but must be meaningfully incorporated into discussions of subsistence and settlement patterns and reconstructions of culture change.

Third, this research situates the study of plant resource use on the Canadian Plateau within the broader theoretical framework of people-plant interactions and demonstrates that the practices of the Plateau peoples, both past and present, are consistent with world-wide patterns of wild plant food production. Previous discussions of root resource utilization (Pokotylo and Froese 1983; Thoms 1989) have aligned Plateau hunter-gatherers more closely with food procurers than with food producers, and consequently, draw support from discussions of hunter-gatherer intensification rather than from models specific to the emergence of systems of plant food production *per se*.

Further, the study of this particular stage of plant food production is of considerable interest. Currently, prehistoric patterns of wild plant food production are less well documented relative to activities at the other end of the spectrum of people-plant interactions, where considerable attention has been focused on the "origins" of agriculture. Smith (1997; in press) has suggested that wild plant food production is more than simply a stepping stone in an evolutionary pathway from foraging to farming, and represents a successful, stable, long-term adaptation often referred to as "incipient agriculture" and in need of scholarly attention.

Finally, the Late Prehistoric Period is a time of particular interest to archaeologists as it marks the emergence of the ethnographic "winter village pattern" (Nelson 1973) on the Canadian Plateau -- the shift from highly mobile "foragers" to logistically organized "collectors" (*sensu* Binford 1980) with concomitant changes in patterns of sedentariness and social complexity. In fact, Chatters (1995:342) notes:

> The development of delayed-return systems from simpler antecedents is seen as the first step toward the complex, agriculturally based adaptations we enjoy today and is, therefore, considered one of the key issues in modern hunter-gatherer research.

Therefore, by linking plant resource use with concepts of plant food production and discussions of resource intensification, this investigation can contribute to our understandings of Late Prehistoric culture change and to broader theoretical perspectives in hunter-gatherer research.

1.4 The Organization of the Study

This research, then, brings new perspectives to interpretations of the ethnographic and archaeological records of the Canadian Plateau. Specifically, it posits that Secwepemc and other Interior Salish peoples were not plant "collectors," but plant food "producers" and points to the significance of root resources and to the central role of earth ovens in transforming carbohydrates necessary for overwintering. Further, it argues that the "roots" of these ethnographically-documented systems of wild plant food production may be traced back at least 3100 years through the archaeology of earth ovens. Finally, it suggests the appearance of such systems represents a strategy to minimize seasonal resource stress adopted by hunter-gatherers in response to a sudden shift in climatic conditions, particularly the onset of longer, colder winters approximately 3900 years ago.

One of the primary objectives of this study, then, is to demonstrate that the Secwepemc and other Interior Salish peoples were wild plant food producers. Accordingly, the ethnographic research questions are as follows:

- What constitutes wild plant food production?
- Were the Interior Salish peoples wild plant food producers?
- What were the relative contributions of root resources to the traditional subsistence economies of Plateau peoples?

The second objective is to trace the emergence of systems of wild plant food production on the Canadian Plateau through the archaeological record of the region. The archaeological research questions may be stated as follows:

- What is the archaeological "signature" of wild plant food production?
- What is the antiquity of these practices on the Canadian Plateau?
- Do patterns of food production change through time?
- What were the conditions favouring the beginnings of wild plant food production?
- What were the larger implications of wild plant food production for Late Prehistoric culture change?

In this dissertation, I develop these arguments and provide evidence to support my assertions (Figure 1.4). My approach is interdisciplinary. By design, it is broad and integrative, drawing upon relevant work in ethnography, ethnobotany, plant ecology

<table>
<tr>
<td rowspan="4">Chapter 1

Introduction
to the
Research
Question</td>
<td rowspan="4">Chapter 2

Theoretical
Considerations
of People-Plant
Interactions
&
The
General Model
of Wild Plant
Food Production</td>
<td>Ethnographic
(Synchronic)</td>
<td rowspan="4">Chapter 6

Summary of
Ethnographic
Data
&
A Model of Root
Food Production
for the
Canadian
Plateau</td>
<td>Archaeological
(Diachronic)</td>
<td rowspan="4">Chapter 9

Synthesis of
Ethnographic
& Archaeological
Data
&
Explanation
of the
Emergence of
Root Food
Production
on the
Canadian
Plateau</td>
<td rowspan="4">Chapter 10

Concluding
Remarks</td>
</tr>
<tr>
<td>Chapter 3

The Canadian
Plateau
&
The Secwepemc
People</td>
<td>Chapter 7

The
Archaeological
Evidence for
Root Food
Production
on the Canadian
Plateau</td>
</tr>
<tr>
<td>Chapter 4

Traditional Root
Resource
Management
Practices</td>
<td rowspan="2">Chapter 8

The
Environmental &
Cultural-
Historical
Contexts for
Root Food
Production</td>
</tr>
<tr>
<td>Chapter 5

Root Resource
Processing</td>
</tr>
</table>

Figure 1.4: The organization of the study.

human nutrition, and archaeology to address the research question. The strength of this approach lies in its ability to link together diverse lines of evidence and bring these to bear on the issue. In doing so, I hope to present more plausible explanations of the past.

Both synchronic and diachronic data are incorporated, reflecting the ecological and evolutionary aspects of this study. As Minnis (1985) notes, ethnological and ecological data are well-suited to identifying and understanding the relationships among components of a system. However, these synchronic data "cannot directly, or easily, be used to document patterns of evolution of food stress adaptation . . . . Neither can these synchronic studies observe the long term consequences of responses" (Minnis 1985:14). Thus, diachronic data, such as archaeological evidence, are necessary to understand the changes in these systems through time.

To evaluate my position, I begin by developing the theoretical foundation for the study in Chapter 2. This foundation is based upon cross-cultural considerations of people-plant interactions and models of plant food production. From this foundation, I derive a general model of wild plant food production which outlines the key components of the systems, as well as conditions favouring their development and consequences and correlates of these activities.

This general framework is then expanded and made specific to the Canadian Plateau through a review of the ethnographic, ethnobotanical and ecological evidence for plant resource use by Secwepemc peoples, supplemented with information from other Interior Salish groups as necessary. Chapter 3 introduces the Secwepemc peoples, the landscapes and environments of their traditional homelands, and their subsistence and settlement patterns as depicted in the ethnographic record. Following this, and in keeping with the general model developed in Chapter 2, I focus on several components of wild plant food production: root resource collection and management (Chapter 4), and root resource processing and storage (Chapter 5). In Chapter 6, I synthesize these data to illustrate that Plateau peoples' root resource production strategies are consistent with the general model of wild plant food production and that earth ovens were essential to these systems. I refine the general model into a model of root resource production specific to the Canadian Plateau.

Chapter 6 also serves as a transition between the ethnographic evidence for systems of root food production and the archaeological evidence for these activities on the Canadian Plateau. Chapter 7 begins by assessing the model of wild root food production for the Canadian Plateau and derives from it a set of expectations concerning the archaeological "visibility" of these components and practices in the archaeological record. Minnis (1985) suggests that where processing technology leaves permanent facilities, these are the easiest to trace archaeologically. I expand on this and establish the argument that earth ovens, as a direct link between past and present, can serve as proxies of plant food production systems. Then, I turn to the archaeological record of the Canadian Plateau and examine the regional evidence for earth ovens, beginning with a case study of Komkanetkwa. Chapter 7 concludes by assessing the fit of the archaeological evidence with the ethnographic expectations to determine whether or not the data are consistent with the specific model and thus, representative of root food production.

In Chapter 8, the evidence for root resource utilization is set into the broader context of the Late Prehistoric Period (4500 to 200 BP). To that end, this chapter presents the paleoenvironmental and culture-historical sequences for the Canadian Plateau to determine whether the proposed conditions and correlates of root food production are discernable in the archaeological record.

Chapter 9 is the major integrative chapter in which I synthesize the theoretical, ethnographic and archaeological data and present my explanation of the emergence of systems of wild root food production on the Canadian Plateau. In addition, I summarize the strengths of this interpretation and discuss the implications of this model for reconstructions of Late Prehistoric culture change. Chapter 10 concludes the discussion.

CHAPTER 2: THEORETICAL CONSIDERATIONS OF PEOPLE-PLANT INTERACTIONS

2.1 Introduction

In this chapter, I establish the theoretical foundations of this study and develop a general model of wild plant food production. I begin by establishing the context for this research with a brief discussion of the changing perceptions of hunter-gatherers and their interactions with the natural environment and review two of the more influential models of plant food production. In particular, I focus on the transition from foraging to systems of wild plant food production, identifying possible catalysts for this change, as well as the components and correlates of these systems. Each of the key components is then reviewed in detail. From this information, I generate the general model of wild plant food production which will be used as framework for investigations of the ethnographic data presented in Chapters 3, 4 and 5.

2.2 MODELS OF PLANT FOOD PRODUCTION

2.2.1 Out of the Wilderness: Perceptions of Hunter-Gatherers and the Environment

The notion that hunter-gatherers throughout North America actively managed the land and its resources -- and in essence, "domesticated" their environments -- is a recent and largely unembraced perspective. A brief history of the development of this perspective reveals why this is so and illustrates the need to fully examine the new paradigm.

The earliest European explorers and settlers in western North America described a "pristine" and "untrammelled" wilderness, unaware that many of the landscapes they observed -- the extensive prairie grasslands of the Midwest, the oak savannas of

California and the camas meadows of the Pacific Northwest -- were, in fact, anthropogenic in nature, the product of generations of careful use and management by Indigenous peoples (Norton 1979; Blackburn and Anderson 1993; Anderson 1996a; Turner and Peacock, in press). Indications are that between four to twelve million Native North Americans had "variously burned, pruned, hunted, hacked, cleared, irrigated and planted in an astonishing diversity of habitats for centuries" (Nabhan 1995:95). As Nabhan (1995:94) observes:

> Is it not odd that after ten to fourteen thousand years of indigenous cultures making their homes in North America, Europeans moved in and hardly noticed that the place looked "lived-in"?

This lack of awareness of, and appreciation for, the role of Indigenous peoples in transforming the landscapes of North America persists today, and stems, in part, from a fundamental dichotomy in the manner in which we perceive foragers and farmers (but see also Cronan 1983; Denevan 1992). Traditionally, hunter-gatherers have been viewed as passive food procurers, "ecologically noble savages" living in harmony with nature and having little or no lasting impact on the environment. Agriculturalists, in contrast, have been regarded as active food producers, modifying and dominating the land and resources.

This dichotomy is deeply embedded in anthropological thought and is evident in early writings concerned with the "origins" of agriculture. Childe (1934, 1936, 1942), in describing the origins of agriculture as a "Neolithic Revolution," was the first to make the distinction between "food procurement" and "food production" strategies (Harris 1989). In this, and other cultural evolutionary schemes, agriculture was viewed as a mark of human progress, the final stage in a unilinear march from savagery to civilization. Agriculture represented the triumph of human technology over nature, an ability to harness the earth's energy to feed increasing numbers of individuals. Agriculturalists were "civilized," hunter-gatherers much less so.

The publication of *Man the Hunter* (Lee and Devore 1968a) did much to alter peoples' perceptions of hunter-gatherer societies and elevated the status of hunting *and* gathering as a subsistence strategy. More important, it was one of the first major publications to acknowledge the significance of plant resources in traditional economies (Lee 1968; Lee and Devore 1968b; Suttles 1968; Woodburn 1968) . However, the subsequent labelling of hunter-gatherers as "the original affluent society" (Sahlins 1968) continued to promote the belief that such societies were merely reaping the rewards of bountiful natural habitats.

Thus, the focus of anthropology remained on how hunter-gatherers "adapted to" their environment rather than on how they might have modified it (Anderson 1993a) and much continued to be made about a dichotomy between forager and farmer. Such binary thinking, as Anderson (1993a) notes, effectively omitted a wide spectrum of cultural practices from consideration, particularly those people-plant interactions now recognized as intermediate between foraging and farming (Figure 2.1).

The rise of evolutionary ecological approaches to prehistory in the 1960s and 1970s marked an important turning point in the study of human-plant interactions and in understandings of the "origins" of agriculture (Harris 1989). New models of plant food production viewed foraging and farming as *processes*, rather than evolutionary *categories*, and in doing so, began to consider these activities as a continuum

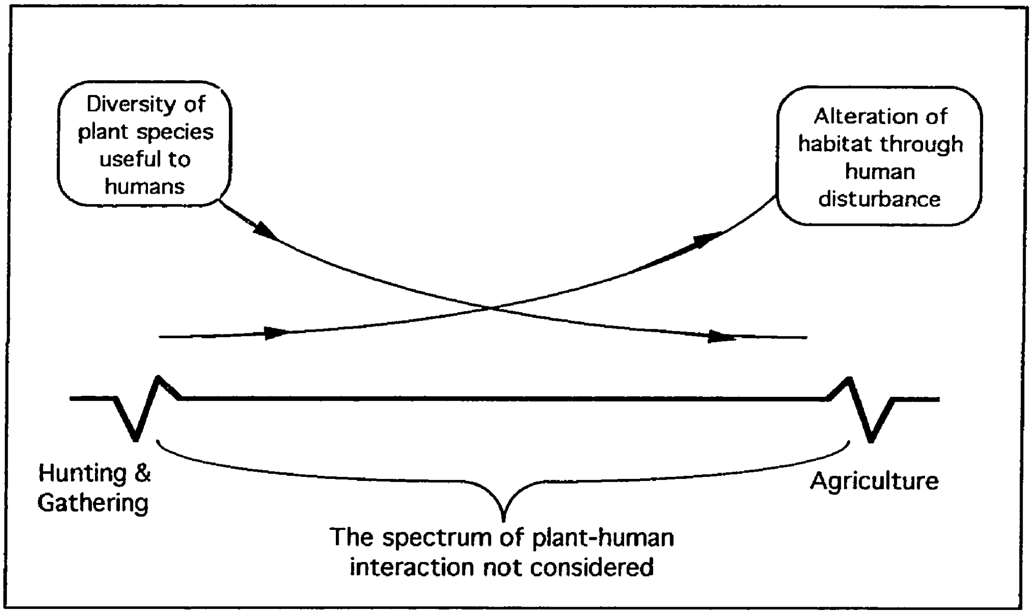

Figure 2.1: The spectrum of plant management practices omitted by a binary approach to people-plant interactions (adapted from Anderson 1993a).

of people-plant interactions, shaped by similar dynamics (Rindos 1984; Ford 1985; Harris 1989). They demonstrated that many of the techniques used by hunter-gatherers to "gather" wild plants were surprisingly similar to those used by horticulturalists and agriculturalists to "produce" plant foods and resulted in similar ecological effects on the "natural" environment. The differences lay in the scale and intensity with which the techniques were applied. Further, the relationship between plants and people was shown to be symbiotic, benefitting both human and plant populations (Rindos 1984).

These models, with their emphasis on a continuum of people-plant interactions, supported by ethnobotanical research which demonstrated that hunter-gatherers did, in fact, "cultivate" plants and effect environmental change (Lewis 1973, 1989; Lewis and Ferguson 1988; Nabhan et al. 1983; Posey and Balée 1989; Shipek 1989; Anderson 1993a,b, 1996a; Minnis and Elisens, in press) have been instrumental in changing our perceptions of hunter-gatherers from "foragers" to wild plant food "producers." In North America, this shift has taken us out of the wilderness by acknowledging the role of Indigenous peoples in creating and maintaining the landscapes and illuminating that middle area of the spectrum of people-plant interactions.

In the following section, I briefly outline two of the most influential models of plant food production, those of Ford (1985) and Harris (1989). These models are especially relevant because they discuss the processes of wild plant food production, and although they differ somewhat in detail, they are complementary in that they share the common objective of delineating the stages and methods of plant food production.

2.2.2 The Stages and Methods of Plant Food Production

In *The Processes of Plant Food Production in Prehistoric North America,* Ford (1985) presents the first major synthetic treatment of the ecological, geographical and archaeological evidence for the emergence of systems of plant food production in North America. Defining plant production as the "deliberate manipulation" of a plant species for human use, he notes this term includes a wide range of cultural activities which influence the life cycle of a plant in order to ensure its availability (Ford 1985). As many of these activities differ largely in the scale and intensity with which they are applied, Ford suggests human behaviours towards plants are best understood as a continuum of categories of interactions based on the degree of human disturbance or manipulation of the plant community.

Accordingly, Ford's model (Figure 2.2) positions the range of people-plant interactions along a continuum from least to most ecologically disruptive and is divided into two main stages: foraging and plant food production. Plant management activities associated with each stage are identified and grouped into broad "methods" of foraging, incipient agriculture, gardening and field agriculture.

Foraging -- both a stage and a method in Ford's model -- is positioned at the least disruptive end of the spectrum. Activities associated with foraging are generally viewed as having little or no intentional impact on plant species; that is, there are no deliberate or conscious actions taken by foraging peoples to encourage or assist a particular plant. However, Ford acknowledges that foraging may have incidental impacts, such as genetic selection.

Food production, in contrast, is characterized by the "deliberate care afforded the

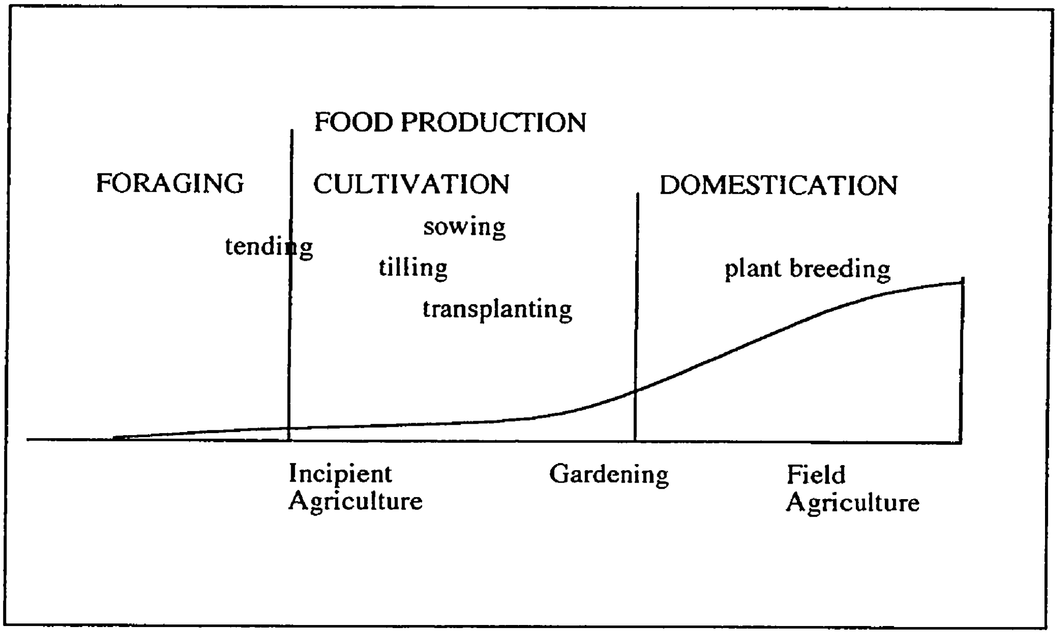

Figure 2.2: Ford's (1985) model of the stages and methods of plant food production.

propagation of a species" (Ford 1985:3) and is divided into two distinct substages: cultivation and domestication. This is an important distinction. Ford's use of the term "cultivation" does not imply that the species managed at this stage are domesticated. Rather, it refers to wild plant species whose life cycles have been disrupted in order to provide humans with more accessible, and/or more productive, food resources. Methods of cultivation include tending (weeding, pruning, or other methods to limit competition), tilling, transplanting and sowing. These activities have both intentional and incidental impacts on the targeted plant communities.

Domestication, the final stage in Ford's scheme, represents an intensification of activities associated with cultivation, but wild plant foods are largely replaced in the food production systems by new, genetically distinct domesticated species. Unlike their wild ancestors, these domesticates are "cultural artifacts," dependent on human populations for survival. Initially, domesticates were probably seasonal supplements, but as their importance increased, people intensified production, clearing "natural" ecosystems and creating anthropogenic habitat favourable for the growth of one or two key crops. The result: field agriculture, the most ecologically disruptive cultural activities associated with systems of plant food production.

2.2.3 A Continuum of People-Plant Interactions

Harris' perspective of plant food production shares many similarities with Ford's work, a point noted by Harris who adds he was unfamiliar with Ford's scheme at the time he was devising his model.

Stating that attempts to understand the "origins of agriculture" have often been "bedeviled by confusion over the meanings attributed to such terms as agriculture, cultivation, domestication and food production," Harris (1989) presents a classificatory model of people-plant interactions in an effort to clarify the terminology used in discussions of the emergence of agriculture. His approach is explicitly ecological and evolutionary, but not, as he emphasizes, unidirectional or deterministic. As he explains (1989:12), the model is:

> . . . ecological in that the analytical target is *interaction* between people and plants, evolutionary in that the *results* of the processes involved in domestication and the emergence of agriculture . . . are assumed to be products of selection working on both biological and cultural variation.

Harris' model, like Ford's, represents a continuum of people-plant interactions (Figure 2.3). However, in this instance, the key variable is human energy. The continuum, therefore, gauges the amount of energy required to exploit a given unit of land and is based upon the assumption that increased human energy input into plant food production systems through time has been rewarded with a corresponding increase in caloric output. It is worth noting, too, that because this increased human energy input is reflected in the amount of ecological disturbance, Harris' continuum also represents a gradient of increased human manipulation and modification of "natural" ecosystems. Given this, foraging activities are situated at the low energy end of the spectrum and farming at the opposite end.

Harris begins building his model by identifying the range of activities associated with plant exploitation and by noting the ecological effects these activities have on plant populations and ecosystems. These activities and impacts, drawn from ethnographic literature, are arranged sequentially along the continuum of increasing

Plant Exploitative Activity	*Ecological Effects (selected examples)*	*Food-yielding System*		*Socioeconomic Trends*	*Time*
Burning vegetation Gathering/collecting Protective tending	Reduction of competition; accelerated recycling of mineral nutrients; stimulation of asexual reproduction; selection for annual or ephemeral habit; synchronization of fruiting; Casual dispersal of propagules; Reduction of competition	WILD PLANT FOOD PROCUREMENT (Foraging)		Increasing sedentism (settlement size, density & duration of occupation)	↓
Replacement planting/sowing Transplanting/sowing Weeding Harvesting Storage Drainage/Irrigation	Maintenance of plant population in the wild; Dispersal of propagules to new habitats; Reduction of competition; soil modification Selection for dispersal mechanisms: positive & negative; Selection & redistribution of propagules Enhancement of productivity soil modification	WILD PLANT FOOD PRODUCTION with minimal tillage	PLANT FOOD PRODUCTION ↓	Increasing population density (local, regional & continental)	
Land clearance Systematic soil tillage Propagation of genotypic and phenotypic variants: Cultivation of domesticated crops	Transformation of vegetation composition & structure Modification of soil texture, structure & fertility DOMESTICATION Establishment of agro-ecosystems	CULTIVATION with systematic tillage AGRICULTURE (Farming)		Increasing social complexity (ranking - stratification - state formation)	
		Evolutionary differentiation of agricultural systems			

Figure 2.3: Harris' (1989) schematic diagram of the evolutionary continuum of people-plant interactions

energy requirements and classified into four food-yielding systems. These systems, or stages, include: wild plant food procurement (foraging); wild plant food production (with minimal tillage); cultivation (with systematic tillage); and agriculture (farming, with domesticates). The last three are subsumed under the broader heading of plant food production.

Harris proposes three thresholds of interaction based upon the different plant exploitative activities and the amount of labour (energy) required to create and maintain the desired ecological effects. Each represents a significant step in energy input into the food-yielding system, as well as increasingly "ecologically interventionist" activities. The first step separates the "spatially diffuse and low-energy" activities of wild plant food foraging from the managed, concentrated efforts of wild plant food production. The second major shift occurs between wild plant food production and cultivation. Harris views the beginnings of cultivation -- which he associates with systematic land clearance, tillage and planting of undomesticated crops -- as a crucial energy threshold, arguing that the costs of clearing and maintaining fields represents a significant increase in human labour costs. The third and final step separates the cultivation of wild plant species from the beginnings of plant domestication and the advent of agricultural activities. This stage represents an intensification of systems of cultivation, but is more labour intensive as people assume the responsibility of plant propagation as well as additional activities such as soil preparation, maintenance of soil fertility, weeding, seed selection and storage. Harris notes that thresholds may exist within these larger steps as well.

Harris explicitly avoids discussing how and why changes occur, and thus his model is descriptive rather than explanatory. He includes as "assumptive correlations" of increasing energy such demographic and socioeconomic trends as increasing population density (*i.e.*, local, regional and continental), sedentism (*i.e.*, settlement size, density, and duration of occupation) and social complexity (*i.e.*, ranking, stratification, state formation), all of which have come to be referred to as the processes of "intensification."

2.2.4 Models of Plant Food Production: A Summary

As is evident from the preceding review, the models developed by Ford and Harris share many characteristics. Both view the transition from foraging to farming as a continuum of interactions based on the amount of energy expended in encouraging the environment to produce plant foods. Further, increased human input into the system results in the increased manipulation and transformation of the "natural" landscape. Foraging practices, which have little or no intentional impact on the natural environment, are the least disruptive, while agricultural activities are considered the most ecologically interventionist.

In addition, the models acknowledge that to some extent, the techniques used to produce plant foods at various stages along the continuum are essentially similar, but differ in the scale and intensity with which they are applied. Thus digging by the hunter-gatherer becomes weeding and tilling of the cultivator and finally, the systematic soil tillage of the agriculturalist.

The models differ slightly, however, in their treatment of the stages of plant food production, as might be expected when assigning arbitrary divisions to a continuum of activities. Of particular interest to this discussion is the stage defined by Ford as "cultivation" and by Harris as "wild plant food production." Although the terminology differs, and each has included a slightly different range of plant exploitative activities in his model, I suggest for all intents and purposes, the activities associated with the beginnings of "cultivation" (*sensu* Ford 1985), that is, those closest to foraging and those associated with "wild plant food production," are functionally equivalent. Essentially, Harris has divided Ford's single stage of "cultivation" into two separate stages: wild plant food production and cultivation.

Wild plant food production, then, represents the first step taken by foragers towards a more active role in the production of plant food resources. Hunter-gatherers are no longer "gathering," but taking deliberate actions to encourage and enhance wild populations of plants. These strategies include such intentional activities as weeding and tilling, sowing and transplanting, and landscape burning, and have both intentional and incidental ecological impacts. All are spatially-focused and of low intensity, but represent an increase in the amount of human effort directed towards the manipulation of the environment. Thus, the transition from foraging to wild plant food production represents the first fundamental change in the nature of human-plant interactions.

2.2.5 The Shift from Foraging to Wild Plant Food Production

The transition from foraging to wild plant food production by hunter-gatherer societies represents a fundamental change in the nature of people-plant interactions. The nature and timing of this shift varies globally, but as the Ford and Harris models indicate, the beginnings of plant food production in different regions of the world are characterized by a similar set of processes. As Smith (1995:16) remarks, "all of these separate beginnings . . . seem to have come about in generally similar ways, in response to a similar motivation."

Investigations into the conditions which may have motivated hunter-gatherers to adopt more intensive systems of food production have intrigued scholars for well over a century and continue to be a subject of considerable debate. Botanists (*e.g.*, Vavilov 1926; Harlan 1971, 1973, 1992), geographers (*e.g.*, Sauer 1936, 1947, 1952) and archaeologists (*e.g.*, Childe 1936; Braidwood 1960; Flannery 1969, 1973; Ford 1973, 1981, 1985; MacNeish 1992; and others too numerous to mention!), concerned with the "origins" of agriculture, have proposed and explored a variety of explanations emphasizing either a "prime mover" such as climate change -- abrupt or otherwise -- (Childe 1952), environmental change (Harris 1977), population pressure (Boserup 1965; Cohen 1977; Binford 1968, 1983) or a combination of variables (Hassan 1981; Flannery 1986a,b).

More recently, new approaches and technologies, coupled with a growing body of archaeological data from around the world (Smith 1995), have helped refine understandings of past human-plant relationships and increasingly, environmental variation is seen as the catalyst for the transition from foraging to wild plant food production (Ford 1985; Flannery 1986a, 1986b; Smith 1995). The end of the Pleistocene was characterized by dramatic climatic changes as the world shifted from glacial to post-glacial conditions. These changes did not "cause" agriculture; however, they did encourage the establishment and expansion of plant communities where many of the wild ancestors of early domesticates grew and therefore afforded the opportunities for development of new strategies (Flannery 1986b). Rather, the catalyst for the development of new adaptive strategies was the increased environmental variation associated with the Holocene. According to Flannery (1986b:14), the early Holocene (ca. 12,000 to 7000 BP) witnessed:

> . . . annual and seasonal climatic variation at least as great as today's, perhaps even exacerbated by the fact that in many parts of the world the late Pleistocene vegetation was being replaced by Holocene floral communities that included the wild ancestors of many eventual domesticates.

Flannery (1986b) identifies two types of environmental variation: seasonal and annual (see also Suttles 1960, 1962 and 1968 for earlier discussions of environmental variation). Seasonal variation, the alternating cycles of spring, summer, fall and winter, is rhythmic and relatively predictable. In contrast, annual variation is random and largely unpredictable. Both sources of variation pose challenges for the plant food procurement strategies of hunter-gatherers, particularly those in temperate regions.

Temperate regions are characterized by marked seasonal climatic patterns with well-defined periods of plant growth and dormancy. Therefore, as Ford (1985) notes, the *availability* of resources throughout the year is a problem. In addition, during the growing season, unexpected annual perturbations in plant productivity occur, making the *predictability* of resources from year to year a problem. This combination of abundant but seasonal resources and annual fluctuations in the productivity of those resources meant hunter-gatherers in temperate regions were frequently faced with the threat of chronic, recurring resource stress, or "hunger seasons." Further, as Minnis (1985) points out, it is often the *perception* of increased vulnerability to food acquisition problems, rather than the food shortages themselves, which motivates people to act. As Suttles (1968:58) observes, the abundance of resources consists "only of certain things at certain places and at certain times and always with some possibility of failure."

It is important to note at this juncture that environmental variation need not be dramatic in order to trigger changes in food getting strategies. The modelling by Flannery and colleagues (Flannery 1986a) of the subsistence strategies for the prehistoric hunter-gatherers of the Valley of Oaxaca, Mexico indicates the fastest improvement in strategies occurred during an unpredictable stream of wet/dry years, suggesting that regular annual variation may be more important than abrupt, acute change. As Flannery (1986b:14) notes,

> . . . a great deal of the prehistoric record can be understood as an effort to cope with uncertainty, even at relatively low population densities and in relatively benign environments.

In other words, it is the stochastic nature of the seasonal and annual fluctuations, rather than the length or severity of environmental variation *per se*, which is significant in culture change (see Winterhalder and Goland 1997 for a discussion of the need to consider stochastic events, rather than long-term averages, in modelling). Further, as Flannery (1985b:14) points out, human groups are capable of dealing with long-term seasonal, annual, predictable, and unpredictable variation "because they have a multi-generational 'memory' and can share information on the success of past subsistence-settlement strategies."

In this context, the beginnings of wild plant food production are best understood as risk reduction strategies to increase the abundance and availability of wild food sources, making them more productive and predictable, and in doing so, reducing the threat of resource stress (Ford 1985; Smith 1995). As modelled by Ford (1985), who builds on work of Binford (1968), Flannery (1968, 1973) and Harris (1977), the transition from foraging to wild plant food production proceeds as follows. When resources are abundant and predictable, populations are able to meet their nutritional requirements by utilizing several key resources, or by resorting to secondary resources if there is sufficient diversity. However, when food supplies are inadequate or unpredictable, groups must adopt alternate strategies to avert resource stress.

If the group's foraging space is large, alternative patches of the same species may be accessible and the population positions itself at productive locales throughout the territory. Often, this is not a feasible strategy. The productivity of the patches may be insufficient, or groups may lose access to certain resource patches through social conflicts or changes in population densities and distributions. Faced with such restrictions, alternatives to foraging from resource patch to resource patch become necessary.

As Ford notes, the solutions to resource stress may be cognitive, social or technological, or a combination of these three approaches. As a first step, groups may choose to utilize food sources of lower cultural preference, or may diversify and collect a wider variety of plant resources even though they may require more energy to collect and process (*i.e.*, a broad spectrum adaptation). The latter strategy may include the deliberate disturbance of specific habitats to maintain the annual availability of ruderal species and, "in the face of changing patterns of availability, these may have been the first steps to effective food production" (Ford 1985:17).

If territories continue to decrease, access to these alternative food choices and collecting areas may be eliminated, necessitating additional strategies. At this stage, groups may adopt social solutions such as food exchange or shifts in residency patterns. Minnis (1985), for example, suggests populations will increase their social networks during times of resource stress in order to have greater access to more reliable food supplies. Suttles (1960) has cogently argued that affinal ties among the Coast Salish peoples of the Northwest Coast serve such a function.

Technological solutions represent a third set of strategies to enhance the availability and predictability of key resources and in the context of plant food production may include activities such as the cultivation or management of key plant resources, the development of plant processing technologies (Minnis 1985; Stahl 1989), and the storage of food surpluses (Binford 1980; Testart 1982; Flannery 1986b; Ford 1985).

In summary, as proposed here, the transition from foraging to wild plant food production is motivated by the need to reduce the risk and uncertainty associated with the increased environmental variation of the Holocene. Ford's theoretical model presents plant food production as a cultural response to the provisioning problems associated with seasonal and annual environmental variation characteristic of temperate regions. When territories are large, populations adopt "positioning" (*i.e.*, extensification) as a risk reduction strategy in order to meet their nutritional requirements. When access to these alternative resource patches is restricted, groups turn to "productivity" (*i.e.*, intensification) strategies to increase the yield and dependability of wild plant food resources and reduce the threat (real or perceived) of hunger seasons.

These solutions or risk reduction strategies include:

> ***Cognitive Solutions***
> • diet breadth increases, foods of lower cultural preference are incorporated;
>
> ***Social Solutions***
> • networks of kinship and/or trade are established;
>
> ***Technological Solutions***
> • management or "cultivation" of wild plant foods;
> • plant food processing;
> • storage of food resources.

These strategies are not mutually exclusive, nor are they necessarily hierarchical in the order in which they might be adopted. All are important alternatives in systems of wild plant food production and as Flannery (1986b:14) notes, they share a common goal of "resiliency, risk reduction, amelioration of environmental extremes, and an increase in resource predictability."

A discussion of each of these strategies is well beyond the scope of this dissertation. So, I turn now to an examination of the "technological" solutions outlined above -- wild plant food management, processing and storage. As Minnis (1985:40) notes, these are the most conducive to both archaeological and ethnographic analysis:

> Probably one of the most common responses, and one that can be difficult to observe with the largely synchronic data of ethnology, is the intensification of food-acquiring activities. . . . Where intensification results in environmental alteration and permanent facilities, this strategy should be one of the easiest to observe archaeologically.

2.3 Wild Plant Resource Management

2.3.1 Introduction

In the preceding section, I suggested wild plant food production represents a suite of strategies which reduce the risk of uncertainty created by environmental variation by increasing the productivity and availability of plant resources. Here, I focus on one of those strategies: the management or "cultivation" of wild plant resources.

As previously discussed, hunter-gatherers are traditionally viewed as passive food procurers, "adapting to" their environment. However, findings from diverse disciplines such as ethnobotany, archaeology and ecology indicate Indigenous peoples of North America were in fact skilful plant managers, who, through a wide variety of practices actively "domesticated" their environments. Further, this evidence indicates that such activities were "regular, constant, and long-term" and created lasting effects on the landscape as reflected in the plant associations, species distributions and composition, and, possibly, in the gene pools and genetic structures of the species and plant assemblages found in many plant communities (Anderson 1996a).

As the review of the models of plant food production indicates, the "cultivation" of plant resources includes: digging and replanting; tending, tilling and weeding; sowing and transplanting; and burning. I include these under the rubric of "management practices" because they are not isolated activities, but components of structured systems of resource use based on both biological and cultural considerations. These plant management practices, although utilized in different environments by different peoples, share many common characteristics. All, whether intentionally or incidentally, acted to maintain the ecological processes necessary to the productivity of culturally important plant resources. All represent forms of anthropogenic disturbance.

Intermediate disturbance theory has become a mainstay of modern ecological research as the "balance of nature" metaphor is replaced by a new ecological paradigm which emphasizes the nonequilibrium of ecosystems (Pickett et al. 1992). It is now widely recognized that certain ecosystems do not remain productive or diverse indefinitely but require periodic disturbance to invigorate, maintain or enhance ecosystem structure and function. These systems actually depend on disturbance and it is the frequency, kind and degree of change that are important (Botkin 1990). Anderson (1996a:157-158) notes,

> Simply put, acorns get wormy, old berry bushes produce less fruit, fire-dependent mushrooms don't grow every year, bunchgrasses decline in productivity as they accumulate dead material, and meadows shrink as trees encroach on them --- all processes that can be reversed by active management to maintain the abundance and diversity needed to support human populations.

I turn now to an examination of the specific methods and processes of plant management utilized by Native North Americans and to a brief discussion of the ecological effects of these disturbance regimes on the productivity of culturally significant plant resources. More particularly, I am interested in examining how these practices functioned to enhance and maintain the productivity and reliability of wild plant food resources, and thus to reduce risk.

2.3.2 The Specifics of Plant Management

To date, few studies have attempted to document the existing wild plant resource management practices of contemporary Indigenous peoples and to examine the ecological effects of these strategies in the field (Anderson 1993a). Thus, the following owes much of its inspiration to the work of Dr. Nancy Turner, whose extensive ethnobotanical research throughout British Columbia provides the foundation of much of this discussion (Turner 1975, 1978, 1979, 1991, 1992; Turner and Efrat 1982; Turner and Kuhnlein 1982, 1983; Turner and Peacock, in press; Turner et al. 1980, 1981, 1983, 1985, 1990) as well as to the innovative research of Kat Anderson (1990, 1991a,b, 1993 a,b,c, 1996a,b, 1997; Blackburn and Anderson 1993). The models developed by Ford (1985) and Harris (1989), as outlined earlier, are also integral to this discussion.

My goal here is to identify broad patterns of wild plant resource management as derived from a survey of the ethnobotanical literature available relating to a variety of Indigenous peoples in North America. While the individual plant species may differ, by and large, the plant management practices are consistent across geographic areas and biologically distinct regions. The following is not meant as an extensive review of the ethnobotanical literature, but rather draws upon the authors identified above, as well as my own insights and experience gained during research with the Piikáni, Blackfoot-speaking peoples of southwestern Alberta and northwestern Montana (Peacock 1992; Reeves and Peacock, in press), the Secwepemc people of the Interior of British Columbia (Turner and Peacock 1995; Peacock and Turner, in press), and the Coast Salish peoples of Vancouver Island (Simonsen et al. 1997; Turner and Peacock, in press).

For discussion purposes, the plant management activities of Indigenous peoples are grouped into three categories on the basis of spatial scale as follows:

> ***Species-level Management***: Spatially-focused activities designed to enhance the longevity, reliability and productivity of any culturally significant plant species; this includes the management of individual members of a species, as well as management at the population level, such as strategies employed to ensure the productivity of a particular harvesting locale;
>
> ***Community-level Management***: Strategies which create and maintain productivity in selected plant communities, habitats or locales, often successional, where associations of culturally significant plant resources occur; and,
>
> ***Landscape-level Management***: The totality of peoples' management effects, including systems of decision-making and social sanctions which control the management and harvesting of plant resources in various habitats throughout a large geographic area, such as a traditional territory.

These management activities are not mutually exclusive, but interact with one another in promoting plant productivity and reliability, whether intentionally or incidentally.

Species-level Management

The species represents the fundamental unit of Indigenous plant management activities. Populations and productivity of plant species with cultural utility were enhanced by Native North Americans through a number of strategies associated with aboriginal harvesting regimes. These strategies were based on both biological and cultural considerations, and included:

- the selective harvesting of plants based on well-defined criteria;
- the application of a variety of "horticultural" techniques;
- a system of scheduling which regulated the pattern (timing, intensity, frequency) of harvest.

Selective Harvesting Criteria: The harvesting of plant resources was selective, being neither random nor all-encompassing. The criteria used to select plants for harvest varied considerably between species and depended upon the type of plant resource and its intended use. Cultural preferences, the physiology of the plant and environmental factors all influenced the selection process. However, in general, the most important criteria were: the yearly growth cycle, reproductive status (*e.g.*, flowering versus non-flowering), maturity and size. Habitat preference (*e.g.*, soil type) also played a role.

The yearly growth cycles of culturally important species were well-known and carefully monitored as the desired qualities of a particular resource varied throughout its development, either seasonally (spring versus summer) or yearly as the plant matured. On a seasonal basis, variations in growth cycles meant certain species could only be harvested during a short period of time at any given location even though the plant might be present throughout the year. For example, the green shoots of cow parsnip (*Heracleum lanatum*), an important spring vegetable for Indigenous peoples throughout the Pacific Northwest, were harvested in early spring, before the plant flowered. After this, the stalks became tough, unpalatable and undesirable. On a yearly basis, variations in growth often meant a particular plant was left to mature for several years prior to harvesting.

The reproductive status of an individual plant, which is linked to growth cycles, was also an important criterion for selection. For example, a number of important root vegetables were harvested only after the plant had gone to seed. In addition, many medicinal roots were collected after flowering, at which point the roots were considered more potent. There were also cultural prohibitions against harvesting certain plants at certain reproductive stages.

Plants were also selectively harvested based on size preferences. Native elders consistently report that in root collecting, the medium-sized individuals were picked, leaving the smaller roots to regenerate and the largest plants to go to seed. Many recall harvesting with grandmothers, who taught them to leave the smallest bulbs and corms. Often, the older women would sort through the childrens' baskets at the end of the day, removing the smallest "roots" and replanting them.

Habitat preference was another criterion used in selective harvesting. Often, plants growing in a specific location were preferred to their counterparts in other regions. Medicinal plants were considered purer and more potent when collected from remote, higher elevations in the mountains. Berries from certain locales were said to taste sweeter than others. Further, if a habitat was particularly productive for one root resource, it was generally productive for other species as well, a fact which tended to concentrate harvesting activities on the landscape.

Horticultural Techniques: Harvesting regimes also included a variety of activities directly associated with the actual gathering of plant species, as well as with the management of those species at the time of harvest. These activities varied according to the species and the intended use of the plant but may be grouped into several broad categories, including: digging and replanting; tending, tilling and weeding; sowing and transplanting; pruning and coppicing; and in some instances, the selective burning of individual plants. These practices, although employed by "hunter-gatherers," are essentially "horticultural" (Anderson 1993a,b, 1996a; Ford 1985; Harris 1989).

Digging was one of the most common harvesting techniques and was used to collect a wide variety of edible roots and medicinal plants. A digging stick manufactured from wood or antler and approximately 1.5 meters in length, often with a crutch-shaped handle of wood, antler or horn, was the basic implement (see Thoms 1989 for a useful summary of digging stick styles in temperate regions of the world). This relatively simple tool represents an extremely effective technology for extracting roots of various shapes and sizes from often difficult terrain. The ability of this apparently "primitive" technology to transform the landscape should not be underestimated (Anderson 1993a).

Elders also mention that they frequently weeded during root digging to remove unwanted, non-utilitarian species. For example, death camas (*Zigadenus veneosus)*, a highly toxic member of the Lily (Liliaceae) family which grows alongside edible blue camas (*Camassia quamash*) was occasionally removed from camas meadows on the Northwest Coast (Turner and Kuhnlein 1983).

During harvest, many Indigenous groups intentionally replanted the ripe seeds of important species. For example, Piikáni elders in Montana buried the seed heads of certain medicinal plants in the holes created by the removal of the root (Reeves and Peacock, in press). Similarly, the Coast Salish peoples of the Pacific Northwest harvested camas when in seed, sometimes breaking the ripe seed capsules into the broken soil and reburying them (Turner and Kuhnlein 1983).

The sowing of seeds is also documented for hunter-gatherers throughout North America, including the Native peoples of California (e.g. Anderson 1993a, 1996a; Shipek 1989) and of course, the peoples of the Great Lakes area who sowed seeds of wild rice (*Zizania aquatica)* in the lakes (Driver and Massey 1957).

The transplanting of species to similar habitats is also well documented. Shipek's (1989) research amongst the Kumeyaay of southern California illustrates the extent to which these peoples experimented with transplanting to extend the range of culturally important species. In the American southwest and in Mexico, agave (*Agave* spp.) is associated with archaeological sites (Minnis and Plog 1976; Parsons and Parsons 1990; Fish et al. 1986; Fish 1997). Investigations reveal the distribution and maintenance of populations of fan palms (*Washingtonia filifera*) in the Sonoran and Mohave Deserts to be anthropogenic in nature (McClenaghan and Beauchamp 1986).

Pruning and coppicing were another form of management practiced on the shoots and stems of herbaceous and woody perennials used as food or materials. Peoples of the Great Basin, for instance, pruned out the older growth of snowberry (*Symphoricarpus racemosus*) to promote the growth of young shoots used to make small arrow shafts (Anderson 1996a). Throughout British Columbia, tule (*Scirpus lacustris*), cat-tail (*Typha latifolia*) and Indian-hemp (*Apocynum cannabinum*), culturally important herbaceous perennials, were sought for their stems, leaves and stem fibre respectively, and were cut in enormous quantities at their full maturity in late summer and fall. Since their rhizomes were not impacted, however, they would grow up anew each spring.

Certain species of berries, such as soapberry (*Shepherdia canadensis*), saskatoon (*Amelanchier alnifolia*) and huckleberries (*Vaccinium* spp.), were harvested by breaking off the berry-laden branches. This, too, was a form of pruning although clearly incidental to the means of harvesting. Hazelnut (*Corylus cornuta*) bushes were burned individually to encourage vigorous new growth in the following years (Turner 1991).

Scheduling: The scheduling of plant harvesting was regulated by a number of constraints. On one hand, the timing and frequency of collecting was imposed by the life cycles of the plants themselves, which in turn, varied between species and according to the micro-environment (*e.g.*, aspect, precipitation, elevation) of a harvesting locale. These, in turn, had to be balanced with cultural preferences for species at certain growth stages, as well as with conflicts which might arise when several species were available simultaneously for harvesting in different locales.

Decisions concerning where, when and what to harvest were dictated by cultural preferences and necessity, but limited by the spatial and temporal availability of the plant resources. This required Indigenous peoples to move extensively from resource patch to resource patch throughout their traditional territory on a seasonal basis.

Decisions concerning how much and how often to harvest were closely linked with fluctuations in the annual productivity of resources. Indigenous people throughout North America were well aware of the cyclical nature of the yield of many key plant resources. Fruits are well known for having multi-year cycles of heavy- and light-bearing years. The cycles of productivity were also known for species and populations that had been burned. Furthermore, specific root-digging beds, once harvested, were left to develop for a few "fallow" years before people returned to the exact spot. Thus, seasonal movements, in conjunction with the rotation of resource patches, prevented over-harvesting of a specific population. This is discussed in greater detail in the section on Landscape Management.

Community-level Management

On a somewhat larger scale, the management of plant communities encompassed the practices described above, but in this instance, people were managing to create a particular habitat type or plant association rather than to increase the production of individual species.

Prescribed fires were the most common form of disturbance at the community level. The use of controlled fires to create and maintain an ecologically heterogeneous mosaic is well documented for Indigenous peoples throughout the world (Day 1953; Lewis 1973, 1977, 1982, 1989; Lewis and Ferguson 1988; Boyd 1986; Timbrook et al. 1982; Anderson 1993a, 1996a; Blackburn and Anderson 1993; Gottesfeld 1994a,b). In fact, fire is recognized as one of the most powerful tools in shaping the landscapes of pre-Columbian North America.

Cross-cultural studies (Lewis and Ferguson 1988) reveal "functionally parallel strategies" in the use and management of fire regimes by hunter-gatherers throughout the world. Further, these anthropogenic regimes differ in important ways from natural fire regimes. According to Lewis and Ferguson (1988:58):

> Natural fire mosaics are characterized by larger, less frequent but usually hotter burned stands of vegetation; man-made fire mosaics, at least those fire-maintained by hunter-gatherers, entail smaller, more frequently, and lightly burned patches of growth. This is largely a consequence of the fact that hunter-gatherer fires differ from natural ones in terms of the seasonality and frequency with which they are set, and they are set in selected areas under essentially safer, managed conditions.

The reasons for burning were varied; however, it was widely recognized that fire, through clearing brush and accumulated debris, provided a quick source of nutrients, and stimulated the growth of certain complexes of plants (Turner 1991). Burning, then, increased the productivity of root foods (Norton 1979), berry bushes (Gottesfeld 1994b; Lepofsky et al. 1998) and basketry materials (Anderson 1996b). In addition, it was used to control insects and other pathogens (Anderson 1993a; 1996a). Burning also was used to reduce the build up of fuels on the landscape (Lewis 1982) and to create "fire yards" and "fire corridors" in forests to attract game and to open travel routes (Lewis and Ferguson 1988).

The success of landscape burning rested in the selection of habitat, as well as in the timing and intensity of the burn. Fires were usually set in early spring or late fall when there was sufficient moisture to prevent the spread of the fire and to minimize the intensity of the fire, avoiding damage to the soils below. The intensity of aboriginal fires was also linked to the frequency with which people burned. For example, berry patches were burned every eight to 10 years and allowed to regenerate for two to three years before harvesting. This period of "fallow" was accompanied by the rotation of harvesting locales as part of the seasonal round, discussed earlier.

Landscape-level Management

As previously discussed, both species and community management activities influenced the overall composition of the landscape. However, Indigenous peoples also employed a number of resource management strategies on a broad scale, such as within a traditional territory, which in turn, influenced species and community productivity and diversity. These included a planned and patterned seasonal round, the rotation of harvesting locales, controlling access to resource patches and religious ceremonies and moral sanctions.

The seasonal movements of people across the landscape were linked to the temporal and spatial availability of culturally important plant resources, as outlined earlier. Forests and woodlands of different types, grasslands, upland meadows and wetlands were all recognized by Indigenous peoples as being valuable habitats for plant resources. Ecological variation and succession, and the interrelationships among plants, other lifeforms and the physical environment were central to peoples' knowledge and lifestyles. It was widely recognized that certain plants grow in association with each other, and that often, life cycles of various plants and animals coincide. Growth and productivity are dependent on local weather conditions as well as aspect, moisture, climate and genetic variation. The cyclical nature of plant resources was also recognized.

All of these factors came into play in broad-scale sustainable resource use. The seasonal round, and the limited periods it entailed for people to focus on particular resources in a particular area, was important in restricting the quantities of a resource harvested at one time in one place. Further, peoples' movements from one area to another through the seasons, and the alternation or rotation of specific harvesting locations over multi-year cycles, were in fact forms of broad-scale resource management, and were comparable to the swidden agriculture practices of many tropical forest peoples (see Posey 1990).

Limiting or controlling access to productive resource locales was another mechanism which ensured that resources were sustainably utilized. For example, although root digging grounds and berry picking areas might be considered common tribal property, access to those areas was carefully monitored. Access to root and berry resources was further controlled and regulated through kinship systems.

Finally, resource management was ensured through the religious principles and moral precepts. In many Indigenous cultures, the manner in which people interacted with the landscape was inextricably linked to spiritual beliefs which were embodied in public ceremonies and oral traditions. These guided people in their day to day interactions with the natural environment, a point eloquently expressed in Gene Anderson's (1996) *Ecologies of the Heart* and well-documented in cultures around the world (Rappaport 1984; Gadgil et al. 1993). As Anderson (1996) cogently argues, effective resource management is not about managing resources but about managing the people who use those resources. In Indigenous societies throughout the world, this was achieved through religiously coded moral rules. Anderson (1996:55) explains:

> The reason for religious representation of resource management seems clear. By using religion as the carrier wave, a society invokes the religious system's emotional power and intellectual authority. This point has been made for the Native peoples of Canada by Robin Ridington (1982). Religion is used to sanction conservation and to teach environmental knowledge. In short, ecology and religion are inseparable.

2.3.3 The Ecological Effects of Anthropogenic Disturbance

As the preceding discussion indicates, Indigenous peoples throughout North America actively managed the plant resources of their environment through a wide range of "horticultural" techniques. In this section, I turn to a discussion of the ecological effects of these anthropogenic disturbance regimes at the species, community and landscape levels and assess how these practices may have enhanced and maintained the productivity and availability of key plant resources. That is, how did they function to reduce risk?

Species-level Effects

At the species-level, plant management was practiced through harvesting strategies dictated by both cultural and biological factors. Harvesting created occasional, spatially focused disturbance regimes that had both intentional and incidental but generally positive effects on the productivity of targeted species. These are outlined in Table 2.1.

By selecting individuals at certain life cycle stages, or according to age and size, Indigenous peoples not only thinned the populations, decreasing intra-species competition, but also altered the age structure of that population. Weeding also decreased competition between desired and undesired species, giving the culturally important plants a competitive advantage. The intentional replanting of "roots" and their propagules, as well as ripe seeds, was also an important factor in maintaining population productivity.

Incidental impacts of harvesting practices included localized soil disturbances from digging and tilling. Ford (1985:4) observes,

> Tilling may prepare a nursery bed for naturally dispersed seeds, or it may have positive biochemical results by increasing the moisture holding capacity of the soil, by aerating it to assist root gas exchange, or by oxidizing allelopaths in the soil.

Further, harvesting of some species was done at a time when seeds were in production, and the activities associated with harvesting -- digging, tilling, turning over the turf -- would help to distribute seeds and propagules. All of these activities acted to increase densities of desired species.

Of particular interest to this discussion is the fact that, without exception, the

Table 2.1: Ecological effects of indigenous horticultural methods on species populations (based on Ford 1985; Harris 1989; Anderson 1993a)

Horticultural Method	Ecological Effects
selective harvesting and replanting	reduces intra-species competition; intentional dispersal of propagules
digging and tilling	incidental dispersal of propagules; local soil disturbance; recycles nutrients, aerates soil; increases moisture-holding ability; possible reduction of allelopaths
tending and weeding	reduces inter-species competition; soil modification
sowing and transplanting	replenishes population; dispersion of propagules to new habitats
pruning and coppicing	removes dead material reducing plant vigor; stimulates vegetative reproduction and eventually flowering & fruiting
landscape burning	reduces competition; accelerates recycling of mineral nutrients; blackened ground encourages spring growth; selection for annual or ephemeral habit; synchronization of fruiting; maintains successional stages; creates openings

species managed by Native Americans are perennials. Unlike many annuals, most perennials have a range of regenerative and reproductive strategies and consequently, can respond to harvesting in a several ways. Virtually all of them have a capacity for regeneration through various means, from regrowth of shoots and leaves from underground or aerial parts, to the more obvious abilities for propagation from seed or spore. Many are very long-lived.

The ability to reproduce vegetatively enables the plant to survive and reestablish itself in place following human disturbance and often expands the portion of the site the plant occupies (Anderson 1993a). As a result, traditional harvesting technologies did not necessarily remove the individual or its genetic material from the population as seeds, root fragments and rhizomes were left behind. Rather, the horticultural techniques used by Indigenous peoples stimulated asexual and sexual reproduction. For example, pruning and coppicing of herbaceous plants and shrubs encouraged the growth of new shoots, leaving the rhizomes intact, as did the burning of selected individuals such as hazelnut bushes. In addition, the accidental detachment of portions of taproots, tubers, corms and bulbs would enable vegetative reproduction of the species. Ford (1985:4) states:

> Using a digging stick to obtain bulbs and tubers may increase the size of a species' population by detaching bulblets or lateral tubers. This is a common result in areas where wild onion or Jerusalem artichokes are intensively harvested: the more one gathers, the more one gets.

In many instances, these anthropogenic effects mimicked natural forms of disturbance (Anderson 1993a). Further, this disturbance prevented the plant from reaching a natural senescence, and thus, was essential to the continued productivity of the individual and the population as a whole.

In sum, the net effect of these anthropogenic disturbances was to increase the density, productivity (yield, longevity) and distribution (range) of a wide variety of plant resources. The effectiveness of these management strategies to enhance and maintain populations of culturally significant plants, has, of course, been long recognized by Native peoples. Many, in fact, point to the loss of productivity and diversity of traditional gathering areas due to the cessation of traditional management regimes (Anderson 1993a,1996a; Peacock and Turner, in press; Turner and Peacock, in press). Only recently, however, have ethnobotanists and other scientists attempted to recreate such traditional practices and monitor the effects of these on the plant populations.

Anderson's (1991a, 1993a,c, 1996b) replication and monitoring of the harvesting practices of Californian Native groups is exemplary of this approach. Her study of the impacts of traditional regimes on three culturally important species, deergrass (*Muhlenbergia rigens*), redbud (*Cercis occidentalis*), and blue dicks (*Dichelostemma capitatum*), reveal they respond positively to burning, coppicing and digging, respectively. Similarly, Elaine Joyal's (1994) research into the sustainable use of palms by local peoples in Costa Rica demonstrates the ecological value of Indigenous strategies.

<u>*Community-level Effects*</u>

At the community level, the management practices of Indigenous peoples resulted in the creation and maintenance of a wide number of community types which varied in species associations, species composition, and species richness and diversity.

Fire played a critical role in the structure and composition of plant communities as well. Frequent, low-intensity fires disrupted successional sequences in a given habitat, and reduced the overall dominance of that particular climax community type on the landscape. In addition, fires also recycled nutrients, removed detritus and eliminated pests and in doing so enhanced the productivity of targeted species.

Thus, a series of anthropogenic fires in various habitats created patches of productive seres across the landscape. These early stages, characterized by open habitats, are recognized as the most biologically diverse, and were critical to the plant (and animal!) management strategies of Indigenous peoples. As Anderson (1996a) points out, most of the species valued by Native Americans are shade-intolerant and depend on burning or other forms of disturbance to maintain the early-successional communities they inhabit.

Landscape-level Effects

By managing for productive species, and by maintaining a diverse number of habitats conducive to the growth of favoured species, Indigenous horticultural practices created mosaics of plant communities, contributing to the overall heterogeneity of the environment.

The key to the use of anthropogenic disturbance regimes in promoting the productivity and diversity of plant populations is regulating the intensity, frequency and size of the disturbance events as these variables alter the composition and structure of plant communities. This is where traditional landscape-level management activities became important. The rotating use of harvesting grounds and burning locales over multi-year cycles, along with controlled access to resource areas and other sanctions enforced through social mechanisms, resulted in intermediate levels of disturbance in any given plant community.

2.3.4 Summary of Wild Plant Resource Management

Indigenous peoples throughout North America actively managed the plant resources of their environment through a wide range of "horticultural" techniques to ensure a productive, predictable supply of culturally significant plants -- whether for food, materials or medicines. Management decisions were not solely economic ones, but were embedded in social contexts and encoded in religious philosophies and oral traditions.

These management strategies represent forms of disturbance which, intentionally and incidentally, revitalized, maintained and enhanced the structure and function of a wide range of habitats and key plant resources. It is now realized that certain resources do not remain productive indefinitely, but reach a stage of senescence, and eventually death, if not exposed to some form of disturbance. Ecologists suggest that plant communities experiencing intermediate levels of disturbance (in terms of size, frequency and intensity) exhibit the highest levels of species diversity as well as high productivity (Anderson 1993a) as is illustrated in Figure 2.4.

Anthropogenic influences, then, act as forms of intermediate disturbance, often mimicking natural disturbance regimes, and represent a symbiotic relationship between people and plants whereby humans increase the range of a plant species by maintaining habitat conducive to its continued growth. In other words, use *can* ensure abundance and without continued use (management), the productivity of traditional plant

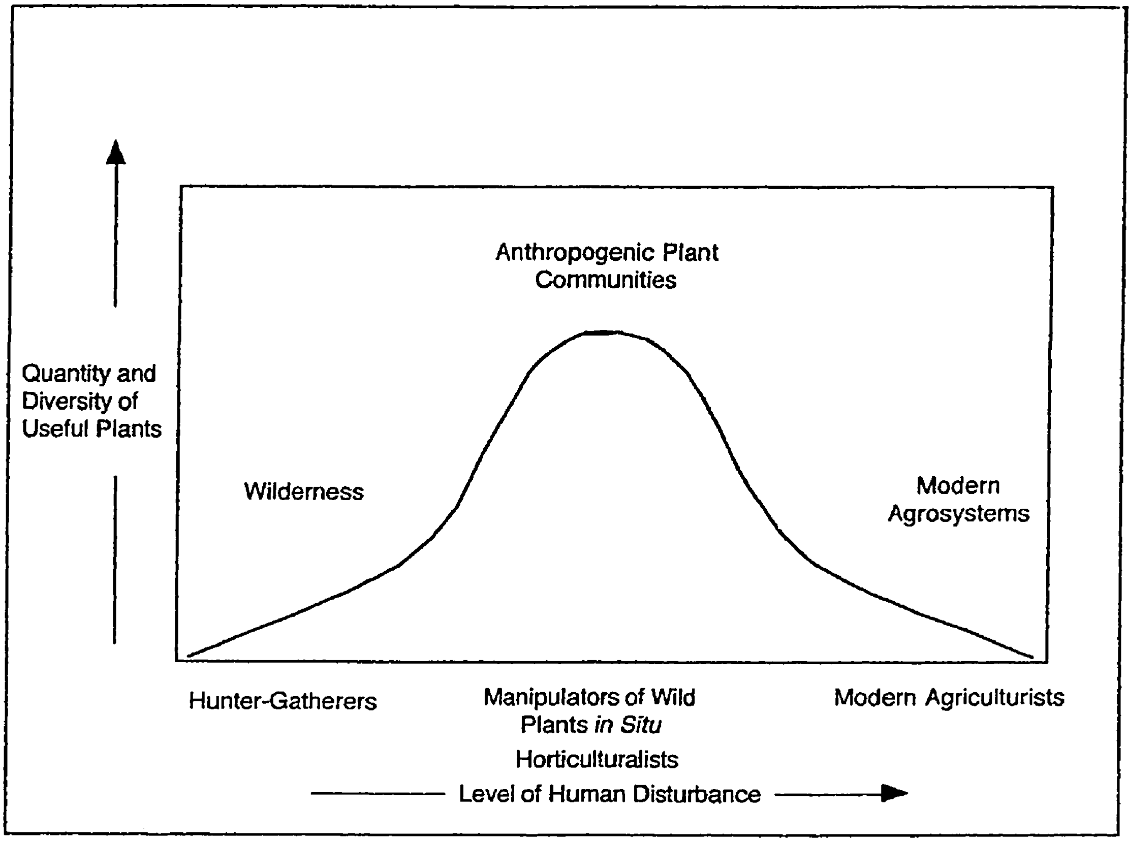

Figure 2.4: The relationship between disturbance level and species diversity and productivity (redrawn from Anderson 1991b).

gathering areas diminishes, just as countless Native American plant harvesters have suggested.

To conclude this section, I refer to Figure 2.5, a schematic diagram outlining the wild plant management strategies of Indigenous peoples and the ecological effects of those strategies at three spatial scales, or levels of biological organization. It suggests the use of a wide range of horticultural methods, guided by management activities designed to regulate the timing, intensity and frequency of harvest, created anthropogenic disturbances within populations of culturally valued species and in the habitats (communities) where they occurred. These disturbances had both intentional and incidental impacts, and acted to increase the density (productivity), distribution (availability), and predictability of key species and to maintain the habitats conducive to their growth. This has the effect of creating mosaics of productive communities on the landscape, increasing not only diversity of species (important to reliability), but ultimately the productivity of landscape. It was this mosaic of productive resource patches which became the "natural" scenes Europeans first encountered and mistook for wilderness.

Use of	Guided by	Regulates the	Scale of Application	Results in:
Use of Horticultural Methods selective harvesting, digging & replanting, tilling & weeding, sowing & transplanting, pruning & coppicing, burning	Guided by Management Activities scheduling of seasonal rounds; rotation of harvesting locales; controlled access; religion/moral sanctions;	Regulates the Scale, frequency and intensity of anthropogenic disturbance	Species Level	Increased productivity of selected species through: Altered age structure, density, distribution, genetic structure, longevity, range and yield of species with cultural utility
			Community Level	Increased habitat diversity through: Altered community dynamics, size, and types; altered species associations, composition, diversity, and richness and vertical structure; creates openings or ecotones; halts successional sequences, creating productive seres
			Landscape Level	Increased heterogeniety of the landscape Creates a mosaic of productive plant communities across landscape with both structural and compositional diversity
				NET RESULT Increased productivity and availability of culturally significant plant resources

Figure 2.5: Indigenous plant management strategies and their impacts on the productivity and availability of plant resources.

2.4 Wild Plant Food Processing

2.4.1 Introduction

In the preceding section, I reviewed evidence for the plant management practices of Native North Americans, demonstrating that through use of horticultural methods, guided by various biological and cultural regulatory processes, Indigenous peoples enhanced and maintained the productivity and availability of key plant resources, whether for foods, medicines or materials.

With regards to food plants specifically, these plant management practices may be thought of as activities which created concentrated patches of "food energy" in various habitats across the landscape. These patches, however, often represent *potential* energy as many of the plant species, in their "raw" form, are indigestible by humans. Plant processing, then, becomes necessary to convert these raw plant resources into more readily available forms of food energy.

The significance of plant food processing techniques is often given short shrift in discussions of changing patterns of plant food exploitation. Stahl (1989:171) notes:

> Archaeologists know remarkably little about the advent of different plant-processing techniques, and even less about the ways that different processing affects the nutritional quality of foods. We frequently ask why societies changed their patterns of plant-food exploitation, but seldom turn our attention to why new processing technologies are adopted.

Stahl (1989:184-185) urges archaeologists to consider plant processing as a "dynamic factor contributing to the nutritive value of a given food" and as well as "a potential avenue for intensification." She suggests processing be viewed as an independent variable in attempts to model the subsistence decisions made by prehistoric populations.

In this section, I examine the role of plant processing as one of the risk reduction strategies associated with wild plant food production. I explore the ways in which the transformation of raw plant resources into readily digestible foods increases the productivity of plant resources, and thereby, reduces the risks associated with environmental variation. I begin with a brief overview of various types of plant processing techniques and then discuss the importance of carbohydrates as a major source of food energy to hunter-gatherer populations. I conclude the section by examining the role of plant processing, specifically pitcooking, in creating those carbohydrates.

2.4.2 Plant Food Processing -- An Overview

Plant processing is undertaken by peoples everywhere, through a variety of methods, but with generally similar goals: to remove unwanted plant parts; to detoxify plants by removing secondary compounds; to preserve or prepare the plant resources for storage; and finally, to enhance the culinary experience (Stahl 1989).

Typically, plant processing is conducted in a sequence which can be broken into a variety of components, each with its own methods and effects. Activities include: grinding, pounding and grating; soaking and leaching; heat treatment and drying; and fermentation. These techniques are itemized in Table 2.2, which represents a summary of Stahl's (1984:172-183) much more extensive treatment of the subject.

The nutritional implications of these processing techniques varies; however, all act to enhance the edibility of foods. This may be accomplished in one of two ways: through physical changes, which alter the size of food particles, or through

Table 2.2: Plant processing activities (adapted from Stahl 1989)

Processing Activity	**Effect**
Grinding, pounding, grating	• separates desirable from undesirable elements • changes the physical form of a food • a step toward detoxification
Soaking and leaching	• softens or hydrates plant tissue • aids in detoxification • precipitates starch from plant foods • contributes to fermentation
Fermentation	• enhances the flavour of foodstuffs • facilitates the preservation of foodstuffs • detoxifies foods • produces beverages
Heat Treatment	• chemically alters the structure of foods, enhancing digestibility • eliminates or reduces the impact of certain "toxins" or digestibility-reducing substances • enhances the culinary quality of a foodstuff • dehydrates foods for storage

chemical changes which alter the form of the nutrients. Although certain forms of processing may lead to a loss of nutrients, Stahl (1989:183-184) argues that generally, processing results in substantial gains in nutritive value and cites the following examples in support of her position :

- Reduction of particle size can enhance digestibility and improve the effectiveness of subsequent detoxification.
- Removal of fibre enhances the availability of digestible carbohydrates, amino acids, and minerals.
- Fermentation can enhance digestibility, allow greater access to nutrients (e.g. amino acids), and add to the vitamin content of foods, in addition to allowing storage.
- Heat treatment makes the digestible carbohydrates more available and can contribute to detoxification.
- Detoxification, which may involve one or a number of processing techniques, enhances nutrient availability and may allow ingestion of greater quantities of a given foodstuff.

Methods of plant food processing, through physical and/or chemical alterations, serve to improve the digestibility of plant foods, thereby increasing their nutritive value. In essence, processing activities give human digestive systems a head start, allowing more energy and nutrients to be obtained from any given quantity of food.

2.4.3 The Need for Carbohydrates

Energy is the most essential nutritional need and digestible carbohydrates that can be converted into glucose or other simple sugars are important sources of energy (Johns 1990). The necessity of carbohydrates in the diets of hunter-gatherer has long been recognized. Flannery (1986b), for example, has suggested that in regions of the world with sufficient supplies of protein, carbohydrates should be the first resources emphasized in food production systems. Similarly, Speth and Spielmann (1983), in their analysis of energy source, protein metabolism and hunter-gatherer subsistence strategies, suggest hunter-gatherers in temperate regions with "sharply seasonal environments" should adopt food-getting strategies which concentrate on building supplies of storable carbohydrates during fall.

In their study, Speth and Spielmann (1983) point out that hunter-gatherer populations in temperate regions experience recurrent periods of moderate to severe food stress, usually in late winter and early spring. These periods are characterized by a reliance on protein as the primary source of calories but, as they note, "such reliance could lead to marginal or inadequate energy intake and other nutritional deficiencies in the diet" (Speth and Spielmann1983:2). The authors observe that historic and proto-historic peoples of the Southern High Plains of North America avoided the consumption of *lean* bison meat in late winter and early spring, despite the fact this was often a time of starvation. Ethnographic evidence suggests the practice of avoiding lean game was not unique to the Plains, but widespread amongst hunter-gatherers in temperate regions. To understand this behaviour, Speth and Spielmann investigated human physiological responses to the consumption of large quantities of lean meat, as would be experienced during winter hunting.

Late winter and early spring represented a period of resource stress for many groups; fresh plants were not yet available, and small mammals, fish and stored plant foods may have been scare or unavailable. Consequently, many hunter-gatherers were frequently forced to rely on large ungulates for the major portion of their diet. However, ungulate populations also experience nutritional stress at this time of the year. The trials and tribulations of the rutting season means male ungulates often enter winter in less than optimal condition, having lost up to 10 to 15% of their body weight. Females, in contrast, enter the winter in better condition, but by late spring, if they are pregnant or lactating, may be in worse condition than the males. The point is, male and female ungulates are at their poorest condition in spring, and both may have become severely fat depleted (Speth and Spielmann 1983). Therefore, hunter-gatherers who rely on ungulates to see them through this period of resource scarcity subsist on a diet consisting largely of protein and whatever fat remains in the meat. Typically, this results in the consumption of large quantities of lean meat.

The consequences of subsisting entirely on a diet of lean meat are well documented in the ethnographic literature (Speth and Spielmann 1983:3-5). In the arctic and subarctic, for example, the term "rabbit starvation" acknowledges the fact that a person can starve to death eating rabbits, which are extremely lean (Stefansson 1944). Why should this be so?

The problem stems from the specific dynamic action (SDA) of protein ingestion coupled with periods of malnutrition (Speth and Spielmann 1983). The SDA refers to the rise in metabolism or heat production which results from ingesting food. The SDA of diet consisting largely of protein is quite high (up to 30%) in comparison with one composed largely of fat (6 to 14%) or carbohydrates (6%). In other words, "for every 100 calories of protein ingested, up to 30 calories are needed to compensate for the increase in metabolism" (Speth and Spielmann 1983:6). If those extra calories can be obtained from other sources, such as fats or carbohydrates, there is no problem.

However, if fat or carbohydrates are not available in the diet, difficulties arise. The body starts degrading ingested protein for energy, converting the amino acids and non-nitrogenous residues to glucose or fat to meet the body's energy needs (Speth and Spielmann 1983:13). The consumed protein, therefore, is not available for its intended functions and the body's protein supply is not replenished. If the problem becomes severe enough, skeletal muscle is degraded and eventually the individual wastes away.

Both fat and carbohydrates exhibit a protein-sparing effect, that is, when consumed they provide energy for metabolism, thus averting the loss of body protein. Speth and Spielmann (1983:20) assess the effectiveness of fats versus carbohydrates in situations of winter starvation and conclude:

> In light of the greater protein-sparing capacity of carbohydrates compared to fat, and the higher essential fatty acid content of many plant foods, hunter-gatherers, when possible, may place equal or greater emphasis on building up storable carbohydrate reserves during the fall than on hunting, particularly in areas where adequate supplies of fat cannot be reliably produced. Thus, we propose that higher quantities of carbohydrate will be included in hunter-gatherer diets than would be expected given the relative availability of carbohydrate and protein in these environments.

Speth and Spielmann end their discussion with several observations relevant to this dissertation. First, they posit that the "limited" or "desultory" cultivation of wild plants by hunter-gatherers represents a buffering strategy designed to provide stores of carbohydrates for those seasons in which lean meat is the major source of subsistence.

This argument, they propose, could be extended to situations of climatic or environmental change where there is an overall reduction in the available energy. During such times, conditions might favour a shift in subsistence strategies towards a greater emphasis on carbohydrate resources. Speth and Spielmann (1983:21) suggest that the "apparent increase in reliance on plant foods in many parts of the world following the end of the Pleistocene might profitably be explored from this perspective."

Finally, Speth and Spielmann contend that long-term increases in the availability of carbohydrates, due perhaps to the cultivation of wild plant species and the development of agriculture, may change the ways in which hunter-gatherers hunt. In particular, it may alter the importance of animal fat to traditional diets and lead to changes in the animal species hunted, the portions butchered and processed, the importance of marrow production and grease rendering, and the timing of the hunt.

2.4.4 Creating Carbohydrates

Carbohydrates are important sources of seasonal food energy in the diets of hunter-gatherers in temperate regions. Roots, as the energy storage organs for plant metabolism in many species, offer "nutritient rewards in the form of dense carbohydrates" (Johns 1990:242). A wide variety of root foods (including taproots and other true roots, rhizomes, bulbs, corms and tubers) were, and are, important contributors to the diets of Indigenous peoples throughout the world.

However, the carbohydrates stored in roots are not always in forms readily digestible -- or palatable -- to humans. The digestibility of a carbohydrate is related to its polymer size and structure (Wandsnider 1997). The carbohydrates found in roots -- known as reserve or storage polysaccharides ("many sugars") -- occur either as starch, a glucose polymer, or fructan, a polymer of fructose and a single glucose residue. In other words, both starch and fructan are complex, or large, carbohydrates which resist digestion in the small intestine. Therefore, they must be converted into their simpler constituent units before digestion can occur.

This is particularly true of roots containing inulin. Inulin is a tasteless carbohydrate consisting of a single glucose unit with fructose chains of varying lengths attached. Molecules with 15 or fewer fructose units are referred to as fructooligosaccharides (FOS). Inulin and FOS of all lengths are indigestible in the upper intestinal tract (Roberfroid 1993; van Loo et al. 1995). Therefore, roots containing inulin must be processed, or chemically altered, to break the inulin into its constituent fructose units and create sweet-tasting, highly digestible carbohydrates.

In a study published as *The Nutritive Value of Cooked Camas as Consumed by Flathead Indians,* Konlande and Robson (1972) were able to hydrolyse the inulin in camas to fructose through incubation in a solution of hydrochloric acid as well as by boiling in distilled water. On the basis of these laboratory experiments, Konlande and Robson suggest traditional pitcooking practices might "result in extensive breakdown of inulin to fructose" through steaming, as well as through volatile organic acids released from the plant materials added to earth ovens.

Heat treatment generally, and pitcooking specifically, is one method of plant processing commonly used to chemically alter the structure of root foods and increase digestibility (Johns 1990; Stahl 1989). The use of earth ovens to pitcook food is widespread and appears to be a processing technology of considerable antiquity. The construction and use of earth ovens is reported in Australia (Gott 1983, 1984; Lourandos 1985), Polynesia (Gill 1880 in Wandsnider 1997), Mexico (Flannery 1986b; Parsons and Parson 1990) and throughout much of North America, including the Great Basin (Fowler et al. 1998), the Southwest (Fish et al. 1986; Fish 1997), the

Pacific Northwest (Norton 1979; Turner 1995; Turner et al. 1983), the Columbia and Canadian Plateau (Dawson 1891; Teit 1900, 1909; Ray 1932; Turner 1997; Turner et al. 1981, 1990; Thoms 1989; Peacock 1996, 1998, this study), and the Northwestern Plains (Peacock 1992). Readers are referred to Wandsnider's (1997) review and synthesis of ethnographic accounts of pitcooking, as well as Thoms' (1989) discussion of pitcooking practices in the northern temperate regions of the world for further details.

The specifics of pitcooking vary between cultures, but the construction and use of earth ovens generally include several essential components. The first is the construction of a basin-shaped pit, which is enlarged in plan, not in depth, according to the kind and quantity of food to be processed. The second critical component is a rock heating element which lines the bottom of the cooking pit and is used to store and release heat. These rocks are heated by a fire, usually built inside the pit, although rocks can be heated outside and then moved into the pit. Wandsnider's (1997) analysis of 110 ethnographic examples revealed the presence of rock elements in 80% of cases where plant processing was conducted. Vegetation, which serves as protective matting and flavouring, is added to the earth oven, and roots and other foods to be cooked are layered in these materials. Water is frequently added. When the pit is filled, it is capped with dirt. Often, a fire is built on top of the earth oven and maintained throughout the cooking period. The length of cooking varies from several hours to several days, depending on the foodstuff being prepared.

Research indicates the length of cooking required for various root foods is related to the chemistry of their carbohydrates (that is, polymer size and structure). Starch, for example, undergoes hydrolysis within several hours at moderate temperatures. Fructans such as inulin, however, require prolonged cooking -- up to 48 hours or more -- at high temperatures in order to hydrolyse the inulin (Konlande and Robson 1972). The relationship between time, temperature and plant chemistry is depicted schematically in Figure 2.6.

It is important to note at this juncture that starch can be hydrolysed through several processes, including boiling and steaming, and does not necessarily require processing in earth ovens. In contrast, pitcooking, with its unique combination of time, heat, moisture and plant matting materials, appears to be essential to conversion of inulin-rich roots. This possibility was first raised by Turner and Kuhnlein (1983:214) who suggest "it would be fair to state that without cooking -- and probably without pit-cooking -- camas could not have attained the importance it did in native diets." Subsequent investigations support this insight (Loewen and Mullin 1997; Mullin et al. 1997a, in press; Peacock 1997, this study) but as they are discussed in Chapter 5, will not be considered further here. However, I concur with Wandsnider's (1997:24) assessment, that:

> In sum, pit-hearth processing of plant tissues is predominately associated with the mass processing of inulin-rich plant parts. By harvesting and pit-processing such foods, people were able to take advantage of an intensifiable and storable energy source that thrived in areas with few other intensifiable resources.

A cautionary note is required. It is important to stress that people are not seeking to maximize calories or nutrients *per se.* Rather they are striving to enhance the organoleptic properties -- taste, colour, odour and texture -- of a food resource. As outlined earlier, processing can improve all of these properties and in doing so, increase

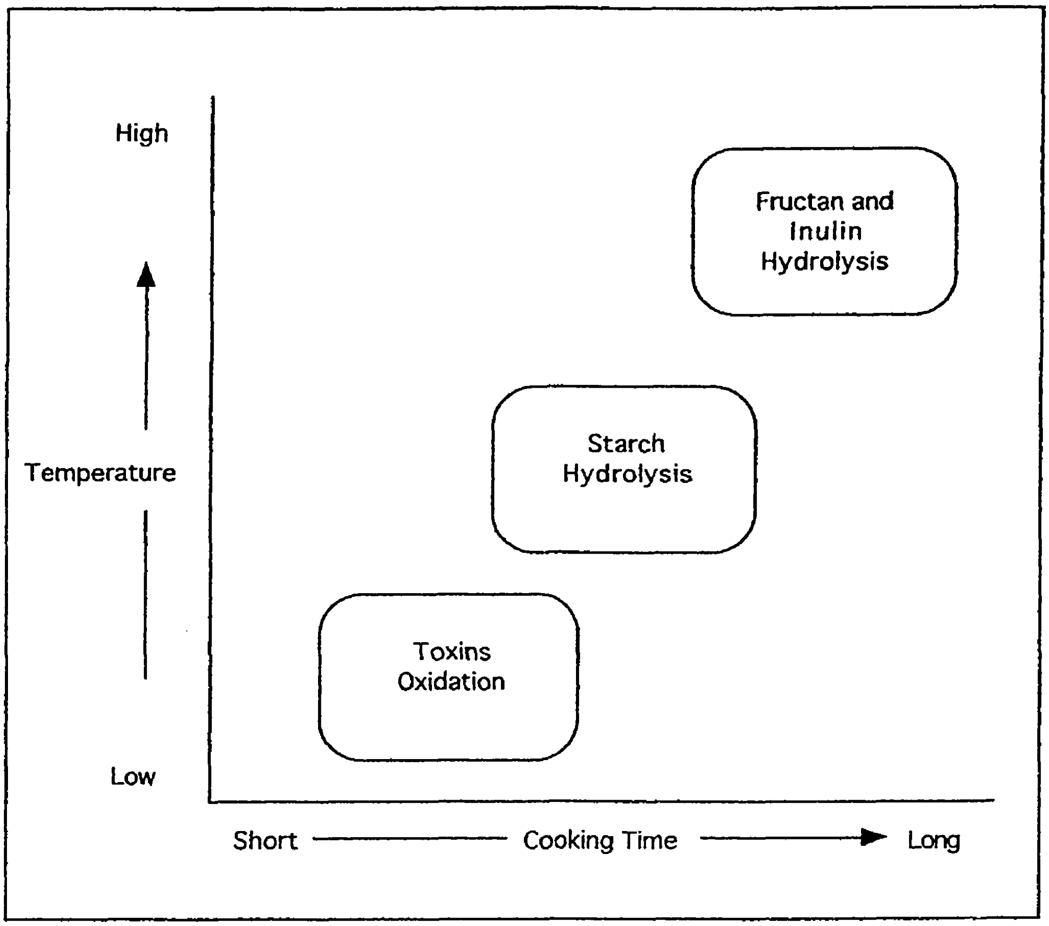

Figure 2.6: The relationship between cooking time, temperature and plant chemistry (adapted from Wandsnider 1997).

the nutritive value of the food. This point is particularly relevant to the processing of inulin-rich foods, which through the conversion of inulin to fructose, become extremely sweet-tasting. Ethnographic descriptions often refer to the pitcooked products as "sugar" or "candy." Johns (1990) argues that humans have an innate craving for sweet-tasting foods because they signal sources of energy, our most basic requirement. Accordingly, I suggest that people, well aware of the differences in taste between "raw" and "cooked" root foods, craved the latter, sweet-tasting version, not necessarily the carbohydrates they provided.

This position challenges statements such as the one made by Wandsnider (1997:18), who states:

> From the understanding of food chemistry and human digestive physiology . . . we expect that certain kinds of food will be boiled, dried, baked or roasted, if people, knowingly or not, are attempting to maximize energy density, minimize disease possibilities and extend food storage life.

In summary, pitcooking is one method of plant processing used to "create" digestible plant carbohydrates. Further, it appears to be an essential technology for the processing of inulin-rich roots into storable, digestible sources of carbohydrate energy. Interestingly, fructans, including inulin, seem to be a preferred storage form for plant species growing in semiarid and temperate regions where growing conditions can change suddenly (Pollack and Chatterton 1988; Hendry 1993; Incoll and Bonnett 1996). These facts have important implications for understandings of the development and use of plant processing technologies by hunter-gatherers in temperate regions of the world where carbohydrates are obtained largely from root resources.

2.4.5 Summary

The evidence presented above suggests plant processing represents an alternative strategy for coping with environmental variability. In particular, it serves to increase the productivity of a food resource (as Stahl [1989] originally noted), by enhancing the palatability and digestibility, making the nutrients and food energy more available to human populations.

I argued that stored carbohydrates represent a particularly critical seasonal food source to hunter-gatherers in temperate regions. In these areas, carbohydrates are obtained largely from root foods, many of which contain inulin, a complex carbohydrate indigestible in its raw form. Pitcooking is one method of plant processing used to "create" digestible carbohydrates and appears to be an essential technology for the processing of inulin-rich roots into storable, digestible sources of carbohydrate energy.

In conclusion, Stahl (1989:185) urges us to consider plant processing as a "dynamic factor contributing to the nutritive value of a given food" and suggests "the application of elaborate food processing technologies to a wide range of wild species by both hunter-gatherers and plant cultivators may well represent intensification of subsistence efforts that took other than agrarian directions." This perspective, I suggest, has much to contribute to our understandings of the emergence of systems of wild plant food production.

2.5 WILD PLANT FOOD STORAGE

2.5.1 Introduction

To this point, I have presented evidence to support my assertion that plant management and plant food processing activities should be considered components of systems of wild plant food production. Both represent a range of activities undertaken by hunter-gatherers to increase the availability and productivity of plant resources. Plant management strategies, as argued, create concentrated patches of food energy on the landscape, while plant processing techniques, which transform the raw to the cooked, are essential in realizing the full potential of that energy.

However, in temperate regions characterized by marked seasonality, the utility of these foodstuffs is limited to a relatively short period of time unless the food energy can be preserved, or set aside, for periods of resource scarcity. Therefore, the subsistence strategies of hunter-gatherers in temperate regions must include the storage of the carbohydrate and other resources if they are to function as effective buffering mechanisms against recurrent food stress. The storage of plant foods, then, represents the third risk reduction strategy associated with wild plant food production.

2.5.2 Food Storage: An Overview

The importance of food storage to hunter-gatherers is widely recognized (Woodburn 1980, 1982; Binford 1980; Testart 1982; Ames 1985; Gould 1985; Price and Brown 1985b,c; Rafferty 1985; Flannery 1986b). Although there is some debate as to the nature of the relationship between food storage, sedentism and social complexity, there is general agreement concerning the conditions favouring storage amongst hunter-gatherers. Testart (1982:523-524) outlines these as follows:

> Where some natural food resources are ***bountiful***, but *seasonal*, they can be gathered en masse while available and stored *on a large scale* once transformed through appropriate food preservation techniques, thus becoming the staple food year-round. This possibility lies at the intersection of four conditions, two ecological (abundance and seasonality of resources) and two technical (efficient food-getting and food-storage techniques). The presence of these four conditions determines an economy in which storage provides the bulk of food during the season of scarcity.

Binford (1968, 1978, 1980) was one of the first to draw attention to the link between the environment and the storage practices of hunter-gatherers. In his discussion of settlement systems and site formation, he identifies two types of hunter-gatherers: foragers and collectors. Foragers "map on" to resources, gathering food each day on an encounter basis. This is accomplished through a series of residential moves. Collectors, in contrast, are "logistically organized," gathering food in a highly planned and patterned manner from a central residential settlement. Task-specific groups are tethered to this home base, venturing out into the territory to obtain the necessary resources. Binford, following Bailey (1960) suggests the type of strategy adopted -- foraging or collecting -- varies with the environment, and more specifically, with the effective temperature (ET) of a region.

Effective temperature is a measure of the length of the growing season and the intensity of solar energy available. These are roughly correlated with latitude, and both influence the productivity of the environment. Areas of the world with a high ET are "food rich," whereas low ET regions are "food poor." By comparing settlement patterns with ET, Binford (1980:14, Table 2) found group mobility was highest in equatorial settings, where productivity is high, and in arctic settings, where the converse is true.

The most sedentary groups resided in temperate and boreal environmental zones. This pattern, he argues, indicates hunter-gatherer mobility represents a response to the spatial and temporal incongruities of resources, rather than to conditions of food "abundance."

In temperate regions, the heterogenous nature of the landscape results in geographically dispersed resources. Therefore, hunter-gatherers face the challenge associated with simultaneously exploiting several resources located in differing, and distant locations. In such instances, Binford argues, a "mapping on" strategy characterized by residential mobility (that is, the movement of the entire group), will be inadequate. Under such conditions, a shift in group mobility towards a more "logistically organized" strategy would be far more effective (Binford 1980).

The problems of coping with abundant but seasonally available resources poses a second subsistence challenge for hunter-gatherers in temperate regions. Binford points out that such temporal incongruities cannot be mitigated by altering patterns of group mobility. Instead, they are dealt with most effectively by extending the "time utility" of resources beyond their period of availability in the habitat (Binford 1980:15). This is achieved through storage.

While acknowledging that storage may not always be feasible, Binford suggests the degree to which storage will be practiced should correspond to reductions in the length of the growing season. However, while storage may reduce problems associated with the seasonal availability of resources, it may increase problems related to their spatial distribution, particularly if hunter-gatherers are storing large quantities in a variety of locations. According to Binford (1980:15):

The degree to which storage is practiced will, in turn, increase the

> likelihood of distributional incongruities and hence condition further increases in logistically-organized settlement systems with attendant reductions in residential mobility, at least seasonally . . . . Given the arguments presented here, we should therefore see a reduction in residential mobility and an increase in storage dependence as the length of the growing season decreases.

In summary, storage strategies adopted by hunter-gatherers represent a way to "make a living" by overcoming the "overwintering problem" of temperate regions. Attempts to deal with such temporal incongruities in resource availability may exacerbate spatial incongruities, prompting a shift to increasingly logistically organized strategies and a decrease in residential mobility. Binford (1980:18) notes, however, that there may be seasonal differentiation in the relative roles of residential versus logistical mobility, stating that in certain environments, "we might see high residential mobility in the summer or during the growing season and reduced mobility during the winter, with accompanying increases in logistical mobility." The point is, these strategies represent organizational alternatives which may be employed at differing times in differing environments rather than opposing principles.

Testart's (1982) discussion of the significance of food storage among hunter-gatherers is similar in some respects to Binford's in its examination of the relationship between storage and sedentism. However, it is more ambitious in its efforts to correlate the presence or absence of storage amongst hunter-gatherers with changes in residence patterns, population densities and social complexity. Testart identifies what he calls "two radically distinct types of economy" practiced by food-gathering societies. One type, found among nomadic groups, involves the immediate use of food resources. This economy is flexible and relies on a variety of procurement strategies. The second type is based on the large-scale storage of food on a seasonal basis. As outlined above, Testart's conditions for food storage include abundant but seasonal resources, as well as the presence of efficient harvesting and processing technologies.

Testart argues that the presence or absence of storage regulates residential mobility, suggesting (1982:524), "storage brings forth sedentarism, and sedentarism presupposes storage. Which historically precedes the other is a chicken-and-egg question." He also contends that *intensive* storage by hunter-gatherers led to increased populations densities and concomitant socio-economic inequalities, trends typically associated with agriculturalists. Testart's willingness to assign the adoption of storage a causal role in culture change has met with criticism (Forbis 1982; Hayden 1982; Ingold 1982). However, his basic point -- that it is the presence or absence of storage, rather than agriculture, which differentiates societies -- has some merit in light of this discussion. Testart (1982:530) notes:

> Storing hunter-gatherer societies exhibit three characteristics -- sedentarism, a high population density, and the development of socio-economic inequalities -- which have been considered typical of agricultural societies and possible only with an agricultural way of life. Furthermore, their economic cycle -- massive harvest and intensive storage of a seasonal resource -- is the same as that of societies based on the cultivation of cereals. The difference between storing hunter-gatherers and agriculturalists lies in whether the staple food species are wild or domesticated.

Both Binford and Testart view storage by hunter-gatherers as an attempt to cope with "bountiful but seasonal" food resources, a strategy, which, in turn, influences residential mobility. It is important to make a distinction between the two types of storage strategies being discussed: storage to accommodate seasonal needs versus storage to accommodate overproduction (Gould 1985). The former is a "practical" strategy

(Ingold 1982) which seeks to store sufficient supplies for overwintering, thereby reducing the risk of resource stress in seasonal environments. This is the storage strategy outlined in Binford's scheme.

The latter is a "social" strategy (Ingold 1982) designed to accumulate a surplus for trade and exchange. As Ingold (1982:532) explains, the social aspect of storage "refers to the convergence of rights to specific resources upon a specific interest and is governed by the perception of the scarcity of those resources conceived as property or wealth." This is the type of storage strategy Testart refers to when he discusses "intensive" storage, that is, the storage and subsequent trade and exchange of surplus foods.

It is also appropriate at this juncture to comment on the use of storage facilities by hunter-gatherers. Binford notes that increased storage typically entails a more logistically-organized settlement pattern characterized by decreased residential mobility, at least seasonally. However, a group can be mobile and storing, depending upon the degree to which storage is practiced. Ingold (1982:531) explains:

> Storage may be incompatible with a nomadism which recognizes no fixed points in the landscape, but in many cases hunter-gatherers move around a "circuit" of fixed points, each strategically located for the exploitation of particular resources in season. Often such points are marked by permanent or semipermanent structures, including facilities for storage. Substantial reserves may be left on departure from each point so that there is food to be had on arrival the next time around.

Similarly, Binford (1980) notes that special facilities, such as caches, are frequently constructed by task groups at resource extraction camps to accommodate the surplus for overwintering. Storage facilities, then, can be located either throughout the landscape at productive resource locales or at residential centres and both should be considered components of hunter-gatherer storage strategies.

2.5.3 Summary

The adoption of food storage strategies by hunter-gatherers represent attempts to even out the spatial and temporal discontinuities in energy flow associated with the abundance, diversity and distribution of plant and other resources (Yesner 1994). Storage extends the "time utility" of resources, ensuring their abundance during seasons of resource scarcity and thus is a critical component of systems of wild plant food production. As discussed, the degree to which storage is practiced may influence patterns of residential mobility, at least seasonally. Further, increased storage has been linked to increases in population densities and social complexity (Testart 1982), a contentious point. It is not my intent here to assign storage a causal role in culture change. I agree with Hayden's (1982:531) comments that storage is a "necessary but not sufficient condition for social stratification" and that by itself, it "will not get us very far in the search for the reasons for change in the past, although it may be useful for monitoring those changes."

2.6 A General Model of Wild Plant Food Production

2.6.1 Introduction

The transition from foraging to wild plant food production represents a fundamental change in the nature of people-plant interactions. The nature and timing of this shift varies globally. However, as outlined in this chapter, the beginnings of wild plant food production are characterized by a similar set of processes and share a similar motivation.

In concluding this chapter, I synthesize the evidence presented here to develop a general model of wild plant food production. This framework sets out the conditions favouring wild plant food production, the components of these systems and the ecological and cultural correlates of these activities. As is evident from Figure 2.7, this model builds on the theoretical foundations of Ford (1985) and Harris (1989) and the notion of an ecological and evolutionary continuum of people-plant interactions.

2.6.2 Developing A General Model of Wild Plant Food Production

It has been suggested that much of prehistory is best understood as efforts to cope with the uncertainty of environmental variation. In this context, the beginnings of plant food production represent strategies designed to minimize the risk of recurrent resource stress common in temperate regions with sharply seasonal environments and annual fluctuations in plant productivity.

Early Holocene environments were characterized by increased seasonal and annual climatic variation relative to those of the preceding Pleistocene. This posed several new challenges to hunter-gatherer food getting strategies. First, the marked

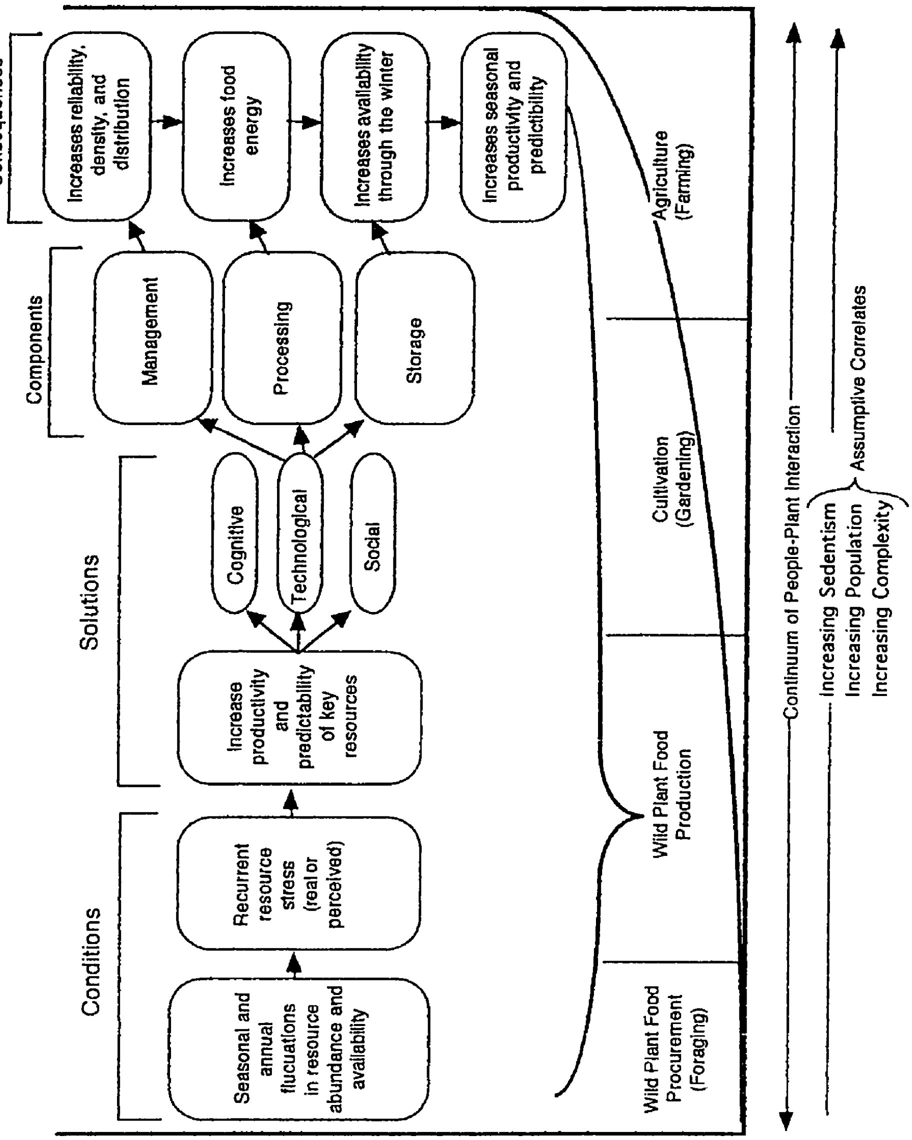

Figure 2.7: A general model of wild plant food production for temperate regions.

periods of plant growth and dormancy meant resources were limited in availability at times throughout the year. Therefore, there was a need to ensure an adequate supply of resources for overwintering. However, annual fluctuations in productivity of those resources often meant that sufficient supplies were not assured from year to year. Consequently, hunter-gatherers were frequently faced with the threat of recurrent resource stress.

The challenge of inadequate or unpredictable food supplies can be met in several ways. If a group's foraging space is large, permitting access to alternative patches of the same species, the population can position itself throughout a territory at productive resource locales. Often, this is not feasible. The productivity of those patches may be insufficient, or the group may lose access to certain areas for a variety of reasons. Faced with such restrictions, alternatives to foraging from resource patch to resource patch become necessary.

Alternatives include both cognitive and social solutions. For example, people may choose to exploit food sources of lower cultural preference, or to diversify the resource base by collecting a broader spectrum of resources. This may be thought of as "extensification." If territories continue to decrease, eliminating less preferred resources, other strategies are required. At this point, groups may adopt social solutions, such as food exchange or shifts in residency patterns.

Technological solutions represent a third set of strategies. These include the "cultivation" or management of key plant resources, the development of plant processing technologies and the storage of food surpluses. Together, these strategies represent systems of wild plant food production which functioned to reduce the risk of seasonal resource scarcity by increasing the productivity and availability of plant food resources. In other words, they represent plant resource "intensification." As Lourandos (1985:389) notes, intensification is a "broad concept and generally refers to increases in both productivity and production." I prefer to make a distinction between these processes, and use intensification here to refer to increased productivity. However, unlike Thoms (1989) who defines intensification as "the trend towards increased expenditure of energy to yield increased food productivity per unit area," I follow Lourandos (1985:389) who points out that increased productivity "may but does not necessarily involve increased labor cost, and the reverse also holds."

Plant management strategies increased the productivity of culturally significant plant resources through the use of a wide range of horticultural methods guided by management activities designed to regulate the timing, intensity and frequency of harvest. These activities were forms of intermediate disturbance which, intentionally or incidentally, revitalized, maintained and enhanced the structure and function of plant populations as well as a wide range of habitats conducive to the growth of key species. This increased the density, diversity and distribution of culturally important plant species and contributed to the overall productivity and predictability of resources across the landscape.

The productivity of plant resources may also be increased through the use of food processing. As discussed, processing techniques enhance the palatability and digestibility of foods through physical changes which alter the size of food particles, or through chemical changes which alter the form of the nutrients. Although certain forms of processing may lead to a loss of nutrients, processing makes the nutrients and food energy more available to humans, resulting in substantial gains in nutritive value for any given quantity of food.

Further, processing of plants is often a necessity for converting indigestible resources into edible food products. This is particularly true for plants containing complex carbohydrates, an important source of food energy for hunter-gatherers in temperate regions. In temperate regions, complex carbohydrates are obtained largely from root foods, many of which contain inulin, which is otherwise indigestible in its raw form. Pitcooking is one method of plant processing used to "create" digestible carbohydrates and appears to be an essential technology for the processing of large quantities of inulin-rich roots into digestible, storable sources of food energy.

Finally, storage plays a key role in ensuring the availability of those managed and processed resources throughout the year, particularly during seasons of resource scarcity. In fact, one might suggest the effectiveness of other strategies in buffering resource stress is extremely limited unless the surplus can be preserved or set aside for winter. Storage, then, is a method of evening out the temporal incongruities associated with the "bountiful" but "seasonal" resources of temperate regions.

Systems of wild plant food production -- the management, processing and storage of wild plant foods -- represent risk reduction strategies designed to reduce the uncertainty of the seasonal and annual variations in resources in temperate regions by increasing the productivity and availability of key resources. If considered in terms of energy flow, the system may be summarized as follows:

> ***Plant food management*** creates a mosaic of productive patches of food energy across the landscape by increasing the productivity, diversity and distribution of culturally significant plant species;

> ***Plant food processing*** increases the value of a given quantity of plant resources by enhancing their palatability and digestibility, increasing the nutritive and energy values;
>
> ***Plant food storage*** evens out the flow of that food energy through time by ensuring the availability of those managed, processed plant resources throughout the year.

The transition to systems of wild plant food production marks the point at which hunter-gatherers are no longer simply “adapting to” the environment, but as well modifying it through a variety of practices to ensure a productive, predictable supply of plant resources for overwintering. There are several ecological and cultural correlates associated with this shift in food-getting strategies.

From an ecological perspective, the emergence of systems of wild plant food production marks the beginnings of an increasingly anthropogenic landscape. Natural ecosystems are transformed in subtle, but significant ways as human populations expend increasing amounts of energy in manipulating the plant resources of their environment. This possibility is represented by the portion under the curve in Figure 2.7.

From a cultural perspective, several demographic and socio-economic trends are associated with systems of plant food production. Following Harris (1989), I include the trend towards increasing sedentism (settlement size, density, and duration of occupation), increasing population density (local, regional, and continental) and increasing social complexity (ranking -- stratification -- state formation) as “assumptive correlates” in my general model noting that such processes of intensification are widely observed as one progresses along the continuum of people-plant interactions from foraging to farming. I treat these correlates as “variables” rather than “states” (*i.e.*, degrees rather than categories) and acknowledge that the definition and measurement of several of these variables, notably sedentariness and social complexity, is extremely problematic in hunter-gatherer studies, an issue I examine in Chapter 8.

2.6.3 Merits of the Model

One of the central tenets of this dissertation is that the Indigenous peoples of the Canadian Plateau were not merely plant food foragers, but plant food producers, who managed, processed and stored a wide variety of wild plant resources in effort to cope with seasonal and annual variation. To support my assertion, I have situated this research within the broader ecological and evolutionary context of people-plant interactions and reviewed models of plant food production, identified key components, conditions and correlates, and developed a general model of wild plant food production to guide investigations on the Canadian Plateau.

This general model has a number of merits. First, by positioning the plant use activities of Indigenous peoples, both past and present, within the broader context of the processes of plant food production, it allows us to view "hunter-gatherers" in a new light. From this perspective, people are no longer passive plant gatherers, adapting to the environment, but active resource managers, modifying the landscape and in essence "domesticating" the environment.

Further, this model positions wild plant food production as a step in the evolutionary-ecological continuum of people-plant interactions which is anchored by foraging at one end and farming at the other. By examining the ecological processes underlying this continuum, we begin to understand that similar dynamics structure both wild plant food production and farming activities and that increased productivity results from changes in the nature, scale and intensity of those activities. The point is, steps along the continuum represent an elaboration of existing strategies of plant manipulation; they are changes in degree, not in kind.

More important, perhaps, the ecological-evolutionary framework presented here elucidates the symbiotic nature of people-plant interactions. Anthropogenic disturbance, if carefully managed to mimic "natural" intermediate disturbance regimes, increases the density, diversity and distribution of important plant species. Careful, considerate use of plant resources *can* ensure continued abundance. In other words, the more one gathers, the more one gets.

Another important aspect of this model is that one need not evoke major environmental crisis or severe resource stress in order to effect change. Rather, it is the stochastic nature of environmental variation in temperate regions, coupled with people's perceptions of resource vulnerability, which serve as the catalysts of change. The management, processing and storage of plant resources, and carbohydrates in particular, are seen then as short-term solutions to provisioning problems which can, and did, have long-term implications, both ecologically and culturally. This line of reasoning distances this model from the realm of functionalist or adaptationist approaches to food production -- the "let's invent agriculture" school of thought. Hunter-gatherers did not "invent" wild plant food production any more than farmers "invented" agriculture.

The model also makes a useful distinction between "productivity" and "production." Gould (1985:430-431), in expressing his concerns with models of resource of intensification, raises this issue, stating:

> One thing still troubles me about the discussions on intensification, and my concern applies equally to intensification among hunter-gatherers and farmers. It has to do with the assumption that increased efforts at improving facilities, techniques, crops, and the like have anything directly to do with increased production, especially of food. There are situations in which hunter-gatherers and farmers apply increased inputs of labour in order to ensure sufficient amounts of key "crops" to make it through stressful periods. In the long run, we would expect such intensive behaviour to produce greater amounts of food . . . But what we are really seeing is risk-minimizing behaviour in which the concern is for more immediate results that will safeguard the wild or cultivated crops that already exist. . . . I have always found it hard to imagine a hunter-gatherer or farmer in a stressful environment making these extra efforts for the sake of some long-term goal like increased food production, which I tend to see instead as perhaps the unintended consequence of shorter-term and more compelling needs to safeguard the essential minimum crop.

Finally, the general model presented here has merit in that it adopts an interdisciplinary approach to issues of hunter-gatherer plant use, drawing upon data from such diverse disciplines as ethnobotany, archaeology, plant ecology and nutritional anthropology. The data presented are both synchronic and diachronic, reflecting the ecological and evolutionary nature of the research. As Minnis (1985) points out, synchronic data, such as ethnobotanical, ethnographic and ecological evidence -- are well-suited to studying the interrelationships of components because they assist us in observing processes. Diachronic data, such as archaeological evidence, on the other hand, are necessary to understand changes in the systems through time.

Thus, the general model of wild plant food production is well-suited as a framework for the investigations of prehistoric root resource use on the Canadian Plateau. I turn now from the general and theoretical to the specific ethnographic and archaeological case studies. The general model developed here serves as the framework for the presentation of the ethnographic evidence for systems of wild plant food production -- including plant management, processing and storage -- by the Secwepemc peoples of the Canadian Plateau.

CHAPTER 3: THE LAND AND THE PEOPLE OF THE CANADIAN PLATEAU

3.1 Introduction

As outlined in Chapter 1, the main thesis of this study is that the Indigenous Peoples of the Canadian Plateau were not merely plant food foragers but wild plant food producers, who managed, processed and stored a wide variety of wild plant resources in response to uncertainties of seasonal and annual environmental variation. Root resources were central to these systems, providing a source of storable carbohydrate energy for overwintering. Further, the origins of these systems of wild plant food production are rooted in the Late Prehistoric period (4500 to 200 BP) and their development may be traced through archaeological remains of earth ovens throughout the Plateau.

In Chapter 2, I established the theoretical framework for this research and developed a general model of wild plant food production. In this section, I move from the general and theoretical to the ethnographic evidence necessary to support my position and to generate a model specific to the Canadian Plateau. I begin this chapter with a brief description of the Canadian Plateau and the Secwepemc peoples who live there. I examine the nature of the Plateau environments and the ways in which the Secwepemc shaped their subsistence and settlement strategies to take advantage of diverse, dispersed and seasonally disparate resources.

This chapter draws upon the excellent and extensive ethnographic materials for the Secwepemc and neighbouring Interior Salish Peoples recorded by ethnographer James Teit (1900, 1906, 1909) as well as the observations of George Dawson (1891), Franz Boas (1891, 1908) and Verne Ray (1939, 1942). It is also informed by the more recent studies of Palmer (1975a, 1975b), Turner et al. (1980, 1990, 1992), the Secwepemc Cultural Education Society (n.d.), Ignace (1998), and various contributors to Hayden (1992). Summaries of Plateau culture are also found in a variety of sources, including Ray (1939), Anastasio (1972) and Walker (1998). This chapter is not meant as an exhaustive review of the ethnographic data and makes no attempt to address all aspects of subsistence and settlement strategies. It is intended as a broad overview of Secwepemc lifeways that will set the context for a more detailed examination of wild root food production in Chapter 4.

3.2 The Landscapes of the Canadian Plateau

The Canadian Plateau (also the Northern or Fraser Plateau) is defined by its physiography as well as by the cultural traditions shared by its Indigenous peoples. Geographically, the Plateau extends throughout the intermountain zone of south-central British Columbia and north-central Washington State (Figure 3.1). It is bounded by the Columbia Mountains on the east and by the Coast Range to the west. To the south, it extends to approximately 65 km below the US/Canada border, while the northern extent is marked by a line at 52°30' north latitude (Holland 1964; Pokotylo and Mitchell 1998).

Culturally, the Canadian Plateau is considered part of the Plateau Culture Area as originally defined by Kroeber (1939). The southern interior portion of the Canadian Plateau, the focus of this discussion, is the traditional territory of Interior Salish-speaking peoples, including the Secwepemc and the neighbouring Stl'atl'imx (Lillooet), Nlaka'pamux (Thompson) and Okanagan peoples. These groups shared many cultural traditions, including a diversified gathering-fishing-hunting economy, with

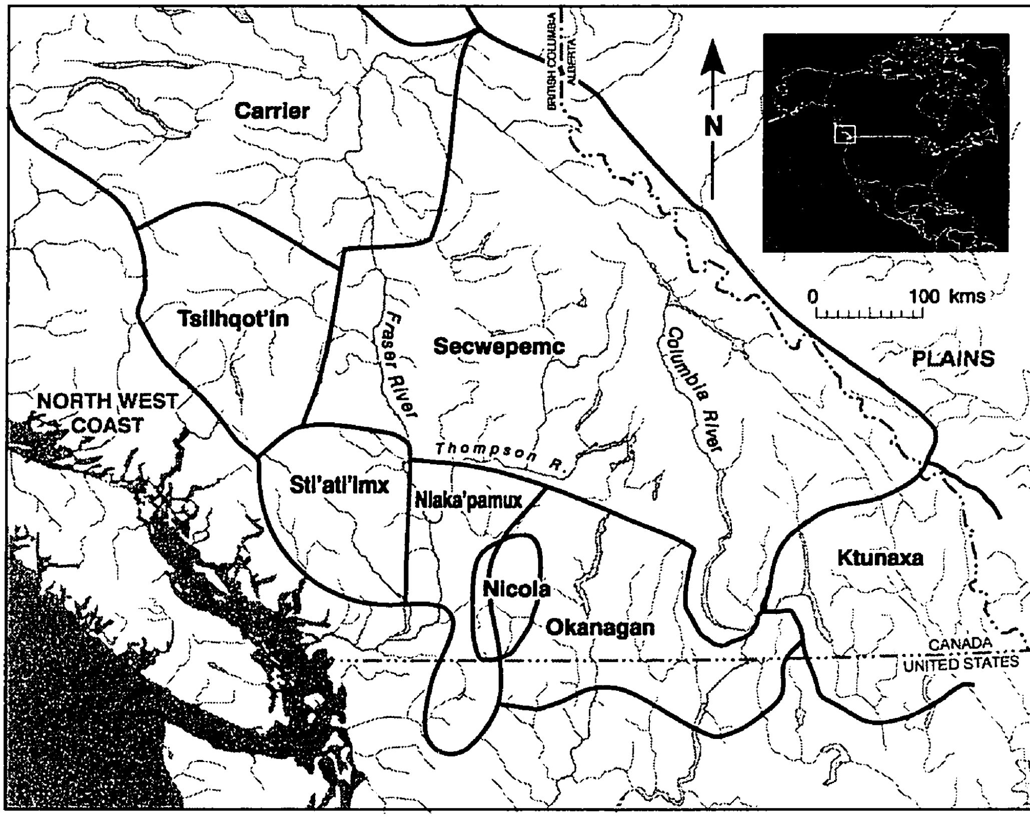

Figure 3.1: The traditional territories of the Secwepemc, other Interior Salish peoples and neighbouring groups as recorded by Teit (1900:450).

many cultural traditions, including a diversified gathering-fishing-hunting economy, with intensive use of wild plant foods.

Secwepemc traditional territory extends over a wide area of the Plateau, encompassing a total of 180,000 sq km (Palmer 1975a) (Figure 3.1). The landscape is characterized by gently rolling uplands, punctuated by highlands and mountains and dissected by the deeply incised river valleys and lakes of the Fraser, Thompson and Columbia River drainages. This juxtaposition of low, mid and high-elevation environments results in a diversity of flora and fauna throughout the region. Nine major biogeoclimatic zones, each with its own characteristic climate, topography and vegetation, occur within Secwepemc traditional territory (Mitchell and Green 1981; Meidinger and Pojar 1991). These are listed in Table 3.1, along with the plant associations representative of each zone.

Paleoecological and paleoclimatic data indicate the vegetation of the Southern Interior of British Columbia has changed little within the last few thousand years. Hebda (1982; 1995) concludes that the vegetation of the Southern Interior has been, with minor variations, relatively constant over the past 4000 to 4500 years. The species composition has remained much the same, although the line between forested areas and shrub-steppe may have fluctuated altitudinally with slight shifts in temperature and precipitation regimes (Turner and Peacock 1995).

Two characteristics of Plateau environments are of particular significance to this discussion. The first is the spatial variation associated with the distribution of the biogeoclimatic zones. As might be expected over such a large territory, there is considerable variation of these zones both latitudinally, as one moves from north to

Table 3.1: Biogeoclimatic zones in traditional Secwepemc territory (adapted from Meidinger and Pojar 1991)

Biogeoclimatic Zone	Abbrev.	Representative (Zonal) Plant Associations
Bunchgrass	BG	Bluebunch wheatgrass - selaginella Bluebunch wheatgrass - junegrass
Ponderosa Pine	PP	Ponderosa pine - bluebunch wheatgrass - fescue Ponderosa pine - red three awn Big sage - bluebunch wheatgrass Douglas-fir - water birch - Douglas maple
Interior Douglas-fir	IDF	Douglas-fir - lodgepole pine - pinegrass - feathermoss; Douglas-fir - snowberry - bluebunch wheatgrass; Douglas-fir - pinegrass - yarrow Hybrid spruce -Douglas-fir - gooseberry - feathermoss
Interior Cedar - Hemlock	ICH	Western hemlock - red cedar - falsebox - feathermoss Douglas-fir - larch - pinegrass - haircap moss Redcedar - western hemlock - oak fern - foamflower Redcedar - western hemlock - Devil's club - lady fern
Montane Spruce	MS	Hybrid spruce - falsebox - feathermoss Lodgepole pine - grouseberry - pinegrass Hybrid spruce - gooseberry - grouseberry Hybrid spruce - horsetail - leafy moss
Sub-Boreal Pine - Spruce	SBPS	Lodgepole pine - juniper - feathermoss Lodgepole pine - kinnikinnick - cladonia White spruce - scrub birch - feathermoss White spruce - horsetail - glow moss
Engelmann Spruce - Subalpine Fir	ESSF	Subalpine fir - oak fern - knight's plume Subalpine fir - huckleberry - feathermess Subalpine fir - devil's club - lady fern Subalpine fir - lady fern - horsetail
Sub-Boreal Spruce	SBS	Hybrid spruce - huckleberry - highbush cranberry Lodgepole pine - huckleberry - cladonia Hybrid spruce - oak fern Hybrid spruce - devil's club
Alpine Tundra	AT	Dwarf willow - small-awned sedge Entire-leaved mountain avens - blackish locoweed Altai fescue - mountain sagewort - cetraria Barratt's willow - sweet coltsfoot

south, and longitudinally as one moves east to west towards the rainshadow of the Coast Ranges. In addition, there is significant altitudinal variation within any given region on the Plateau. A typical progression of plant associations from the river valleys to the mountain peaks begins with Bunchgrass (BG) communities in the dry valley bottoms, followed by shrub-steppe communities on the low-elevation terraces. Ponderosa Pine (PP) forests occur above the benchlands in hotter, drier areas, and Interior Douglas-fir forests (IDF) are situated above these. Increases in altitude result in increasingly forested conditions, including the Montane Spruce (MS) and the Engelmann Spruce - Subalpine Fir (ESSF) zones. In areas with sufficient elevation, the sequence culminates in Alpine Tundra (AT). While the exact combination and arrangement of the biogeoclimatic zones varies slightly from north to south and east to west, the linear or altitudinal pattern of vegetation persists.

Another feature of Plateau environments relevant to this discussion is the marked seasonal climatic variation (Table 3.2). Generally, the southern interior Plateau is characterized by hot, dry summers and cold, relatively moist winters. This results in distinct periods of plant growth and dormancy. The timing and duration of climatic variation, and hence of periods of resource productivity and resource dearth, varies between biogeoclimatic zones. A brief comparison of two zones important to the Secwepemc people illustrates this point.

The Bunchgrass zone, of the lower elevations of the major southern interior valleys, is characterized by warm to hot, dry summers and moderately cold winters with relatively little snowfall. Spring is normally dry and summer precipitation evaporates before it can contribute to recharging soil moisture. Thus, plant growth depends mainly

Table 3.2: Climate characteristics of the biogeoclimatic zones in Secwepemc territory (adapted from Meidinger and Pojar 1991)

Zone	Elevation (m)	Mean annual precip (mm)	Mean summer precip (mm)	Wettest month	Mean annual snowfall (cm)	No. of months with snow	Mean annual temp (°C)	Mean temp coldest month (°C)	Mean temp warmest month (°C)
AT	2347	755.5	287.0	December	551.4	12	-1.8	-11.1	9.5
BG									
Max	588	335.7	174.5		99.6	9	10	-2.7	22.4
Min	297	205.6	98.0	January	50.5	6	5.9	-10.8	18.0
ESSF									
Max	1862	1995.4	424.5		1431.0	12	1.8	-7.9	13.3
Min	863	514.1	204.6	December	246.5	9	1.1	-10.9	11.3
IDF									
Max	1128	1198.9	290.7		283.4	10	9.6	-2.9	21.3
Min	122	295.1	107.5	June	82.0	7	1.6	-10.1	13.2
ICH									
Max	1085	1419.0	439.3		733.6	9	8.9	-2.9	20.8
Min	314	497.7	199.9	January	122.3	7	4.1	-10.1	16.3
MS									
Max	1554	663.8	252.1			11	4.7	-7.8	17.4
Min	1128	380.8	158.2	December	397.8	9	1.7	-12.5	13.2
PP									
Max	939	604.5	270.3		80.8	9	9.6	-2.7	21.6
Min	244	319.5	86.3	December	96.9	6	4.8	-8.6	17.2
SBPS									
Max	1219	517.8	299.8		19.2	10	2.5	-12.3	14.3
Min	914	464.1	242.6	June	177.5	9	0.4	-13.8	9.2
SBS									
Max	1245	1588.2	352.6		378.9	10	5.0	-7.7	16.9
Min	488	438.9	188.9	August	110.5	8	1.7	-14.6	12.9

on winter moisture and summer droughts are common (Meidinger and Pojar 1991). In comparison, the Interior Douglas-fir (IDF) zone, which occurs at slightly higher elevations, has a continental climate with warm, dry summers and cool winters. Notably, 20% to 50% of the precipitation in the IDF zone falls as snow and the average temperature remains below 0°C for two to five months. Although the IDF is characterized by a fairly long growing season, moisture deficits during the growing season are common and frost can occur at any time (Meidinger and Pojar 1991).

In summary, the landscapes of traditional Secwepemc territory can be categorized as a "heterogenous environment with linear zonation" (Palmer 1975a:204). The complex physiography of this portion of the Canadian Plateau supports a wide variety of unique plant associations, creating a diverse, dispersed and seasonally disparate resource base.

3.3 The Secwepemc People

The landscapes of the Canadian Plateau have been home to the Secwepemc peoples for generations. Archaeological evidence indicates the Interior Salish "ethnographic pattern," characterized by a diversified economy of gathering, fishing and hunting, may be traced back approximately 3,000 to 4,000 years in the region (Pokotylo and Mitchell 1998) although the area was initially peopled by at least 10,000 years ago (Fladmark 1982; Rousseau 1993; Stryd and Rousseau 1996). It is only within the last two hundred years that traditional Secwepemc lifeways have been disrupted due to the arrival of European explorers, traders and settlers and the subsequent loss of traditional territories and livelihoods. Fortunately, many of the old ways continue to play an important role in Secwepemc society and people continue to maintain a strong connection to their traditional beliefs and homelands.

At the time of European contact, Secwepemc peoples were seasonally transhumant, wintering in villages along the major river systems of the Plateau, as their ancestors had for thousands of years. Population estimates by Teit (1909) suggest the Secwepemc numbered approximately 7,200 in 1850. However, it is generally believed this figure does not accurately represent pre-contact populations, which may have been as high as 33,000 people (Palmer 1975a). The discrepancy between the low historic figures and the higher proto-historic numbers is attributed to a variety of introduced European diseases, such as smallpox, which first swept through the region well in advance of the first explorers and settlers to the west. Consequently, early population estimates of Plateau populations were, in fact, reflecting Indigenous populations already decimated by disease (*e.g.*, Dobyns 1983; Cronon 1983; Denevan 1992). Given these estimates, Palmer (1975a:226) concludes pre-contact population densities ranged from approximately one person per 26km^2 to one person per 5km^2.

According to Teit (1909), the Secwepemc peoples were divided into seven "well-recognized" divisions, which were further divided into bands of related families. As Teit (1909:457) explains:

> The people of all the divisions are further divided into a number of bands wintering in certain definite localities, with headquarters at a principal village. These bands . . . were not so well marked fifty years ago as now. This was owing to the far greater number of small villages existing at the time. The inhabitants of those situated at equal distances from two central villages or headquarters of different bands sometimes affiliated with one band, sometimes with another. Besides, the small wintering-places were changed frequently, and even the main locality or village of a band would have more families one winter, and less another . . . Yet on

> the whole, each band was composed of a group of families closely related amongst themselves who generally wintered within a definite locality, at or within a few miles of a larger village or centre.

Thus, in Teit's scheme there were four levels of social organization amongst the Secwepemc: division, band, village and camp or family residence, depending upon the time of year or economic circumstances (Dawson 1891; Teit 1909; Palmer 1975a). The seven divisions and associated bands, as recorded by Teit (1909), are presented in Table 3.3.

Secwepemc social organization was flexible and fluid. Kinship, rather than a hierarchical political structure, appears to have been the main integrative principle in Secwepemc society, as it was throughout the Plateau culture area in general (Ray 1939; Anastasio 1972; Palmer 1975a). Palmer, after reviewing the ethnographic evidence for kinship systems amongst the Secwepemc, concludes that the kinship terms recorded by Boas (1891) indicate "a weak patrilineal succession, marked differentiation of male and female roles, the importance of age and experience, and the general lack of class distinctions" (1975a:231).

Teit (1909), however, notes differences in the social and political organization between the Secwepemc bands in the south and east and those to the north and west. According to Teit, the southern bands were organized in much the same manner as the neighbouring Nlaka'pamux peoples. The position of chief was hereditary and descended through the male line. Each Secwepemc band had a chief. According to Teit (1909:570):

> The chiefs had no special privileges, and their only duties were to look after the general welfare of the band, regulating, when necessary, the gathering of the food-supply, so that all could have an equal chance, and

> admonishing the lazy and quarrelsome. They also gave their advice on all important matters, and were the agents of the band in dealing with strangers. The chief was looked upon as a kind of father and leader of the people, and was expected to set a good example, and to act fairly in all matters.

The Secwepemc also had war chiefs, hunting chiefs, and chiefs of dances. These were elected positions, filled by the most highly-qualified men in Secwepemc society. In addition, there were a very few other people called chiefs because of their influence obtained through excellence of oratory, wise counsels, wealth, or generosity. Historically, there were no nobility or privileged classes, clans or societies amongst the southern Secwepemc (Teit 1909).

In contrast, Teit (1909: 575-583) notes that several bands along the Fraser River, in the northwestern portion of Secwepemc territory, were organized into three classes: noblemen, common people, and slaves. The nobles were referred to as "chiefs," "chiefs' offspring" or "chiefs' descendants" and according to Teit (1909:576), "constituted in various bands from nearly one-half to over two-thirds of the whole population." Nobles were also divided into hereditary crest groups.

Teit viewed the adoption of crests by the western Secwepemc as a relatively recent development (*i.e.*, since the early 1800s), although he suggests the practice of dividing people into classes originated earlier than the crest groups. The entire system, he believed, was introduced by the neighbouring Stl'atl'imx, Carrier and Tsilhqot'in (Chilcotin), who were in turn influenced by coastal peoples. He concludes that the organizational system of the southern Secwepemc bands was at one time typical of the entire tribe.

Table 3.3: Divisions and bands of the Secwepemc (from Teit 1909)

Division	Band	Estimated Population ca. 1850
Kamloops	Deadman's Creek	350
	Kamloops	350
Shuswap Lake	South Thompson	400
	Adams Lake	400
	Shuswap Lake	200
	Spallumcheen	300
	Arrow Lake	100
Fraser River	Soda Creek	300
	Buckskin Creek	50
	Williams Lake	350
	Alkali Lake	175
	Dog Creek	200
	Canoe Creek	250
	Empire Valley	100
	Big Bar	
	High Bar	625
	Clinton	
Cañon	Riskie Creek	100
	North Cañon	200
	South Cañon	300
	Chilcotin Mouth	100
Lake	Lac la Hache	100
	Canim Lake	350
	Green Timber	100
North Thompson	Upper North Thompson	250
	Lower North Thompson	500
	Kinbaskets	150
Bonparte	Pavilion	150
	Bonaparte	400
	Main Thompson	150
	Total Population	7200

The Secwepemc subsistence economy reflects the diverse nature of the resource base of the Plateau. A variety of resources, including numerous species of ungulates, mammals, and birds, as well as anadromous and freshwater fish were utilized, although the relative importance of these resources varied throughout Secwepemc territory depending upon local availability (Dawson 1891; Teit 1900, 1909; Palmer 1975a). As Teit (1909:513) observes:

> The Shuswap may be classed as a hunting and fishing tribe; the former occupation, on the whole, predominating . . . Salmon was of greatest importance to the Fraser River and Cañon people, trout and small fish to the Lake people, and game to the rest of the tribe. Fishing, however, was of great importance to every band. In comparison with the Thompson tribe, the people as a whole depended less on salmon, and more on small fish and game.

Although much is made of the importance of salmon and ungulates in current discussions of traditional economies (Driver 1993; Hayden 1992; Stryd and Rousseau 1996), ethnographic and ethnobotanical evidence reveals plants were important contributors to all aspects of subsistence economies of Interior Salish peoples generally, and the Secwepemc people specifically (Dawson 1891; Teit 1900, 1909; Steedman 1930; Palmer 1975; Turner et al. 1980; Kuhnlein and Turner 1991; Turner et al. 1990; Turner and Peacock 1995; Secwepemc Cultural Education Society (SCES) n.d.). Dawson (1891) identifies over 35 plant species valued for a wide variety of purposes. Teit (1909:514) notes that "roots and berries formed an important part of the food-supply, and the latter were gathered in great quantities." He goes on to identify over 25 different plant species important to traditional economies. Today, it is recognized that the Secwepemc and other Interior Salish peoples traditionally made use of between 200 to 300 plant species for foods, medicines, materials and spiritual purposes (Turner et al.

1990; Ignace 1998).

Plant resources were particularly important to the diet of the Secwepemc peoples. Over 75 species were consumed as greens, root vegetables, fruits, nuts and seeds, beverages, famine foods and flavourings (Turner and Peacock 1995; SCES n.d.). These contributed valuable vitamins, minerals and dietary fibre (Kuhnlein and Turner 1991) and may have accounted for up to 70% of peoples' food energy needs as has been estimated for groups on the Columbia Plateau (Hunn 1981; Hunn et al. 1998). Plant foods, then, were integral components of Secwepemc subsistence economies and their collection, processing and storage formed a significant portion of the planned and patterned seasonal movements of Secwepemc peoples.

Secwepemc seasonal rounds were tethered to the winter village sites which served as focal points of Secwepemc lifeways. As the heterogenous environment of the Plateau created "patches" of resources which were both spatially and temporally distributed, the Secwepemc people moved from their winter residences to camps in riverine, lacustrine, upland and montane ecosystems at various times throughout the year to gather plants, to hunt and to fish. As Palmer (1975a:213) explains, "the zoned pattern of resources in the Fraser Plateau allowed a typical riverine community to exploit almost any type of habitat occurring in the Plateau within the distance of a few miles," a situation which favoured economic diversification. Thus, the factors that concentrated settlement in the major river valleys during the winter -- water, shelter and firewood (Dawson 1891) -- also permitted age and sex-specific task groups access to critical resources throughout the remainder of year.

The degree of group mobility was influenced to a certain extent by the abundance and availability of resources. As noted, the vertical zonation of resources throughout Secwepemc territory meant ready access to most resources from central locations along river valleys. However, as Teit (1909) remarks, the Fraser River and Cañon divisions, who controlled the productive Fraser River salmon runs, were practically sedentary whereas the North Thompson peoples, who relied on hunting, were the most nomadic. "The great bulk of the tribe, however, were semi-sedentary, but many families did not winter habitually in the same place" (Teit 1909:570).

The same places for resource harvesting were visited year after year, in a more-or-less predictable seasonal round. Some places were frequented for long periods of time -- several weeks or more -- and might be occupied several times during a single year if there were a variety of resources to be obtained at different seasons. Amongst the southern Secwepemc, land was considered "tribal" property, accessible to all Secwepemc peoples. However, each band had its own common, recognized hunting, fishing, berrying and root-digging grounds (Dawson 1891; Teit 1909). Although members of other bands were permitted to use these areas without restriction, it does appear that access to the different resources was controlled to varying degrees depending upon the circumstance. For example, berry patches were tribal property, but harvesting was regulated by the chief of the band in whose district the productive spots were situated (Teit 1909:572-573).

In the northwestern portion of Secwepemc territory, productive resource locales were owned and controlled by the nobility. According to Teit (1909:582):

> The hunting-territory, root-digging grounds, berrying-resorts, and camping-places in the mountains of each band belonged to the nobility of the band in common, but the trapping-grounds and fishing-places were

divided among the crest groups of the nobility of each band.

Chiefs or crest group members collected rents for the privilege of fishing and trapping on their grounds, and fined those caught there without permission. Teit (1909:583) notes that the more remote hunting, root-digging and berrying places were considered tribal property, probably as the nobles could not enforce their claims.

The subsistence and settlement pattern of the Secwepemc shows evidence of considerable antiquity, existing in the Plateau region for thousands of years. It is also reflected linguistically in the vocabulary of the Plateau peoples and in particular, in the Secwepemc "calendar" (Table 3.4). According to Teit (1909), the Secwepemc recognized five seasons and thirteen moons, beginning in November when people entered their winter pithouses. The Secwepemc year paralleled that of the neighbouring Nlaka'pamux peoples, which Teit (1900:239) describes as follows:

> The moons are grouped in five seasons: winter, beginning with the first snow that stays on the ground, and lasting until its disappearance from the valleys, generally the second, third and fourth months; spring, beginning with the disappearance of the snow, and embracing the period of frequent Chinook months, the fifth and sixth months; summer, the seventh, eighth and ninth months; early autumn, embracing the tenth and eleventh months; and late fall, which takes up the rest of the year. This indefinite period of unnamed months enabled the Indians to bring the lunar and solar years into harmony.

Clues to the timing and importance of the seasonal round and the resource harvesting activities of the Secwepemc may be gleaned from the names of the various "months." May, for example, is known as "digging roots month," a time when the Secwepemc collected root "vegetables" such as the spring beauty or "Indian potatoes" and balsamroot in upland valleys. July, or "getting ripe month," is when the

Table 3.4: The Secwepemc Calendar (adapted from Secwepemc Cultural Education Society, Language Department, 1992)

Moon	Secwepemc Name	Activities
1 (November)	***Pellts7elltsw 7úlltswten'*** "entering month"	People enter winter homes
2 (December)	***Pelltetéq'em*** "crosses over month"	Moon "crosses over"and days become longer
3 (January)	***Pellkwet'mín*** "remain at home month"	People remain in winter homes
4 (February)	***Palltsípwan'tan*** "cache-pit time"	People consume foods stored in cache-pits
5 (March)	***Pellsqépts*** "spring wind"	Snow melts in the valley; fishing for steelhead in the rivers begins
6 (April)	***Pesllééw'ten'*** "melting of snow"	The snow melts, even on the mountains; deer hunted high up in the mountains
7 (May)	***Pell7é7llqe7ten*** "digging roots month"	Indian potato and balsamroot collected; trout fishing in lakes
8 (June)	***Pelltspántsk*** "mid-summer month"	People picked soapberrries, speared fish in rivers and set weirs for spring salmon in creeks
9 (July)	***Pelka'kaldemex*** (Teit 1909:518) "getting ripe month"	People picked ripe saskatoon berries, strawberries, blueberries and huckleberries
10 (August)	***Pellt'écel'tsten*** "salmon run up stream"	Fishing season begins
11 (September)	***Pesqelqlélten*** "many salmon month"	People fish, dry and store salmon
12 (October)	***Pesllwélsten*** "deer travel month"	People hunt, dry meat and prepare winter homes and cache pits

Secwepemc gathered a variety of ripening berries, including saskatoons (*Amelanchier alnifolia*), strawberries (*Fragaria* spp.), huckleberries and blueberries (*Vaccinium* spp.). August marks the beginning of the fishing season and the congregation of peoples along the major rivers of the Plateau. Accordingly, it is referred to as the "salmon run up stream" month. In the fall, people hunted deer and other wild animals, activities reflected in the name for October "deer travel month."

Secwepemc subsistence and settlement strategies were thus designed to deal with the diverse, dispersed nature of Plateau resources, as well as with seasons of resource abundance and relative resource scarcity. During times of abundance -- late spring, summer and early fall -- the Secwepemc people were highly mobile, collecting, processing and storing resources for winter. During periods of resource scarcity -- late fall, winter, and early spring, the Secwepemc peoples lived off stores of roots, berries and salmon supplemented by fishing in upland lakes and by hunting of game wintering in lower elevations along river valleys and upland areas (Dawson 1891; Teit 1900, 1909).

Surpluses for overwintering were stored in caches which included several types of scaffolds as well as the more common "Indian" or circular cellar (Teit 1900, 1909). These storage facilities were located in, or adjacent to, residences at winter villages and near productive resource locales (Dawson 1891; Teit 1906). Teit (1900:198-199) describes the circular cache:

> This is used solely for the storing of berries, fish, etc. A circular hole about four feet in depth, and of the necessary diameter, is dug. In it are carefully laid the articles to be stored. If these are berries or roots, they are placed in baskets, and wrapped over with birch bark. The roof is then put on. It consists of small poles laid closely side by side across the excavation. Above these are laid in the same manner, but at right angles, another row of poles. The structure is then covered with pine-needles and

> earth. An opening is left in the centre of the poles for removing stored articles. This is generally closed by putting sticks or bark across it, and covering them with earth.

Teit (1906:223) also discusses the use of cache pits by the Stl'atl'imx people, making a distinction between two different types of cellars:

> The Upper Lillooet stored food in two kinds of cellars. One kind (called *powa'wan*) was made very carefully and lined with bark. The roots, berries and other foods stored therein were done up in bundles and wrapped in birchbark. All the surplus food required during the winter was placed in it, and not disturbed until spring. The other cellars (named *spo'zeks*) were situated near the house, and made with less care. From them provisions were taken as required during the winter. Food stored in the permanent cellars and kept over until spring was called *ka'za*.

Interestingly, the Secwepemc name for February is "cache food month" and it is possible they too had permanent storage cellars, located away from the winter dwellings, in which stored food was set aside for late winter and early spring. This period is often the hunger season for hunter-gatherers in temperate regions, a time when stored food may have become low or exhausted, game was poor and hard to catch, and plants were not yet ready to harvest.

The Secwepemc were well acquainted with the threat of recurrent resource stress. Famine foods, such as freshwater clams and other shellfish (Teit 1909) and a variety of plant foods, including black tree lichen *(Bryoria fremontii)* or kinnikinnick berries *(Arctostaphylos uva-ursi)* (Turner and Davis 1993) are recorded. Famine also figures prominently in the oral traditions of the Secwepemc peoples. Teit (1909:700-701), for example, records the story of Famine, a "man with a lean body, hollow cheeks, sunken orbits, protruding eyes, projecting jaws and teeth, and long finger-nails." According to the legend, Famine lived on the top of a high mountain and was fond of killing men from a nearby village as they came to hunt deer at a favoured spot on the mountain. Eventually, there were no males left in the village, except an old man, Owl, and his young grandson, Têkiê´tcen. When the boy reached puberty, his grandfather insisted he train and sleep on the mountain to become wise and strong in magic power in order to avenge the death of his relatives. In time, Têkiê´tcen gained his power and used it to destroy Famine, proclaiming:

> Famine, henceforth you shall be no more a being of mysterious power, and you shall never be able to kill people as long as they have food to eat. Occasionally you may hurt them when their food is all gone; but as soon as they get more food and eat, you will have to leave (Teit 1909:701).

The figure of Famine was also represented by one of the numerous winter dance societies of the Secwepemc. This society had a unique song as well as a dance in which Hunger or Famine is portrayed by an actor, who, according to Teit (1909:578):

> . . . appeared almost naked, and painted like a skeleton to represent the famine. White strips ran down the legs, arms, and backbone, across the shoulders, and along the ribs. These marks represented bones. He had his face painted with circles around the eyes, and with dots or marks on the brow, cheeks, and chin. He had white paint or down on his head, and a long white streak across his mouth. Sometimes he wore a mask with hollow cheeks, protruding eyes, and projecting jaws and teeth. He personified hunger, which is one of the figures of Shuswap mythology.

In summary, faced with the marked seasonality of resources, as well as the differences in the spatial and temporal availability of those resources within the yearly cycle, the Secwepemc people developed subsistence and settlement strategies to cope with cycles of abundance and scarcity. This included exploiting diverse, dispersed resources through a planned and patterned seasonal round of hunting, fishing and plant gathering. Further, as Palmer (1975a:200) notes,

> Shuswap social organization was structured in response to the economic and political problems posed by dispersal and intermittent scarcity of food resources. They developed minimal interest in formal concepts of ownership of resources. They had instead an economic system based on the movement of small task groups to places of temporary resource concentration; they provided for alternative residential affiliations to accommodate the dispersal and variability of resources; and they traded between areas of plenty and areas of scarcity.

3.4 Summary

The Canadian Plateau is a land of contrasts. The complex physiography results in a heterogeneous environment which supports a wide variety of ecosystems, creating a diverse, dispersed and seasonally disparate subsistence base.

The nature of this resource base is reflected in Secwepemc subsistence and settlement patterns. Faced with the marked seasonality of resources, as well as the differences in their spatial and temporal availability within the yearly cycle, the Secwepemc people developed a series of strategies to cope with the uncertainty of Plateau environments. These strategies included a diverse economy based on plant gathering, fishing and hunting and a planned and patterned seasonal round focused on collecting productive resources when abundant, available and culturally desired, and processing and storage of these items for overwintering. Plant resources, although commonly undervalued in current discussions of Plateau subsistence strategies, were important contributors to traditional diets and figured prominently in the scheduling of task groups, as reflected in the Secwepemc calendar.

Late winter and early spring represented a period of potential resource stress for the Secwepemc peoples, a fact acknowledged in their oral traditions and in the various risk reduction strategies which were integral to the subsistence and settlement patterns. Surplus foods harvested and processed during times of abundance were stored for overwintering, and, it would appear from the ethnographic evidence, specifically for February or March. Kinship systems too, and the flexible social organization they promoted, must be viewed as a social strategy for ensuring the availability of food resources in times of scarcity.

With this background, then, we turn to an examination of the ethnographic and ethnobotanical evidence for wild plant food production, and specifically, the management, processing and storage of root resources by the Secwepemc people as one risk reduction strategy for dealing with the diverse, dispersed and seasonally disparate resources of the Canadian Plateau.

Chapter 4: Ethnobotanical Evidence for Root Resource Management

4.1 Introduction

As outlined in Chapter 2, the plant management activities of Indigenous peoples included a variety of "horticultural" practices which were guided by various management strategies that regulated the timing, frequency and intensity of plant resource use. These anthropogenic disturbances acted, both intentionally and incidentally, to increase the productivity and reliability of plant resources.

In this chapter, I present ethnographic and ethnobotanical evidence to demonstrate that principles and practices of Secwepemc plant resource use were, in fact, forms of plant management. In particular, I focus on activities associated with root resource utilization. As argued in Chapter 2, roots should be one of the key "crops" managed, processed and stored by hunter-gatherers in temperate regions. The chapter begins by reviewing evidence for the role of root resources as food staples in traditional Secwepemc subsistence economies. This is followed by a discussion of root-harvesting practices and the various strategies designed to regulate these activities. The ecological impacts of traditional harvesting regimes are assessed to determine whether or not these activities acted to increase the reliability and productivity of root foods as proposed by the general model of wild plant food production.

The case for plant management practices by the Interior Salish peoples is outlined in Peacock and Turner (in press) and information on root resource use and management presented in this section is abstracted from this larger study. While the ethnographic and ethnobotanical evidence to support my arguments is drawn from information concerning the Secwepemc peoples, supporting evidence from other Interior

Salish peoples is introduced when relevant. My intent here is to demonstrate that the root resource management activities of the Secwepemc peoples are representative of a broader, more encompassing system of wild plant food production which existed historically on the Canadian Plateau. In addition, I argue that the Secwepemc peoples did not merely map onto abundant patches of plant resources, but actually modified and maintained productive resource locales to ensure critical plant foods were sufficiently available and abundant for processing and storage for winter.

4.2 Root Resources as Food Staples

Plant resources in general, and root foods in particular, were significant contributors to the traditional diets of the Secwepemc peoples. Although plant resources are often overlooked in current discussions of traditional economies, plants contributed a variety of essential nutrients and food energy. Further, their collection, processing and storage were part of the planned and patterned seasonal round of the Secwepemc peoples.

Root resources were particularly important in traditional diets, serving as storable sources of carbohydrates and other essential nutrients (Kuhnlein and Turner 1991). Ethnographer James Teit, who worked amongst the Secwepemc, Stl'atl'imx and Nlaka'pamux peoples during the late 19th and early 20th centuries, identifies at least 20 plant species whose roots, rhizomes, bulbs, corms and tubers were consumed (Teit 1900, 1906, 1909). When combined with the observations of other early travellers and ethnographers (Boas 1891; Dawson 1891; Davidson 1915, 1916; Steedman 1930) and ethnobotanical information shared by contemporary elders (Palmer 1975b;

SCES n.d.; Turner et al. 1980, 1990; Turner and Peacock 1995), some 35 species (depending upon the group and location) were traditionally harvested, processed and stored by Interior Salish peoples. Of these, 20 were regularly harvested in significant quantities and may be considered staples in Secwepemc subsistence economies. These are identified in Table 4.1.

The harvesting of roots, like other plant resources, was a planned and patterned activity, dictated by the spatial and temporal availability of culturally significant plant species. Teit (1909) observes that the various root foods were not distributed evenly throughout Secwepemc territory and that while many of the roots "grew abundantly" in the southern parts of Secwepemc territory, many of these same species were not available in the northern regions. "Thus, in the grounds of some bands not over five or six kinds of edible roots were found, while in those of others as many as fifteen kinds might be obtained" (Teit 1909:514).

Further, the distribution of root resources varied altitudinally, according to the biogeoclimatic zones. According to Teit (1900:231), "some of the roots used grew in the dry valleys, while the majority were obtained in the higher mountains only." Similarly, Dawson (1891:20) notes that root-harvesting localities were "generally situated at some height above the principal valleys on the plateaux or mountains, where camps are formed during the season of harvest."

During harvest, considerations of location and season had to be balanced with cultural preferences for species at certain growth stages, as well as with conflicts which might arise when several species or other culturally important resources were available simultaneously for harvesting in different locales. Consequently, decisions concerning

Table 4.1: Traditional root foods of the Secwepemc Peoples (from Turner and Peacock 1995; SCES n.d.)

Scientific Name	Common Name
Allium cernuum	Nodding onion
Balsamorhiza sagittata	Balsamroot
Calochortus macrocarpus	Mariposa lily
Camassia quamash	Blue camas
Cirsium edule	Edible thistle
Claytonia lanceolata	Spring beauty or mountain potato
Erythronium grandiflorum	Yellow avalanche (or glacier) lily
Fritillaria pudica	Yellowbells
Fritillaria lanceolata	Chocolate lily
Hydrophyllum capitatum	Waterleaf
Lewisia rediviva	Bitterroot
Lilium columbianum	Tiger lily
Lomatium dissectum	Chocolate tips
Lomatium macrocarpum	Hog fennel
Lomatium geyeri	Geyer's lomatium
Perideridia gairdneri	Wild caraway
Potentalla anserina	Silverweed
Sagittaria latifolia	Wapato
Sium suave	Water parsnip
Triteleia grandiflora	Cluster lily

where, when and what to harvest were dictated by cultural preferences and necessity, but limited by the location and seasonal availability of the plant resources. This required the Secwepemc peoples to move frequently and extensively from resource patch to resource patch throughout their traditional territory on a seasonal basis.

Harvesting of root foods began in April and May at the lowest elevations in river valleys, and continued throughout the summer and into the fall as families moved to base camps at traditional root gathering grounds to harvest the various species as they "ripened" at higher elevations. Secwepemc elder Mary Thomas recalled, for example, that in her area, women first dug desert parsley (*Lomatium macrocarpum*) roots in the valley bottoms, then the lower elevation spring beauty or "Indian potato" corms and avalanche lily bulbs (*Erythronium grandiflorum*), then the large taproots of balsamroot, all at lower elevations. By this time, a variety of berries were ready to be picked. In mid-summer, people would move up to the mountains and dig more spring beauty and avalanche lily "roots". After this, other later ripening fruits, such as huckleberries and blueberries (*Vaccinium* spp.), were collected. Similar rounds of progressive resource access are noted for other British Columbia Plateau peoples (Turner et al. 1980, 1990; Turner 1992a), as well as for peoples to the south on the Columbia Plateau (Marshall 1977; Hunn et al. 1990).

In general, root-digging grounds were considered common tribal property. However, evidence suggests certain locales were owned and controlled by elites (Teit 1900, 1909). Places where important root foods were abundant were well known and regularly visited (Dawson 1891). For example, Teit (1900:294), in discussing a well-known root-harvesting locale of the Nlaka'pamux peoples, notes:

> Botani Valley, situated in the mountains . . . has been from time immemorial a gathering place for the upper divisions of the tribe, chiefly for root-digging during the months of May and June. Sometimes over a thousand Indians, representing all divisions of the tribe, would gather there... . Each division had, besides, its separate and recognized camping ground.

Contemporary Secwepemc elders have clear recollections, experience and knowledge of their traditional root-harvesting grounds, and several, accompanied by their children and grandchildren, still visit locales such as Neskonlith Meadows near Chase, Mt. Lolo to the northeast of Kamloops, and Komkanetkwa, on the Kamloops Indian Reserve No. 1, to collect root resources.

4.3 Root-harvesting Techniques

The collection and processing of root resources was the responsibility of women and children whose basic tool kit consisted of a digging stick, "a pointed stick about four feet in length, with a crutch-shaped handle" (Dawson 1981:19) and a basket carried on the back. The most common type of digging stick, or "*pétse*" (Kuipers 1983), was manufactured of the fire-hardened wood of shrubs such as saskatoon (*Amelanchier alnifolia*) or black hawthorn (*Crataegus douglassi)*, with a handle of birch (*Betula* sp.) or sometimes antler or goat horn. A second, shorter type was made from a single piece of caribou, mule deer or elk antler (Teit 1909; Turner and Peacock 1995). Digging sticks were used to pry roots out of the ground, an extremely effective technique for extracting large tap-rooted species such as balsamroot or others with deep roots such as desert parsley. These activities are described by Dawson (1981:20), who writes:

> Early in July the wild onion [*Allium cernuum*], nearly ready to flower, is in

> condition to be gathered, and some families, camping in favourable places for the purpose, engage in this harvest. The women search the open woods and hillsides with crutch-like root-digging sticks in hand, and as each bunch of roots is extracted deftly toss it over the shoulder into a basket carried on the back.

According to Teit (1909:587), young girls in ritual isolation practiced digging trenches "so that in after years they might be expert at root-digging."

Root resources were harvested selectively according to a number of well-defined criteria based on both cultural and biological considerations. Size preference was one of these. Elders report that in root collecting, often the medium-sized individuals were picked, leaving the smaller roots to regenerate and the largest plants to go to seed. Secwepemc elder Mary Thomas recalls digging chocolate lily (*Fritillaria lanceolata*), spring beauty and avalanche lily with her grandmother, who taught her to leave the smallest bulbs and corms. In fact, her grandmother would sort through the childrens' baskets at the end of the day, removing the smallest "roots" and replanting them.

Typically, judgements concerning the appropriate size to harvest were based on certain characteristics of the above-ground growth of the plant. Mary Thomas, for example, said multi-flowered (and therefore older, large-bulbed) individuals of avalanche lily were preferred (Loewen 1998). Spring beauty was also harvested according to the number of flower stems present, which indicated the size of the corm below. As Les Jules remarked, "the bigger the flower, the bigger the potato" (SCES n.d.). Conversely, only the "carrot-sized" roots of balsamroot were dug, leaving the larger "mothers" to flower and go to seed. According to Aimee August, her mother-in-law cautioned:

> Don't dig the mother plant -- it's got little ones around. Dig them . . . away from the main plant, just dig around and take the 'sprouts'; then

there's another crop in the fall (SCES n.d.)

An alternative method of root digging also allowed for selective harvesting. Instead of prying roots out with a digging stick, Secwepemc people often cut a small patch of turf around a number of roots, flipping it over and removing the appropriate-sized roots from the underside. This was commonly practiced with spring beauty and chocolate lily, whose bulbs grow just below the ground surface. With avalanche lily, a large clump of turf was removed, then the bulbs were dug out from the subsurface soil. Dirt and the small "roots" were replanted, but the turf was left off, as a form of weeding. Elders also mention that they frequently weeded during root digging to remove unwanted, non-utilitarian species, especially grasses.

The Secwepemc peoples also harvested roots according to the reproductive status of an individual plant. For example, a number of important root vegetables, including desert parsley, blue camas (*Camassia quamash*) and balsamroot were typically harvested only after the plant had gone to seed. There were also cultural prohibitions against harvesting certain plants at certain reproductive stages. For example, women were to avoid collecting the "male" (flowering or fruiting) individuals of desert parsley in favour of the "female," or pre-flowering (vegetative) individuals.

Habitat preference was another factor which figured prominently in harvesting decisions. Often, roots growing in a specific location were preferred to their counterparts in other regions. Further, if a habitat was particularly productive for one root, it was generally productive for other species as well. As a result, harvesting activities tended to be concentrated within these productive habitats, which, as I argue, were productive because of on-going use and management.

Ethnographic evidence suggests the Secwepemc peoples made extensive use of prescribed burns to maintain the habitats conducive to the growth of a wide range of root resources as well as other culturally valued species (Peacock and Turner, in press). Secwepemc elder Mary Thomas recalled that not only did fire stimulate the growth of huckleberries and blueberries, root vegetables and mushrooms, but her mother told her that fire also killed harmful plant-eating insects that accumulated in a given area (SCES n.d.)

Ethnographic and ethnobotanical evidence confirms similar uses of fire in various parts of the Plateau. Teit (1900:230) describes the practice of landscape burning by the Nlaka'pamux peoples noting, "They sometimes set fire to the woods in order to secure a greater abundance of roots on the burnt hillside." Baptiste Ritchie's (1971) *Burning Mountainsides for Better Crops* gives eloquent evidence for community-level management practiced by Stl'atl'imx people:

> They [Stl'atl'imx] burned them [the hills] so that they would get good crops there. They told others who went there, 'Do the same at your place, do the same at your place'. Their own hills were just like a garden.

In all, at least 19 species of plants, including seven herbaceous "edible root" species, 11 fruiting shrubs and one herbaceous fruit (strawberry, *Fragaria* spp.) have been identified by various sources as having their production enhanced by periodic burning by various First Peoples of British Columbia (Turner 1991, in press). Those of relevance to this discussion are listed in Table 4.2 Readers are referred to these references for a comprehensive treatment of the subject.

It was widely recognized that fire, through clearing brush and providing a quick

Table 4.2: Plant food species managed through the use of fire by Interior Salish peoples (based on Turner 1991)

Roots
Allium cernuum (nodding wild onion)
Claytonia lanceolata (spring beauty or mountain potato)
Erythronium grandiflorum (yellow avalanche lily)
Lilium columbianum (tiger lily)
Berries
Amelanchier alnifolia (saskatoon)
Ribes divaricatum (wild gooseberry)
Rubus idaeus (wild raspberry)
Rubus leucodermis (blackcap)
Vaccinium caespitosum (dwarf mountain blueberry)
Vaccinium membranaceum (black mountain huckleberry)
Vaccinium spp. (wild blueberries)
Nuts
Corylus cornuta (hazelnut)

source of nutrients, can stimulate the growth of certain complexes of plants. Native elders state that the regrowth of the "root" plants after burning is accompanied by a notable increase in the size of the edible portion, and attribute this to the burning (Turner 1991). Baptiste Ritchie, on one occasion, recalled:

> When they used to burn that grass above timberline they used to say the Indian Potatoes [*Claytonia lanceolata*] were as big as your fist. Now they are only that big [*i.e.*, small], because they are not cultivated. They would burn every five or six years. The ground can only support so much. Now it's only timber grows. It takes away from the other (Baptiste Ritchie, transcription from taped interview with Dorothy Kennedy, May 1977 as cited in Peacock and Turner, in press).

The success of this management technique rested in the selection of habitat, as well as in the timing and intensity of the burn. The timing of fires was carefully controlled by specialists within the community. Fires were usually set in early spring or late fall when there was sufficient moisture to prevent the spread of the fire and to minimize the intensity of the fire, avoiding damage to the soils below. The late Annie York, Nlaka'pamux elder of Spuzzum in the Fraser Canyon, recalled the practice of landscape burning from her early childhood, between 70 and 80 years ago.

> They wait until close to fall. They know just when to burn. And then two or three years after, lots of huckleberries, lots of blueberries... And the ***skamec*** [*Erythronium grandiflorum*], that's when it grows, when you burn. I've seen it, when the old people used to do it. I was just a little girl. I'd go up the mountain with granny. After we'd pick berries, my uncle would say, "It's going to rain pretty soon; time to burn." [so the fire will not spread too much.] He stays up [after we finished]. Then, we go back the next year, it's all burned. Now, it turns into bush. That's why we don't get many berries any more. We're not allowed to burn. [We get] some, but not the same as it used to be.

The intensity of these aboriginal fires was also linked to the frequency with which people burned. Generally, berry patches were burned every eight to 10 years and allowed to regenerate for two to three years before harvesting. Presumably, root resources were burned according to a similar schedule, although this is not clear at this point. As Baptiste Ritchie noted, the period of "fallow" following a burn was accompanied by the rotation of harvesting locales in the seasonal round.

4.4 Root Management Practices

It is difficult to estimate the quantities of various root foods formerly harvested as elders commonly make reference to "bushels" and "baskets" when describing the amounts. However, Turner and colleagues (Turner et al. 1990:27-28; Turner and Peacock 1995) estimate each family collected the equivalent of at least 50 litres of roots in a season and up to a maximum of 100 to 200 kg for species such as spring beauty and yellow avalanche lily.

These estimates, if correct, suggest the Secwepemc peoples harvested substantial quantities of root resources annually. To ensure the root-digging grounds were not over-harvested, a number of management strategies were employed. These included a planned and patterned seasonal round, the rotation of harvesting locales, controlling access to resource patches, and religious ceremonies and moral sanctions (Turner, in press; Peacock and Turner, in press).

The seasonal movements of people across the landscape were linked to the temporal and spatial availability of culturally important plant resources. In addition, these were balanced with cultural preferences for root resources at certain stages of the life cycles, as well as the demands of acquiring other essential resources. Further, the cycles of productivity were also known for species and populations that had been burned. Specific root-digging beds, once harvested, were left to develop for a few fallow years before people returned to the exact spot. The seasonal round, and the limited periods it entailed for people to focus on particular resources in a particular area, was important in restricting the quantities of root resources harvested at one time in one place.

Limiting or controlling access to productive resource locales was another mechanism which ensured resources were sustainably utilized. Although root-digging grounds and berry-picking areas in general were considered common tribal property, access to those areas was carefully monitored. For example, Dawson (1891:21) notes among the Secwepemc that "the picking of each kind of berry is regulated by custom. For each recognized berrying ground some experienced old woman takes charge and watches the ripening of the fruit. Finally, when it is full time, word is sent to the other neighbouring Indians and the harvest begins." A similar system existed amongst the Nlaka'pamux and Teit (1900) notes that women of one village could pick in the berry patches of another as long as they did so at the proper season.

Teit (1909:573) describes the regulation of saskatoon-berry harvesting near Big Bar on the Fraser River. He observes:

> All the large and valuable berrying-spots were looked after by the chief of the band in whose district they were situated. Thus there were several large service-berry [saskatoon-berry] patches near Big Bar. The chief there watched the ripening of the berries, and deputed young men to watch and report on the various places. From time to time the watchman brought in branches and showed them to the chief. When the berries were about ripe, he sent word out that on a certain day the berrying would commence at a certain berry patch. Women would come from as far away as Alkali Lake and Clinton. The first day each woman picked only a little, about enough for herself and her friends to eat fresh during that day and night. After the first day they picked all they could

> and began to cure them. When they had finished one patch, the chief directed them to the next one which was ripe, and so on until they had finished all.

Controlled access, then, appears to have been a form of stewardship, managed by the chief of the band. As villages and bands were composed of two or more related families, it can be suggested, following Ackermann (1994), that access to key plant resources was controlled and regulated through kinship systems.

Finally, resource management was ensured through the religious principles and moral precepts of the Plateau people. On the Plateau, as with many Indigenous cultures, the manner in which people interacted with the landscape was inextricably linked to spiritual beliefs which were embodied in public ceremonies and oral traditions. These guided people in their day to day interactions with the natural environment.

Amongst the Interior Salish peoples, first foods ceremonies were one of the more prominent mechanisms used to control harvesting. Hill-Tout (1978) summarizes these as follows:

> As far as I could learn, the hunting, fishing and berry grounds of the Thompson [Nlaka'pamux] were common property. But no one under penalty of a severe punishment could take a fish, pick a berry, or dig a root until after the Feasts of First Fruits had been held.

Teit (1909:601) reports a first-fruits ceremony for berries amongst the Secwepemc:

> There was a feast of first-fruits at the commencement of each berrying season, when the first fresh service-berries were eaten. The people, during the feast, had to eat all the berries that had been picked; otherwise they would be unlucky. If any were left over, there would be a poor crop next year. In some places the chief prayed over the berries, asking that there might be a good harvest every year, but it seems there was no ceremony offering part of the first-fruits to the earth or the mountains.

Although there is no mention of a first-foods ceremony specific to root resources, it is interesting to note that prayers were offered to at least one root resource -- balsamroot -- during other ceremonies. Teit observes that all young Nlaka'pamux people, when eating the first berries, roots, or other products of the season, addressed a prayer to the "Sunflower Root" (balsamroot):

> I inform thee that I intend to eat thee. Mayest thou always help me to ascend, so that I may always be able to reach the tops of mountains, and may I never be clumsy! I ask this from thee, Sunflower-root. Thou art the greatest of all in mystery (Teit 1900:349).

It is not clear as to whether or not the Secwepemc had a similar observance.

Women offered a variety of prayers, and often painted their faces, prior to collecting roots and berries, and songs and dances associated with these activities were included in the winter ceremonies (Teit 1900, 1909). Plants in general, and several root species in particular, also figured prominently in Secwepemc mythology (Dawson 1891:31-33; Teit 1909:683, 707-709)

In addition to these public ceremonies, people were taught, through oral traditions, to understand and appreciate their connections with the "natural" world, and to respect and honour those ties. This philosophy is captured in the Nlaka'pamux story of the Old-One and his role in creating the earth, the sky and the people.

> Now Old-One appeared, and transformed Sun, Moon, and Stars into those we see in the sky at the present day, and placed them all so that they should look on the Earth-woman, and she could look at them. He said, "Henceforth you shall not desert people, nor hide yourselves, but shall remain where you can always been seen at night or by day. Henceforth you will look down on the Earth."
>
> Then he transformed the woman into the present earth. Her hair became the trees and grass; her flesh, the clay; her bones, the rocks; and

> her blood, the springs of water. Old-One said, "Henceforth you will be the earth, and people will live on you, and trample on your belly. You will be as their mother, for from you, bodies will spring, and to you they will go back. People will live as in your bosom, and sleep on your lap. They will derive nourishment from you, for you are fat; and they will utilize all parts of your body ... .
>
> After this, the earth gave birth to people, who were very similar in form to ourselves; but they knew nothing, and required neither food nor drink. They had no appetites, desires, knowledge, or thoughts. Then Old-One travelled over the world and among the people, giving them appetites and desires, and causing all kinds of birds and fish to appear, to which he gave names, and ascribed them all certain positions and functions. He said to the people, "Where you see fish jump, there you will find water to drink. It will quench your thirst and keep you alive." He taught the women how to make birch baskets, mats, and lodges and how to dig roots, gather berries and cure them. He taught the men how to make fire, catch fish, shoot, snare, trap and spear game . . .
>
> When he had finished teaching them, he bade them good-by, saying "I leave you now, but if you forget any of the arts I have taught you, or if you are in distress and require my aid, I will come again to you. The sun is your father, and the earth is your mother. When you die, you will return to your mother's body. You will be covered with her flesh as a blanket, under which your bones will rest in peace" (Teit 1912:321).

4.5. Summary of Secwepemc Root Harvesting and Management Activities

In Chapter 2, I argued that Indigenous peoples were not merely plant collectors, but plant managers, who, through a variety of horticultural techniques, guided by differing management strategies, acted to enhance and maintain populations of culturally important plant foods. Such management activities were grouped into three management categories: species, community and landscape. These activities are not mutually exclusive, but interact with one another in promoting plant productivity and reliability, whether intentionally or incidentally.

The preceding review of Secwepemc root-harvesting practices, supplemented by information pertaining to other key plant resources, suggests the described activities are consistent with those outlined in the general model of wild plant food production as components of wild plant food management. At the species level, management activities identified by the general model include: the selective harvesting of plants based on well-defined criteria; the application of a variety of "horticultural" techniques; and the system of scheduling which regulated the pattern (timing, intensity and frequency) of harvesting. Each of these components is represented in Secwepemc root-harvesting strategies.

The collection of root foods specifically, and plant resources generally, by the Secwepemc was not opportunistic, but part of a planned and patterned seasonal round designed to accommodate spatial and temporal variations in resource distribution and availability. People moved to traditional root-gathering grounds at specific times during the season to collect and process large quantities of root resources for winter stores. The collection of roots at harvesting locales was selective, based upon cultural preferences as well as biological considerations. The size of the roots, the reproductive status and growth cycle of the individual plant, and habitat preferences all played a role in harvesting choices. Clearly, Secwepemc root resource harvesting was not a haphazard activity, but a carefully considered strategy.

Further, the actual techniques employed by the Secwepemc peoples to extract root resources, and the spatially focused management activities that accompanied these actions, may be described as "horticultural." Armed with nothing more than digging sticks and baskets, Secwepemc women and children transformed the landscape, tending traditional harvesting grounds through digging and tilling the soil, weeding out unwanted species, and re-planting the smallest individuals. Occasionally, roots may have been transplanted in more favourable locations.

At the community level, plant management activities identified in the general model were those which served to create and maintain particular habitats conducive to the growth of culturally valued plants or plant associations. Traditionally, Indigenous peoples accomplished this through burning of selected habitats, and the Secwepemc peoples were no exception. Ethnographic evidence clearly indicates fire was an important tool in the maintenance of early successional habitats -- in this instance, grasslands and open forests -- for roots foods and other resources, such as berries.

Finally, management activities at the landscape level included a planned and patterned seasonal round, the rotation of harvesting locales, controlling access to resource patches, and religious ceremonies and moral sanctions. Each of these was integrated into Secwepemc lifeways. As previously discussed, Secwepemc seasonal rounds were highly mobile and this served to effectively limit the amount of time spent in any one location and to guard against over-harvesting. Further, access to productive areas was controlled, to a certain extent, through kinship systems. Finally, while these plant management techniques had economic motives, they were embedded in a larger decision-making system structured by religious and moral ideologies. These principles guided the Secwepemc people's interactions with the natural environment and ensured careful, considerate use of plant resources.

In summary, the Secwepemc peoples and other Interior Salish groups of the Canadian Plateau were active managers of root resources. But what influence did these management strategies have on the productivity and reliability of key resources? Did they in fact, act to enhance reliability and productivity as suggested in the general model? To address this issue, I turn now to a brief discussion of the ecological impact of these harvesting regimes on root resources.

4.6 The Ecological Effects of Secwepemc Harvesting Regimes on Root Resources

It appears that on the Canadian Plateau, the most productive, prolific areas in which to find particular edible or useful plants, especially wild root vegetables, are those traditional root-digging grounds where they have been harvested in large quantities for generations. One might assume that such populations, having been intensively exploited, might show decline compared to places where they were not harvested, but this does not seem to be the case. This observation is supported by many elders, who insist the best places to collect particular plant resources today are where they have always been harvested.

Elders also observe that, since the harvesting of many culturally important plants has decreased, or ceased altogether, plants are not as plentiful and habitats not as productive. This depletion of traditional resources is attributed to several causes, one of the major ones being that people no longer look after the plants as they did in the past.

Burning, for example, is prohibited and many elders have expressed deep regret that they are no longer allowed to follow their traditional burning practices. They are convinced that loss of control of their traditional lands and prohibitions against landscape burning have caused severe deterioration of traditional plant foods. For example, Baptiste Ritchie (1971) stated:

> But now, because the white man really watches us, we don't burn

> anything. We realize already, it seems the things that were eaten by our forefathers have disappeared from the places where they burned. It seems that already almost everything has disappeared. Maybe it is because it's weedy. All kinds of things grow and they don't burn. If you go to burn then you get into trouble because the white men want to grow trees.

Similarly, Annie York noted that Frozen Lake near Yale used to be a prime huckleberry picking spot, but it is not as good as it used to be. "Before, it was plentiful, [when] they used to burn. Now, nobody burns." Botanie Mountain, near Lytton, was another area where burning was practiced, but now, according to Annie, the ***skamec*** (avalanche lily) is not as good, nor as plentiful (Annie York, personal communication to N. Turner, 1991; Turner et al. 1990:123).

Similar observations have been made by other First Nations peoples concerning the deterioration of berry picking locales:

> Where we used to pick berries, oh, they were really plentiful! Right here where our house is situated now [in Mount Currie], that is where we used to come to pick berries, like gooseberries [*sxniz'* - *Ribes divaricatum*]. Now there are no gooseberries near us. Now the other berries are the same. They have all disappeared. We named other grounds of ours around here; called them 'The Picking Places' because that is where we went to pick berries. Now you will not find one single berry there (Ritchie 1971).

The cessation of management practices, combined with impacts of livestock grazing and introductions such as knapweed (*Centaurea* spp.), mustards (*Sisymbrium* spp., *Brassica* spp.), couchgrass (*Agropyron repens*), and European thistles (*Cirsium* spp.), have also had a detrimental impact on traditional root resources. Elders have noted a significant deterioration in the quality and quantity of root foods (specifically spring beauty, avalanche lily, water parsnip, *Sium suave*, and wapato, *Sagittaria latifolia*) and medicines (such as valerian, *Valeriana sitchensis*) in traditional harvesting areas due to trampling by horses and cattle and the invasion of weedy species (Turner et. al. 1990).

Mary Thomas discusses the difficulties associated with collecting traditional root foods such as spring beauty and avalanche lily today, stating:

> Everything is deteriorating -- the surface of the soil where we used to gather our food, there's about 4-6 inches of thick, thick sod and all introduced. And on top of that the cattle walk on it, and it's packing it to the point where there's very little air goes into the ground, very little rain, and it's choking out all the natural foods, and it's going deeper and deeper, and the deeper they go the smaller they're getting (personal communication to N. Turner, 1993).

This anecdotal evidence suggests the traditional plant management practices of the Secwepemc people were effective in enhancing and maintaining the productivity of culturally desired species. Further, these observations are consistent with aspects of intermediate disturbance theory and plant ecological evidence as discussed in Chapter 2.

Of particular importance to this discussion is the impact of particular types of anthropogenic disturbance on the productivity of root resources. Throughout this discussion, I have used the general term "root" to refer to a variety of vascular plants known more specifically as "geophytes." Geophytes are perennial plants which die back to subterranean storage organs ("roots") during times when growing conditions are unfavourable, such as during winter. These "roots," include bulbs, corms, taproots, tubers and rhizomes.

Like most perennials, geophytes are capable of reproducing sexually through seed, or asexually through vegetative propagation. Vegetative reproduction occurs through several methods. Numerous species of geophytes produce offset or daughter bulbs -- bulblets or cormlets that form around the main storage organ. During harvesting, these tiny corms are often broken away from the main plant and left to regenerate. Harvesting may also cause trauma to the main storage organ of a geophyte, stimulating the growth of a new bulb or corm. Alternatively, vegetative reproduction can occur when a portion of a taproot or rhizome is broken off during harvesting and left behind.

Populations of geophytes typically include a variety of "age sets," ranging from seeds, immature individuals, senescent individuals or dormant ones. Further, many geophytes require some form of disturbance to maintain vigorous populations.

The characteristics of roots or geophytes have important implications for human harvesting. The potential ecological impacts of the anthropogenic disturbance created by Indigenous harvesting were identified for three levels of biological organization: species, community and landscape levels. We can review these with specific reference to root resources and Secwepemc harvesting strategies.

At the species level, Secwepemc root-harvesting practices created disturbance regimes that had both intentional and incidental but generally positive effects on the productivity of targeted species. By selecting individuals at certain life cycles, or according to age and size, Secwepemc peoples thinned the populations of root species, decreasing intra-species competition. Weeding also decreased competition between desired and undesired species, giving the culturally important plants a competitive advantage. The intentional replanting of "roots" and their propagules was also an important factor in maintaining population productivity.

Incidental impacts of harvesting practices included localized soil disturbances from digging and tilling. In addition, the accidental detachment of portions of taproots, tubers, corms and bulbs would enable vegetative reproduction of the species.

Traditional harvesting technologies, then, did not necessarily remove the individual or its genetic material from the population as seeds, root fragments and rhizomes were left behind. Further, harvesting of some species was done at a time when seeds were in production, and the activities associated with harvesting -- digging, tilling, turning over the turf -- would help to distribute seeds and propagules.

Their ability to reproduce vegetatively enabled geophytes to survive and reestablish themselves in place following human disturbance and often to expand the portion of the site they occupied. In many instances, these anthropogenic effects mimicked natural forms of disturbance and this disturbance prevented the plant from reaching a natural senescence, and thus, was essential to the continued productivity of the individual and the population as a whole.

At the community level, frequent, low-intensity fires were used to disrupt successional sequences in a given habitat, and reduce the overall dominance of that particular community type on the landscape. Ethnographic evidence indicates Secwepemc and other Interior Salish people typically burned to increase the productivity of certain berries and root foods, species which commonly occur in montane, subalpine and alpine areas throughout the Plateau in upland meadows, open forests and along the edge of mature forests. Certain plant associations within these areas, such as the Ponderosa Pine and Interior Douglas-fir forest, are in fact, fire dependent (Meidinger and Pojar 1991). Thus, burning can create and maintain productive parkland and ecotones. Many species valued by Native Americans are shade-intolerant and depend on burning or other forms of disturbance to maintain the early-successional communities they inhabit. In addition, fires also recycle nutrients, remove detritus, eliminate pests and in doing so, enhance the productivity of targeted species.

By managing for productive species, and by maintaining a diverse number of habitats conducive to the growth of favoured species, Secwepemc horticultural practices created a mosaic of plant communities across the landscape, contributing to the overall heterogeneity of the environment. The key to the use of anthropogenic disturbance regimes in promoting the productivity and diversity of plant populations is regulating the intensity, size and frequency of the disturbance events in the community. This is where landscape-level management became important. Traditional landscape-management strategies employed by the Secwepemc peoples monitored the frequency and intensity of harvesting and burning practices on a regional scale to ensure appropriate levels were maintained. Rotating use of root-harvesting grounds, burning locales on multi-year cycles, and controlled access to resource areas resulted in intermediate levels of disturbance. These management principles were ultimately embedded in religious ideologies and enforced through social mechanisms.

In sum, ecological theory outlined in Chapter 2 lends support to the anecdotal evidence of Secwepemc peoples who suggest traditional harvesting regimes acted to increase the density, productivity and distribution of culturally desired root resources. The characteristics of root resources, or geophytes -- the ability to reproduce both sexually and vegetatively -- means intermediate forms of anthropogenic disturbance, such as Secwepemc horticultural practices, actually maintained vigorous populations, expanded the range of key resources and ensured their continued productivity.

4.7 Summary

Root resources were important contributors to Secwepemc economies, much more so than many current interpretations of past subsistence and settlement patterns acknowledge. More than 20 species were regularly collected from a wide variety of habitats as part of a planned and patterned seasonal round. The Secwepemc and other Interior Salish peoples not merely "mapping onto" naturally abundant resources, but were actively managing populations of root species. These practices -- selective harvesting, digging, tilling and weeding, landscape burning, and the rotation of harvest locales, were essentially "horticultural," and, when guided by management strategies and moral precepts, operated intentionally and incidentally to enhance the productivity and availability of desired species. Root resource collection and management is only one component of larger systems of plant management for foods, medicines and materials which existed ethnographically amongst the Plateau peoples (Peacock and Turner, in press).

Chapter 5: Ethnographic Evidence for Root Food Processing & Storage

5.1 Introduction

The Secwepemc people cultivated a wide variety of plant species to ensure an abundant, available supply of key resources and in doing so, increased the productivity of the Plateau landscape. These management strategies represent one component of wild plant food production. Plant processing represents a second component and may be regarded as an alternative strategy for increasing the productivity of available plant resources (Stahl 1989). One of the keys to understanding the emergence of these systems of wild plant food production is to understand the properties of the plants being managed, processed and stored. I propose Secwepemc subsistence strategies emphasized the production of storable carbohydrates as a means of coping with the seasonal and annual fluctuations in resource availability characteristic of northern temperate regions. These carbohydrates were obtained, in large part, through root foods. Further, I argue that plant processing technologies, such as pitcooking, were an essential component of these plant food production systems because they transformed indigestible root resources into highly digestible sources of carbohydrate energy.

In this chapter, I evaluate my position by reviewing the ethnographic evidence for root food processing by the Secwepemc and other Interior Salish peoples. Then, I describe a recent experiment which replicated traditional Interior Salish pitcooking methods and processed samples of balsamroot (*Balsamorhiza sagittata* (Pursh) Nutt.), a former root food staple which contains inulin as its major carbohydrate (Yanovsky and Kingsbury 1931, 1938; Peacock 1997). Results of a carbohydrate analysis of the raw and cooked samples are presented and the nutritive values of each assessed to evaluate the effectiveness of traditional pitcooking methods in "creating carbohydrates."

5.2 Root Resource Processing: The Ethnographic Evidence

The collection of root resources was an important component of the planned and patterned seasonal round of the Secwepemc people. Families, camped in productive root digging grounds, harvested quantities of root resources and processed these for winter storage.

Typically, the processing of root resources involved cleaning, peeling and drying, and depending upon the species, pitcooking in earth ovens (Dawson 1891; Teit 1900, 1909; Turner et al. 1990). Dawson (1891:20) observes:

> Returning to camp, the collections of the day are roasted or steamed in the usual way. They are next dried, and finally made up very neatly into bundles or chaplets and stored for future use. Thus treated, the roots [*Allium* spp.] are nearly black, and are said to be sweet-tasted.

Similarly, Teit (1909:516) notes:

> Nearly all the roots were tied in strings or threaded on strings before cooking in the earth ovens. Roots of the wild potato (*Claytonia lanceolata*) and the lavender lily (*Calochortus macrocarpus*) were not generally cooked in these ovens, but threaded on strings and hung up to dry, or were spread loosely on mats to dry. Afterwards, they were put in sacks or baskets, and cooked in small quantities as required by boiling in the manner of potatoes. It was generally preferable, however, to steam them as then they did not get so watery.

The construction and use of earth ovens is described by ethnographers (Dawson 1891; Teit 1900; 1909) and contemporary elders (Turner et al. 1990; Turner and Peacock 1995) (Figure 5.1). Teit describes the traditional Nlaka'pamux pitcooking process, which he regards as essentially similar to those of all Interior Salish peoples:

> Dry roots are cooked in the following manner: a circular hole is dug in the ground to the depth of two feet and a half and large enough in diameter to contain the roots to be cooked. Into this hole are put four or five flat stones -- one in the centre and the others around the sides. Above these is piled a large heap of dry fir-wood, on which is placed a quantity of small stones. The wood is then kindled, and allowed to burn until nothing but the embers remain, when the small stones drop down to the bottom of the hole.
>
> The unburnt wood is next taken out, leaving nothing but the ashes and stones. Enough damp earth is then shovelled in to cover thinly the top of the stones, and this is overspread to the depth of half a foot or more with the broken fir branches, over which is spread a layer of dry yellow-pine needles, and still another layer of fir-branches. By this time the hole is nearly filled up.
>
> The roots are then placed on the top, and covered carefully with a thick layer of fir branches. The whole is covered with earth, and a large fire of fir-wood is kindled on top. In this way immense quantities of roots are cooked at one time. They remain in the oven -- according to the kind being cooked -- from twelve to twenty-four hours (Teit 1900:236-237).

Water was often added during pitcooking in order to steam the roots, a process also described by Teit (1900:237):

> Many roots, were steamed in the following way: Before any branches were put into the hole, a stick from an inch and a half to two inches in diameter was planted perpendicularly in the ground, reaching considerably above the level of the hole. When everything was covered up, the stick was pulled out, leaving an aperture into which water was poured, causing steam to rise from the hot stones underneath. When sufficiently steamed, the usual fire was kindled on top.

Dawson (1891) provides two accounts of Interior Salish pitcooking practices. The first describes camas processing by the Secwepemc of the Columbia River region where camas was "abundant" and an "important article of diet." It is reprinted from an article by J.M. Macoun, which appeared in *Garden and Forest* on July 16, 1890.

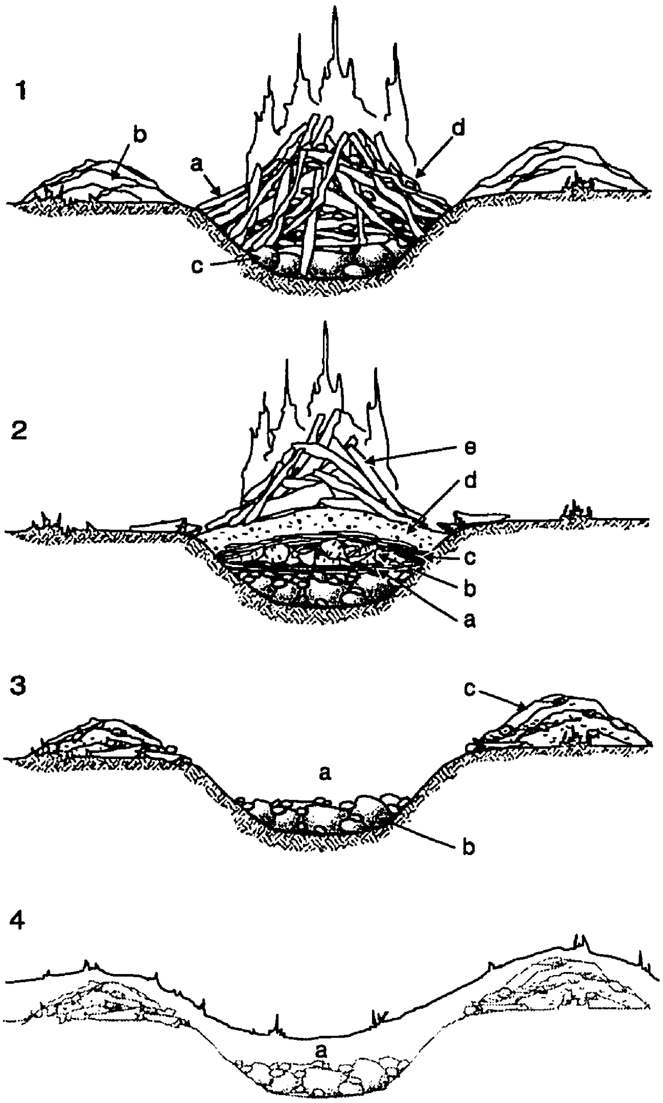

Figure 5.1: The construction, use and abandonment of an earth oven based on Teit (1900). A basin-shaped pit is excavated (1a) and the earth is piled around the edges (1b). The bottom of the basin is lined with cobbles or boulders to create a heating element (1c) and a fire is built on top (1d). Once the rocks are heated sufficiently, a layer of vegetation (2a) is added, then the roots to be cooked are placed on these (2b) and this is covered with more vegetation (2c). This is covered with a mat, and then capped with dirt (2d) and a fire is kindled on top (2e). The food is removed after the appropriate time (3), leaving the pit (3a), charcoal and fire-cracked rock in the bottom (3b) and rim deposits of fire cracked rock and charcoal (3c). In time, the earth oven is filled with sediments (4).

Dawson (1891:20) notes this "excellent description of the mode of cooking the camass" applies to the processing of other root foods. As it provides details not available elsewhere, I have included it in its entirety, as follows:

> The bulbs were collected by the Indians before the seed was fully matured, at which time they consider them at their best. The party I speak of had between twenty and twenty-five bushels of them at the lowest estimate. For two or three days before cooking was begun, the women of the party were engaged in cutting and carrying to camp branches of the alder and maple (*Alnus rubra* and *Acer glabrum*). Several bundles of the broad leaves of *Lysichitun Kamtschatcense* [*Lysichitum americanum*](skunk-cabbage) and two or three of *Alectoria jubata [Bryoria fremontii]*, the black hair-like lichen that grows in profusion on *Larix occidentalis*, had been brought with them.
>
> Everything being ready, the men of the party cut down a huge pine for no other object, apparently, than to obtain its smaller branches, as no other portion of it was used. A hole about ten feet square and two deep was then dug in a gravelly bank near the lake shore, which was filled with broken pine branches. Upon these were piled several cords of dry cedar and pine, and this was covered over with small boulders. The pile was then lighted in several places, and left for some hours to take care of itself.
>
> When the Indians returned to it the stones lay glowing among a mass of embers. The few unburnt pieces of wood which remained near the edges were raked away, and the women with wooden spades banked up the sides of the pile with sand, throwing enough of it over the stones to fill up every little crevice through which a tongue of flame might be thrust up from the coals that still burned beneath the stones. Then the whole was covered with the maple and alder boughs to the depth of a foot or more after they had been well trampled down.
>
> Over these were placed the wide leaves of the skunk-cabbage until every cranny was closed. Sheets of tamarac-bark [larch, *Larix occidentalis*] were then spread over the steaming green mass, and upon these the bulbs were placed. About half of them were in bark baskets closed at the mouth, and each holding about a bushel and a half. These were carried to the centre of the pile. The lichen of which I have spoken was then laid over the unoccupied bark, having been well washed first, and over it were strewn the bulbs that remained. The whole was then covered with boughs and leaves as before and roofed with sheets of bark. Upon this three of four inches of sand was thrown, and over all was heaped the

> material for another fire, larger even than the first one. When this was lighted, the sun was just setting, and it continued to burn all night.
>
> The next morning, our camp was moved away, and I was unable to see the results of the day's labour. I was told, however, by one of the Indians who could speak a little English, that their oven would be allowed a day in which to cool, and that when opened the bulbs in the baskets would have 'dissolved to flour', from which bread could be made, while those mixed with the lichen would have united with it to form a solid substance resembling black plug tobacco in colour and consistency, which could be broken up and kept sweet for a long time (Macoun 1890 in Dawson 1891:20-21).

Dawson's (1891:9) second description differs from his first, as well as from those provided by Teit, and appears to describe a roasting platform or mound, rather than a basin-shaped depression:

> In baking various roots, more particularly those of the lily (*Lilium columbianum*), a spot is first cleared and a fire built upon it. When the surrounding soil has become sufficiently heated, the roots, enveloped in mats or green herbage, are laid upon the bed of the fire, and the whole is covered up by piling together the earth from all sides upon the mass of roots. After the lapse of sufficient time the roots are dug out in a baked or steamed condition, and either at once eaten or dried for future use.

Ethnographic evidence indicates the distribution of earth ovens is closely linked with the distribution and abundance of important root resources. Dawson (1891:9) notes "such root-baking places are usually in the vicinity of root-gathering grounds" and "signs of the old roasting places are common on hillsides where the plant [*Balsamorhiza sagittata*] abounds" (Dawson 1891:20). As the majority of the key root species are found only in the upland valleys and mountains (Teit 1900), root digging grounds were "generally situated at some height above the principal valleys, on the plateaux or mountains, where camps are formed during the season of harvest" (Dawson 1891:19).

Finally, Dawson (1891:9) comments on the remains of Secwepemc earth ovens, which he describes as follows:

> Such root-baking places . . . after some years appear as low cones, from fifteen to twenty feet in diameter, with miniature craters in the middle. These might easily be mistaken by an imaginative antiquarian for old sacrificial sites, on account of the evident traces of fire which the stones and earth show (see Figure 1.2).

5.3 Creating Carbohydrates

Of the 20 root foods consumed by the Interior Salish, over half were processed regularly in earth ovens (Table 5.1). Several of the root foods traditionally pitcooked, including balsamroot, camas, wild onion and edible thistle (*Cirsium edule*), contain inulin as the major carbohydrate (Yanovsky and Kingsbury 1931, 1938). Inulin, as discussed earlier, is a complex carbohydrate which is indigestible in the upper intestinal tract (Roberfroid 1993; van Loo et al. 1995). Therefore, roots containing inulin must be processed, or chemically altered, to break the inulin into its constituent fructose units and to create sweet-tasting, highly digestible foods. Heat treatment generally, and pitcooking specifically, is one method of plant processing commonly used to chemically alter the structure of root foods and increase digestibility.

Of particular interest to this discussion is balsamroot, a large herbaceous perennial of the Aster family (Asteraceae or Compositae) (Figure 5.2). Balsamroot grows to a height of approximately 80cm from a deep, thick, rough-barked taproot. Its numerous silver-coloured leaves are large and arrowhead-shaped. The bright yellow blossoms of balsamroot are visible on sunny hillsides and in open woods from April to July, depending upon elevation. Its fruits are one-seeded achenes which resemble miniature sunflower seeds and in fact, balsamroot is often called "spring sunflower"

Table 5.1: Root foods traditionally pitcooked by the Interior Salish peoples (from Turner and Peacock 1995)

Species	Family	Pitcooked
Allium cernuum (Nodding onion)**	Liliaceae	R
Balsamorhiza sagittata (Balsamroot)**	Asteraceae	R
Calochortus macrocarpus (Mariposa lily)	Liliaceae	O
Camassia quamash (Blue camas)**	Liliaceae	R
Cirsium edule (Edible thistle)**	Asteraceae	R
Claytonia lanceolata (Spring beauty)	Portulacaceae	O
Erythronium grandiflorum (Yellow avalanche lily)†	Liliaceae	R
Fritillaria pudica (Yellowbells)	Liliaceae	O
Fritillaria lanceolata (Chocolate lily)	Liliaceae	O
Hydrophyllum capitatum (Waterleaf)	Hydrophyllaceae	R
Lilium columbianum (Tiger lily)	Liliaceae	R
Lomatium dissectum (Chocolate tips)	Apiaceae	R
Lomatium macrocarpum (Hog fennel)	Apiaceae	R
Perideridia gairdneri (Wild caraway)	Apiaceae	R
Potentilla anserina (Silverweed)	Rosaceae	O
Sagittaria latifolia (Wapato)	Alismataceae	R
Sium suave (Water parsnip)	Apiaceae	R

R = regularly; O = occasionally;
**contains inulin as major carbohydrate
† trace amounts of inulin

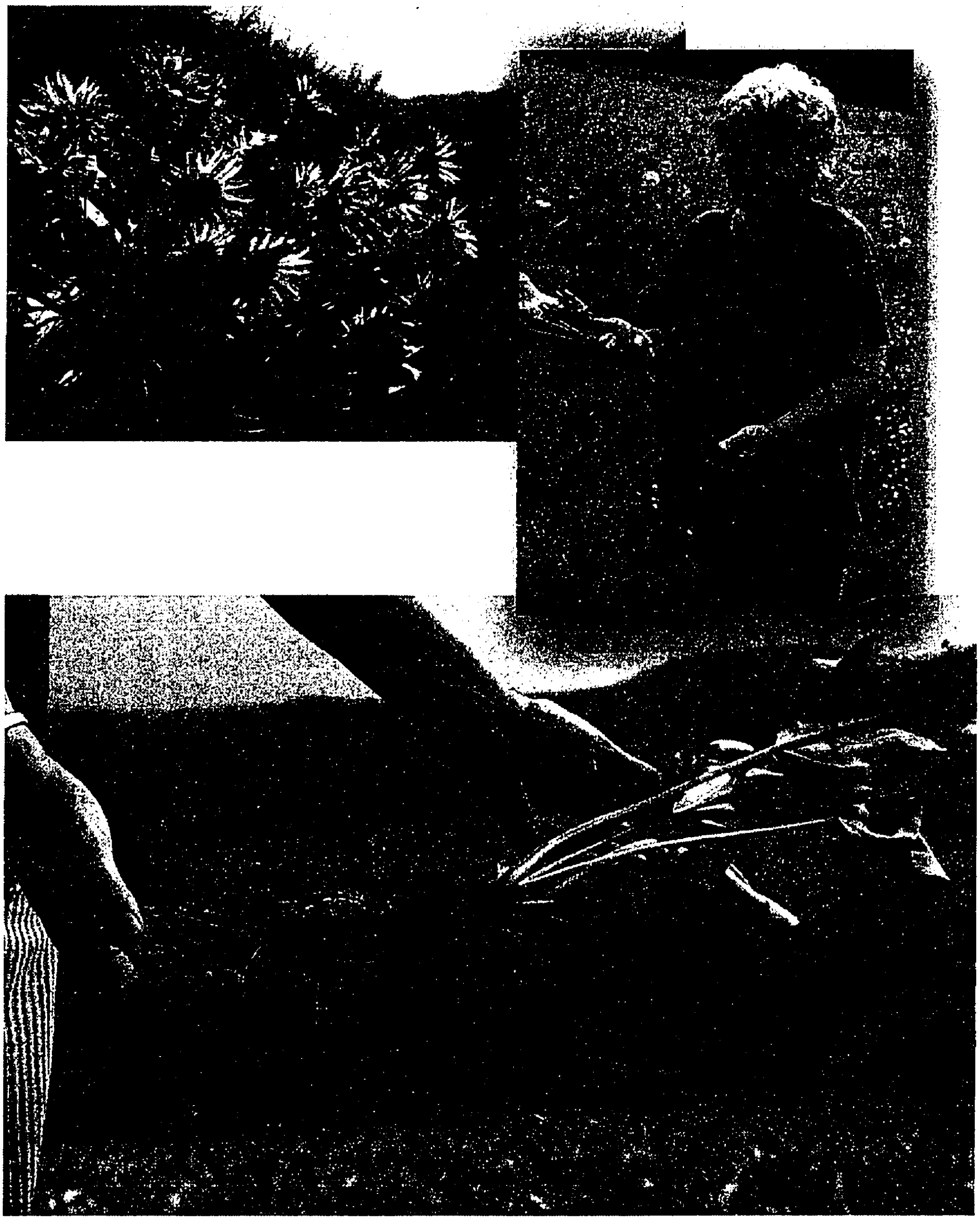

Figure 5.2: (clockwise from top left): Balsamroot (*Balsamorhiza sagittata*) in blossom above the South Thompson River; Secwepemc elder Mary Thomas holding a "carrot-sized" root; A specimen of balsamroot from Komanetkwa. Note the thick, bark-like outer covering of the taproot.

although it is not related to the true sunflower (*Helianthus* spp.). It is widespread and frequently abundant throughout the hot, arid regions of the Plateau, where it occurs on dry, often stony slopes in grasslands, open forests of ponderosa pine and Interior Douglas-fir. Balsamroot also occurs at mid- to subalpine elevations throughout the region (Parish et al. 1996).

The presence of inulin in balsamroot was first identified by Yanovsky and Kingsbury (1931) who noted that although balsamroot contains a great deal of inulin at certain stages of its life cycle, "it cannot be considered a very good source of inulin on account of the heavy bark and the woody structure of the root itself."

The ethnobotanical literature reveals balsamroot was used for a variety of purposes by the Secwepemc and other Interior Salish peoples who valued it as a dietary staple, medicine and spiritual helper (Dawson 1981; Teit 1900, 1909; Steedman 1930; Turner et al. 1990; Peacock 1996; Bannister and Peacock 1998; SCES n.d.). Given its significance, it is perhaps not surprising that Secwepemc elders refer to balsamroot as "the plant to end all plants" (SCES n.d.). The Secwepemc name for balsamroot is *tset'selq*, which may be translated as "the head, or the chief" (Marianne Ignace, pers. com. 1996).

In the spring, the root crown, young leafstalks and budstems of balsamroot were eaten as fresh greens, and in the fall, the seeds were collected and pounded into a "flour," mixed with oil, water or broth and berry mixtures, and eaten as a porridge, especially in times of famine. Roots, in particular, were an important food staple, and were collected in significant quantities during the summer, cooked in earth ovens and stored for winter (Dawson 1891; Palmer 1975b; Teit, 1900, 1906; 1909; Turner

1992; Turner et al. 1980; Turner et al. 1990; SCES n.d.). According to Dawson (1891:20):

> The root of the Balsamorhiza (*B. sagittata*) is also eaten, being previously roasted or baked in the ground for a period of two or three days. The root itself is rather woody, but even when fresh has a not unpleasant liquorice-like taste. It is named *tsat-tsilk'* by the Shoo-wha-pa-mooh.

> Secwepemc elder Aimee August described how the balsamroot was processed:

> Oh, they were nice, like potatoes .... You can put it on a stick and dry to use in the winter and [then] soak them and cook them in a deep pit. Make a fire, midnight [sic], and sleep and take it out in the morning. Got to put water in each corner and put a long pole in each corner; fire, rocks, where reeds are and cover the roots with reeds like used for mats [cover the roots to be cooked with plaited reeds to keep the dirt off them] (SCES n.d.).

Secwepemc elder Lilly Harry also described the method of pitcooking balsamroot, which she explained required a great deal of preparation. After harvesting, the roots were beaten until the tough covering could be removed. According to Lilly, many people got together for this work as it took about four or five days to gather enough roots to pitcook, while at the same time the rocks, fuel and different plants used for flavouring (*e.g., Penstemon* spp.) had to be gathered (SCES n.d.). The following is a direct translation by Mona Jules of Lily Harry's narrative *Re Stq'elsém* ("Open-pit Cooking"), which describes the pitcooking of balsamroot:

> These balsam roots must have been boiled with pitch wood. No! Nothing was boiled. It was piled up there on fir boughs. Why would anyone want to set them on fire. By myself though, I would light the pitch wood and that would be what I would burn.

> You dig up the balsam roots. If there are children around they can pick it up for you. They can pick it up for you and they will pile it up for you there, what you have dug up. You go there in the evening and pile them up. Taking off the, it's like a hard covering you know. You take it off ...

that thing and . . . you peel it right off. You gather up these peelings of the balsam roots. And then these balsam roots . . . you put them there. They've finished fixing it there, you've finished fixing it.

And there where you are going to steam cook it on rocks, all of it there will heat up. You get the fire going down below. It will burn and it will go like the sweat-house until it is all gone. It will all fall in, all those rocks. It will heat up the ground. Then you bury those rocks until it is good. And then you take the pitch wood and you chop it up. You lay one there, you lay one there. You do this until you have finished. You cover it over with peelings of the balsam roots. You sprinkle water on it, you sprinkle lots of water on it.

And then you get the tops of the jackpine tree, one branch, you lay it there. You take this flower that grows around here [Penstemon fruticosus], you pull lots of it out by the roots. You pile it on top, you will take off your coverings there. And this here when you have finished fixing it. You get some old fir boughs. An old tree you will chop down and that is what you can break up. You fix it good there.

Then you finally take the balsam roots, and you pile it in there. It doesn't matter how you put down the balsam roots. Or how many sacks you make. It doesn't care, the balsam roots, if it is happy or not. You take the cactus, you make several containers of cactus. You put it in there. Then you finally take the fir boughs, you cover them until they are nicely fixed. No dirt will get down there. And then you finally get the jackpine, again you put that on there. You get this pitch wood, and again you will do the same thing. You take the kinnikinnick bush, the kinnikinnick bush goes there, the soapberry bush. These all go into your cooking pit. Many things are put there before it is buried. It is piled up nicely there so that it doesn't get dirty when it is uncovered from down below. No dirt at all will get on them if it is uncovered carefully.

And that is what I find very difficult to make. The balsam root is very hard work. The lichen is easy . . . . but the balsam roots require many things. "Medicine plants for pit-cooking" is what the old people called it (Secwepemc Cultural Education Society Language Department, 1994:33-41).

Teit (1900:237) records prayers and taboos associated with the harvesting and preparation of balsamroot and adds "the root of the wild sunflower [balsamroot] is difficult to cook, and is therefore allowed to lie in the oven for two days." According to

Teit (1900:349):

> A number of restrictions refer to the use of the sunflower-root (*Balsamorhiza sagittata*), which is very difficult to cook. Women, while cooking or digging this root, must abstain from sexual intercourse. A man must not come near the oven when the women are cooking the root. The women, when going out to dig the root, often painted the whole face red, or they painted a large black or a red spot on each cheek.
>
> Sometimes they took four long, thin fir-branches, the small ends of which they spread out in different directions near the bottom of the oven where the roots were, while the thick ends were tied together, and raised above the centre of the oven, protruding a little.
>
> When the oven was finished, and after the roots had been cooking for a while, these branches were pulled out, and according to their color the Indians divined whether the roots would be successfully cooked or not. If the branches were black or dark colored, the roots would cook well; but if spotted or light colored, the reverse would be the case. It was sometimes said, when sunflower-roots had been cooked successfully, that the coyote had caused the success by urinating on them.

Based upon the work of Konlande and Robson (1972), it has been assumed that pitcooking converted the inulin in balsamroot to fructose; it was, after all, a root food staple of many Interior Salish peoples and thus must have been palatable and digestible However, this had never been demonstrated. Accordingly, I developed an experiment to document the chemical changes which occur in balsamroot during pitcooking and to assess the nutritive value of balsamroot prepared in this manner. I believed this information could contribute to our understandings of the role of earth ovens in Late Prehistoric plant food production on the Canadian Plateau.

5.4 Reconstructing Interior Salish Pitcooking Practices

To gain a better understanding of the role of traditional Interior Salish pitcooking practices in transforming balsamroot's inedible taproots into digestible sources of carbohydrates, balsamroot was pitcooked in earth ovens according to Interior Salish "recipes" derived from ethnographic accounts (Dawson 1891; Teit 1900, 1909) and from contemporary elders (Mary Thomas, pers. com. 1995-96; Turner et al. 1990; Turner and Peacock 1995). The carbohydrate components of these cooked samples, along with their raw counterparts, were determined.

Methods: Balsamroot samples were collected in early July of 1996 from experimental plots established at Komkanetkwa. Following instructions from elders, the roots were harvested after the plants had flowered and only "carrot-sized individuals" were selected. These ranged between 15 to 20cm in length, 4 to 5cm in width, with an average weight of 75g. After harvesting, the roots were refrigerated and then frozen prior to pitcooking in order to preserve them for subsequent analysis.

Details of the samples and treatments are presented in Table 5.2. Each sample represents a composite of several roots combined to provide the largest sample possible for the analysis which required a minimum of 10g (freeze-dried weight) of balsamroot. As I was interested in determining whether or not peeling prior to pitcooking affected the nutritional qualities of balsamroot, each treatment was divided into a peeled and unpeeled component.

Roasting pits were constructed on two separate occasions in 1996 following different Interior Salish pitcooking "recipes" provided by Secwepemc elders and recorded by Turner and colleagues (SCES n.d.). According to elders' instructions, each oven was approximately 1.0m wide and 0.8m deep, or just "large enough in diameter to contain the roots to be cooked" (Teit 1900:236). In the first roasting pit (RP #1), 20 porous

Table 5.2: Balsamroot samples and treatments

Sample	Treatment	Fresh weight (g)	% Moisture	Freeze dried weight (g)	Residual Moisture
BS-1	Raw, peeled	114.1	67.4	38.27	3.1
BS-2	Raw, unpeeled	144.0	45.7	80.58	3.0
BS-3	Cooked, peeled, Roasting Pit #1	69.75	65.5	25.0	3.5
BS-4	Cooked, unpeeled, Roasting Pit #1	91.26	62.5	35.03	2.1
BS-5	Cooked, peeled, Roasting Pit #2	36.83	41.8	22.34	4.0
BS-6	Cooked, unpeeled, Roasting Pit #2	78.47	44.3	45.65	4.3

"volcanic" rocks, averaging 15 to 20cm in length, were heated in a fire constructed *beside* the oven, a technique used by elders such as Mary Thomas, but not reported on in the Interior Salish ethnographic literature (but see Alexander et al. 1985) regarding the occasional use of this technique by the Tsilhqot'in peoples). These were heated and placed inside the bottom of the earth oven and a thin layer of dirt added to cover them.

In the second roasting pit (RP #2), 25 "dense" river cobbles, approximately 10 to 15cm in length, were heated in a fire kindled *inside* the oven feature, the more "traditional" pitcooking method described in the literature. Once the rocks were "red hot and glowing," they were spread across the bottom of the roasting pit and a thin layer of dirt was added.

In both instances, a layer of moistened Interior Douglas-fir boughs, followed by branches of rose (*Rosa* spp.) and then thimbleberry (*Rubus parviflorus*) were placed above the rock heating element. The balsamroot samples, wrapped in gauze, were placed on top of this vegetation matting in the centre of the pit and were covered by layers of thimbleberry, rose and Douglas-fir. Bulbs of the yellow avalanche lily (*Erythronium grandiflorum*), were also included as part of a parallel experiment conducted by Dawn Loewen of the University of Victoria (Loewen and Mullin 1997; Mullin et al. 1997; Loewen 1998; Mullin et al., in press) to assess the carbohydrate content of this traditional root food. Approximately three litres of creek water were added, the entire pit was covered with a cloth tarp, and capped with dirt. Two temperature probes were inserted during the assembly of each earth oven to monitor temperature changes during cooking. RP #1 was left to cook for 21 hours; RP#2, for 20 hours. Due to time constraints, these cooking times are approximately half the length of those recorded

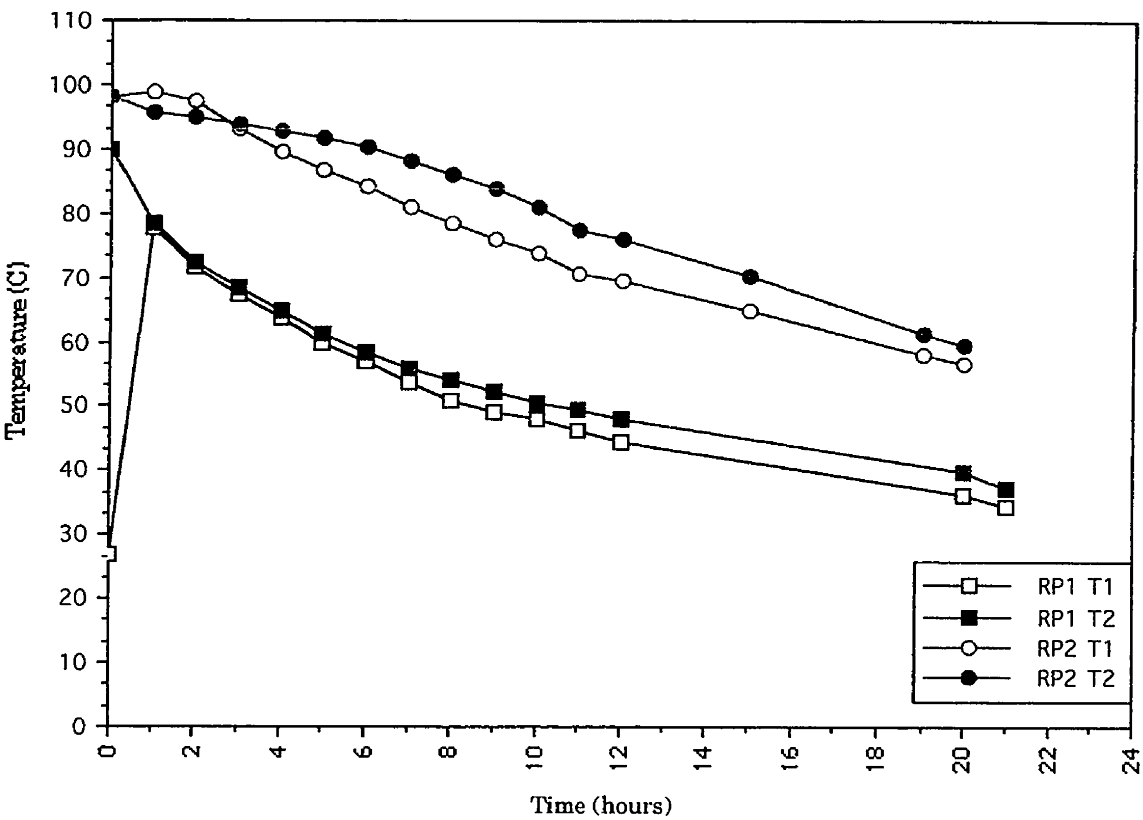

Figure 5.3: Temperatures recorded in experimental earth ovens during balsamroot pitcooking.

ethnographically. Temperatures were recorded at regular intervals throughout this time (Figure 5.3).

After cooking, the samples were immediately refrigerated, then frozen, and then freeze dried and sent to Dr. John Mullin, Agriculture and Agri-Food Canada, Ottawa, for carbohydrate analysis. Water extractable sugars were separated by HPLC on DIONEX PA-1 and PA-100 ion exchange columns fitted with an electrochemical detector. Dietary fibre was determined by the gravimetric method of Mongeau and Brassard (1990) and protein from the nitrogen generated by the Kjeldahl digestion method (International Dairy Federation 1993) with a conversion factor of 6.25. Starch was determined by the method of McCleary et al. (1984) and ash by the AOAC (1984) method #31.0113. Moisture was calculated from the weights of samples before and after freeze drying and from a determination of residual moisture by oven drying to constant weight (see Table 5.2) (Mullin et al. 1997; Mullin et al., in press).

Results: The major components of balsamroot, on a percentage dry basis, are listed in Table 5.3. As might be expected in root crops, no measurable amount of fat was detected; small amounts of protein and ash were found, but the majority of the dry weight was due to carbohydrates, including glucose, fructose, sucrose, starch, soluble and insoluble dietary fibre and inulin. As is evident, there is very little difference between the peeled and unpeeled pitcooked samples in terms of the energy-yielding carbohydrates.

Figure 5.4 depicts the energy-yielding carbohydrate component (fructose, glucose, sucrose, starch and soluble dietary fibre) of the different balsamroot samples. When these values are graphed, and compared with the values for inulin, the chemical changes which occur during pitcooking become evident. The cooked samples from

Table 5.3: Macronutrient analysis of raw versus pitcooked balsamroot (% dry basis)

Sample	Treatment	% Total Carbohydrates Yielding Energy								
		% glucose	% fructose	% sucrose	% starch	% soluble dietary fibre	% insoluble dietary fibre	% ash	% protein	Inulin as % soluble sugars by difference
BS-1	Raw, peeled	0.6	2.6	1.7	0.1	7.2	17.8	3.3	2.1	64.71
BS-2	Raw, unpeeled (bark included in analysis)*	0.4	1.3	0.7	0.1	5.8	49.0	3.2	2.1	37.42
BS-3	Cooked, peeled, RP#1	0.7	3.6	1.7	0.1	6.9	25.5	2.9	3.1	55.44
BS-4	Cooked, unpeeled, RP#1 (bark removed prior to analysis)	0.6	2.5	1.6	0.1	7.9	28.0	3.7	3.1	52.6
BS-5	Cooked, peeled, RP#2	2.9	22.0	3.5	0.1	8.5	34.9	4.2	4.2	19.69
BS-6	Cooked, unpeeled, RP#2 (bark removed prior to analysis)	2.4	20.7	2.9	0.1	9.8	26.6	4.2	4.2	29.05

*Bark adds fibre and weight without contributing to the carbohydrate content; this accounts for the relatively high figure for insoluble dietary fibre; and the relatively low figure for inulin (compared to the raw, peeled sample).

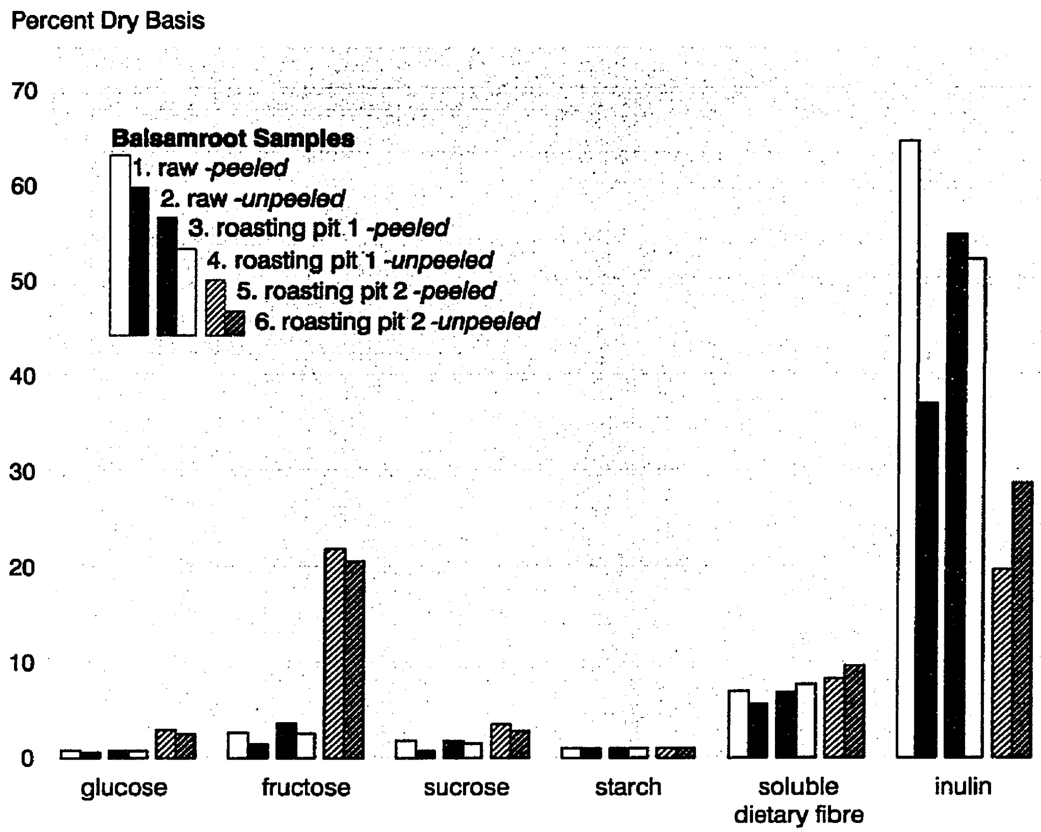

Figure 5.4: Results of the carbohydrate analysis of the raw and pitcooked balsamroot.

Roasting Pit #2, BS-5 and BS-6, show a dramatic increase in fructose, and a corresponding decrease in inulin, when compared to the raw samples (BS-1, BS-2). Samples BS-3 and BS-4, processed during the first pitcooking experiment, however, do not exhibit the same pattern and are similar to the raw samples, showing low fructose values and a high percentage of indigestible carbohydrates.

These changes in the quantities of fructose translate into differences in the energy contributions between the raw and cooked samples as presented in Table 5.4 and illustrated in Figure 5.5. The carbohydrate energy of the raw samples averages 40kcal/100g. In contrast, BS-5 and BS-6, from the second roasting pit, average approximately 140kcal/100g, an increase in energy of approximately 250%. However, samples BS-3 and BS-4 show only a slight improvement in carbohydrate energy when compared to the raw samples.

Discussion: These results show, quite graphically, the chemical changes which occur in balsamroot during pitcooking under the proper conditions. What are these conditions?

Sufficient heat (or "hot rocks"), is the first, and perhaps most obvious, requirement. As the carbohydrate analysis demonstrates, there appears to be a minimum temperature below which hydrolysis of inulin does not occur, regardless of the cooking time. Balsamroot samples (BS-3 and BS-4) processed in the first roasting pit were essentially raw, despite being cooked for 21 hours. As the cooking times and materials were similar in both reconstructions, one must conclude that the rocks used in the first roasting pit were insufficiently heated, or did not retain the heat as effectively as those used in the second roasting pit. Certainly, placing hot rocks into cold pits would

Table 5.4: Energy values of raw versus pitcooked balsamroot

Sample	Treatment	% Total carbohydrates yielding energy	Energy yielding carbohydrates Kcal/100g	Protein energy Kcal/100g	Total energy Kcal/100g
BS-1	Raw, peeled	12.18	46.76	5.74	52.50
BS-2	Raw, unpeeled (bark included in analysis)*	8.23	32.07	5.73	37.80
BS-3	Cooked, peeled, RP#1	13.06	50.14	8.64	58.78
BS-4	Cooked, unpeeled, RP#1 (bark removed prior to analysis)	12.67	48.64	8.52	57.16
BS-5	Cooked, peeled, RP#2	37.08	142.40	11.58	153.98
BS-6	Cooked, unpeeled, RP#2 (bark removed prior to analysis)	35.95	138.03	11.62	149.65

*Bark adds fibre and weight without contributing to carbohydrate content; this accounts for relatively low figure for % carbohydrates (compared to the raw, peeled sample).

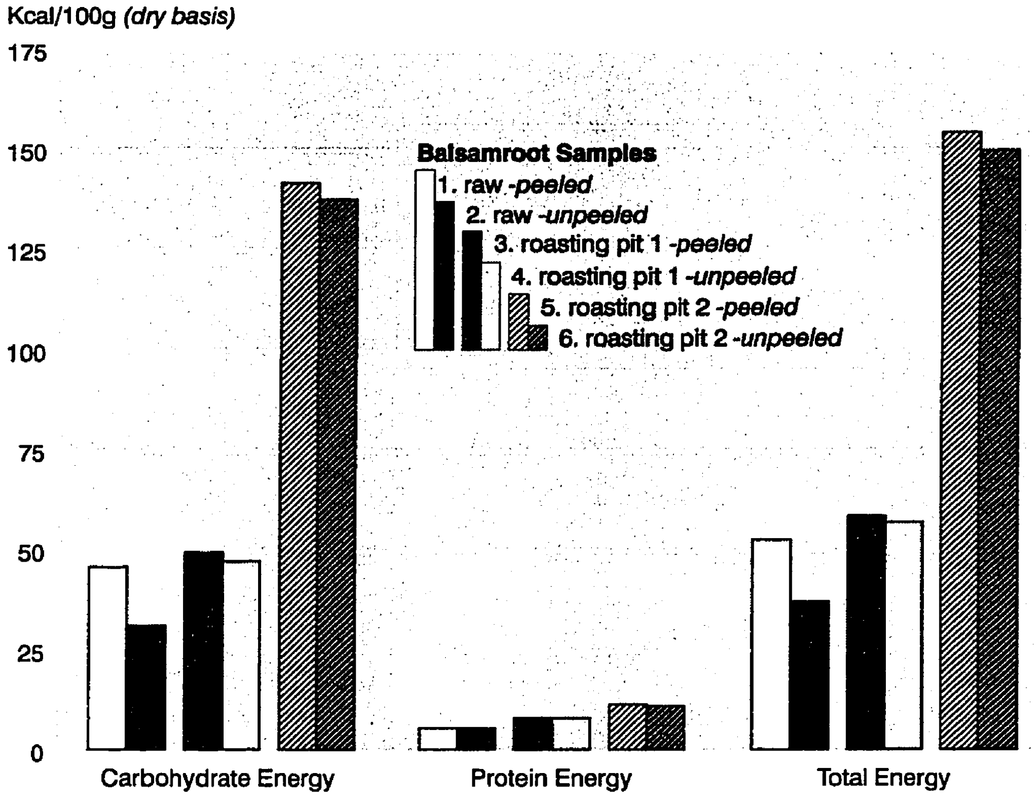

Figure 5.5: The energy values of raw versus pitcooked balsamroot.

result in an immediate loss of heat through transfer to the surrounding soils. This would not be a factor if the rocks were heated inside the earth oven.

As the temperature graph (see Figure 5.3) indicates, initial temperatures in RP#1 reached 90°C, however this was not maintained for any length of time and dropped into the 50-60°C range after several hours. In contrast, RP #2 reached a maximum temperature of 99°C and remained in the 90°C range for five hours before beginning to cool. Temperatures in the second roasting pit were approximately 20°C higher for a longer time than those in the first attempt.

Water is the second essential ingredient. The water added during pitcooking creates steam, which is known to enhance the digestibility of foods more effectively than dry heat. In starchy foods, for example, water swells the starch granules, increasing their solubility in the digestive tract (Stahl 1989).

Steam is also important to the release of the third ingredient -- volatile organic acids contained in certain species used as plant matting in earth ovens. According to Konlande and Robson (1972:194), "it is well known that plant materials contain volatile organic acids which are released when these materials are heated." John Mullin (pers. com. 1997) suggests the volatile acids, such as those contained in Douglas-fir, may be a critical factor in the chemical conversion of inulin to fructose. The "medicine-plants for pit-cooking" described by Lilly Harry may also contribute to this process.

In summary, pitcooking combines three key ingredients -- heat, moisture and volatile organic acids -- to drive the chemical changes necessary to convert inulin to fructose. These experiments confirm the earlier analyses of Yanovsky and Kingsbury (1931, 1938) concerning the content of balsamroot and lend support to Konlande and

Robson's (1972) insights. This research also underscores the effectiveness of traditional Interior Salish pitcooking practices in creating digestible carbohydrates high in food energy from raw, inedible root resources.

5.5 The Need for Stored Carbohydrates

Resources, no matter how abundant and productive, are of limited utility to a population if they cannot be preserved and stored for times of scarcity. Storage, as a method of extending the "time utility" of resources, therefore, is critical to successful overwintering in temperate regions.

Ethnographic evidence indicates the storage of carbohydrates derived from root foods was particularly important to the Secwepemc people, who set aside large quantities of these items for winter. Surpluses were stored in cache pits which were located in, or adjacent to, residences at winter villages and near productive resource locales.

Of particular interest to this discussion are those cache pits specifically utilized in the late winter and early spring, a period known to the Secwepemc as "cache food month" -- a time when they lived off stored supplies. Late winter-early spring is often the hunger season for hunter-gatherers in temperate regions, as stored foods may have become low or exhausted, game is lean and difficult to catch, and plants are not yet ready to harvest. It is at this point that access to stored carbohydrates would have been necessary.

Energy is the most essential nutritional need and digestible carbohydrates that can be converted into glucose and other simple sugars are important sources of food energy. Speth and Speilmann (1983:20) suggest:

> . . . in light of the greater protein-sparing capacity of carbohydrates compared to fat, and the higher essential fatty acid content of many plant foods, hunter-gatherers, when possible, may place equal or greater emphasis on building up storable carbohydrate reserves during the fall than on hunting (1983:20).

The "desultory" cultivation of plants by hunter-gatherers, in their view, is a buffering strategy to ensure a source of carbohydrates during seasons in which lean meat comprises a larger portion of the diet.

I concur and propose that root processing represents an additional buffering strategy adopted by the people of the Canadian Plateau. The preceding experiment has shown that pitcooking increases the productivity of a given quantity of inulin-rich root resources by creating significant increases in the caloric value of those roots. When combined with effective storage techniques, pitcooking acted to ensure a productive, reliable source of storable carbohydrates for overwintering.

5.6 Summary

The construction, use and maintenance of earth ovens by the Secwepemc and other Interior Salish peoples of the Canadian Plateau represents a significant investment in time, materials and social organization. This investment is more fully appreciated when the chemistry of pitcooking is understood.

The experimental results presented here indicate pitcooking was essential to transforming raw, inedible inulin-rich root resources, such as balsamroot, into sweet-tasting (due to the increase in fructose), digestible foods high in carbohydrate energy. This was accomplished through a unique combination of heat, moisture and volatile organic acids, which acted in concert to drive the chemical conversions. Traditional pitcooking practices, then, represent a method of increasing the productivity of a given quantity of root resources. Storage extended the availability of these carbohydrates to the critical period of late winter and early spring.

Secwepemc subsistence strategies emphasized the production of storable carbohydrates as means of coping with the seasonal and annual fluctuations in resource availability characteristic of northern temperate regions. These carbohydrates were obtained, in large part, through root foods. Plant processing technologies, such as pitcooking, were an essential component of these plant food production systems because they transformed inedible root resources into highly digestible sources of carbohydrate energy.

Chapter 6: A Model of Root Food Production for the Canadian Plateau

6.1 Introduction

Systems of wild plant food production are thought to represent a risk reduction strategy adopted by hunter-gatherers in temperate regions in response to recurrent food stress created by marked periods of resource abundance and scarcity. In particular, this strategy emphasizes the production of storable carbohydrates for overwintering. This is accomplished through the management, processing and storage of key plant foods, especially root resources. These activities act, both intentionally and incidentally, to enhance the productivity and availability of plant foods. Correlates of this process include increased population, increased sedentism and increased social complexity.

The ethnographic evidence presented in Chapters 3, 4 and 5 fits well with the general model of wild plant food production and indicates that systems of wild plant food production existed historically amongst the Secwepemc and other Interior Salish peoples. Further, the data demonstrate that roots, which represent dense sources of carbohydrates, were one of the principal plant foods managed, processed and stored.

Here, I refine the general model using evidence presented in the preceding chapters to develop a model of root food production for to the Canadian Plateau. To that end, this chapter summarizes the ethnographic, ethnobotanical and ecological data to identify the conditions, components, consequences and correlates of the ethnographically-documented systems of wild root food production. This information forms the framework for the exploration of the archaeological record of the Canadian Plateau in Chapters 7 and 8.

6.2 Specifying the Model

The general model of plant food production, derived from cross-cultural comparisons of hunter-gatherers from around the world, provides a framework for the development of a model of root food production specific to the Canadian Plateau. Based upon ethnographic evidence, the specifics are as follows:

Conditions: The Canadian Plateau is a land of contrasts. Two characteristics of this landscape are relevant to the discussion. The first is the diverse, dispersed nature of the resource base, which results from the complex interactions of climate and topography. The second is the marked seasonality typified by long cold winters and the short, hot summers and well-defined periods of resource abundance and availability and resource scarcity or inaccessibility. The picture is complicated by the fact that periods of resource plenty are subject to variations in productivity, some of which are relatively predictable (seasonal availability) and others which are much more stochastic (annual fluctuations).

One of the consequences of this pattern of predictable and unpredictable resource variation is the potential for recurrent resource stress. Ethnographic evidence suggests the Secwepemc and other Interior Salish peoples were well-acquainted with periods of food scarcity. The threat of famine was particularly acute during the late winter/early spring when stored supplies may have been exhausted, game was lean, and fresh plant resources were unavailable.

Solutions: The solutions to periods of resource stress may include cognitive, social or technological measures. These solutions are not mutually exclusive, nor hierarchical in the manner in which they are adopted. Thus, any or all of these strategies may be operating at one time or another. Further, it is often the perception of resource stress, rather than actual occurrence of resource stress, which motivates people to act. In this context, root food production represents a "technological" solution employed by the Secwepemc peoples to cope with recurrent resource stress.

Components: On the basis of the information presented in the preceding chapters, systems of root food production include three components: the management, the processing, and the storage of large quantities of resources for overwintering.

Ethnographic evidence indicates at least 20 root food staples were collected regularly as part of the planned and patterned seasonal round of the Secwepemc people. Families congregated in traditional root gathering grounds in upland valleys throughout the Plateau for weeks at a time during the spring and summer to harvest the various root resources as they "ripened" at differing locales. Root collecting was the responsibility of women and children, who through the use of a relatively simple technology, carefully harvested, weeded, tilled and tended root habitats. Their horticultural practices acted, both intentionally and incidentally, to ensure the continued productivity of these critical resources. In essence, the Secwepemc women "domesticated" the environment, creating productive patches of resources across the landscape of the Plateau.

Many of the root foods gathered were processed in earth ovens. Pitcooking of root foods (particularly those containing inulin) was essential to transform indigestible roots into valued foodstuffs high in carbohydrate energy. Therefore, earth ovens, and the significant investment of time, materials and social organization they represent, may be viewed as an additional method of increasing the productivity of root resources.

Finally, the utility of processed root resources was extended through time through preservation and storage. The storage of sufficient supplies of carbohydrates was critical to overwintering on the Plateau, particularly through the lean times of late winter and early spring.

Context: In order to fully appreciate and understand the role of root food production in traditional Secwepemc society, the broader socioeconomic context for root food production must also be considered.

It is evident from the ethnographic evidence that the Secwepemc and other Interior Salish peoples had a diversified subsistence economy based on wild plant food production as well as the collection of a variety of riverine, lacustrine and terrestrial resources. The successful exploitation of these diverse, dispersed resources necessitated a highly mobile seasonal round which ensured access to productive resource locales at critical periods. People were seasonally sedentary, wintering in large villages along the major rivers of the Plateau and travelling to known resource locales across the landscape in a systematic manner during the productive seasons of spring, summer and fall. The stochastic nature of the resource base was well recognized and subsistence efforts focused on obtaining sufficient supplies in times of plenty to ensure survival during times of scarcity.

Secwepemc social organization also reflects the exigencies of Plateau environments. Systems of kinship and reciprocity, flexible winter residency, and the various alliances must be viewed as social strategies to ensure access to resources in times of hardship. The evidence for social complexity, which appears to have been much more strongly expressed among those peoples in the mid-Fraser region, may also reflect differences in resource structure of the Plateau, or more particularly, differential access to and control over those resources.

In sum, root food production represents one component of a larger socioeconomic strategy employed by the Secwepemc to cope with the uncertainty of Plateau environments. This does not detract from the importance of root food processing in traditional economies. Rather, it serves to underscore the problems associated with well-defined periods of resource abundance and scarcity and points to the need to consider all aspects of socioeconomic strategies in reconstructing the "ethnographic pattern".

6.3 A Model of Root Food Production

Figure 6.1 presents the model of root food production for the Canadian Plateau. The foundations of this model were derived from the general model of plant food production articulated in Chapter 2 and made specific to the Canadian Plateau through the use of ethnographic, ethnobotanical and ecological evidence for root resource utilization by the Secwepemc and other Interior Salish peoples. The conditions, components, consequences and correlates of root food production, as outlined in the model, may be summarized as follows:

Conditions: Ethnographically, root resource production occurred under conditions of marked seasonality characterized by long, cold winters, and well-defined periods of resource abundance and scarcity. These conditions often led to recurrent resource stress amongst the Secwepemc peoples.

Solutions: As modelled, the solutions to resource stress may be cognitive, social or technological. Root food production represents a technological solution which

CONDITIONS		SOLUTIONS		COMPONENTS	CONSEQUENCES
Marked seasonality; long cold winters; well-defined periods of resource abundance & scarcity;	Recurrent resource stress in late winter & early spring	Increase the availability of stored carbohydrates for overwintering	Increase the productivity & availability of root resources	Root Resource Management at the Species, Community & Landscape levels	Enhances the density & distribution of root resources across the landscape
				Root Food Processing in Earth Ovens	Transforms inedible roots into digestible carbohydrates high in calories
				Root Food Storage	Extends the availability of food energy through the winter

CONTEXT:
- diversified subsistence economy
- seasonal transhumance
- varying degrees of social stratification and status differentiation

CORRELATES:
increasing sedentism, increasing populations, increasing social complexity

Figure 6.1: A model of root food production for the Canadian Plateau

increases the productivity and availability of resources, particularly carbohydrates, for overwintering.

Components: The components of ethnographically-documented systems of root food production include:

- the collection and management of root foods through a variety of horticultural practices;
- the processing of large quantities of roots in earth ovens;
- the storage of root resources for winter;

Consequences: Plant management, processing and storage, acted individually, and in concert with one another, to increase the productivity and availability of culturally significant root resources by:

- intentionally and incidentally increasing the density and distribution of root species, and thus enhancing the long-term productivity of root harvesting grounds;
- transforming indigestible root resources, particularly those containing inulin, into readily digestible, sweet-tasting food sources high in carbohydrate energy;
- extending the availability of root resources from the season of abundance into the season of resource scarcity through preservation and storage.

Context: Root food production existed ethnographically as a component of a socioeconomic system characterized by a diversified subsistence economy, seasonally transhumant populations who overwintered in semi-permanent residences, well-developed kinship networks and instances of social stratification suggestive of social complexity.

Correlates: The ethnographic context, in essence, represents a single point along the continuum of increasing sedentism, increasing population densities and increasing social complexity proposed as correlates of plant food production.

6.4 The Search for the Beginnings

The ethnographic evidence demonstrates that systems of root food production existed historically amongst the Secwepemc and other Interior Salish peoples of the Canadian Plateau. Root food production represents one component of a more extensive system of wild plant food production which functioned to increase the productivity and availability of plant resources for overwintering.

The challenge, now, is to determine when these systems first developed, under what conditions, and what, if any, were the consequences and correlates of these activities. To do this, we must now shift from the synchronic ethnographic evidence to the diachronic archaeological and paleoenvironmental data. Based on the preceding discussion, a number of expectations may be derived concerning the appearance of past systems of root food production in the archaeological record.

First, we would expect to see evidence of the various components of root food production: root resource management, root processing and root food storage.

Secondly, if root food production represents a response to recurrent resource stress triggered by well-defined periods of resource abundance and scarcity, then we would expect these systems to develop under conditions of marked seasonality, characterized by long, cold winters.

Finally, we might also expect the beginnings of root resource production to be set within a broader socioeconomic context characterized by:

- a diversified subsistence economy which emphasizes hunting, fishing and plant food production to varying degrees at different points throughout the year;
- a seasonally-transhumant population who were highly mobile throughout the productive seasons, and seasonally sedentary during the winter months;
- varying degrees of social complexity and status differentiation.

As modelled, the correlates of this include increasing sedentism, increasing population and increasing social complexity through time (*i.e.*, from the beginnings of root food production to the proto-historic period).

I turn now to a discussion of the archaeological record of Canadian Plateau and specifically, to the evidence for the emergence of systems of root food production.

Chapter 7: The Archaeological Evidence for Root Food Production

7.1 Introduction

In the preceding chapters, I drew upon ethnographic and ethnobotanical evidence to demonstrate that root food production represents one component of a much more extensive system of wild plant food production practiced historically by the Interior Salish peoples to cope with the sharply seasonal environments of the Canadian Plateau. Earth ovens, which transformed inedible roots into culturally-valued sources of food energy, were integral to these systems which sought to ensure a reliable, productive supply of plant foods, particularly carbohydrates, for overwintering.

In this chapter, I look to the archaeological record of the Canadian Plateau to trace the emergence of root food production. To that end, I examine the archaeological evidence for earth ovens. Earth ovens provide direct evidence of root processing activities, and, as suggested in Chapter 1, can serve as proxies for the range of activities associated with root food production, a position I develop in more detail in the following discussion. After this, I outline a set of expectations regarding the representation of ethnographically-documented root processing activities in the archaeological record. These expectations form the framework around which the archaeological data are presented and assessed.

Presentation of the evidence for prehistoric root food production begins with a case study of the archaeology of Komkanektwa, a traditional root gathering ground of the Kamloops Secwepemc peoples described at the outset which serves as the basis of this dissertation. This is followed by a review of the archaeological evidence from other upland root processing locales on the Canadian Plateau. One locality from the northeastern edge of the Columbia Plateau is also examined. This review of the archaeological data is not meant as an exhaustive treatment of the subject. My goal is to synthesize the data (much of which occurs in the "grey" literature), search for patterns, and assess whether these are consistent with the ethnographic expectations. In particular, I am interested in exploring what these data can tell us about the timing and development of root food production, and by inference, the emergence of systems of wild plant food production on the Canadian Plateau.

7.2 Pits as Proxies for Root Food Production

Root food production, as one component of systems of wild plant food production which existed ethnographically on the Canadian Plateau, involves a complex and integrated suite of activities and artifacts. As proposed in the model of root food production for the Canadian Plateau outlined in Chapter 6, these consist of: the collection and management of root resources; the processing of root foods in earth ovens; and the storage of root foods for overwintering.

Not all of these activities will leave signatures discernable in the archaeological record. For example, the activities and artifacts associated with root collecting are frequently "invisible" (Pokotylo and Froese 1983; but see Hayden and Schulting 1997 for a useful synthesis of the distribution of digging stick handles). Further, those artifacts which are visible will not necessarily be representative of, or directly related to, root food production (*e.g.*, multi-purpose stone tools). The challenge, then, is to uncover evidence of past plant use which is highly visible, directly related to root food production and amenable to analyses which will generate insights concerning the emergence of systems of wild plant food production.

Minnis (1985:40), acknowledges that changes in food-acquiring strategies through time are the most difficult to observe with synchronic ethnographic data but suggests where "intensification results in environmental alteration and permanent facilities, this strategy should be one of the easiest to observe archaeologically." Leaving the issue of environmental alteration aside momentarily, earth ovens, as enduring features, are well-suited to addressing issues of resource intensification for several reasons.

First, earth ovens are highly visible archaeologically. Their construction and repeated use for the processing of large quantities of root resources created relatively permanent features on the landscape: massive rock-filled basins and mounds several meters in diameter which are visible today in traditional root gathering grounds. Recall the words of George Dawson (1891:9), who notes:

> Such root-baking places are usually in the vicinity of root-gathering grounds, and after some years appear as low cones, from fifteen to twenty feet in diameter, with miniature craters in the middle. These might easily be mistaken by an imaginative antiquarian for old sacrificial sites, on account of the evident traces of fire which the stones and earth show.

Such observations are supported by a growing body of archaeological evidence from both the Canadian and Columbian Plateau (Pokotylo and Froese 1983; Alexander and Matson 1987; Thoms 1989; Simonsen 1994; Stryd 1995; Peacock, this study) and for other areas (see Thoms 1989 for a synthesis of the archaeological evidence for earth ovens in temperate regions of the world) which attest to the visibility of earth ovens on the landscape.

Secondly, earth ovens provide direct evidence of root resource use. Unlike lithic artifacts which may have served multiple functions, earth ovens were employed chiefly (but not exclusively) for the processing of large quantities of root resources. As I have argued, earth ovens were essential to the transformation of inedible root resources to highly digestible sources of carbohydrates and, therefore, must be considered an integral component of root food production systems. Earth ovens represent the range of activities associated with root food production, many of which are largely invisible to us archaeologically -- such as root collecting and the manipulation of specific plant communities. They are a direct link between present ethnobotanical knowledge and past subsistence strategies.

Finally, earth ovens are amenable to a variety of analyses. They contain clues concerning the kinds and quantities of root foods collected and consumed (and by inference, the productivity and sustainability of those resources), the technologies and materials used to process these resources, and the age of these activities. Changes in the size, shape, distribution and densities of earth ovens through time and space may reflect shifts in resource use strategies and social structures. Thus, investigations of the content and structure of earth ovens have potential to provide significant insights into the subsistence and settlement strategies of past Plateau peoples.

Evidence of environmental alteration can also play a supporting role, as suggested by Minnis (1985). Systems of wild plant food production include large-scale manipulations of plant communities. The extent to which these alter the environment is dependent upon the scale and intensity with which they are practiced. Landscape burning was perhaps the most dramatic form of plant management practiced by Plateau peoples. While burning can leave permanent traces, the evidence is often difficult to interpret (*e.g.*, natural versus anthropogenic) and may or may not be directly related to the management of an area for plant food production. Nonetheless, the study of pre-contact patterns of landscape burning have the potential to yield much information regarding past land management practices. Recent investigations of burning in traditional Sto:lo territory on the lower Fraser River show fire return intervals over the last 2500 years which appear to be consistent with patterns of anthropogenic burning (Lepofsky et al. 1998). However, patterns of human influences on past Plateau landscapes have not been sufficiently documented to permit us to examine how environmental alteration may relate to plant food production.

In sum, earth ovens are the most robust archaeological representatives of systems of root food production currently available. They are highly visible, they constitute direct evidence of root resource use (and by inference, of root collection, management and storage) and they are amenable to a wide range of analyses pertinent to broader questions of changing subsistence and settlement strategies. However, if we are to make interpretations regarding processes of root food production in the past, we must assess whether or not prehistoric earth ovens were functionally equivalent to those described ethnographically. What then are the archaeological implications of ethnographically-documented pitcooking practices?

If Plateau peoples of the past were using earth ovens in a manner consistent with ethnographic practices, then following Pokotylo and Froese (1983) and Thoms (1989), and based upon my own observations, a number of archaeological expectations may be derived regarding the representation of ethnographically-documented root processing activities. These include, but are not limited to:

Site Types and Distribution: Root processing sites (earth ovens and base camps) should be located in upland areas where there is an abundance of economically important root species, as well as sufficient materials for the construction and use of earth ovens, including water, firewood, vegetation for matting, and rocks for heating elements. As these sites were "well known and regularly visited," there should be evidence of repeated use and occupation.

Earth Oven Morphology: Surficially, the archaeological remains of earth ovens should resemble large circular, rimmed depressions and/or mounds, varying between 3 to 6 m in diameter and 0.5 to 0.75 m in depth, with traces of charcoal and fire-altered rock in the surface sediments. Excavations should reveal subsurface basins lined with quantities of flat rocks or large boulders to form the heating element. Fire-altered rock and charcoal should be present in the subsurface basin sediments as well.

Earth Oven Contents: Based on the ethnographic data, sediments associated with earth oven features should contain the carbonized remains of plant species used as fuel and matting. Ovens may also yield, depending upon the specific methods used in the preparation of roots for the oven (*e.g.*, stringing roots versus placing them in baskets), carbonized remains of plant foods. As other subsistence resources, such as game and fish, were occasionally cooked along with roots in the earth ovens, limited quantities of faunal remains might also be expected.

To explore the fit between the root collecting and processing activities of the ethnographic present with those of the past, I turn now to evidence for earth ovens from the Canadian Plateau, beginning with the archaeology of Komkanetkwa.

7.3 The Earth Ovens of Komkanetkwa: A Case Study

7.3.1 Introduction

Komkanetkwa, or the "place where the waters meet" is one of the traditional root gathering and processing grounds of the Secwepemc peoples (Turner and Peacock 1995). This broad, upland valley is situated above the confluence of the North and South Thompson Rivers on Kamloops Indian Reserve No. 1 at Kamloops, British Columbia. (Figure 7.1). The valley floor, at 600m in elevation, is surrounded to the north and south by steep slopes up to 1100m in height, and to the east by several higher mountain peaks. Paul Creek, a meandering stream, bisects the valley and flows into a small, narrow canyon marking the western extent of Komkanektwa.

Modern vegetation was established in the region by approximately 4000 years ago (Hebda 1995) and today three biogeoclimatic zones occur in the valley. These include the Bunchgrass, Ponderosa Pine and Interior Douglas-fir zones (Meidinger and Pojar 1991) within which there are nine distinct plant communities. Together, these plant communities provided the Secwepemc people with access to over 70 different plant species used as food (Table 7.1), medicines (Table 7.2) and materials (Table 7.3).

Of particular interest are the 17 edible root species identified in the region, many of which were traditionally pitcooked (Table 7.1). These root resources are distributed throughout a variety of habitats at differing elevations, often in considerable densities (Table 7.4). The abundance of balsamroot at Komkanetkwa is of considerable interest

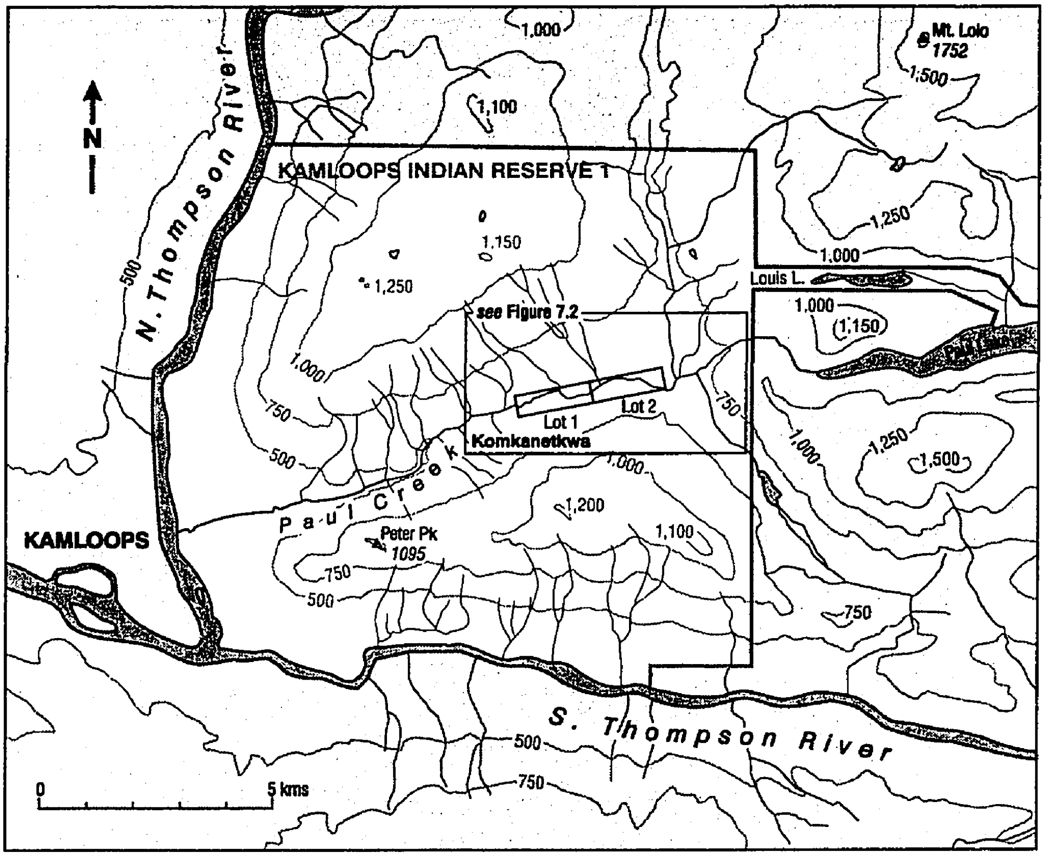

Figure 7.1: Map of the Komkanetkwa locale and surrounding area.

Table 7.1: Traditional Secwepemc Plant Foods and Plants Used in Food Preparation found in the Komkanetkwa Region (from Turner and Peacock 1995)

A. Root Vegetables (*regularly pitcooked; †occasionally pitcooked)

**Allium cernuum* (nodding onion)
**Balsamorhiza sagittata* (balsamroot)
†*Calochortus macrocarpus* (desert lily; mariposa lily)
**Cirsium undulatum* (wild thistle)
**Claytonia lanceolata* (mountain potato; spring beauty)
†*Fritillaria lanceolata* (chocolate lily)
†*Fritillaria pudica* (yellowbells)
**Lilium columbianum* (tiger lily)
Lomatium ambiguum (yellow-flowered desert parsley)
**Lomatium dissectum* (chocolate tips)
**Lomatium macrocarpum* (desert parsley)
Lomatium triternatum (narrow leaved desert parsley)
Osmorhiza chilensis (sweet cicely)
**Perideridia gairdneri* (wild caraway, yampah)
†*Potentilla anserina* (silverweed)
**Sium suave* (water-parsnip)
Taraxacum officinale (common dandelion)

B. Green Vegetables

Balsamorhiza sagittata (balsamroot)
Epilobium angustifolium (fireweed)
Heracleum lanatum (cow-parsnip; Indian rhubarb)
Lomatium dissectum (chocolate tips)
Lomatium triternatum (narrow-leaved desert parsley)
Opuntia fragilis (fragile prickly-pear cactus)
Taraxacum officinale (common dandelion)

C. Fruits

Amelanchier alnifolia (Saskatoon berry; service berry)
Arctostaphylos uva-ursi (bearberry; kinnikinnick)
Berberis aquifolium (Oregon-grape)
Cornus sericea (red-osier dogwood)
Crataegus douglasii (black hawthorn)
Fragaria virginana (wild strawberry)
Prunus virginiana (choke cherry)
Ribes cereum (desert currant)
Ribes inerme or R. irriguum (wild gooseberry)
Ribes lacustre (swamp gooseberry)
Rubus idaeus (wild raspberries)
Shepherdia canadensis (soapberry; soopolallie)
Viburnum opulus (highbush cranberry)

Table 7.1: Continued

D. Tree Inner Bark
Pinus contorta (lodgepole pine)
Pinus ponderosa (ponderosa pine)
Populus balsamifera ssp. trichocarpa (cottonwood)

E. Mushrooms, Lichens and Mosses
Bryoria fremontii (black tree lichen)
Tricholoma populinum (cottonwood mushroom)

F. Casual Foods and Flavourings
Pseudotsuga menziesii var. *glauca* (Douglas-fir - sugar; pitch for chewing)
Rosa woodsii (Wood's rose)
Rosa acicularis (prickly rose)

G. Beverage Plants
Mentha arvensis (field mint)
Shepherdia canadensis (soapberry; soopolallie)

H. Plants used in Pit Cooking Process (excluding foods)
Agropyron spicatum (bluebunch wheat grass)
Calamagrostis rubescens (timbergrass; pinegrass)
Elymus cinereus (giant wild rye grass) - stems and leaves possibly used;
Penstemon fruticosus (shrubby penstemon)
Picea engelmannii (Engelmann spruce) - wood for fuel;
Pinus contorta (lodgepole pine) - wood for fuel;
Pinus ponderosa (Ponderosa pine) - wood for fuel; needles for pit-cooking;
Pseudotsuga menziesii var. *glauca* (Douglas-fir) - wood for fuel; boughs for pit-cooking;
Betula papyrifera (white birch or paper birch) - wood for fuel;
Populus balsamifera ssp. *trichocarpa* (cottonwood) - wood for fuel;
Populus tremuloides (trembling aspen) - wood for fuel;
Rosa woodsii (Wood's rose) - branches
Rosa acicularis (prickly rose) - branches

Table 7.2: Traditional Secwepemc Medicinal Plants available in the Komkanetkwa region (from Turner and Peacock 1995)

Abies lasiocarpa (subalpine fir)
Achillea millefolium (yarrow)
Alnus crispa (creek alder)
Amelanchier alnifolia (Saskatoon berry; service berry)
Arctostaphylos uva-ursi (bearberry; kinnikinnick)
Artemisia frigida (northern wormwood)
Artemisia tridentata (big sagebrush)
Aster conspicuus (showy aster)
Berberis aquifolium (Oregon-grape)
Chrysothamnus nauseosus (rabbitbrush)
Clematis ligusticifolia (white clematis)
Clematis occidentalis (blue clematis)
Cornus sericea (red-osier dogwood)
Equisetum hiemale (scouring rush)
Heuchera cylindrica (alumroot)
Juniperus scopulorum (Rocky Mountain juniper)
Lonicera involucrata (black twinberry)
Mentha arvensis (field mint)
Medicago sativa (alfalfa)
Nuphar polysepalum (yellow pond-lily)
Penstemon fruticosus (shrubby penstemon)
Picea engelmannii (Engelmann spruce)
Pinus contorta (lodgepole pine)
Pinus ponderosa (Ponderosa pine)
Prunus virginiana (choke cherry)
Pseudotsuga menziesii var. *glauca* (Douglas-fir)
Ranunculus glaberrimus (sagebrush buttercup)
Ribes lacustre (swamp gooseberry)
Rosa acicularis (prickly rose)
Rosa woodsii (Wood's rose)
Salix spp. (willows)
Sambucus racemosa (red elderberry)
Shepherdia canadensis (soapberry; soopolallie)
Smilacina racemosa
Spiraea betulifolia (flat-topped spirea)
Symphoricarpos occidentalis (waxberry; snowberry)
Taraxacum officinale (common dandelion)
Urtica dioica (stinging nettle

Table 7.3: Traditional Secwepemc Plant Plant Materials available in the Komkanetkwa region (from Turner and Peacock 1995)

A. Woods and other Materials for Fuel
Alnus crispa (creek alder)
Artemisia tridentata (big sagebrush - smudge for mosquitoes)
Betula papyrifera (white birch; paper birch)
Picea engelmannii (Engelmann spruce)
Pinus contorta (Lodgepole pine)
Pinus ponderosa (Ponderosa pine)
Populus balsamifera ssp. *trichocarpa* (cottonwood)
Populus tremuloides (trembling aspen)
Pseudotsuga menziesii var.*glauca* (Douglas-fir)
Thuja plicata (western red-cedar)

B. Woods for Construction
Acer glabrum (Rock Mountain maple)
Alnus crispa (creek or green alder)
Amelanchier alnifolia (Saskatoon berry; service berry)
Betula papyrifera (white birch; paper birch)
Betula occidentalis (western birch; water birch)
Cornus sericea (red-osier dogwood)
Crataegus douglasii (black hawthorn)
Elymus cinereus (giant wild rye grass)
Juniperus scopulorum Rocky Mountain juniper)
Picea engelmannii (Engelmann spruce)
Pinus contorta (Lodgepole pine)
Pinus ponderosa (Ponderosa pine)
Populus balsamifera ssp. *trichocarpa* (cottonwood)
Populus tremuloides (trembling aspen)
Pseudotsuga menziesii var. *glauca* (Douglas-fir)
Salix ssp. (willows)
Thuja plicata (western red-cedar)

C. Fibres and Fibrous Materials
Acer glabrum (Rocky Mountain maple)
Artemisia tridentata (big sagebrush)
Betula papyrifera (white birch; paper birch)
Clematis ligusticifolia (white clematis)
Picea engelmannii (Engelmann spruce)
Scirpus acutus (round-stem bulrush)
Thuja plicata (western red-cedar)
Typha latifolia (cattail)

D. Dyes, Tanning Agents and Preservatives
Alnus crispa (creek alder)
Berberis aquifolium (Oregon-grape)
Letharia vulpina (wolf lichen)

Table 7.4: Densities of Culturally Important Root Vegetables in the Komkanetkwa Region (form Turner and Peacock 1995)

Species	Plant Community/Location	Plants/m^2
Allium cernuum	ravine, west end Paul Creek	60
Balsamorhiza sagittata	shrub-steppe, north side of valley	10*
Calochortus macrocarpus	shrub-steppe, east end of valley	40
	shrub-steppe, south side of valley	20
Claytonia lanceolata	fir woodland, east end of valley	200
Fritillaria pudica	shrub-steppe, south side of valley	20
Lomatium macrocarpum	shrub-steppe, south side of valley	20
	shrub-steppe, west end of valley	50
	shrub-steppe, east end of valley	17

**Balsamorhiza sagittata* is a very large plant and therefore, there are fewer per square metre. On the south-facing slopes, however, densities of balsamroot ranging between 15 to 30 plants/$2m^2$ have been observed.

to this discussion. Experimental harvest plots sampled in 1995 and 1996 revealed densities of between 450 to 800 plants per $10m^2$ over an area of approximately $2.5km^2$ on the upper south-facing slopes along the northern side of the valley. These densities suggest balsamroot may have been one of the key root resources cultivated, collected, and processed at Komkanetkwa.

Clues to the significance and duration of the relationship between the Secwepemc people and the plant resources of Komkanetkwa are concentrated in the valley bottom. Here, a series of systematic surveys of the region (Schurmann 1969; Rousseau and Howe 1987; Stryd 1989, 1995; Simonsen 1994), combined with small-scale excavations in 1992 (Simonsen 1994; Stryd 1995) and 1996 (Peacock, this study), identified 75 archaeological sites, including 61 root processing sites with 170 earth ovens, one multi-component campsite, a cache pit site containing 19 food storage pits, and 10 lithic scatters (Appendix 1, Table 1) (Simonsen 1994). The distribution of these sites is illustrated in Figure 7.2.

Komkanetkwa represents one of the most thoroughly investigated root processing sites on the Canadian Plateau, due to the fact that a small parcel of land along the valley bottom was the subject of recent litigation (*Jules et al. v. Harper Ranch et al.*). This land, referred to as "Scheidam Flats" and identified as District Lots 1 and 2 in Figure 7.2, was pre-empted from inclusion in the surrounding Kamloops Indian Reserve and granted to John Holland in October of 1872. Title to this property changed several times until March of 1955, when it was conveyed to Harper Ranch Ltd. In the late 1980s, the land was sold to a local developer whose proposed plans for the 130 hectare parcel included a golf course and housing development. In May of 1989, the

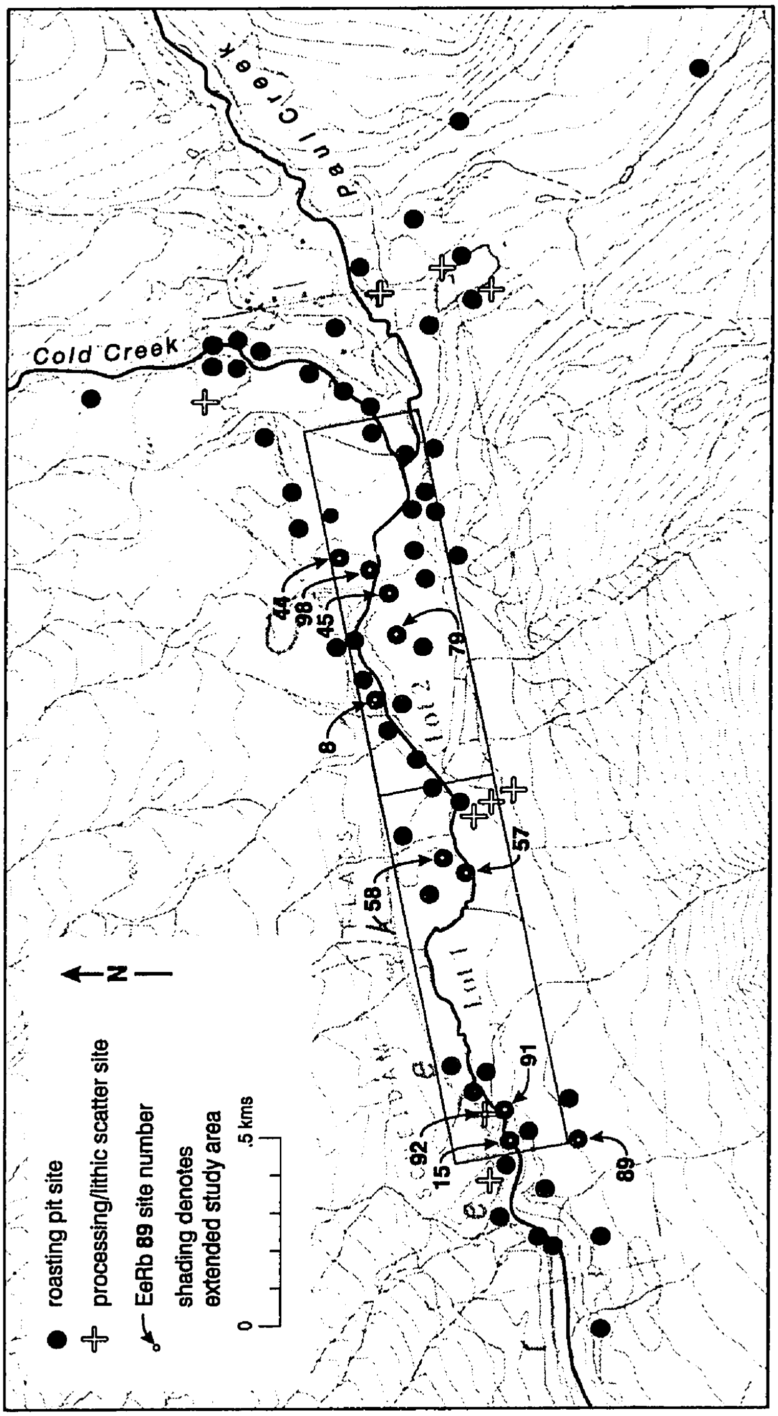

Figure 7.2: Map of the Komkanetwa locale showing the distribution of archaeological sites. Numbers identify sites discussed in the text.

Kamloops Indian Band (KIB) obtained an interlocutory injunction preventing the development from proceeding until the issue of land ownership had been settled (Simonsen 1994).

The early archaeological surveys of the region (Schurmann 1969; Rousseau and Howe 1987; Stryd 1989) established the significance of the heritage resources at Komkanetwka. As Rousseau and Howe (1987:10) observed after their 1979 inventory of the area:

> The Scheidam Flats roasting pit sites have a high potential for providing sorely needed information about an important seasonal (springtime) segment of prehistoric aboriginal subsistence and settlement practices. No other mid-altitude root processing locations in the Kamloops area are known to have comparably high densities of roasting pit sites. From a scientific perspective, the site cluster on Scheidam Flats is a unique and important archaeological resource.

Lawyers representing the Band reasoned that these archaeological resources, along with the oral testimony of Kamloops Indian Band members, could provide the necessary evidence of the long-standing use and occupation of the valley and its resources by the Secwepemc people. Consequently, in the spring of 1992, Komkanetkwa became the focus of intensive archaeological and ethnobotanical investigations designed to assess the nature, extent and age of the heritage resources of the valley. The archaeological investigations included a systematic survey of the valley bottom and surrounding hillsides by two teams of archaeologists, one (The Bastion Group) representing the Kamloops Indian Band (Simonsen 1994), the other (Arcas Consulting Archaeologists), the developer (Stryd 1995). The survey component was followed by small-scale test excavations at several sites. The ethnobotanical research included vegetation inventories and interviews with Band members (Turner and Peacock 1995). These multiple investigations played a pivotal role in the outcome of the land claim dispute, which was settled in favour of the Kamloops Indian Band.

My involvement with Komkanetkwa began in 1992 when I participated in the ethnobotanical research directed by Dr. Nancy Turner and in the archaeological survey and excavation program conducted by The Bastion Group. In 1996, with the permission of the Chief and Council of the Kamloops Indian Band and the support of John Jules, Director, Cultural Resources Management Program, I returned to Komkanetkwa to conduct small-scale excavations of seven earth ovens.

In summary, Komkanetkwa, with its unique combination of ethnobotanical data and cultural traditions, a high density of root processing sites, and extensive history of archaeological investigations, is one of the most thoroughly studied root collecting and processing locales on the Canadian Plateau and therefore has much to contribute to the study of the emergence of systems of plant food production in the region. The following discussion synthesizes the results of the archaeological investigations, with an emphasis on the earth oven features. Detailed discussions of survey methodologies, excavation procedures, site types and analyses are available in Simonsen (1994) and on archaeological site inventory forms on file with the Archaeology Branch of the British Columbia Ministry of Small Business, Tourism and Culture. Readers are referred to Turner and Peacock (1995) for a detailed discussion of the ethnobotanical resources of Komkanetkwa.

7.3.2 The Archaeology of Komkanetkwa

Survey Results: The site survey conducted by The Bastion Group included Lots 1 and 2, an arbitrary 250m strip of land paralleling the north and south sides of these lots. This "corridor" was extended downstream (west of the west boundary of Lot 1) for approximately 500m and upstream (east of Lot 2) for a similar distance. A 6-person crew surveyed this entire area following east-west traverses at 10m intervals.

The Arcas team re-surveyed this corridor and extend the boundaries to the north and south to include the slopes and upper elevations (up to 3200m) of Komkanetkwa where they conducted a series of transects down the numerous seasonal watercourses. Mid- and upper-elevation terraces were surveyed on a judgemental basis. The Arcas crew also extended the survey area to the east along Paul Creek to its outlet at Paul Lake and investigated the lower reaches of Cold Creek and a low-lying region to the south and east of Komkanetkwa.

The 75 archaeological sites identified in these surveys included root processing sites with earth ovens, lithic scatters, cache pits, and a multi-component campsite. The distribution of these sites is closely linked to the low, level terraces above the meander channel and floodplains of Paul Creek. In fact, the majority of sites are situated in a narrow band approximately 5km long and 0.5km wide along the valley bottom (see Figure 7.2).

The Root Processing Sites

Survey Results: Of the 75 sites, 61 (81%) are root processing sites, characterized by the presence of one or more earth oven features. The number of earth oven features at sites ranged from one to 12, with a mode of 1 and a mean of 2.8 (SD=2.33). The remains of prehistoric earth ovens are distinctive and readily distinguished from the surrounding terrain as large circular depressions or mounds. Shovel tests placed in either the rims or basins of these features reveal a matrix of dark, carbon-rich deposits, charcoal fragments and fire-altered rock.

Four types of earth ovens were identified at Komkanetkwa on the basis of surface morphology (after Thoms 1989). These are depicted schematically in Figure 7.3. The first is the basin-shaped oven (n=98), which has well-defined rims and central basin depressions. The second type is the mound oven (n= 10). These are built up to a height of between 35 to 60 cm and often have small depressions in the sides or tops of the mounds. The third type, the platform oven (n=11), is characterized by extensive scatters of fire-altered rock and dark, stained sediments, but these features lack prominent mounding. The fourth type, which is not described ethnographically, is the terraced oven (n=36). These are basin-shaped or platform oven features excavated into the slope of a terrace.

There is some variation within each of these categories in terms of how strongly the characteristics are expressed; many of the earth ovens are asymmetrical, and in the case of the basin-shaped oven, the prominence of the rims and the depth of the basin varies. There does not appear to be any patterning in the distribution of these earth oven types throughout the study area, with several types often occurring at one site.

Following the methodology of Pokotylo and Froese (1983), measurements of surface dimensions were recorded, when discernable, for each of the 170 earth ovens (Appendix 1, Table 2), including rim crest length (longest axis), rim crest width, basin

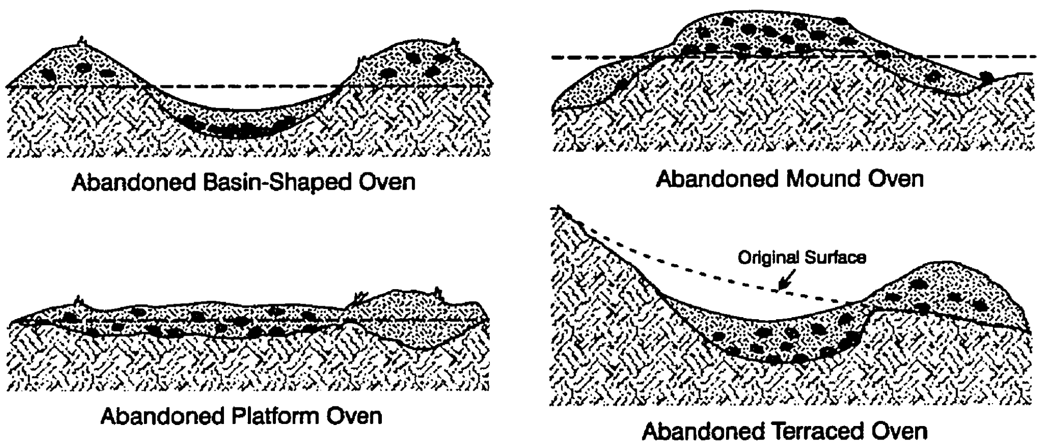

Figure 7.3: Earth oven types identified at Komkanetkwa (after Thoms 1989)

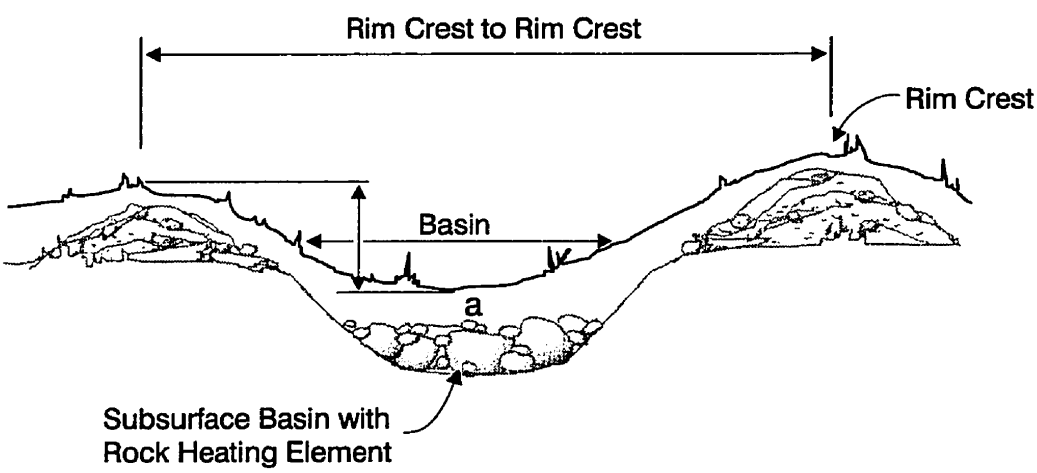

Figure 7.4: Schematic diagram of earth oven attributes (after Pokotylo and Froese 1983)

depth and the exterior edge diameter/length and width (see Figure 7.4). Results are summarized in Table 7.5.

To permit comparisons with data from other root processing sites on the Canadian Plateau, the rim crest length and rim crest width of 150 earth ovens at Komkanetkwa (for which accurate measurements were possible) were averaged to provide an estimate of rim crest diameter. As rim crest diameter is correlated with both basin depth and size of the subsurface basin (Pokotylo and Froese 1983; Peacock, in press), this measure serves as a convenient indicator of overall earth oven size. The rim crest diameters were classified in 0.5 m increments and presented in Figure 7.5. The average rim crest diameters range in size from 1 to 8.6m, with a mean of 3.51m (SD=1.21) and a median of 3.52m. The interquartile range is from 2.84 to 4.1m. These data are normally distributed (K-S z=.0875, P=.0069)) and show that the majority of the earth ovens are within the size range of 3 to 6m predicted by the ethnographic record.

Excavations: Eleven earth ovens were the focus of small-scale test excavations. These are identified by their site number in Figure 7.2. In 1992, four earth oven sites (EeRb 8, 44, 45, and 91) were selected for test excavations in order to obtain detailed information about the age and function of the sites. All excavation locations within site areas were judgmentally selected, using a variety of criteria, which included the size of the earth oven and its location in the valley (*i.e.*, east versus west) (Simonsen 1994).

An additional seven earth ovens were excavated in 1996 (Peacock, this study) to expand the sample size of excavated ovens and to gather additional information on subsurface structure, contents and age. In particular, the excavations sought materials

Table 7.5: Summary of Surface Measurements from Komkanetkwa Earth Ovens

Attribute	Range	Mean	Median	Mode	SD	IQR	No.
Rim crest length	1-8.6m	3.68m	3.6m	3.6m	1.26	–	150
Rim crest width	1-8.6m	3.35m	3.23m	2.9m	1.19	–	150
Average rim crest diameter	1-8.6m	3.51m	3.43m	3.5m	1.21	2.84 to 4.1m	150
Basin depth	0.08-0.8m	0.31m	0.30m	0.3m	0.14	–	137
Exterior edge length	3.2-9.4m	5.99m	6.0m	6.0m	1.64	–	65
Exterior edge width	2.8-8.6m	5.27m	5.15m	6.0m	1.47	–	56

Note: SD = standard deviation; IQR = interquartile range or midspread

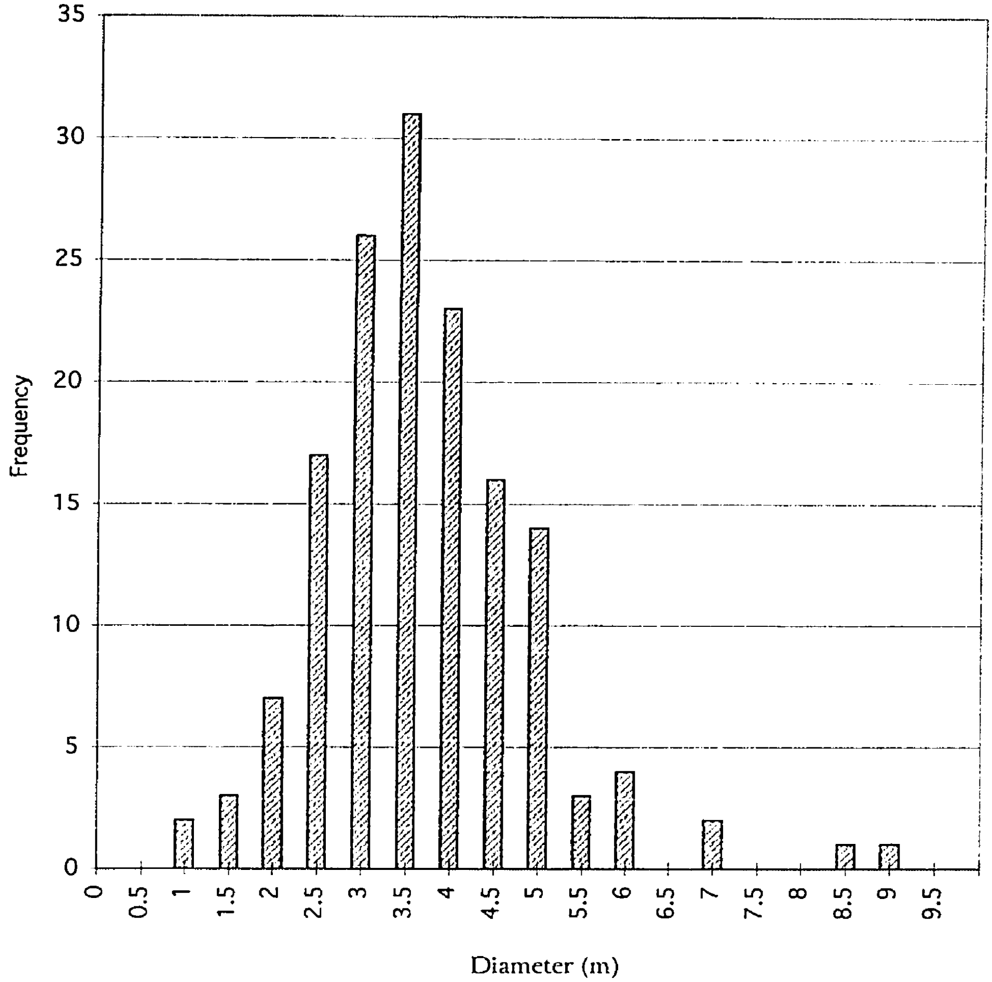

Figure 7.5: Average rim crest diameters of earth ovens at Komkanetkwa (n=150).

suitable for radiocarbon dating and sediment samples for archaeobotanical analysis. Criteria used to select features for excavation included the size, shape, and distinctiveness (or visibility) of the earth oven, as well as its location relative to other previously excavated sites. As Pokotylo and Froese (1983) and Thoms (1989) had suggested that the size of earth ovens varied through time -- the largest earth ovens representing the oldest features and the smallest, the most recent, the 1996 project sought to test and refine these observations. Accordingly, two "small" (1 to 3m), two "medium" (3 to 5m) and three "large" (greater than 5m) earth ovens were judgementally selected from several locations throughout the valley. The intent was to cover all portions of the valley as evenly as possible in the event that the temporal differences were spatially related (that is, all the old sites were at one end of the valley, for instance).

Research methodologies and standards differed between the two seasons. Earth ovens investigated during 1992 were excavated by 5cm arbitrary levels with all sediments being screened through 3.2mm (1/8") mesh. All units were 1.0 by 0.5m and were excavated to a least one 5cm level below cultural sediments into the underlying alluvial deposits. These excavation units combined to form 4.0 by 0.5m trenches placed to provide cross-sections of the earth ovens. Trenches at two of the larger earth oven sites (EeRb 44 and EeRb 45) were subsequently extended with a backhoe (Simonsen 1994).

In 1996, faced with a limited crew (2), a limited budget, and unlimited data requirements (!), I evaluated the pros and cons of a time-intensive controlled excavation (*e.g.*, 5cm arbitrary levels, screened sediments) versus a more expedient program of "chunking it out." After examining the results of the 1992 project and assessing my research objectives, I concluded a controlled excavation would not provide significantly greater insights into the structure and content of the earth ovens than the more expedient trenching method.

Accordingly, a trench 50 to 70cm wide was excavated through the centre of each of the seven earth ovens along the entire length of the longest axis (*i.e.*, from rim crest to rim crest). These trenches were excavated to at least 5cm below cultural sediments. This approach exposed the subsurface profile of the earth oven and permitted the collection of sediment samples for archaeobotanical analysis as well as the recovery of materials for radiocarbon dating. Results of the 1992 and 1996 excavations are summarized in Table 7.6 and described below.

The limited test excavations of these 11 earth ovens provide a picture of the subsurface structure and contents of such features (Simonsen 1994; Peacock, in press). Figure 7.6 depicts the profile of a "typical" oven (EeRb 89) excavated at Komkanetkwa. Basic subsurface morphology is characterized by a shallow, basin-shaped depression ranging from 1.5 to 4m in length excavated into alluvial silts and gravels to depths of between 25 to 80cm, with an average depth of approximately 50cm. A rock pavement, which forms the heating element of the earth oven, lines the bottom of the basin.

The matrix associated with earth ovens consists of brown to dark grey/black sediments characterized by silts, small gravels, wood charcoal and carbonized plant remains, and fire-cracked rock (FCR). Quantities of these materials differ between the rim and basin deposits, as well as between depths within the basin. Rim deposits are characterized by dark grey sediments (Munsell code 10YR 3/1), charcoal and small

Table 7.6: Summary data for excavated earth ovens at Komkanetkwa

Site and Feature No.	Rim Crest Length (m)	Rim Crest Width (m)	Avg. Rim Crest Diam. (m)	Sub-surface Basin Depth (m)	Sub-surface Basin Length (m)	Radiocarbon Age Estimate (years before present)
EeRb 8-5	2.6	2.4	2.5	25	1.8	70 ± 70 BP (Beta 57436) * 80 ± 70 BP (Beta 57437) **
EeRb 8-7	3.9	3.8	3.9	55	2.4	Not dated
EeRb 15-4	6.75	4.9	5.8	50	4.0	1060 ± 80 BP (Beta 97955)
EeRb 44-1	7.1	4.5	5.8	50	3.0	2360 ± 150 BP (Beta 57433)† 1660 ± 90 BP (Beta 57434)††
EeRb 45-2	5.2	5.1	5.15	50	3.8	1300 ± 50 BP (Beta 57435)
EeRb 57-1	7.0	6.3	6.65	70	3.8	1780 ± 80 BP (Beta 97956)
EeRb 58-1	5.7	5.5	5.6	55	3.0	Not dated
EeRb 58-2	2.75	2.5	2.6	30	1.7	160 ± 60 BP (Beta 97954)
EeRb 89-1	4.8	4.2	4,5	55	3.0	1830 ± 60 BP (Beta 97957)
EeRb 91-1	4.1	4.0	4.1	30 70	2.5 1.5	870 ± 50 BP (Beta 57439) Not dated
EeRb 98-4	2.8	2.5	2.7	50	1.8	Not dated

EeRb 8: * From basin deposits; **From rim deposits;
EeRb 44: †From lowest stratigraphic level; ††From upper stratigraphic level;

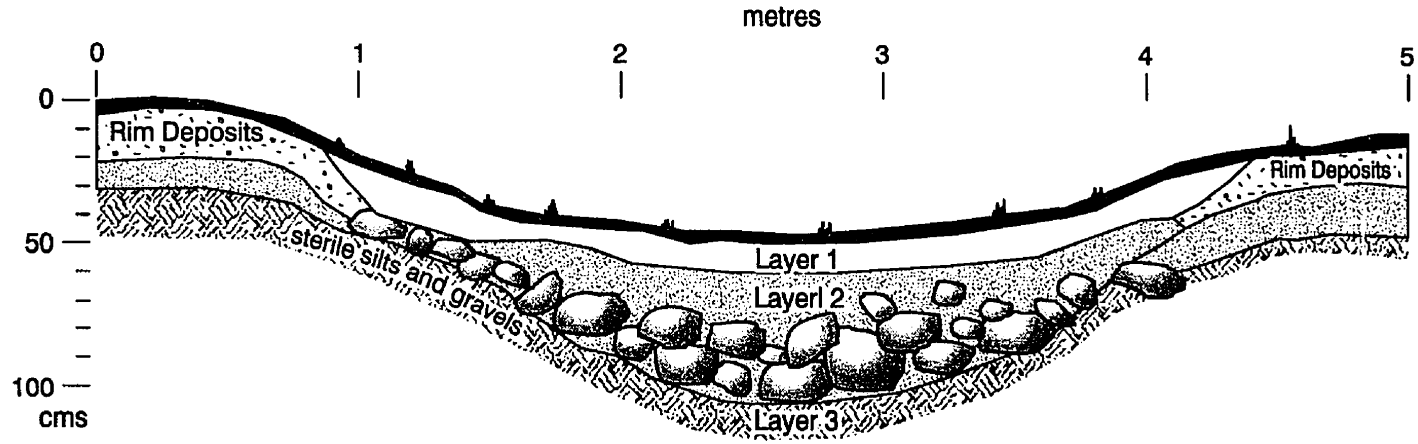

Figure 7.6: Schematic diagram of the profile of a typical earth oven at Komkanetkwa. The ovens are characterized by shallow, basin-shaped depressions ranging from 1.5 to 4m in length and excavated into alluvial silts and gravels to depths of between 25 to 80cm. A rock pavement, which forms the heating element of the oven, lines the bottom of the basin. Rim deposits contain small pieces of charcoal and fire-cracked rock, as do the greyish-brown sediments which comprise Layer 1 deposits. Layer 2 deposits are blackened, due to carbon-staining, and contain larger pieces of fire-cracked rock and charcoal. The third layer consists of sterile silts and gravels.

fragments of fire-cracked rock (< 5cm). The rim deposits are slightly mounded and extend approximately 1 to 2m around the edge of the subsurface basin.

Within the subsurface basin, three major stratigraphic layers are discernable. The first layer is visible immediately below the sod and consists of very dark greyish brown silts (Munsell code 10YR 3/2) mixed with charcoal, small pieces of fire-cracked rock (<10cm) and quantities of small gravels. Below this, the sediments became much blacker (Munsell code 10YR 2/1), a result of carbon-staining, and the size and the quantity of fire-cracked rock increase with depth in this layer. Fragments of fire-cracked rock range from 10 to 20cm in length and quantities recovered from excavation units (1.0 x 0.5 x 0.05m) in 1992 weighed anywhere from 15 to 40kg, with the largest quantities towards the bottom of the basin (Simonsen 1994). The base of Layer 2 is marked by the rock pavement or heating element. These rock pavements are made of cobble-to-boulder-sized stones ranging from 30 to 70cm in diameter and weighing as much as 25kg. The third and final layer occurs below the heating element and is characterized by yellowish-brown (Munsell code 10YR 7/4) alluvial silts and gravels that contain virtually no fire-cracked rock and only trace amounts of charcoal.

There were at least two exceptions to this pattern. The earth oven feature at EeRb 91 contains two superimposed rock-lined basins. Both basins are characterized by large amounts of fire-cracked rock, charcoal and a rock heating element. The upper basin occurs at a depth of between 15 to 30cm below surface; the lower, at a depth of 50 to 70cm below surface.

The other exceptional earth oven, EeRb 98-4, is unique among the excavated sample at Komkanetkwa. It is a small feature, measuring 2.8 x 2.5m, located at the edge of the terrace associated with the multi-component campsite EeRb 98 (see below). Unlike the other excavated earth oven features at Komkanetkwa, EeRb 98-4 did not contain a rock heating element and produced very little FCR (most of which was less than 10cm in length). A thin lens of charcoal occurred approximately 10cm below surface, beneath which there was a concentration of greyish-brown ash and silt. The main pit fill, immediately below this layer, consisted of a mixture of silts, ash lenses and small fragments of FCR. Of particular interest, however, are the two basalt bifaces recovered from the bottom of the feature, both of which were resting upon the alluvial gravels. These bifaces are similar to those recovered from a similar context at the Parker Site in Oregon Jack Creek (Rousseau et al. 1991).

As one of the main objectives of the 1996 excavations was to obtain sediment samples for archaeobotanical analysis, five-litre bulk flotation samples from cultural stratigraphic layers within each earth oven's centre and rim were collected. Control samples were also collected from non-feature areas at each site. All samples were measured to a standardized volume of one litre, floated using the modified-bucket technique (Watson 1976; Pearsall 1988) and the light fraction was poured into stacked 2.0mm and 0.5mm geological sieves.

Archaeobotanical Remains: A preliminary analysis of the archaeobotanical materials recovered during 1996 resulted in the identification of wood charcoal from Douglas-fir (*Pseudotsuga menziesii*) and cottonwood and/or aspen (*Populus* sp.), two tree species common in the region, from the earth oven features at sites EeRb 8 and EeRb 58 respectively (D. Lepofsky, pers. com. 1996). In addition, carbonized apical buds, tentatively identified as *Populus* sp., were recovered in 1992 from earth ovens at EeRb

44 (n=2) and EeRb 45 (n=1) (Hebda and Allan 1994).

The presence of carbonized remains of edible roots has not yet been confirmed by the preliminary analysis which has concentrated on the identification of wood charcoal. However, analysis of archaeobotanical materials from earth ovens in the Upper Hat Creek Valley identified food plants (*Allium* sp. and unidentified members of Asteraceae and Liliaceae), as well as species used as fuel (mostly coniferous species) and vegetable matting (Pokotylo and Froese 1983). Similar results might be expected from the earth ovens at Komkanetkwa, given the cultural and ecological parallels between the two locations.

Faunal Remains: Faunal remains were recovered at two of the earth oven sites in 1992. Flotation of sediment samples obtained from the rim of EeRb 45-2 revealed a small number of fish bones (n=15). The majority of these were burned. Only one specimen, a salmonid vertebra, could be identified. Two fish bones, one a salmonid vertebra, the other unidentifiable, were recovered from EeRb 91 (Crockford 1994).

Lithic Materials: Lithic materials were recovered from the excavated earth oven features in limited quantities. Excavations of the earth oven EeRb 44-1 in 1992 yielded two retouched flakes and lithic debitage (n=25). A single retouched cortex spall tool was found in EeRb 45, along with lithic debitage (n=4), and a single stone bead (Mason 1994). One utilized basalt flake and 14 pieces of basalt debitage were recovered from the 1992 excavations of the earth oven feature at EeRb 91. Excavations in 1996 recovered lithic materials in the pit fill at earth oven EeRb 98-4. These included a number of basalt (n=12) and chert flakes (n=5), and, as previously mentioned, two basalt bifaces.

Concentrations of lithic materials were found in association with at least two of the excavated earth oven sites, however. At EeRb 15, a small test unit (2m x 0.5m) excavated into this concentration to a depth of 15cm below surface yielded a total of 1029 flaked stone artifacts, including a microblade and microblade fragment both of vitreous basalt, two utilized basalt flakes and 1024 pieces of debitage. The latter were predominately basalt (n=1018); the remainder, chert (n=6) (Mason 1994). A surface scatter of lithic materials was also associated with the three earth ovens at EeRb 91 (Simonsen1994). Artifacts included a hammerstone, basalt bifaces, a basalt projectile point (Plateau Horizon, 2400 to 1200 BP), basalt flakes and a Walhachin chert flake.

Lithic scatters of varying sizes were also observed at 13 non-excavated earth oven sites (see Appendix 1, Table 1 for details).

The Antiquity of Root Processing Activities: Ten radiocarbon age estimates were obtained on charcoal and/or wood samples from eight of the 11 excavated earth ovens at Komkanetkwa (Simonsen 1994; Peacock 1996). These are presented with the excavation data in Table 7.6 and are depicted graphically in Figure 7.7. As indicated, radiocarbon age estimates were obtained from rim and basin deposits at EeRb 8 and represent the same event. At EeRb 44, radiocarbon age estimates were obtained from two different stratigraphic levels within the main basin fill. The older date of 2360 ± 150 BP comes from the bottom of the basin at a depth of approximately 50cm below surface. The younger date (1660 ± 90 BP) comes from the middle of the basin at a depth of approximately 30cm below surface. These two estimates are significantly different ($t = 2.63$, $P < 0.05$) and therefore provide age estimates for two different events.

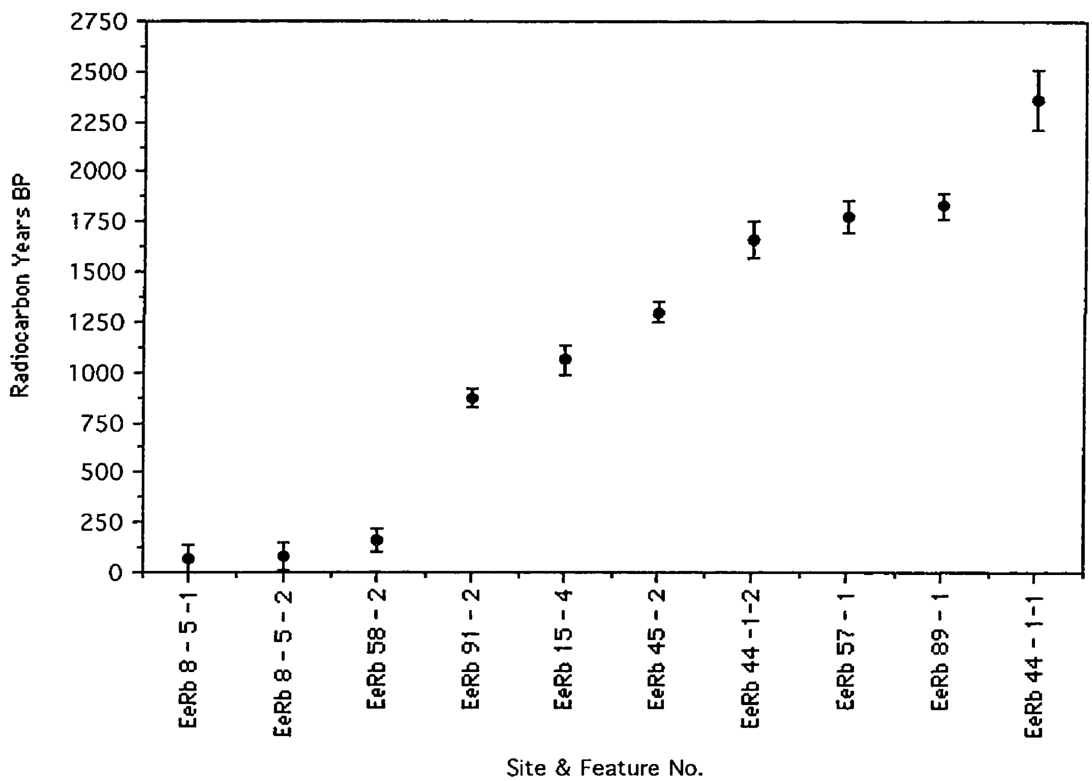

Figure 7.7: Radiocarbon age estimates from earth ovens at Komkanetkwa (n=10)

Radiocarbon age estimates from the roasting pits range from 70 ± 70 years BP to 2360 ±150 years BP, suggesting a continuity of root collecting and processing activities from approximately 2400 years ago until historic times. On the basis of the current evidence, there does not appear to be a relationship between the age of a processing site and its location in the valley bottom. Sites of a similar age are distributed throughout the study area *(e.g.,* EeRb 15, EeRb 89, EeRb 57, EeRb 45).

Site EeRb 98: A Multi-Component Base Camp

Site EeRb 98 was recorded and test-excavated during the 1992 field season and is reported fully in Simonsen (1994). It is situated at the east end of the valley on a low terrace immediately above the present course of Paul Creek. The site extends approximately 150m by 50m, and contains four earth ovens (one of which, EeRb 98-4 was excavated in 1996 as discussed above).

Lithic and faunal materials recovered from the four 1 x 0.5m units suggest the site functioned as a base camp where a number of activities took place, including pit cooking, stone and bone implement production, and the processing of a wide variety of mammals, birds, fish and shellfish (Simonsen 1994).

The lithic assemblage is dominated by debitage (n=1079) (Table 7.7). However, a number of formed (n=16) and flake tools (n=45), which included several diagnostic artifacts, were recovered. These include a pentagonal graver/drill similar to those associated with Kamloops Horizon (1200 to 200 BP) of the Late Prehistoric period. Also of interest are two stemmed basalt points, characteristic of the Shuswap Horizon (3500 to 2400 BP), and the single, barbed, basal-notched point, associated with the

Table 7.7: Summary of lithic and bone artifacts recovered from EeRb 98 (from Mason 1994)

Item	Number
Chipped Stone Artifacts	
Contracting-stem point (small)	2
Barbed basal-notched point (large)	1
Point tip	7
Drill	1
Continuous scraper	3
Pièce esquillée	2
Flake Tools	
Acute-angled utilized flake	7
Steep-angled utilized flake	7
Flake with acute-angled unifacial retouch	6
Flake with steep-angled unifacial retouch	2
Microblade	6
Microblade, proximal fragment	2
Microblade, medial fragment	3
Microblade, distal fragment	1
Miscellaneous Chipped Stone	
Steep-angled retouched/utilized slab/tabular material	1
Ground Stone Artifacts	
Disc bead	3
Debitage	
Platform remnant-bearing flake	198
Bifacial thinning flake	361
Flake shatter	505
Block shatter	15
Bone artifacts	
Awl point	4
Beaver incisor (fragment)	1
Miscellaneous Artifacts	
Ochre	1
TOTAL	1140

Plateau Horizon (2400 to 1200 BP) (see Richards and Rousseau 1987 for a detailed discussion of these cultural horizons and associated artifacts).

Table 7.8 presents a summary of the faunal remains. Mammals (including deer, elk, goat [or sheep], dog, bear, rabbit, squirrel, muskrat and beaver) make up 72% of all identifiable bone elements (n=1078). Nineteen percent of the sample includes fish, both salmonids and other fresh water species, in almost equal amounts. Salmon is represented by pectoral fin, tail or vertebral elements, which is consistent with consumption of preserved rather than fresh salmon. In contrast, freshwater fish remains were represented by both cranial and vertebral elements. Bird bone comprises 2% of the sample and includes eagle, swan, large grebe and grouse. The remainder consists of undetermined bird/small mammal. Most bone from this site is burnt (74%) (Crockford 1994 in Simonsen 1994).

On the basis of her analysis of the faunal materials from EeRb 98, Crockford (1995) concludes:

> Both resident terrestrial fauna (deer, elk, rabbit, grouse) and riverine/lacustrine fauna (mussel, salmon/trout, sucker, squawfish, chub, grebe, beaver, muskrat) make up the bulk of the diet. Incidental species (swan, eagle, goat/sheep?, fox, bear) indicate a wide ranging foraging strategy.

Diagnostic artifacts provide several relative dates for the occupation of EeRb 98. A series of projectile points and artifacts recovered suggests the site was occupied throughout the Late Prehistoric Period (4000 to 200 BP) (Simonsen 1994).

Table 7.8: Summary of faunal materials recovered from EeRb 98 (from Crockford 1994)

Faunal Group	Burnt (N)	Burnt (%)	Unburnt (N)	Total (N)
Salmonid	41	20.5	22	63
Fresh water fish	49	24.5	18	67
Unidentified fish	22	11	48	70
Total Fish	**112**	**56**	**88**	**200**
Ungulate	3	0.4	19	22
Large mammal	169	21.9	52	221
Other mammal	15	1.9	3	18
Unidentified mammal	409	52.9	103	512
Total Mammal	**596**	**77.1**	**177**	**773**
Bird/Small Mammal (undetermined)	75	91.5	7	82
Identified bird	2	87	6	8
Unidentified bird	12	52.2	3	15
Total Bird	**14**	**60.9**	**9**	**23**
TOTAL BONE	797	73.9	281	1078

Note: N = number of bone elements

EeRb 92: A Processing Site

EeRb 92 is a small site located on the northern the edge of Paul Creek towards the western end of Komkanektwa. Excavations of a 1m x 1m unit in 1992 revealed a variety of lithic artifacts and faunal remains, suggest to Simonsen (1994) that the site had been used for processing game, including land mammals, birds and fish. The age of this site is unknown.

The faunal materials included the fish (n=2), mammal (n=19), bird/small mammal (n=8) and bird (3). Unfortunately, these remains were highly fragmented and could not be identified to species (Crockford 1994).

A total of 97 lithic artifacts were recovered. Of these two are flake tools, and the remainder debitage associated with lithic reduction activities. Vitreous basalt accounts for 84.3% of all raw material, while chert (12.%%) and chalcedony (3.2%) make up the balance (Mason 1994).

EeRb 79: A Cache Pit Site

EeRb 79, which contains 19 cache pits, is the only site of this type at Komkanetkwa. It is located on a higher terrace approximately 100m south of Paul Creek and does not appear to directly associated with a campsite or root processing site. The nearest sites (EeRb 45, EeRb 84, EeRb 85) are approximately 100m east and west of EeRb 79. Originally recorded in 1989 (Stryd 1989), it was re-recorded, shovel-tested and test-excavated in 1992 (Simonsen 1994; Stryd 1995).

Systematic excavations of two depressions (EeRb 79-7, EeRb 79-8) and backhoe trenching of a third (EeRb 79-15), revealed small (approximately 2m in diameter) depressions, up to 1.5 meters deep, but lacking the charcoal and firecracked rock characteristic of earth ovens. These units did not contain any diagnostic materials, only surface lithic scatters in the general vicinity. Two of the sediment samples that were subjected to flotation contained a total of nine bone fragments. Although these were too small and fragmented for positive identification, they appear to be fish bone (Simonsen 1994).

Of particular interest is the presence of six tightly formed birch bark rolls, ranging from 5 to 10cm in length, recovered at 60 to 65cm below surface and from 130 to 150cm below surface during excavations of a cache pit EeRb 79-8. Birchbark was used ethnographically to line food storage pits (Dawson 1891:9; Teit 1900, 1906) and has been recovered from other excavated cache pits contemporaneous with the Plateau Horizon (Richards and Rousseau 1987) and later. A single radiocarbon age estimate from a sample of charcoal fragments recovered at a depth of 120 to 136cm below surface in the backhoe trench at EeRb 79-15 produced an age estimate of 2010 ± 110 BP (Beta 57438).

Lithic Scatters

Ten lithic scatters were recorded at Komkanetkwa, four in the western portion of the study area (*i.e.,* Lot 1), and six in the eastern area (see Appendix 1, Table 1 for listing). These are in addition to the lithic scatters associated with earth oven sites and discussed above. Sites EeRb 103, 104 and 105 are clustered together on a knoll at the eastern end of Lot 1. Similarly, sites EeRb 112, 114, 117 form another group at the very eastern extent of the survey area (see Figure 7.2). Surface scatters were left *in situ* and therefore, there are no further details available for these sites.

Summary of the Archaeology of Komkanetkwa

In summary, the archaeological data point to the role of Komkanetkwa as a root collecting and processing ground. The remains of earth ovens, still very visible, are concentrated along the valley bottom on the terraces above Paul Creek. These areas of low, level ground provide access to the abundant and diverse plant resources of the slopes above, as well as to water, firewood and other materials necessary for pitcooking. The presence of these features at Komkanetwka, along with lithic scatters, base camp and food storage facilities, is consistent with ethnographic expectations and conforms with archaeological evidence from other root gathering grounds on the Canadian Plateau.

Radiocarbon age estimates obtained from earth oven features suggest Komkanetkwa has been the focus of root collecting, processing and storage activities for approximately 2400 years. Diagnostic artifacts recovered from the multi-component campsite at EeRb 98 extend the history of human use and occupation of the valley to approximately 4000 years ago. In addition, a projectile point recovered from one of the surface lithic scatters is characteristic of the Early Nesikep Tradition, which dates to between ca 4500 and 8500 BP (Stryd and Rousseau 1996) on the Canadian Plateau. These early diagnostic materials suggest the human use of Komkanetkwa began several thousand years prior to the earliest known use of the earth ovens.

7.4 The Regional Evidence for Earth Ovens

To date, only a handful of upland root collecting and processing sites has been investigated on the Canadian Plateau. As a result, this aspect of past subsistence strategies is poorly documented and understood. A paucity of archaeological evidence for root resource use reflects the vision of Plateau archaeology which, driven largely by mitigation concerns, has focused on major river valleys rather than the mid and upper elevation environments where root collecting and processing traditionally took place (Pokotylo and Froese 1983; Richards and Rousseau 1987; Pokotylo and Mitchell, in press).

Figure 7.8 identifies those locales reviewed in this discussion. These may be classified as follows:

Locales on the Canadian Plateau within Interior Salish territory: In addition to Komkanetkwa, these include the Upper Hat Creek Valley (Beirne and Pokotylo 1979; Pokotylo 1978, 1981; Pokotylo and Froese 1983) and nearby Oregon Jack Creek Valley (Rousseau et al. 1991). Botanie Valley, near Lytton, is also included, although archaeological investigations in this locality are extremely limited (Baker 1975).

Locales on the Canadian Plateau outside Interior Salish territory: Potato Mountain, a traditional root-gathering ground of the Athapaskan-speaking Tsilhqot'in (Chilcotin) peoples, is located on the western periphery of the central Interior Plateau (Matson and Alexander 1987; Alexander and Matson 1990). Potato Mountain represents one of the few root-processing grounds documented on the Canadian Plateau and is included here because it provides useful comparative data.

Locales outside of the Canadian Plateau but within Interior Salish territory: Thoms' (1989) investigation of camas processing in the Calispell Valley in northeastern Washington is also included. This locality is situated within the traditional territory of

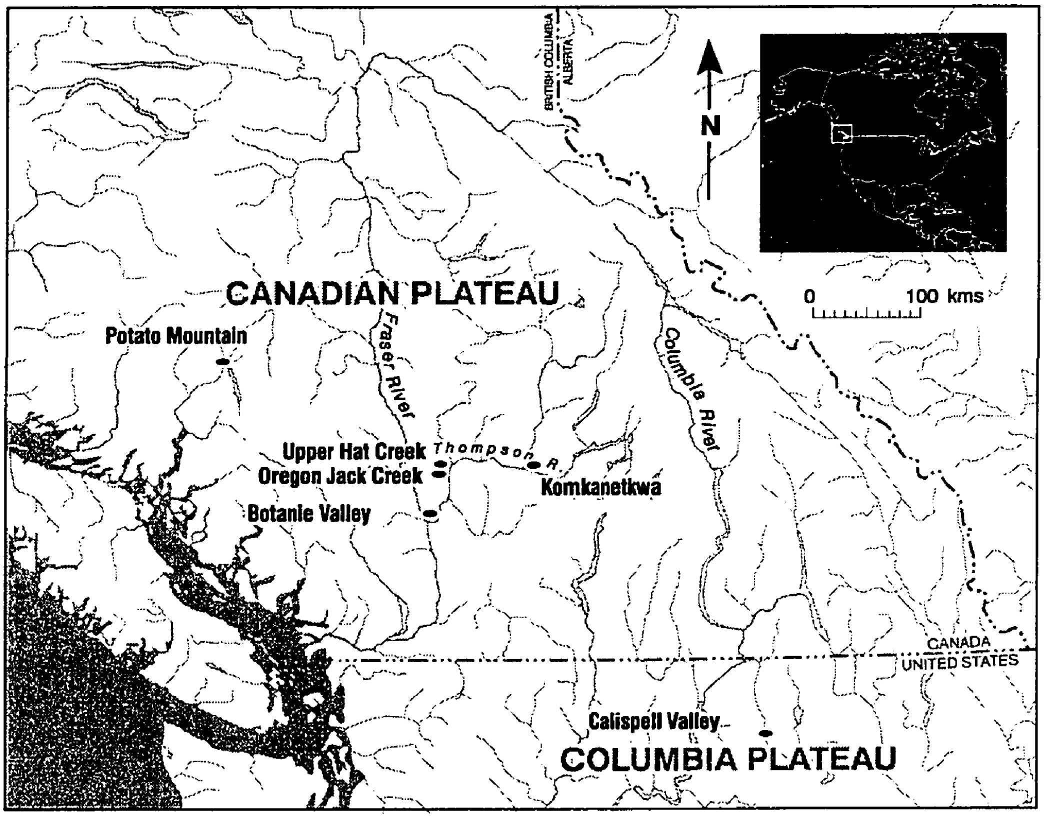

Figure 7.8: Map showing the location of the root collecting and processing locales discussed in this chapter. All are within the traditional territory of the Interior Salish peoples, with the exception of Potato Mountain, which is in Tsilhqot'in traditional territory.

the Interior Salish-speaking Kalispel peoples and provides an extra-regional perspective.

Several comments concerning the nature of the archaeological evidence for earth ovens are warranted. First, with the exception of the work by Pokotylo and Froese (1983), the remainder of the earth oven data dwells in that "grey" zone of unpublished consultant's reports and site inventory records, conference papers, manuscripts and dissertations. These sources are often difficult to locate and once they are retrieved and reviewed, one often finds the methods of data collection and reporting are inconsistent. Second, the grey literature contains several reports of earth ovens located in low-elevation riverine settings, including the Vallican site (DjQj 1) (Mohs 1982; Eldridge 1984), DjQj 18 (Choquette 1985) and in winter villages such as the Bell site (EeRk 4) (Stryd 1973), Keatley Creek (EeRl 7) (Brian Hayden, pers. com. 1998), and EeRc 44 near Kamloops (Pokotylo and Froese 1983). However, for the purposes of this discussion, I suggest these features are not functionally equivalent to the large concentrations of earth ovens found in upland root gathering areas. Nor is it certain, on the basis of current evidence, that these features were used for root processing. Teit (1900:235), for example, describes the use of square pits, lined with slabs of stone and plastered with mud, for rendering salmon oil, an activity which presumably took place in low elevation, riverine settings. For these reasons then, I include here only those ***upland*** root collecting and processing site locales that are ***sufficiently documented*** to compare with the case study from Komkanetkwa and that will permit meaningful analyses and interpretations regarding the emergence of systems of root food production.

The following summary is not an exhaustive review of all previous investigations. Readers are referred to the detailed site inventories and the various reports. My objective is three-fold: to present the dispersed data relevant to the current discussion in a consistent manner; to assess the fit between the observed archaeological data and ethnographic expectations; and to synthesize the data to identify broad patterns and trends in the nature and timing of root food production on the Canadian Plateau.

7.4.1 The Upper Hat Creek Valley Locality

The first detailed investigation of an upland root processing locale was conducted between 1976 and 1982 by Pokotylo and colleagues in the Upper Hat Creek Valley (Beirne and Pokotylo 1979; Pokotylo 1978, 1981; Pokotylo et al. 1983). In addition to providing data on what remains a relatively poorly documented aspect of prehistoric subsistence activities, the Upper Hat Creek Valley study also established a methodology for the documentation and analysis of earth oven sites and provided an insightful analysis of these features. Consequently, it has been influential in the work of subsequent investigators (Alexander and Matson 1987; Thoms 1989; Rousseau et al. 1991; Simonsen 1994) and in this analysis as well.

The Upper Hat Creek Valley is situated in the inter-riverine transition zone between the Fraser and Thompson Plateaux (Figure 7.8) and was used historically by both the Nlaka'pamux and the Secwepemc peoples (Teit 1900, 1909; Pokotylo and Froese 1983). The base of the valley is situated at an altitude of 1050m, while the surrounding mountains of the Clear and Marble Ranges reach as high as 2150m. Vegetation characteristic of the Ponderosa Pine - Bunchgrass, Interior Douglas-fir, Engelmann Spruce - Subalpine Fir and the Alpine Tundra biogeoclimatic zones occurs at various elevations throughout the valley.

A systematic survey of the valley floor, lower slopes and headwaters areas in the Clear Range identified a total of 223 archaeological sites. While lithic scatters dominated the observed site types (n=178), 44 sites were interpreted as prehistoric root processing areas based on the presence of "cultural depressions" interpreted as the remains of earth ovens (Pokotylo and Froese 1983). Altogether, 84 earth ovens were identified, "nearly all of which were located near streams and adjacent to plant communities with a variety of edible roots" (Pokotylo and Froese 1983:133). The majority of the earth ovens (n=49) occur in groups of two or more, with the largest number of depressions at any one site being ten. Thirty-two sites contain only one earth oven. Twenty-nine of the earth ovens are associated with lithic scatters.

Surface dimensions of each earth oven were measured and the following attributes recorded: rim crest to rim crest diameter, basin width and depth, and exterior edge diameter. These are summarized in Table 7.9 (see Appendix 1, Table 2 for details). Average rim crest diameter ranged from 1.65 to 6.95m, with a mean of 4.3 (SD=1.31) and a median of 4.23m. The interquartile range is from 3.35 to 5.37m. Following the methodology for the analysis of the earth ovens at Komkanetkwa, the average rim crest diameters of the Upper Hat Creek Valley features were classified into 0.5m increments and graphed. The results are shown in Figure 7.9. The rim crest diameters are normally distributed (K-S z=0.1183, P=0.0054).

Analysis of all of the surface attributes led Pokotylo and Froese (1983) to conclude that the surface diameters of the Hat Creek earth ovens overlap with the range of those recorded for housepits and cache pits in the major river valleys, making it difficult to infer the function of cultural depressions based on surface dimensions alone.

Table 7.9: Summary of surface measurements from earth ovens in the Upper Hat Creek Valley (from Pokotylo and Froese 1983)

Attribute	Range	Mean	Median	SD	IQR	No.
Avg. rim crest diameter	1.65-6.95m	4.30m	4.23m	1.31	2.85-4.1m	84
Basin depth	0.07-1.3m	0.32m	0.27m	0.23	--	84
Avg. exterior edge diameter	2.75-13.2m	7.84 m	--	2.43	--	84

Note: SD = standard deviation; IQR = interquartile range or midspread;

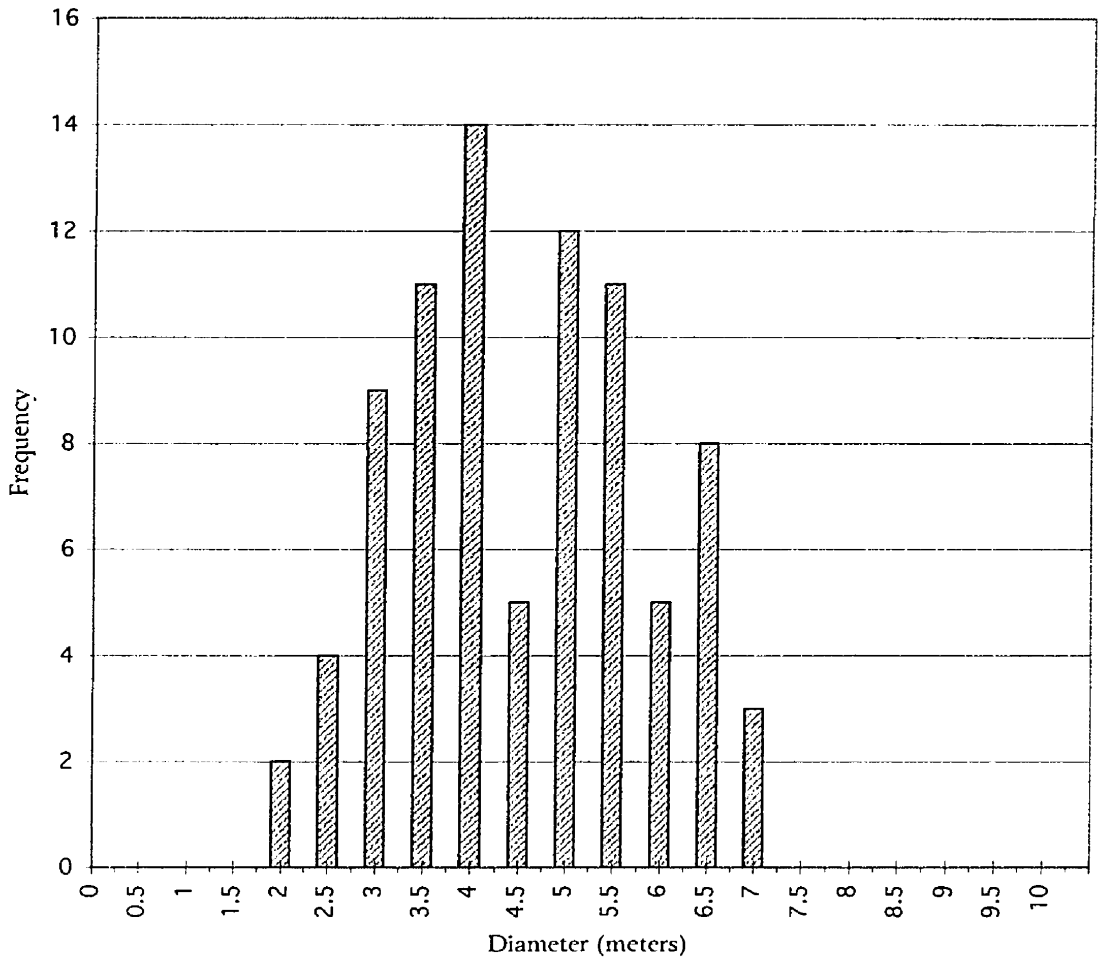

Figure 7.9: Average rim crest diameters of earth ovens in the Upper Hat Creek Valley (n=84).

Excavations of the earth ovens were more informative (Table 7.10). Test excavations of 15 cultural depressions revealed a mixture of burned earth, charcoal, ash and heat fractured rocks. Several of the pits were lined with large rocks, while others were dug into glacial gravels. There was also evidence of re-use suggesting that several of these earth ovens were associated with base processing camps established at strategic locations and re-occupied seasonally (Pokotylo and Froese 1983).

Analysis of carbonized floral remains preserved in the roasting pits provided information on food plants (*Allium* sp., and unidentified species of Asteraceae and Liliaceae), plant matting and fuel types. Coniferous needles and branches, as well as kinnikinnick (*Arctostaphylos uva-ursi*), were used as matting in the roasting pits, while various coniferous species were used as fuel. In addition, the roasting pits yielded faunal remains of mule deer, elk, grouse and fish (Pokotylo and Froese 1983).

Thirteen radiocarbon age estimates were obtained on charcoal from 11 of the excavated earth ovens (Figure 7.10). These range from 2245 ± 50 BP (S-1642) to 600 ± 40 BP (S-1581), with approximately half clustering around 2000 BP (Pokotylo and Froese 1983).

Pokotylo (1978, 1981) also undertook a technological analysis of the stone tools and debitage associated with the earth ovens. This research suggests these lithic assemblages reflect differences in the intensity of site occupation and the relative emphasis on maintenance versus extractive activities. According to Pokotylo (1981:387):

> Sites with cultural depressions occur [two groups] both of which are interpreted to represent a wide range of tool manufacturing activities. This association supports the hypothesis of intensive utilization at

Table 7.10: Summary data for excavated earth ovens at Upper Hat Creek Valley (from Pokotylo and Froese 1983)

Site and Feature No.	Rim Crest Diameter (m)	Basin Depth (m)	Subsurface Basin Length (m)	Radiocarbon Age Estimate (years before present)
EeRj 1-9 Rock basin 1	5.4	0.08	n/a	970 ± 55 BP (S-1579)
EeRj 1-9 Rock basin 2	5.4	0.08	n/a	2030 ± 45 BP (S-1580)
EeRj 46-1	5.2	0.36	3.4	1550 ± 60 BP (S-1454)
EeRj 55-1	6.8	0.73	5.0	1220 ± 70 BP (S-1455)
EeRj 55-2	3.6	0.09	2.0	600 ± 40 BP (S-1581)
EeRj 71-1 Rock basin 1	5.55	0.29	n/a	2120 ± 65 BP (S-1453)
EeRj 71-1 Rock basin 2	5.55	0.29	n/a	2245 ± 50 BP (S-1642)
EeRj 93-1	3.65	n/a	n/a	1270 ± 140 BP (SFU 277)
EeRj 101-1	3.6	0.20	2.7	2090 ± 65 BP (S-1456)
EeRk 42-1	4.10	0.33	n/a	1940 ± 100 BP (SFU 278)
EeRk 43-1	6.36	0.34	n/a	2000 ± 160 BP (SFU 381)
EeRk 53-1	3.35	0.11	n/a	790 ± 120 BP (SFU 280)
EeRk 53-2	2.65	0.11	n/a	700 ± 100 BP (SFU 365)

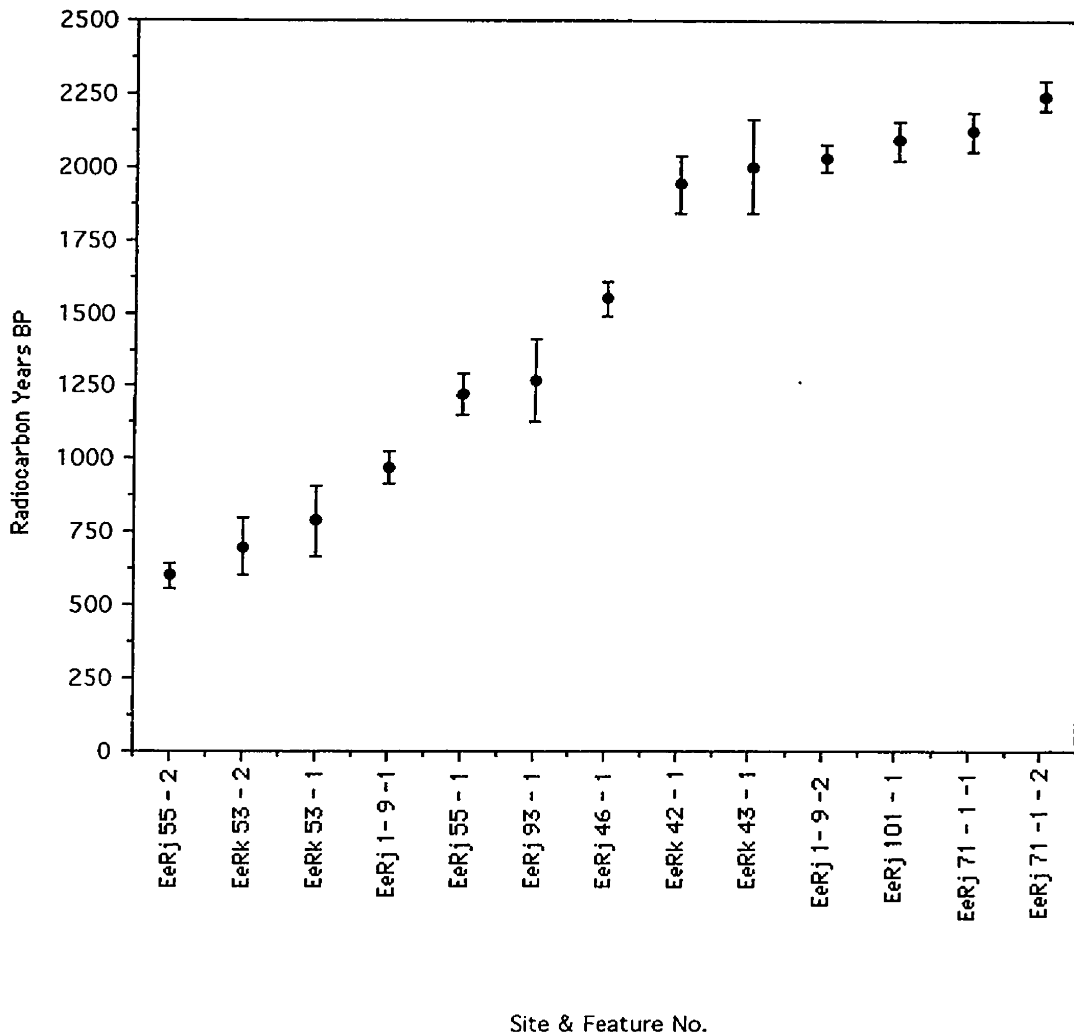

Figure 7.10: Radiocarbon age estimates from earth ovens in the Upper Hat Creek Valley (n=13).

> cultural depression locations. Sites with cultural depressions had a basic extractive use involving the processing of vegetal resources, although it is probable that a portion of the plants were immediately consumed at camps which were base settlements for gathering activities. At the sites, both maintenance and extractive tasks would likely be performed.

However, in their 1983 publication, Pokotylo and Froese acknowledge that while lithic implements were undoubtedly used in plant processing, it is difficult to differentiate these task-specific lithic remains from those associated with general camp maintenance activities. They conclude that while statistical tests demonstrate some relationships between lithic scatters and earth ovens that reflect the general nature of the site, "lithic data alone are insufficient to identify root processing activities" (Pokotylo and Froese 1983:145).

In summary, three types of root processing base camps were distinguished in the Upper Hat Creek Valley. These include: 1) sites with only cultural depressions; 2) sites with small, single-use cultural depressions and lithic scatters reflecting extractive activities; and 3) sites with large multiple-use cultural depressions and lithic scatters produced by maintenance activities (Pokotylo and Froese 1983). Pokotylo and Froese suggest the correlation of earth oven diameters with lithic assemblage artifact counts indicates that the site types reflect a continuum of site-specific activities and occupation intensities.

Although they note that the sample of dated earth ovens is too limited to permit reliable statements concerning the maximum antiquity of root processing on the Canadian Plateau, Pokotylo and Froese conclude that in the Upper Hat Creek Valley, earth ovens, and by inference, root collecting activities, were well established by approximately 2250 BP. Further, they suggest that the period between 2500 to 1200

BP represents a time of more intensive root resource gathering relative to the following Kamloops Phase (1200 to 250 BP) and the ethnohistoric period.

7.4.2 The Oregon Jack Creek Locality

The Oregon Jack Creek Valley, located to the south and east of Hat Creek, was the site of another large-scale investigation of an upland area on the Canadian Plateau (Rousseau et al. 1991). Oregon Jack Creek is a small tributary of the Thompson River and is cradled between the east-west trending Cornwall Hills and White Mountains (see Figure 7.8). The upper, or western portion of the valley rests at an elevation of 1220m, while the lower reaches, where the valley joins with the Thompson River valley approximately 15km southwest of Ashcroft, are situated at 670m. The upper and central portions of the valley are dominated by vegetation characteristic of the Interior Douglas-fir and Ponderosa Pine biogeoclimatic zones, while the lower portion is characterized by open grasslands and the shrub-steppe of the Bunchgrass zone. A number of edible root species are present in the valley, most notably balsamroot, and in the lower reaches, bitterroot (Rousseau et al. 1991).

Like the Hat Creek Valley, Oregon Jack Creek was used traditionally by both the Secwepemc and Nlaka'pamux peoples. Ethnographic evidence indicates the village "*nte qEm*" (Muddy Creek) of the Spences Bridge Band of the Nlaka'pamux was located approximately two kilometres upstream from the Thompson River (Teit 1900:173) (see Alexander in Rousseau et al. 1991 for a thorough discussion of the ethnographic information for the region).

Surveys of the valley bottom and terraces of Oregon Jack Creek, as well as the area surrounding a nearby lake, conducted by the Department of Archaeology, Simon Fraser University in 1987, 1988 and 1989, identified a total of 67 sites, 38 of which contained a total of 100 earth ovens (Rousseau et al. 1991). Only one of the earth oven features was excavated (see below). Four localities were surveyed: upper Oregon Jack Creek, east-central and lower Oregon Jack Creek, and Woodcutter Lake. In the following discussion, the earth oven data from each of these localities is briefly reviewed and summarized. Although I have treated these separately in the text, the relevant data from each locality are amalgamated and included simply as Oregon Jack Creek in Table 3 of Appendix 1.

Upper Oregon Jack Creek: In 1988, a complete, systematic, ground-surface reconnaissance survey of the valley bottom and terraces along the north side of the upper or western portion of Oregon Jack Creek identified 21 archaeological sites. Of these, 12 sites containing a total of 32 earth oven depressions were recorded. Five are associated with lithic scatters (Rousseau et al. 1991).

Following the lead of Pokotylo and colleagues, researchers recorded the surface dimensions of the earth ovens. According to Rousseau et al. (1991), the rim crest diameters of the roasting pits range from 2.0 to 7.0m, with a mean rim crest diameter of 3.8m and a mode of 3.0m. Measurements of the surface rim to the depth of the basin range from 20 to 80cm, with a mean of 48cm and a mode of 40cm (Rousseau et al. 1991:156) In reviewing these statistics, Rousseau et al. (1991) suggest the values are roughly compatible with those determined for earth oven features in Upper Hat Creek Valley and at "Scheidam Flats" (*i.e.*, Komkanetkwa). As earth oven features from the former site date to between 2500 to 1200 BP, Rousseau et al. suggest those from Oregon Jack Creek may date to this time period as well.

Two sites in Upper Oregon Jack Creek warrant further discussion. The first is the Landels site (EdRi 11). Located in the upland area of the Oregon Jack Creek Valley of the Thompson River region, it yielded a cultural component 10 to 25cm below Mazama tephra (ca. 6800 BP). Deer bone fragments provided a radiocarbon age estimate of 8400 ±90 BP (SFU-867) (Rousseau et al. 1991), making this the oldest excavated upland site on the Canadian Plateau. There is evidence for repeated occupation of the Landels site throughout the last 7000 years.

The excavated pre-Mazama component at the Landels site yielded 70 bone fragments, weighing a total of approximately 80 grams. Although most were unidentifiable, 12 were positively identified as deer and one as a muskrat-sized mammal (*Cricetidae*) (Rousseau et al. 1991:109).

Of note are the seven earth ovens also associated with the Landels site, three of which range between 6 and 7m in diameter. Unfortunately, none of the earth ovens was excavated, and no mention is made of presence of these features in the published journal article which presents the Landels site as the locus of intensive deer hunting throughout last 8500 years (Rousseau 1993:156). However, in the unpublished permit report, the authors acknowledge that root collecting and processing activities were conducted at the Landels site during its most intensive occupation between 2400 and 1200 BP when the site was repeatedly used as a "springtime residential base camp from which logistical forays (notably deer hunting and root gathering expeditions) were dispatched" (Rousseau et al. 1991:111).

The Parker site (EdRi 27), which currently represents the oldest dated earth oven on the Canadian Plateau, is the other noteworthy site located in the Upper Oregon Jack Creek Valley. Here, a small basin-shaped depression, discovered eroding out of a road cutbank, was excavated in 1989. The depression measures approximately 1.5m in diameter and is approximately 0.5m in depth and although it lacks a rock heating element such as those described ethnographically, Rousseau et al. (1991) interpret this as an earth oven. Analysis of the light fractions of a flotation sample from the lowest stratum revealed the presence of charcoal (which presumably was not identified as it is not listed in the report), as well as a single seed of either Oregon grape (*Berberis* sp.) or soapberry (*Shepherdia canadensis*), and a partially burned birch bark fragment (Rousseau et al. 1991:119). In addition, nine unidentifiable fish bones were recovered from the lowest level.

A radiocarbon age estimate of 3130 ± 100 BP was obtained from charcoal from the bottom of the earth oven feature. Of particular interest are the five basalt knives, characteristic of the Shuswap Horizon (3500 to 2400 BP), which were recovered from the bottom of the Parker site earth oven where they were resting on the sterile, underlying sediments (Rousseau et al. 1991:Figure 65). Rousseau et al. (1991:121) suggest these knives were "used to prepare bitter-root and balsamroot shoots and roots, which accounts for their low incidence of microwear and edge damage". The investigators assume a primary depositional context for these artifacts, which may seem a somewhat questionable assumption given the formation processes associated with earth oven construction and use. However, basalt bifaces resembling those from the Parker site have now been recovered from similar depositional contexts in at least four other earth ovens in the region. These include: two basalt bifaces recovered from EeRb

98-4 at Komkanetkwa; one biface from Keatley Creek (EeRl 7) (Brian Hayden, pers. com. 1998); a basalt biface, recovered at 82cm bs in an earth oven in the Twaal Valley (EdRi-T1), approximately 10km south of Oregon Jack Creek (Millennia Research 1997); and a basalt biface from an earth oven at EcRi-T4 in the Skoonka Creek watershed, approximately 10 km west of Spences Bridge (Millennia Research 1996). This evidence suggests the placement of bifaces at the bottom of earth ovens may be intentional, although the motives for this behaviour are unknown.

In summarizing the earth oven feature at the Parker site, Rousseau et al. (1991:121) conclude:

> Several salient trait differences are apparent between the initial use of Pit Feature 1 and earth ovens typical of the ensuing [2400 years]. Although the general conformation of the initial pit is similar, it is smaller than most [ovens dating to this time], and it lacks large quantities of fire-altered rock and charcoal typically associated with most later ovens. The presence of the knives is also unusual, since lithic items of any kind are usually absent from most later ovens.

East Central & Lower Oregon Jack Creek: The east-central and lower portions of Oregon Jack Creek and the areas immediately surrounding nearby Woodcutter Lake were the focus of investigation during the 1989 field season. Following the methodology established in the preceding year, a complete, systematic ground surface reconnaissance survey of the valley bottom and terraces on both the north and south sides of Oregon Jack Creek was completed. In addition, an area of approximately 1.5km^2 was surveyed around Woodcutter Lake. The survey program identified a total of 46 sites, including 24 roasting pit sites, in three areas: east central Oregon Jack Creek, lower Oregon Jack Creek and Woodcutter Lake. Each of these areas will be reviewed briefly.

Survey of the east-central portion of Oregon Jack Creek resulted in the identification of eight sites, seven of which contain depressions interpreted as earth ovens. A total of 17 earth ovens was recorded, with rim diameters ranging from 2 to 4.5m and basin depths ranging from 0.25 to 0.75m. Six of the sites contain low to medium lithic scatters likely related to hunting or short-term field camp domestic activities (Rousseau et al. 1991). While none of the earth oven sites was dated directly, diagnostic artifacts recovered suggest the valley was used for hunting and root resource processing during the last 2400 years (Rousseau et al. 1991:234). This interpretation, they suggest, is consistent with the results of the 1988 survey of the west-central aspect of the valley.

A total of 28 sites was identified in the lower reaches of Oregon Jack Creek during the 1989 survey. Of these, 25 are lithic scatters of varying sizes. According to Rousseau et al. (1991:234) "small circular depressions" were observed at 11 sites. While most of these appear to have functioned as root processing ovens, a few may also have been cache pits. Surface dimensions of the 21 cultural depressions show rim diameters ranging from 1.5 to 4m and basin depths from 0.25 to 0.75m.

Diagnostic artifacts indicate extensive use of this region during the Late Prehistoric Period. A few sites have evidence of earlier occupations. Rousseau et al. (1991:234) suggest the region was used primarily for hunting and short-term seasonal (non-winter) field camp activities.

The Woodcutter Lake locality is located approximately three kilometres north of Oregon Jack Creek. The shallow, ephemeral lake is fed by a marshy spring and is bordered on the southwest by an extensive grassland area known as "Thousand Flats." According to Rousseau et al. (1991:233) "balsamroot and bitterroot abound in the area today, and there are several other important but less abundant economic floral resources that may have also been exploited."

The 1989 survey identified 10 sites, seven of which contain a total of 27 earth oven features. These range in size from 2 to 6m in diameter, and from 0.3 to 0.6m in depth. None of the earth ovens was excavated or dated directly. However, Rousseau et al. (1991) suggest these "likely date" to the between 2400 and 200 BP based on comparisons with sites in the Upper Hat Creek Valley.

Despite the relative abundance of earth ovens and the presence of extant populations of edible root resources, Rousseau et al. (1991:233) interpret the low, medium and high-density lithic scatters recorded at six of the ten sites as "most probably related directly to hunting and domestic field camp activities rather than to floral resource extraction and processing" suggesting the region around the lake was ideal habitat for deer. Diagnostic materials point to intensive use of the Woodcutter Lake locality during the period between 2400 and 1200 BP (Rousseau et al. 1991:233), although one site (EdRi 32), with 10 earth ovens, has an earlier (4000 to 2400 BP) component (Rousseau et al. 1991:173).

Summary: In summary, archaeological investigations in the Oregon Jack Creek locality identified 37 root processing sites containing 100 earth ovens ranging in size from 1.5 to 7.0m in diameter. Figure 7.11 represents the average rim crest diameters of the 39 earth ovens for which accurate measurements were reported. These have a mean of 3.35m (SD=1.25) and a median of 3.0m. The interquartile range is from 2.5

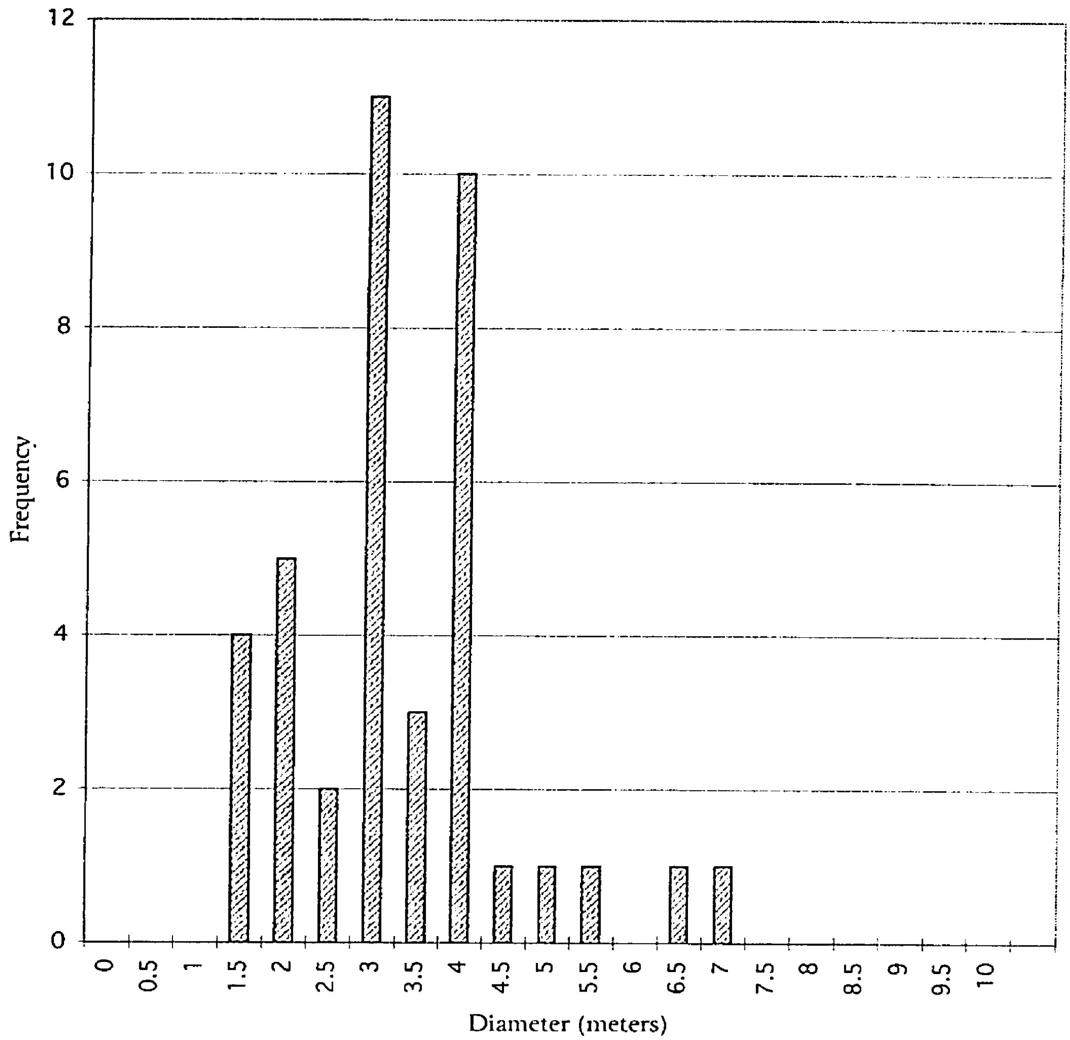

Figure 7.11: Average rim crest diameters of earth ovens at Oregon Jack Creek (n=39).

to 4.0m. These rim crest diameters are normally distributed (K-S z=.1746, P=.0042).

With the exception of the earth oven at the Parker site dated to 3130 ± 100 BP, none of the other earth ovens was excavated or dated directly. However, earth ovens are associated with campsites and diagnostic materials spanning the period from 8500 years ago up into the historic period. If, as Rousseau et al. (1991) suggest, the earth ovens of Oregon Jack Creek are contemporaneous with those of similarly-sized and dated features from Upper Hat Creek and Komkanetkwa, then it is plausible to suggest root food production was well underway in Oregon Jack Creek by 2400 years ago. However, a larger sample of dated earth ovens from this locale is required to confirm this hypothesis.

7.4.3 The Potato Mountain Locality

Further north, on the western periphery of the central Interior Plateau, Alexander and Matson (Alexander and Matson 1987; Matson and Alexander 1990) conducted archaeological investigations in the mid-1980s in the montane zone of the Potato Mountain Range (see Figure 7.8). This research was an extension of the Eagle Lake Archaeological Project (Matson et al. 1980; Magne and Matson 1984) and of earlier ethnoarchaeological investigations by Tyhurst and Alexander (Alexander et al. 1985). One of the principle objectives of the Potato Mountain project was to evaluate prehistoric land use patterns in relation to a number of ethnographically derived models by recording the density, distribution and ecological correlates of archaeological resources in the region (Alexander and Matson 1987).

The Potato Mountains are located within the traditional territory of

Athapaskan-speaking Tsilhqot'in peoples. As the name suggests, the area is known for the abundance of "mountain potato" or "Indian potato" (spring beauty, *Claytonia lanceolata*) which grows in the alpine areas. In addition, balsamroot is present in limited quantities and avalanche lily bulbs are still harvested occasionally (Alexander and Matson 1987; Matson and Alexander 1990). Three biogeoclimatic zones are present: Interior Douglas-fir, Engelmann Spruce - Subalpine fir, and Alpine Tundra.

In 1984, a preliminary reconnaissance of the Potato Mountain Range indicated most of the human use of the area occurred in the subalpine-alpine ecotone at the south end of the range. To test and refine these observations, researchers designed a probabilistic survey for the south end of the range which divided elevations between 1830 and 2000m into three environmental zones: Parkland (or Engelmann Spruce - Subalpine fir); Alpine Tundra; and subalpine forests (that is, the lower elevation boundary of the survey area). Eighteen 400m x 400m quadrats were surveyed, nine in the Parkland (13%) and nine in the Alpine (7%).

The 1985 survey identified 35 sites at the south end of the mountain range which included 335 cache pits and 102 earth ovens (Alexander and Matson 1987). Those sites identified in 1985 occurred exclusively in the Parkland zone. As Matson and Alexander (1990:2) note:

> The archaeological settlement patterns are very sharp and clear in the Potato Mountains. The Alpine is bare of archaeological remains while the Parkland contains large numbers of sites with roasting and cache pit features.

Six earth oven features and two cache pits were test-excavated in 1985. Excavations consisted of a trench from the centre of the pit to the rim crest, excavated in natural layers to varying depths depending upon the depth of the underlying sterile deposits. All materials were screened through 1/4" mesh. The results are summarized in Table 7.11 and reviewed briefly in the following discussion.

The Echo Ridge Site (EjSB 12) runs along a ridge which parallels the western shore of Echo Lake. The site is large, with 342 cultural depressions recorded and many more observed (Alexander and Matson 1987). Excavations of three earth ovens revealed variation in the shape and content of the structures, as well as in the radiocarbon ages associated with the features. No artifacts were recovered.

The shape and content of the three excavated roasting pits varied considerably in terms of the amount of fire-cracked rock associated with each (Alexander and Matson 1987). For example, Roasting Pit No. 1 contained relatively little FCR (approximately 14kg) and very little charcoal. However, a large concentration of FCR and charcoal occurred adjacent to the earth oven. This was dated, on the assumption that it represented material cleaned from the earth oven. The radiocarbon age estimate of 100 ± 60 BP suggests recent use or contamination (Alexander and Matson 1987).

Roasting Pit No. 2 contained approximately 23kg of FCR and sufficient charcoal for radiocarbon samples. The small size of the FCR in the feature led researchers to suggest the rocks were heated outside of the earth oven. This oven yielded a radiocarbon age estimate of 1910 ± 50 BP. The third feature, estimated to date to 1710 ± 90 BP, contained approximately 69kg of FCR, large quantities of charcoal, and numerous large rocks, suggesting these were heated *in situ* (Alexander and Matson 1987).

EjSb 26 is located on a small bench above the steep bank of a stream and

Table 7.11: Summary data for excavated earth ovens at Potato Mountain (from Alexander and Matson 1987)

Site & Feature No.	Rim Crest Diameter (m)	Basin Depth (m)	Fire-cracked rock (kg/m³)	Radiocarbon Age Estimate (years before present)
EjSb 12-1	2.0	0.41	200	100 ± 60 BP (WSU 3381)
EjSb 12-2	2.25	0.18	153	1910 ± 50 BP (WSU 3381)
EjSb 12-3	2.0	0.13	300	1710 ± 90 BP (WSU 372)
EjSb 26-1	2.0	0.27	285	450 ± 70 BP (WSU 3376)
EjSb 33-1	2.75	0.33	229	615 ± 80 BP (WSU 3373)
EjSb 39	2.4	0.13	ca. 311	1680 ± 90 BP (WSU 3380)

contains two large earth ovens, one of which was test-excavated. No artifacts were recovered, but the feature was dated 450 ± 70 BP. Another site, EjSb 33, is located approximately 65m upslope from EjSb 26 and parallel to the same small stream. It also contains two large roasting pits. Excavations at one of the earth ovens yielded a radiocarbon age estimate of 615 ±80 BP. No artifacts were recovered, but the feature did contain 39kg of FCR.

The Mountain Fan Site (EjSb 39) consists of a lithic scatter and two roasting pits situated along Lingfield Creek at the foot of the west slope of Middle Mountain. It is the only stratified site in the study area and is interpreted as a summer root gathering site. Test excavations in the centre of a large cultural depression confirmed its function as an earth oven, revealing a rock pavement lining the bottom and an accumulation of 27cm of FCR and charcoal in the centre of the feature. A radiocarbon age estimate of 1680 ± 90 BP was obtained from charcoal in the pit. Dates on excavations of the associated lithic scatter are 960 ± 80 BP (WSU 3374) and 2220 ± 80 BP (WSU 3375).

The 1985 survey project also provided evidence of base camps for root collecting and processing at two sites. The first site, Mountain Pond (EjSb 54), is a lithic scatter associated with 18 cultural depressions representing both earth ovens and cache pits. It is located on a bench midway down the slope of Middle Mountain. Alexander and Matson (1987) interpret this as a summer root gathering site. No diagnostic materials or radiocarbon age estimates were obtained from this site. The second site is the Middle Mountain site (EjSb 52). It is also a lithic scatter and is associated with 12 cache pits. Although there is no archaeological evidence of earth ovens, it is interpreted as a summer root collecting and processing camp and was used historically by the Redstone Band for these purposes. Diagnostic artifacts recovered at the site suggest occupations during the last 2400 years.

The earth ovens and cache pits recorded during the 1985 survey are a subset of the 456 cultural depressions mapped, measured and recorded at the south end of Potato Mountain Range during the 1984 judgemental survey (Alexander et al. 1985). On the basis of ethnographic analogy, the researchers assume cultural depressions measuring less than 90cm in diameter did not function as roasting pits. Using these criteria, and interpreting the frequency distributions of rim diameters presented in Figure 12 of Alexander et al. (1985:104), I estimate approximately 150 of those cultural depressions recorded in 1984 may have served as earth ovens. All of the cultural depressions recorded in 1984 and 1985 are less than 2.7m wide (rim crest to rim crest). The six reported on here ranged in size from 1.5 to 2.75m, with a mean of 2.11m (SD=0.42) and a median of 2.0m. The interquartile range is from 1.88 to 2.48m.

In summary, Alexander and Matson (1987:96) conclude from their investigations of the Potato Mountain range that there was "an intense utilization of the alpine/subalpine ecotone, almost certainly based on the collection and processing of mountain potatoes" . They note that although spring beauty is concentrated in the Alpine tundra zone, it was processed in the sheltered Parkland zone where wood, and presumably water, for pit-cooking were abundant. Matson and Alexander (1990) suggest that the location and density of sites appears to be more dependent on camping and processing requirements than on the density of the main subsistence resource.

Radiocarbon age estimates from test excavations of six of the roasting pits ranged from 1910 ± 50 BP to 100 ± 60 BP, suggesting the area has been used for root collecting and processing activities for at least 2000 years. The gap in the dating sequence between 1000 and 1700 years BP was assessed and determined to result from small sample size rather than cultural patterning. The dates on the earth oven features are consistent with those obtained from excavations of lithic scatters and base camps which indicate sites were occupied only during the last 2400 years. However, there is scattered evidence for much earlier occupation at the north end of the Potato Mountains. Diagnostic materials recovered from EjSb 53 point to occupations as early as 4000 years ago, while a large stemmed point with lateral edge grinding is characteristic of the period between 7000 and 8000 BP was also found (Alexander and Matson 1987).

7.4.4 Botanie Valley

Although essentially unexplored archaeologically, the Botanie Valley locality rates an "honourable mention" in the discussion of regional evidence for earth ovens on the Canadian Plateau. Baker's investigations of Botanie Valley were limited as the locale was but one component of a much more extensive regional survey. However, he did note the presence of "earth oven sites" (Baker 1975:4). My own limited observations from the spring of 1996 indicate concentrations of cultural depressions throughout the valley, accompanied by lithic scatters as might be expected at base processing camps and documented at localities discussed above.

It is unfortunate that there has not been more archaeological attention focused on this area as it is well-known as a traditional root gathering ground of the

Nlaka'pamux peoples. Ethnographer James Teit (1900:294), for example, notes:

> Botani Valley, situated in the mountains, some ten miles from Spences Bridge, and about fifteen miles from Lytton, has been from time immemorial a gathering-place for the upper divisions of the tribe, chiefly for root-digging during the months of May and June. Sometimes over a thousand Indians, representing all divisions of the tribe, would gather there. The Lower Thompsons even permitted the Coast Indians to gather berries in their territory. Each division had, besides, its separate and recognized camping ground.

Detailed discussions of recent root gathering and processing activities at Botanie are included in Turner et al. (1990) and Turner (1997).

While the archaeological resources of Botanie Valley are not well documented, the locality does demonstrate, once again, the ties between the ethnographic present and the prehistoric past and aids in broadening our perspective of upland root collecting and processing locales on the Canadian Plateau.

7.5 Extra-Regional Comparisons: The Calispell Valley Locality

Although outside of the area on which this study focuses, I include here a brief review of research into the archaeological evidence for root processing just south of the Canada-U.S. border. It is relevant to points I wish to make later in the dissertation regarding the emergence of root resource exploitation on the Canadian Plateau. The Calispell Valley in the northeastern corner of Washington State on the Columbia Plateau (see Figure 7.8) is the traditional territory of the Interior Salish-speaking Kalispel peoples and therefore pertinent to discussions of Interior Salish resource use patterns on the Canadian Plateau.

Geographically, the Calispell Valley is situated in the Selkirk Mountain region of the Northern Rocky Mountain area. The Pend Oreille River flows northward along the eastern margin of the valley for approximately 100km before it joins the Columbia River in south central British Columbia. The Calispell Valley is 32km long, between 1.5 to 6.5km wide, and contains approximately 12,000ha of flat bottomlands, portions of which were annually inundated prior to the construction of dams and levees (Thoms 1989). The lower elevations of the valley bottom support extensive camas meadows, covering between 6000 and 7000ha. According to Thoms (1989), the ethnographic literature indicates the valley was one of the most intensively utilized camas grounds along the western slopes of the Northern Rockies and in fact, explorer David Thompson spoke of the Calispell Valley as the "Root Plains" in reference to the economic importance of the camas grounds.

Between 1984 and 1987, the valley was the site of a multi-stage archaeological investigation, the Calispell Valley Archaeological Project (CVAP), whose goal was to assess and mitigate the impacts of the construction and operation of a large newsprint mill on the archaeological sites in the valley. Initial survey and limited testing of the region were conducted in the fall of 1984, followed by full-scale excavations in 1985 and 1987.

Three reconnaissance level surveys resulted in the identification of 168 sites in Calispell Valley and vicinity, including: 59 camas processing sites, two residential sites, 35 "special purpose" sites (sites which exhibit a limited range of artifact types and lack evidence of surface or subsurface features); 17 "miscellaneous" sites (including sites with large depressions of probable cultural origin, as well as cache sites and burial sites) and five sites of an undetermined nature (Thoms 1989). Of the 168 sites identified by the survey, two residential sites (45PO137 and 45PO138) and four camas processing sites (45PO139, 45PO140, 45PO141, and 45PO144) were selected for excavations.

The four camas processing sites, although recorded as discrete units, are essentially contiguous. They occur along the same shoreline landform or meadow rim, over an area measuring approximately 50m by 1300m (Thoms 1989:Figure 27), but have been bisected and disturbed by a gravel pit and landfill operations. Thoms attributes the differences between sites to their locations on the meadow rim, which is composed of differing combinations of glacio-fluvial sediments.

Earth ovens (n=85) are the most common feature at the camas processing sites, although features such as concentrations of FCR lacking definable pit features (n=5), possible storage pits (n=6), and several pits of an "unclassified" nature (n=5) were also recorded. Charred camas bulbs were recovered in earth ovens, in FCR concentrations and in several storage pits from these sites (Thoms 1989:Table 31). Charred camas bulbs were also recovered from earth ovens (n=4) located at residential site 45PO137 and both residential sites had charred camas bulbs in FCR concentrations, kitchen middens, hearths, and small pits (Thoms 1989).

It is difficult to determine the exact number of earth ovens excavated as Thoms does not provide this figure. Table 7.12, derived from Thoms (1989:Table 32), provides the descriptive data for excavated camas ovens at the residential and processing sites for which there are radiocarbon age estimates and/or "adequate size data," that is, "at least one complete horizontal dimension" (Thoms 1989:401). This totals 38 of the 89 earth ovens identified at the camas processing and residential sites. Thoms notes that "minimal size data for ovens with at least one horizontal dimension" are available

Table 7.12: Summary data for excavated earth ovens from the Calispell Valley (Thoms 1989)

Site & Feature #	SSBD* (m)	DSSB** (m)	FCR*** (kg)	Radiocarbon Age Estimates (years before present)
45PO137				
3.1	2.2	0.26	308.9	820 ± 70 (WSU 3670)
3.11	2.7	0.25	521.9	No date
21.0	1.6	0.16	65.6	No date
25.0	2.1	0.16	52.8	610 ± 90 (WSU 3747); 590 ± 60 (Beta 13297)
45P0139				
1.11	2.2	0.20	41.0	4150 ± 95 (WSU 3138);4000 ± 60 (Beta 13297)
4.30	2.5	0.42	444.2	3360 ± 135 (WSU 3756)
5.41	1.75	0.37	161.3	3050 ± 80 (WSU 3329)
5.61	2.4	0.34	138.7	3310 ± 60 (WSU 3400); 300 ± 60 (WSU 3300)
5.81	2.1	0.38	198.8	No date
8.31	2.5	0.40	78.1	1520 ± 60 (WSU 3331)
8.41	3.5	0.47	357.5	3460 ± 70 (WSU 3337)
8.51	2.7	0.45	--	3160 ± 80 (WSU 3332)
8.61	2.5	0.33	250.1	No date
16.10	2.25	0.39	108.2	2980 ± 110 (WSU 3674)
27.00	2.7	0.4	--	2680 + 100 (WSU 3750); 5510 ± 130 (WSU3751)
45PO140				
9.1	2.1	0.16	101.5	No date
13.0	3.0	0.36	1,138.3	2500 ± 80 (WSU 3713)
45PO141				
3.0	1.65	0.30	89.8	5340 ± 390 (WSU 3349);2740 ± 70 (WSU 3726)
8.1	2.1	0.37	216.1	1480 ± 60 (WSU 3725)
9.0	1.65	0.18	84.1	1020 ± 90 (WSU 3724)
10.0	2.5	--	--	2970 ± 110 (WSU 3758)
11.0	2.3	0.25	--	2460 ± 100 (WSU 3717):1800 ± 100 (WSU 3727)
14.1	2.85	0.34	441.5	3410 ± 185 (WSU 3719)
18.0	1.2	--	--	No date
19.0	2.4	--	--	No date
20.0	1.9	--	--	No date
21.0	1.7	--	--	No date
22.0	1.9	--	--	No date
23.0	2.0	--	--	No date
45PO144				
1.1	2.5	0.10	124.5	1210 ± 80 (WSU 3659)
2.0	3.25	0.10	46.7	3190 ± 90 (Beta 13398)
3.1	3.0	0.49	107.9	No date
4.0	3.2	0.36	412.5	No date
5.0	2.85	0.42	521.8	2970 ± 80 (WSU 3660)
9.1	3.25	0.24	144.5	No date
9.2	1.8	0.14	31.6	No date
11.0	3.1	0.37	34.6	915 + 110 (WSU 3763):770 + 70 (WSU 3658)
14.0	1.25	0.10	9.8	No date

*Subsurface basin diameter; **Depth of subsurface basin; ***Fire cracked rock for another 14 ovens. Unfortunately, these figures are not included, but are said to range from 1.6m to 3.5m and average 2.2m in diameter (Thoms 1989:401). This brings the count of excavated earth ovens to 52. The remaining 37 earth ovens were apparently identified in test units or in backhoe trenches and were not systematically excavated or measured, although Thoms notes that reliable depth measurements were recorded for 10 of these (but does not include these figures).

There is considerable variation in the size and shape of the earth ovens recorded. Basin-shaped ovens are the dominant type at all camas processing sites in the Calispell Valley. According to Thoms, of the 56 excavated ovens with reliable depth measurements, 42 are basin-shaped pits and range in depth from 17 to 57cm below the surface of origin, with the average being 32.6cm. Platform ovens, which are less common, range in depth from 10 to 44cm, with the average being 24.6cm. Nine of the excavated ovens listed in Thoms (1989:Table 32) are classified as platform ovens. At least one hillside platform oven, measuring approximately 5.0 x 5.0m, was recorded. It is unclear from the discussion if other hillside platform ovens were identified. One mound oven, measuring approximately 10.0m in diameter and 1.0m in height was identified and said to be similar to those described for other areas in the Pacific Northwest. It yielded a modern radiocarbon age estimate of 60 ± 60 BP (WSU 3347).

Accurate size data are available for 38 of the excavated ovens (see Table 7.12). It should be noted that Thoms reports the length and width of the *subsurface* basin (that is, the rock heating element) rather than the *surface* rim crest diameter. These measurements have been averaged to obtain an average diameter of the subsurface basin and, as most are circular or oval in plan, this should not distort the data and allows comparison with the other localities on the Canadian Plateau for which comparable data exist. Figure 7.12 is a histogram of subsurface basin sizes.

Thoms also includes estimates of the amount of fire-cracked rock present in the heating elements (see Table 7.12). Approximate weights of the rock heating elements were calculated by multiplying the average weight of FCR per m^2 of excavated heating element by the estimated diameter of the oven. Table 7.12 shows the weight varies between ovens, even among those of similar sizes. The heaviest element weighed an estimated 1138kg and the lightest approximately 10kg. Thoms suggests the variation in the weight of FCR from ovens of similar sizes may be due to the salvaging of rocks from old heating elements to build new ovens (Thoms 1989).

Analysis of the macrobotanical remains (Stenholm 1988) revealed the presence of charred camas bulbs in "just over one-half" of the earth ovens (Thoms 1989:394). Wood charcoal used for fuel and the remains of vegetal material used for packing were also identified. Fuel species, listed in order from most to least common, include: lodgepole pine (*Pinus contorta*), ponderosa pine (*Pinus ponderosa*), western larch (*Larix occidentalis*), Douglas fir (*Pseudotsuga menziesii*), spruce (*Picea* sp.), western white pine (*Pinus monticola*), Rocky Mountain juniper (*Juniperus scopulorum*) and hemlock (*Tsuga* sp.). Charcoal from hardwoods, including poplar/aspen/cottonwood (*Populus* sp.), willow (*Salix* sp.) and alder (*Alnus* sp.) were found occasionally.

Charred remains of materials likely used in lining the roasting pits included sedge (*Carex* spp.), panic grass (*Panicum* sp.), kinnikinnick (*Arctostaphylos uva-ursi*), skunk cabbage (*Lysichiton americanum*) and bracken fern (*Pteridium aquilinum*) (Stenholm

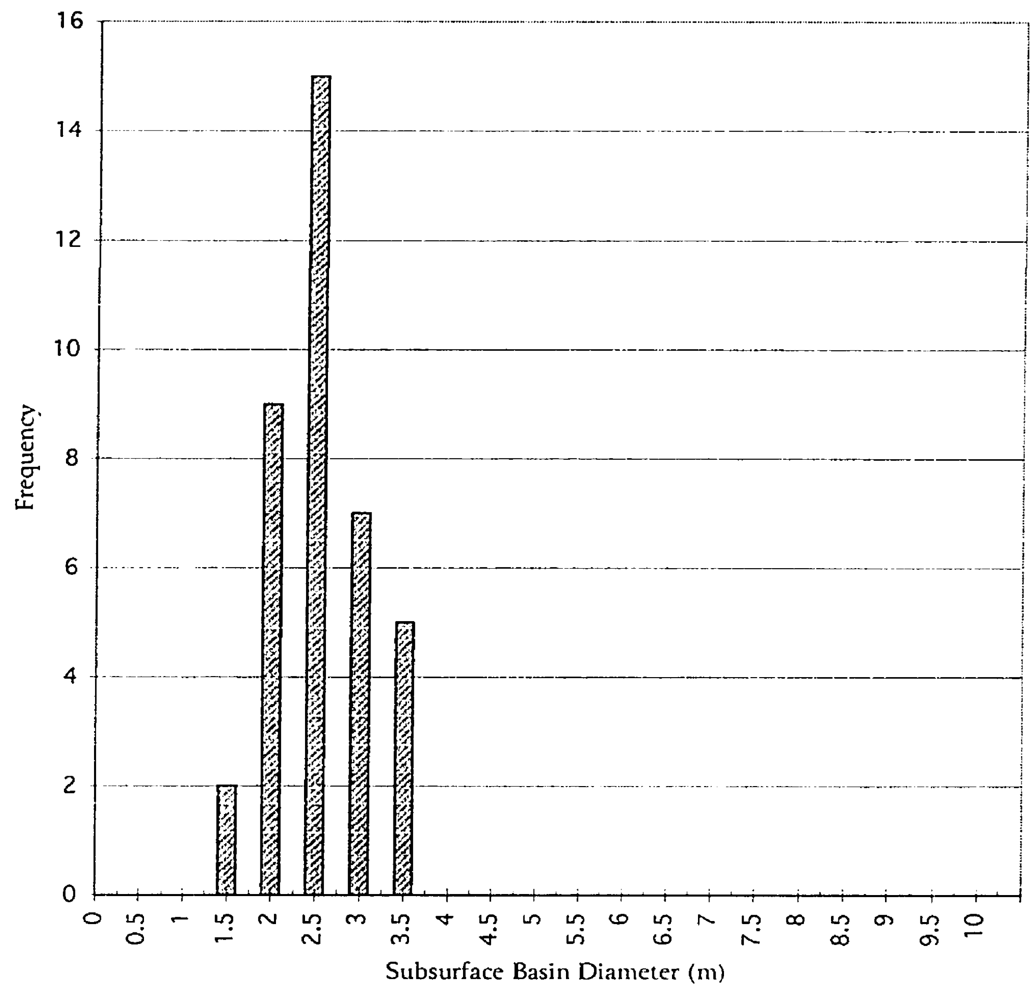

Figure 7.12: Subsurface basin diameters of excavated earth ovens in the Calispell Valley (n=38).

1988). On the basis of the macrobotanical evidence, Thoms infers a mid-to late summer harvest (Thoms 1989:394-395).

Radiocarbon age estimates were obtained from oven features tested as part of the survey program, as well as from the more extensive excavations of earth ovens at the four camas processing sites and the two residential sites. Unfortunately, Thoms does not include a complete list of his radiocarbon age estimates which makes it difficult to assess his conclusions, outlined below, concerning the time depth of camas processing activities in the Calispell Valley.

Radiocarbon age estimates from the excavated camas processing sites range from 5510 ±130 BP to 210± 60 BP (WSU 3714). Those obtained from oven features at 10 of the surveyed camas processing sites range from 2930 ± 100 BP (WSU 3346) to modern, 60 ± 62 BP (WSU 3347) (Thoms 1989:380). A full listing of these dates is not included.

Radiocarbon age estimates from five of the surveyed residential sites range from 2870 ± 190 BP (WSU 3703) to modern (*i.e.*, 75 ± 80 BP, WSU 3701). This latter date was from a site that also yielded glass trade beads. Dates from the two excavated riverside residential sites range from modern (WUS 3351) to 2790 ± 120 BP (WSU 3708). The majority of the residential sites identified in the survey are on the first terrace above the Pend Oreille River, which Thoms suggests is probably less than 4000 years old. Several are on or above the second terrace, which predates the fall of Mazama Ash (ca. 6700 BP) and contains a still older palaeosol. The recovery of large side-notched and stemmed dart points from sites on these older terraces leads Thoms to conclude the earliest use and occupation of the Calispell Valley may have occurred several millennia before the oldest sites for which there are radiocarbon age estimates.

Figure 7.13 represents Thoms' analysis of the radiocarbon age estimates from the Calispell Valley in an attempt to assess changes in the intensity of camas exploitation. It is redrawn from his work (Thoms 1989:Figure 44) for, as discussed previously, Thoms does not provide a complete list of his radiocarbon age estimates. According to Thoms (1989:431), the figure is based on 85 age estimates derived as follows:

> Fifty radiocarbon dates were obtained from 43 camas ovens at the four excavated camas processing sites and 10 additional dates were from other feature types and nonfeature charcoal at these sites. Seven more dates were from earth ovens at surveyed camas processing sites in meadow rim settings. All of these dates are considered to be representative of camas exploitation at camas grounds.
>
> Four other dates were obtained on three camas ovens at residential site 45PO137, and four more dates were from three camas ovens at surveyed residential sites. Ten additional radiocarbon dates were from features at the two excavated residential sites that yielded camas remains. These features included hearths, FCR concentrations, stone boiling pits, unclassified pits and kitchen middens. The frequency per unit time of camas related dates from residential sites provides a measure of the intensity of camas exploitation per se, but these dates are not as direct a measure of camas intensification as are the dates from camas processing sites.

Thoms plots these 85 dates (uncorrected) by 250 year intervals, treating each as a discrete point within a single 250 year period, regardless of its sigma. Dates are distinguished as discussed in the preceding paragraph.

Thoms' (1989:431-433) interpretation of these data is as follows. The earliest charred camas bulbs recovered from the valley (processing site 45PO139) date to 5510 ± 130 BP. Six other dates between 5350 and 3800 BP were obtained from charcoal in

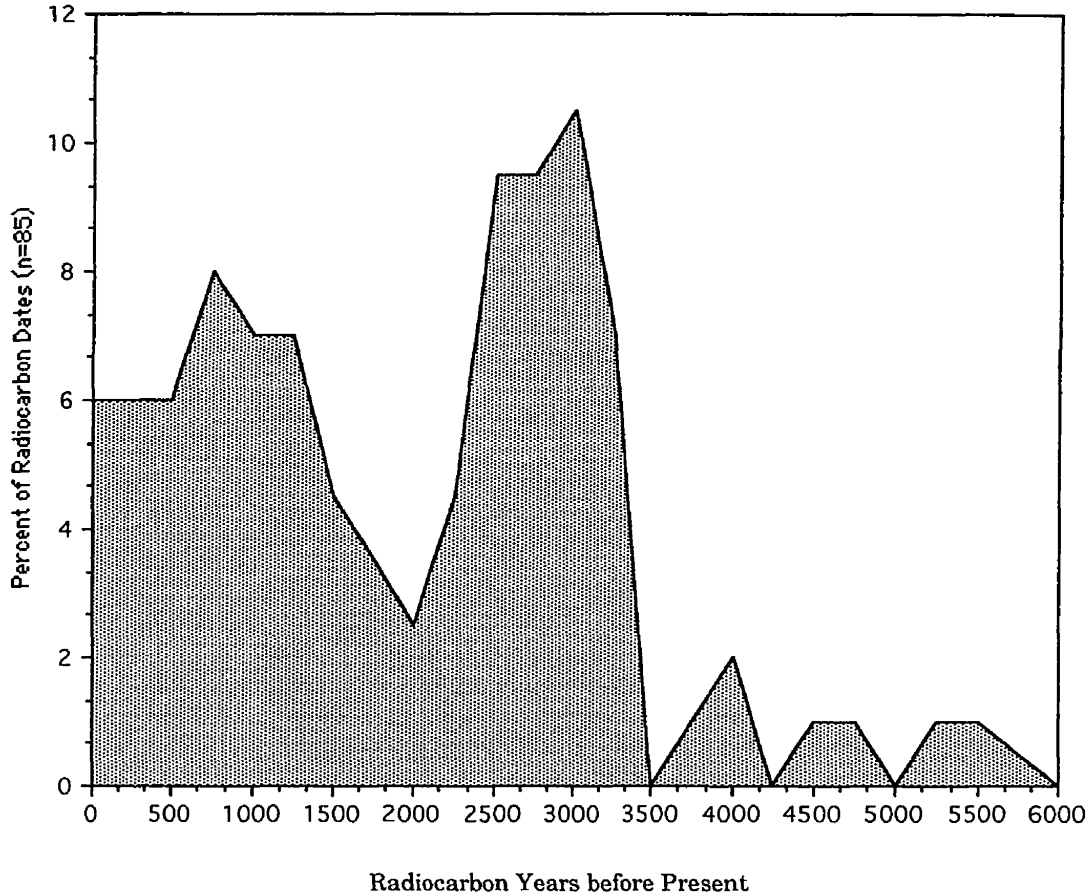

Figure 7.13: Distribution of radiocarbon age estimates from camas-related features in the Calispell Valley as a measure of intensification (redrawn from Thoms 1989:441).

earth ovens. Thoms interprets these seven dates (from six ovens) as evidence for the regular use of camas prior to its intensification. This period of regular use is followed by the initial intensification of camas exploitation 3500 and 2500 BP. Between 2500 and 1500 BP, there is an "intensification nadir," a thousand-year interval which may represent a decline in the use of the camas grounds. Then, beginning 1500 years ago, there is the "final intensification," when the number of dated camas related features approximates the frequency of dates during the initial period of intensification.

7.6 Patterns of Root Food Production on the Canadian Plateau

I have examined the archaeology of root processing from Komkanetkwa, Upper Hat Creek Valley, Oregon Jack Creek and Potato Mountain on the Canadian Plateau, and from the Calispell Valley on the northeastern edge of the Columbia Plateau (Table 7.13). Each of these locales falls within the traditional boundaries of Interior Salish territory, with the exception of Potato Mountain. Botanie Valley, although its archaeological resources are not sufficiently documented to include in this discussion, nonetheless provides further evidence of root gathering and processing activities in upland areas.

Archaeological investigations of these locales has varied in nature and scope. Yet, much of the information is comparable and amenable to analysis. While these data represent a relatively small sample of what was once an extensive subsistence practice, certain patterns emerge. In this final section, I identify the broad patterns of root food production evident in the archaeological record of the Canadian Plateau and compare these with the ethnographic expectations outlined at the beginning of this

Table 7.13: Summary of archaeologically-investigated root processing locales discussed in the study.

Locality	No. of Root Processing Sites	No. of Earth Ovens	No. of Excavated Earth Ovens	No. of Radiocarbon Age Estimates from Earth Ovens
Komkanetkwa	61	170	11	10
Upper Hat Creek	44	81	15	13
Oregon Jack Creek	38	100	1	1
Potato Mountain*	35	102	6	6
SUBTOTAL	178	453	33	30
Calispell Valley	59	89	56	29
TOTAL	237	542	89	59

*1985 data only;

chapter. I conclude with a brief discussion of the implications of these data for our interpretations of past root resource use.

7.6.1 The Fit Between Expected and Observed

As outlined in Section 7.2, if prehistoric earth ovens were functionally equivalent to those of the ethnographic period, we should expect patterning consistent with the ethnographic record regarding the visibility of root processing activities, the locations of root processing sites across the landscape, the shape and structure of the earth oven features at those sites, and the plant materials recovered from the earth ovens. How then does the archaeological record of root processing for the Canadian Plateau "fit" with the ethnographic expectations outlined above?

Site Types and Distributions

As suggested by ethnographic evidence, the remains of earth ovens from sites across the Canadian Plateau are distinctive and, for the most part, are readily distinguished from the surrounding terrain as large, circular depressions or mounds, containing carbon-stained deposits and fire-cracked rock. Concentrations of earth ovens occur in upland areas, often in areas where root collecting and processing activities occurred historically. These areas support an abundance of plant foods and root staples, and provide access to materials necessary for pitcooking, including water, rocks, shrubs and herbaceous plants for matting, and fuel.

The association of earth oven features with multi-purpose base camps and related activity areas such as lithic scatters is also consistent with the ethnographic record which indicates root collecting and processing locales were well-known and regularly visited. Although lithic artifacts alone are not good indicators of root processing sites, the association of these with earth ovens points to the possible processing of plant resources and to differing intensities of site occupation (Pokotylo and Froese 1983).

One exception to the anticipated pattern of site types and distributions is apparent. The presence of food storage facilities at root processing locales such as Komkanetkwa is not commented upon in the ethnographic literature for the Interior Salish and one would expect such facilities to be located at, or near to, winter residences in the major river valleys. However, according to Alexander et al. (1985), the Tsilhqot'in people used cache pits at spring beauty grounds to store those corms which could not be carried to wintering sites in a single trip. In addition, cache pits were apparently used to keep newly collected roots fresh for processing while the diggers were on the mountain.

The presence of storage facilities at upland root gathering and processing sites raises questions concerning past storage strategies and challenges our usual perception that storage occurred mainly at winter residences in the major river valleys.

Earth Oven Morphology

The morphology of the earth ovens at each of the four localities is generally consistent with that described for ethnographic root processing facilities, although there are variations in shape, subsurface structure and size.

For example, of the four earth oven types identified at Komkanetkwa, the forms of the basin-shaped, mound and platform ovens match ethnographic descriptions. Only the terrace oven is not described. Nor is there any mention in the ethnographic record of what, if anything, these different oven shapes may represent. The shapes may be related to the types of roots processed, as suggested by Dawson's (1891) description of a mound oven used to cook tiger lily (*Lilium columbianum*). Alternatively, oven shape may be time sensitive. Or, shapes may reflect individual preferences in style, different cooking procedures, or the limitations of surrounding terrain.

Overall, the size of the earth ovens recorded at the various locales (Table 7.14) is generally consistent with the Interior Salish ethnographic evidence which suggests roasting pits averaged between 3 and 6m in diameter. This is evident in Figure 7.14, which depicts the average rim crest diameter, classified by 0.5m increments, for earth ovens from the four locales on the Canadian Plateau (n=279). The size of these features ranges from 1 to 8.6m in diameter, with a mean of 3.69m (SD=1.30), a mode of 3.0m and a median of 3.5m. The rim crest diameters of the earth ovens are normally distributed (K-S z=1.4447, P =.030), with approximately 75% (n=212) of the values falling within the range of ethnographic expectations. Of the remaining 25%, a number are smaller (n=41) or larger (n=15) by up to one meter; 11 ovens vary by as much as two meters.

The size of the subsurface basin heating element, which is correlated with the average rim crest diameter of the earth ovens (Pokotylo and Froese 1983), also varies slightly from the expected pattern (Table 7.14). At Komkanetkwa, these rock pavements vary from 1.5 to 4.0m in length, with a mean of 2.69m, and thus must be considerably larger than Teit's "four or five flat rocks." The subsurface basins at Upper

Table 7.14: Average rim crest diameters and subsurface basin lengths for earth ovens at root processing locales

Attribute		Komkanetkwa	Upper Hat Creek Valley	Oregon Jack Creek	Potato Mountain	Calispell Valley	All Sites
Avg. Rim Crest Diameter	Range	1-8.6m	1.65-6.95m	1.5-7m	1.53-2.74m	n/a	1-8.6m
	Mean	3.51m	4.3m	3.35m	2.11m	n/a	3.69m
	Median	3.52m	4.23m	3.00m	2.00m	n/a	3.50m
	Up Quartile	2.84	3.35	2.50	1.88	na/	--
	Lo Quartile	4.1	5.37	4.00	2.48	n/a	--
	IQR*	1.26	2.02	1.50	0.605	n/a	-
	SD**	1.20	1.27	1.25	0.42	n/a	1.30
	Number	150	84	39	6	n/a	279
Subsurface Basin Length	Range	1-5.4m	2-5m	n/a	n/a	1.2-3.5m	n/a
	Mean	2.69m	3.27m	n/a	n/a	2.34m	n/a
	Number	12	4	n/a	n/a	38	n/a

Note: IQR = interquartile range; SD = standard deviation;

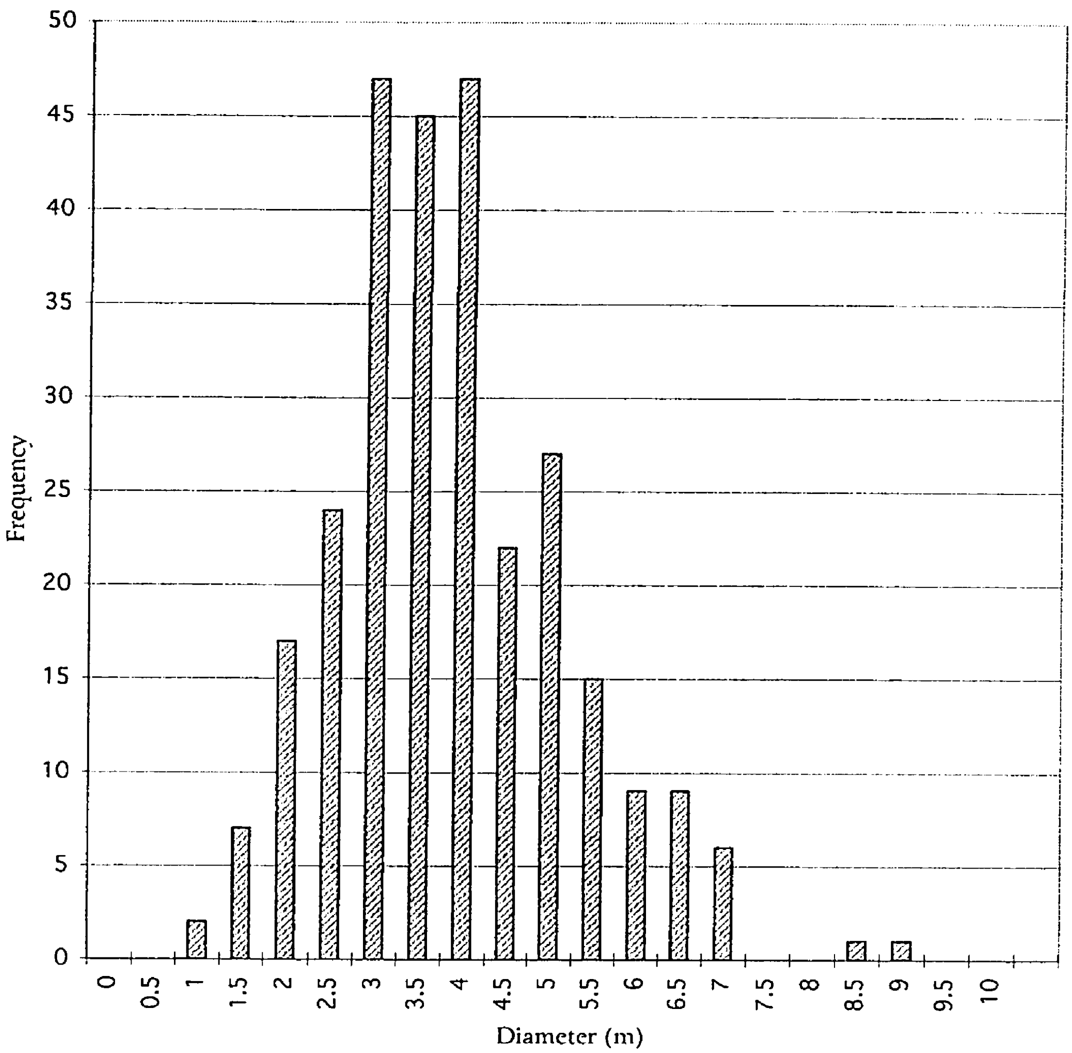

Figure 7.14: Rim crest diameters of earth ovens from four locales on the Canadian Plateau (n=279).

Hat Creek are also much larger than would be expected based on this information. Thoms' (1989) data from excavated earth ovens in the Calispell Valley indicate subsurface basin diameters range between 1.2 and 3.5m. It appears, then, that the rock heating elements more closely resemble those described by Macoun (1890 in Dawson 1891) as holes "about ten feet square and two deep" filled with cords of wood and "covered over with small boulders."

Several factors may account for the variation between the size of the prehistoric earth ovens and those documented ethnographically, not the least of which is the fact that ethnographic observations often under-represent the amount of variation that existed. With this proviso in mind, what factors may have influenced the size of the earth ovens and resulted in the apparent discrepancies between the expected and observed?

Age may be one factor. A number of researchers (Pokotylo and Froese 1983; Thoms 1989) have suggested the differences in size and structure of earth ovens may be a function of age, with the largest ovens representing the oldest features, but were unable to demonstrate this statistically due to small sample sizes. I tested this hypothesis by combining data from Komkanetkwa with similar information from earth ovens in the Upper Hat Creek Valley, the two locales within Interior Salish territory for which significant samples exist. The relationship between the average rim crest diameters and radiocarbon age estimates of the excavated earth ovens from Komkanetkwa and Hat Creek was tested and a positive correlation was found (r_s=0.62, P=0.002) (Figure 7.15). In other words, the largest ovens tend to be the oldest, and the smallest tend to be the youngest. But what makes older ovens larger?

First, the overall size of the earth oven and heating element may reflect the intensity of reuse. Roasting pits represent a significant investment in labour and materials, and although not commented upon in the ethnographic literature, it is reasonable to suggest these features were cleaned, refurbished and reused (Pokotylo and Froese 1983). Replacing heat fractured rocks and/or re-excavating the oven may have increased the size through time. There is evidence for at least one multiple-basin earth oven at Komkanetkwa. In the Upper Hat Creek Valley, the oldest cooking pits have large, superimposed rock-lined basins, while the most recent have small basins which exhibit little evidence of reuse (Pokotylo and Froese 1983).

Alternatively, earth oven size may be indicative of the *quantities* of roots being processed at any one time. Teit (1900:236) indicates roasting pits were "large enough in diameter to contain the roots to be cooked." The amounts of root foods processed, should, in turn, vary according to the size of the family or social group constructing and utilizing the earth ovens. If so, changes in earth oven size could be examined in the context of social change on the Plateau during the last 4500 years (see Chapter 8). The archaeological record of this period reveals changes in the sizes of winter villages, as well as in the size and shapes of the pithouses themselves. Researchers have linked these shifts in residential structures to aspects of social organization (Richards and Rousseau 1987; Hayden 1992, 1997). These social changes may also be reflected in subsistence structures such as earth ovens.

Thirdly, the size of the heating element (and therefore the earth oven) may be related to the *qualities* of the roots being cooked. Teit (1900:237) states that roots "remain in the oven, according to the kind being cooked -- from twelve to twenty four

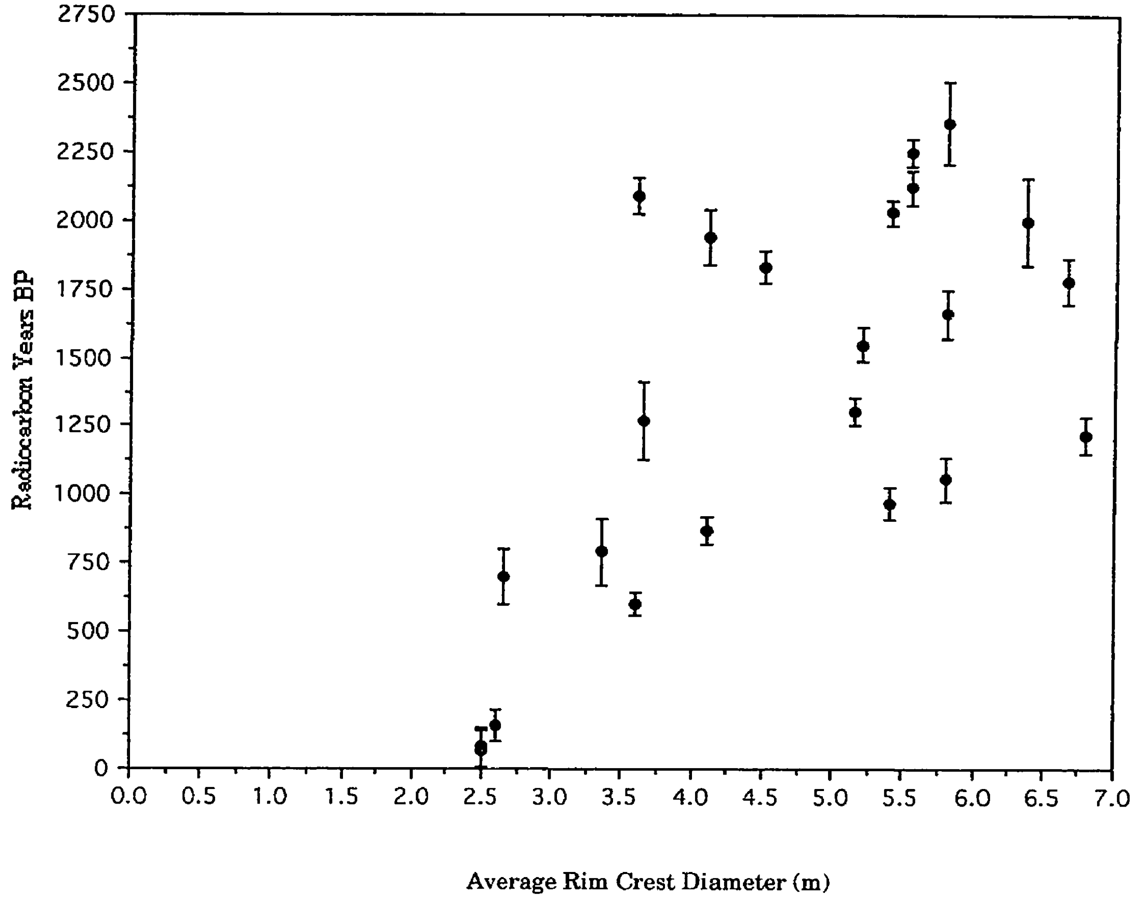

Figure 7.15: Scatterplot showing the relationship between the age and the size of earth ovens from Komkanetkwa and the Upper Hat Creek Valley (n=23).

hours." Balsamroot, he notes, was difficult to cook and was kept in the oven for two days. As previously discussed, balsamroot contains inulin, which requires extensive processing. In contrast, starch is the major carbohydrate component of other root foods, such as spring beauty, and requires only minimal heating before consumption. In short, the ethnographic and chemical ecological evidence suggests cooking time varies, according to the root species, from 12 to 48 hours. As a larger quantity of rock would retain more heat than a smaller amount, a larger heating element would be necessary to maintain sufficient heat for the period of time required to properly process large quantities of certain species of roots, such as balsamroot. Ethnographic evidence from Tsilhqot'in elders, reported in Alexander and Tyhurst (1984), lends support to this interpretation. Thus, the types of roots processed may have changed through time accounting for the changes in size.

Finally, these three factors -- intensity of earth oven use, quantities of roots processed, and types of roots processed -- are not mutually exclusive and may have been operating simultaneously at any given point in time. In sum, while each of these represents a plausible explanation for the variation in earth oven size through time, given the current evidence, it is difficult to determine just which one(s) are responsible for this pattern.

There are also inter-regional or spatial variations to the broad patterning in earth oven size (see Table 7.14). Figure 7.16 compares the average rim crest diameters of earth ovens from each of the four Canadian Plateau locales. The boxplots indicate the median, the interquartile range (the midspread or range of the middle 50% of the values), outliers (those values more than 1.5 times the IQR) and extreme cases.

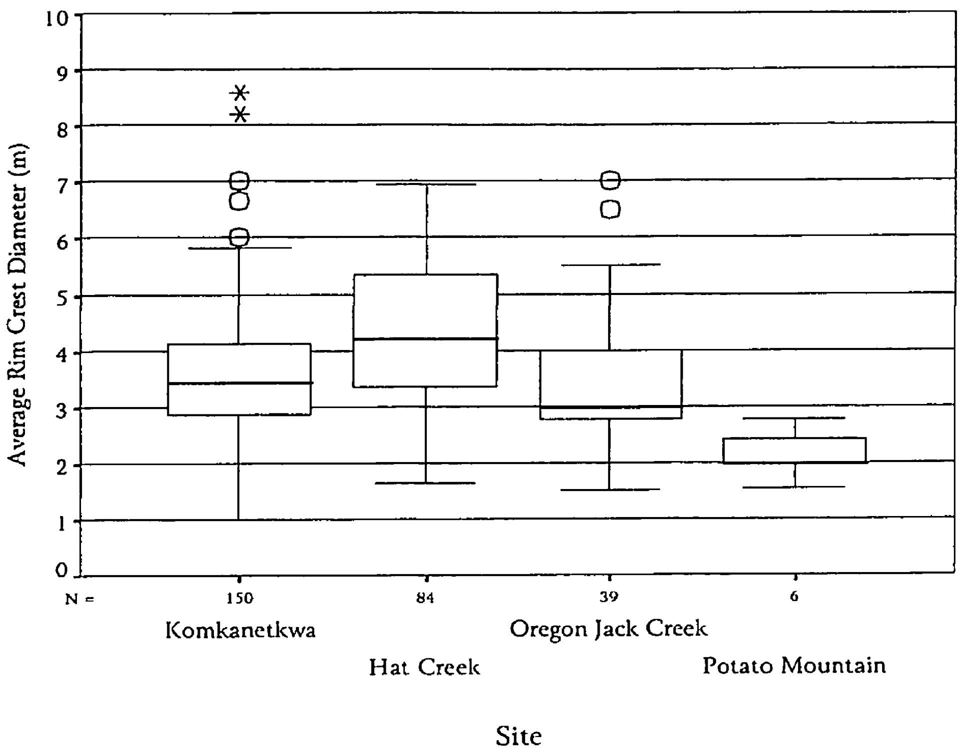

Figure 7.16: Comparison of the average rim crest diameters of earth ovens from each of the four Canadian Plateau root processing locales.

The range of rim crest diameters from Komkanektwa, the Upper Hat Creek Valley and Oregon Jack Creek is wider than expected on the basis of the ethnographic evidence, a point made earlier in reference to Figure 7.14. In contrast, the sizes of the six excavated features at Potato Mountain fall well below the range of ethnographic expectations for Interior Salish earth ovens, as do the 150 earth ovens identified in the locale whose rim crest diameters range between 0.9 to 2.7m in diameter (Alexander et al. 1985). They are consistent, however, with the range of sizes indicated by Tsilhqot'in consultants.

The median rim crest diameters of ovens from Komkanetkwa (3.52m), Hat Creek (4.23m) and Oregon Jack Creek (3.00m) also fall well within the predicted range of 3 to 6m. Potato Mountain, with a median of 2.00m, is well below. The interquartile ranges present a similar picture. At Hat Creek, 50% of the earth ovens are between 3.35 to 5.37m in diameter, and thus fit the predicted pattern. At Komkanetkwa and Oregon Jack Creek, the lower limits of the interquartile range are below the 3m mark, although not substantially so. It could be argued then, that approximately 50% of these populations are also within the ethnographic range. Again, the Potato Mountain ovens are much smaller.

In sum, Figure 7.16 indicates the rim crest diameters of earth ovens from the Upper Hat Creek Valley are larger than those from Komkanetkwa and Oregon Jack Creek, which are similar in size. Earth ovens from these three locales are considerably larger than those from Potato Mountain. A Kruskal-Wallis one-way analysis of variance confirms these differences in rim crest diameter are statistically significant (x^2=29.69, P =.000). A two-way comparison using a Mann-Whitney test indicates the earth oven sizes from Upper Hat Creek and Potato Mountain are distinct, while those at Komkanetkwa and Oregon Jack Creek are similar (Table 7.15).

The fact that the size of the earth ovens from Potato Mountain differ significantly from the other three locales is interesting, but perhaps not surprising. Potato Mountain is a traditional root-digging ground of the Tsilhqot'in peoples, not the Interior Salish. The sites are located at much a higher altitude and in different biogeoclimatic zones than those of Komkanetkwa, the Upper Hat Creek Valley and Oregon Jack Creek. Consequently, the plant resources available at Potato Mountain are quite different from the mixture of species available in the lower elevation Bunchgrass, Ponderosa Pine and Interior Douglas-fir communities characteristic of the other three sites. Further, it appears that the principal root resource harvested and processed at Potato Mountain was spring beauty, which, according to Tsilhqot'in elders, required a relatively short cooking period and therefore was processed in small earth ovens.

While the earth ovens from the Potato Mountain locale do not fit well with the Interior Salish ethnographic evidence presented here, they are consistent with the ethnographic data outlined by Alexander and Tyhurst (1985). Potato Mountain is of interest, however, to the discussion of factors influencing earth oven size. On the basis of the information presented here, the size of the earth oven in the Potato Mountains appears to be related to the type of root being processed.

Differences in size between the ovens in the Upper Hat Creek Valley and those of the other two locales are not as readily explained. Age may be one factor influencing size. On average, the earth ovens in the Upper Hat Creek Valley are older ($\bar{x}=1501$ years; median=1550 years, SD=604) than those at Komkanektwa ($\bar{x}=1117$ years;

Table 7.15: Results of the two-way comparison of average rim crest diameters from the four Canadian Plateau root processing locales

Locales	Mann-Whitney U	2-Tailed P
Komkanetkwa - Hat Creek	4075.0	.0000
Komkanetkwa - Oregon Jack Creek*	2694.5	.4485
Komkanetkwa - Potato Mountain	95.0	.0011
Hat Creek - Oregon Jack Creek	976.5	.0003
Hat Creek - Potato Mountain	21.0	.0002
Oregon Jack Creek - Potato Mountain	40.0	.0091

*no statistically significant difference median=1180 years; SD=814). However, these age differences are not statistically significant (t=-1.25, P=.228).

The slightly larger size of the Upper Hat Creek earth ovens might be the result of more intensive use of these features relative to those at the other locales. Pokotylo and Froese (1983) indicate the larger ovens at Hat Creek had multiple basins, suggesting episodes of reuse. Greater intensity of use may be related to the large, nucleated winter villages present along the mid-Fraser River between 2000 to 1000 BP (Pokotylo and Froese 1983). The greater size of the ovens may be indicative of larger household sizes and/or larger populations in the region.

The size differences might also be be related to the kinds of roots being processed, as was the case at Potato Mountain. However, all three locales -- Hat Creek, Oregon Jack Creek and Komkanektwa -- have a similar environmental setting and a similar suite of plant resources. It seems unlikely, then, that differences in rim crest diameters are related to the processing of different species. On the other hand, this possibility cannot be ruled out, but without detailed palaeoethnobotanical analyses from these locales, the issue will remain unresolved.

Finally, the size differences also may be related to sampling methods. The Upper Hat Creek Valley data are a sample of the population of all earth ovens in that locale. This sample, may, for some reason, under-represent smaller features. In contrast, the data from Komkanetkwa represent a complete census of the earth ovens in the valley. The Oregon Jack Creek study, from my understanding, also represents a complete census of sites in that locale.

In summary, it is important to emphasize that overall patterns of shape, subsurface structure and size of the observed earth ovens from Komkanetkwa, the Upper Hat Creek Valley and Oregon Jack Creek are generally consistent with the archaeological expectations derived from Interior Salish ethnographic evidence. There are minor spatial and temporal variations in the degree to which the attributes are expressed which cannot be adequately explained at present. However, these differences do not detract from the broader patterns identified here.

Earth Oven Contents

Results of the archaeobotanical analyses undertaken to date, although limited, support the ethnographic expectations. Preliminary analysis of the archaeobotanical remains associated with earth ovens at Komkanetkwa provide data on two species used as fuel and/or matting in the pitcooking process. A more detailed analysis of sediments from earth ovens in the Upper Hat Creek Valley yielded the remains of possible root foods such as wild onion, as well as species used for fuel and matting. Sediments from the earth oven at the Parker site at Oregon Jack Creek also yielded wood charcoal, partially burned birchbark rolls, and several seeds.

Although relatively few of the macrobotanical remains from earth ovens have been identified as root species, it is worth noting that the identification of carbonized plant tissues (other than wood charcoal and seeds) requires a level of expertise and specialization not widely available in Canada. As Thoms (1989) recovered hundreds of charred camas bulbs from earth ovens in the Calispell Valley, I would expect there is a good possibility of recovering charred root remains from earth ovens in this region as well, depending of course on the manner in which the different species were prepared and placed in the earth ovens (*e.g.*, in containers, on strings).

Although the presence of charred roots would strengthen interpretations of these features as root processing facilities, the lack of archaeobotanical remains does not detract from this position, nor does the fact that several of the roasting pits contain scattered faunal remains. The presence of faunal remains is not what one would expect to find if the earth ovens were utilized *solely* for the processing of root resources. However, the ethnographic literature does indicate meat and fish were cooked in conjunction with plant resources on occasion (Teit 1900, 1909; Alexander et al. 1985). Further, my experience indicates the site formation processes associated with earth oven use and abandonment are quite complex. Certainly the reuse of earth ovens provides opportunities to introduce camp refuse into the depression. Earth ovens might also be reused for other activities involving food processing or disposal of food remains.

<u>The Age of Root Collecting and Processing Activities</u>

One of the benefits of using earth ovens as proxies for root food production is that this allows us to obtain radiocarbon age estimates from charcoal that is directly associated with root processing activities. Figure 7.17 plots the radiocarbon age estimates (n=30) obtained from the excavated earth ovens (n=33) on the Canadian Plateau. This figure includes multiple radiocarbon age estimates from single earth oven features. This includes two estimates each from EeRb 8-5 and EeRb 44-1 at Komkanetkwa and EeRj 71-1 and EeRj 1-9 from Upper Hat Creek Valley.

As is evident in Figure 7.17, the radiocarbon age estimates indicate root collecting and processing activities were underway in upland valleys across the Canadian

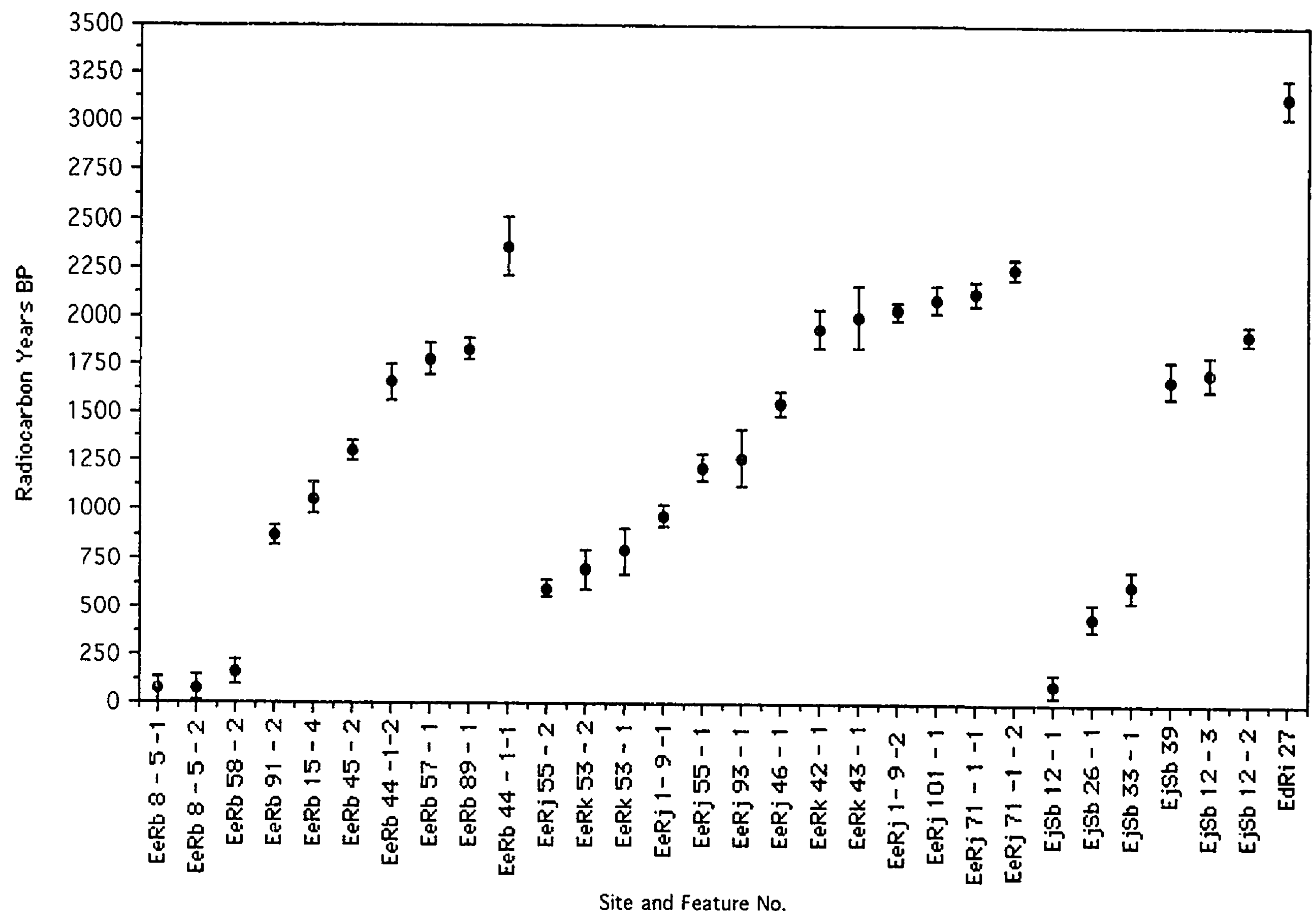

Figure 7.17: Radiocarbon age estimates from earth ovens from (left to right): Komkanetkwa (n=10), the Upper Hat Creek Valley (n=13), Potato Mountain (n=6) and Oregon Jack Creek (n=1).

Plateau by approximately 3100 years ago and continued uninterrupted until the historic period. Figure 7.18 presents the frequency of the radiocarbon age estimates from the earth ovens grouped into 250-year intervals. Although the number of radiocarbon age estimates is too small to make much of this distribution, the data are skewed, suggesting a beginning at 3100 BP followed by an increase in activity. There appears to be a peak of activity developing between 2250 and 1750 BP.

Diagnostic materials associated with these upland sites provide relative age estimates for the use and occupation of these areas. Figure 7.19 plots the radiocarbon age estimates from earth ovens with the relative dates obtained from diagnostic materials and demonstrates that upland areas of the Plateau were the focus of resource extraction activities throughout the Late Prehistoric period (4500 to 200 BP). Further, Figure 7.19 indicates these areas were utilized for several thousand years prior to the earliest dated earth ovens. Given this, and the small sample size of dated earth oven features, there is potential for the discovery of earlier root processing sites on the Canadian Plateau, although these may not be numerous. Thoms has suggested that camas processing began some 5500 years ago in the Calispell Valley. We might accordingly expect earth ovens dating to the Middle Prehistoric Period (7000 to 4500 BP) on the Canadian Plateau.

7.7 Summary

By employing earth ovens as proxies for the range of activities associated with root resource use, it is possible to trace the emergence and development of these systems of root food production on the Canadian Plateau. The archaeological record of earth

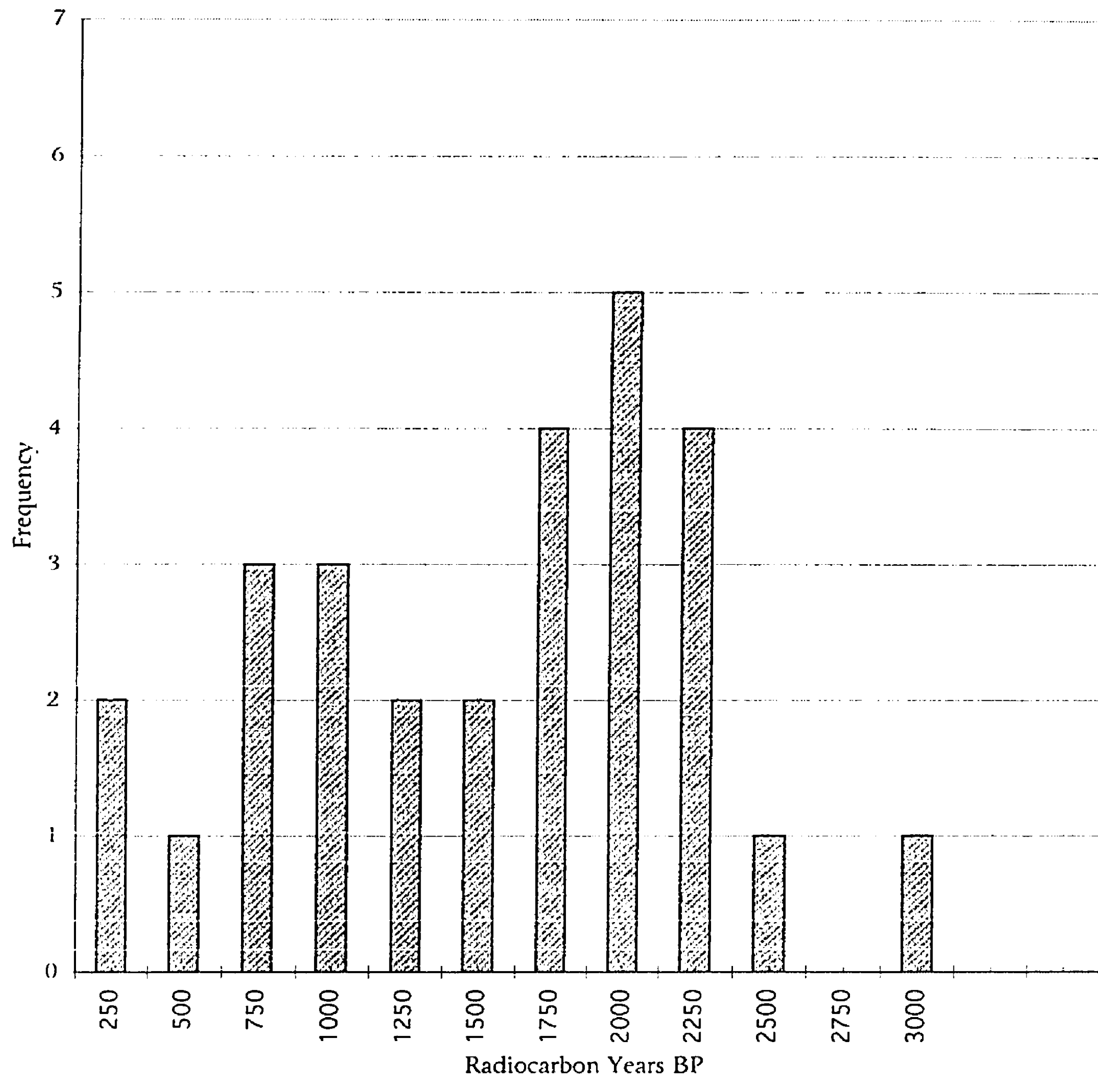

Figure 7.18: Frequency of radiocarbon age estimates from excavated earth ovens on the Canadian Plateau (n=30).

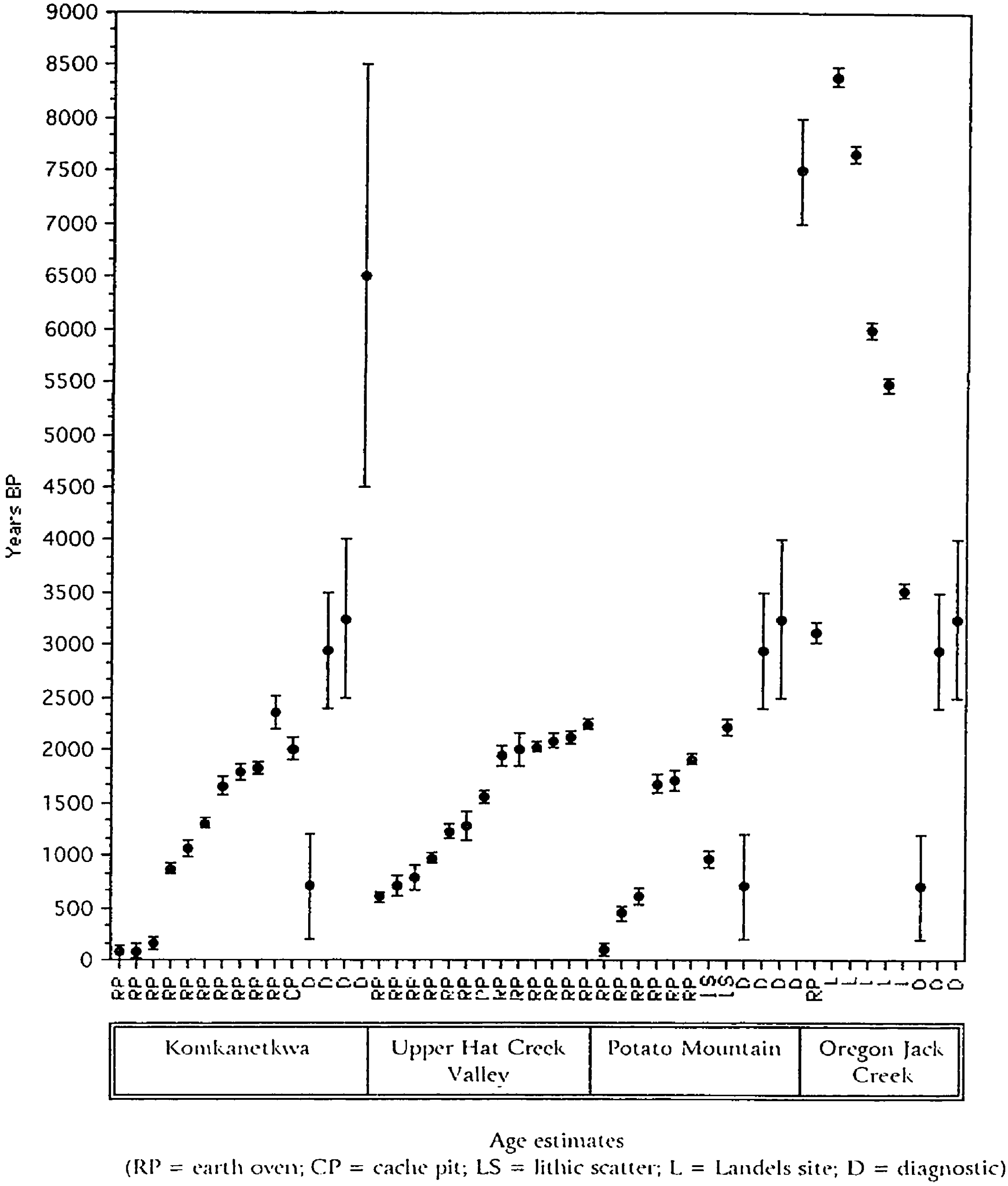

Figure 7.19: Radiocarbon age estimates and diagnostic materials associated with upland root collecting and processing locales on the Canadian Plateau.

ovens from Komkanetkwa, the Upper Hat Creek Valley and Oregon Jack Creek indicates people have been collecting, processing and storing roots in a manner generally consistent with the ethnographic pattern throughout the last 3100 years. The Potato Mountain earth ovens, although they do not conform to Interior Salish ethnographic expectations in terms of size, show a consistent patterning in terms of age and are thus indicative of broader trends in root processing activities on the Canadian Plateau. These activities were concentrated in upland areas where people had access to economically important plant species, as well as fuel, water and materials necessary for the construction and use of earth ovens. Base camps established in these mid- to upper-elevation locales served multiple purposes and were repeatedly occupied.

There are inter-regional variations in the expression of this pattern, most notably in the size of the earth ovens, which appears to vary both spatially and temporally. While 75% fall within the range of ethnographic expectations, there are a number both larger and smaller, although not substantially so. Of particular interest is the variation between the earth ovens in the Upper Hat Creek Valley and those at Komkanetkwa and Oregon Jack Creek. There are several possible explanations, however the sample of excavated earth ovens is too small, and our current understandings of trends in Plateau prehistory too limited (see Chapter 8) to draw any firm conclusions at this point in time. These inter-regional variations do not detract from the broad pattern identified for Canadian Plateau as a whole.

This period between 3500 and 2500 years ago has been interpreted as the emergence of root resource "intensification" on the Plateau (Pokotylo and Froese 1983; Richards and Rousseau 1987; Thoms 1989). On the Columbia Plateau, Thoms'

(1989) research on camas processing suggests root resource intensification begins 3500 years ago after some 2000 years of regular use. A similar pattern may exist for the Canadian Plateau, as there is no reason to suggest the current sample of dated earth ovens represents the maximum antiquity of pitcooking practices. Certainly, the diagnostic artifacts recovered from upland areas indicates people were utilizing these areas much earlier than the earliest dated earth ovens. There is no reason to assume they were not exploiting root resources in these areas at this time.

At least, we can now say that root food production systems were underway by approximately 3100 years ago on the Canadian Plateau and that ethnographically-documented practices of root processing are well-represented after 2500 BP. In Chapter 8, I examine the broader environmental and culture-historical contexts for root food production and identify conditions which may have favoured "putting down roots."

CHAPTER 8: THE ENVIRONMENTAL AND CULTURAL-HISTORICAL CONTEXT FOR ROOT FOOD PRODUCTION ON THE CANADIAN PLATEAU

8.1 Introduction

The archaeological record indicates earth ovens have been used throughout the last 3100 years on the Canadian Plateau and I contend, this record represents the emergence of systems of plant food production--specifically, the management and processing of root resources for stores of carbohydrates necessary for overwintering. Several researchers (Ames and Marshall 1980; Pokotylo and Froese 1983; Richards and Rousseau 1987; Thoms 1989) have suggested these activities reflect a period of root resource intensification. I concur and further suggest that the emergence of systems of root food production represents one of the most significant documented changes in subsistence strategies of the Late Prehistoric Period (4500/3500 to 200 BP).

To assess this assertion, and to understand why roots were intensified when they were, the emergence and practice of root food production must be viewed from the broader paleoenvironmental and cultural context of the Late Prehistoric period. To that end, I begin with a review of the paleoenvironmental conditions of the last 5000 years, with an emphasis on the beginning of the Late Prehistoric Period. Then, I review the archaeological evidence for Late Prehistoric subsistence and settlement patterns on the Canadian Plateau.

8.2 The Environmental Context for Root Food Production

Landscapes of the Holocene provided the setting for the adaptive strategies of

Plateau peoples. In the following discussion, I examine paleoenvironmental conditions on the Canadian Plateau, with particular reference to the changes which occurred between approximately 5000 and 2000 years ago. The discussion is based on a recent analysis by Hebda (1995), which provides a synopsis of the Holocene environments of British Columbia and makes specific reference to the southern interior Plateau. This information is complemented by Chatters' (1995, 1998) summaries of the regional paleoenviromental data from both the Canadian and Columbia Plateaus.

Climate Interpretations: Hebda's 1995 article represents a synthesis of previous paleoenvironmental sequences for British Columbia and an interpretation of Holocene climatic states and trends throughout the province. In his discussion, he makes the distinction between climatic "states" (*i.e.*, temperature and precipitation relative to the present "modern" state) and climatic "trends." Hebda identifies three climatic states for the Holocene (Figure 3.1), including: 1) a warm, dry Xerothermic Interval (*ca* 9500 to *ca* 7000 BP); 2) a warm moist Mesothermic Interval (*ca* 7000 to *ca* 4500 BP); and 3) a state of moderate moisture and temperature (*ca* 4500 to present). He also identifies two major climatic trends for the province following rapid warming at the beginning of the Holocene. The first trend reflects a significant increase in precipitation (relative to the early Holocene) which occurred between 8000 and 6000 BP, and peaked approximately 7000 years ago. Hebda suggests this may have been associated with a cooling trend. The second trend represents a definite cooling period, which may have been associated with a minor increase om precipitation, between 4500 and 3000 BP.

Details of the changing temperature and precipitation regimes are summarized as follows. In the early Holocene, the climate was warmer and drier than present and

<table>
<tr><th>Years Before Present</th><th>Climate States & Trends (relative to present)

(Hebda 1995)</th><th>Climate States & Trends (relative to present)

Chatters (1995)</th><th>Vegetation

(Hebda 1995)</th></tr>
<tr><td>0</td><td rowspan="8">Modern
Temperature (T)
&
Precipitation (P)

Decreasing T</td><td rowspan="4">Modern
Temperature (T)
&
Precipitation (P)</td><td rowspan="6">Grasslands at modern extent

Modern Douglas-fir forests established</td></tr>
<tr><td>500</td></tr>
<tr><td>1000</td></tr>
<tr><td>1500</td></tr>
<tr><td>2000</td><td rowspan="4">T = colder
P = wetter

Glacial advances peak
ca 3500 -3400 BP</td></tr>
<tr><td>2500</td></tr>
<tr><td>3000</td><td rowspan="2">Grasslands at minimum extent, restricted to valley bottoms;</td></tr>
<tr><td>3500</td></tr>
<tr><td>4000</td><td rowspan="6">Mesothermic Interval

T = warmer
P = modern
begins to decline
at
5500 BP

Increasing P</td><td rowspan="6">T =warmer,
begins to decline between
5000 BP
&
4500 BP</td><td rowspan="8">Mesic grassland extent reduced;

Douglas-fir & ponderosa pine forest expansion</td></tr>
<tr><td>4500</td></tr>
<tr><td>5000</td></tr>
<tr><td>5500</td></tr>
<tr><td>6000</td></tr>
<tr><td>6500</td></tr>
<tr><td>7000</td><td rowspan="7">Increasing P

Xerothermic Interval

Warmer
&
Drier</td><td rowspan="7">Warmer
&
Drier</td></tr>
<tr><td>7500</td></tr>
<tr><td>8000</td><td rowspan="5">Grasslands maximum;
Lodgepole pine at upper elevations;</td></tr>
<tr><td>8500</td></tr>
<tr><td>9000</td></tr>
<tr><td>9500</td></tr>
<tr><td>10,000</td></tr>
</table>

Figure 8.1: Holocene climatic and vegetation reconstructions.

temperatures were, on average, 2 to 4°C higher than today. Conditions remained relatively warm and dry until approximately 8000 BP, when precipitation increased, reaching a maximum at about 7000 BP. The mid-Holocene, at approximately 6000 BP, was wetter than the early Holocene and may have been similar to current conditions.

Beginning 5500 years ago, temperatures declined, signalling a cooling trend. In general, the transition from a warm state to a cool state occurred between 5000 and 4000 BP throughout most of the province, although it appears to be concentrated between 4500 and 3800 years BP. According to Hebda (1995:77):

> The clearest indications of cooling occur about 4000 BP with changes in the vegetation on the coast and in the interior and further Neoglacial ice advances. Temperatures reach modern values or may even briefly decline below modern values at this time.

Hebda suggests "more or less present-day temperatures" were established by 4000 BP throughout most regions of the province, including the Southern Interior Plateau, although the transition to modern conditions occurs as late as 2000 BP in the Fraser Canyon and on Vancouver Island (Hebda 1995, Figure 9).

Chatters (1995, 1998), synthesizes much of the same literature for both the Canadian and Columbia Plateaus and also suggests Mid-Holocene temperatures were warmer than those at present and began to decline between 5000 and 4500 BP. However, Chatters argues that temperatures "plummeted" 3900 years ago, and remained cool until approximately to 2200 BP. Multiple lines of evidence support this position and Chatters concludes that the period between approximately 4000 and 2200 BP represents "the coldest and wettest of the Holocene" (Chatters 1995:381-387,

Figure 9). Of interest is a period of alpine glacial advances in the Cascades and Northern Rocky Mountains which occurred between 4000 and 2000 BP, peaked between 3500 to 3400 BP and waned after 2400 BP. According to Chatters (1995:385):

> Advance or retreat of alpine glaciers results from changes in ice mass balance, caused by quantitative and/or seasonal shift in temperature or precipitation. Because precipitation rarely changes synchronously over large regions, widespread synchronous changes in glacial mass balance can be attributed to temperature changes.

In Chatters' paleoenvironmental reconstruction, modern climatic regimes became established only after alpine glaciers receded and temperatures warmed, sometime after 2400 BP. Modern climatic conditions persisted, with no major changes, for the last 2000 years.

Reconstruction of Vegetation Patterns: Analyses of pollen cores reveal changing vegetation patterns in response to the climatic variations outlined above. Hebda's (1982, 1995) analysis of the southern interior Plateau is based on cores from a variety of sites throughout the region, including Finney Lake in the Hat Creek Valley and Pemberton Hill Lake situated in an upland valley (1020m) approximately 30km east of Komkanetkwa. Noting that the "number of sites investigated is far too small for such a complex terrain" (Hebda 1995:65), he reconstructs Holocene vegetation communities as follows.

During the early Holocene, grasslands covered much of the southern interior. These open, xeric communities were characterized by abundant grasses (Poaceae) and sagebrush (*Artemisia* sp.). Lodgepole pine forests (*Pinus contorta*) dominated the uppermost elevations. Grasslands declined after 8000 BP as increasing precipitation favoured an expansion of the forests. However, valley bottoms remained open and grasslands were still more extensive throughout the southern Interior than they are today.

Between 7000 and 6000 BP, precipitation reached maximum post-Pleistocene levels, promoting continued expansion of the forest as well as a shift in forest composition. This period marked the beginnings of the Interior Douglas-fir forests, although pine continued to be present. Open grassland communities remained in what is now forested terrain. The expansion of moisture-dependent species, descending tree lines, relatively full lakes and reduced fire frequencies leads Hebda (1995) to suggest the Mid-Holocene, and particularly the 6000 BP horizon, was wetter than the early Holocene and perhaps as wet as today. Temperatures remained warmer than present.

Between 4500 and 3000 BP, the effects of the cooling trend were on the landscape of the southern interior Plateau. Forests began to expand and coalesce and by 4000 BP, open grassland and sagebrush communities disappeared from mid-elevation valleys and were replaced by modern forests under modern climatic regimes. Grasslands were reduced to their minimum extent at this period, and were restricted to valley bottoms. At the Pemberton Hill Lake site, modern Interior Douglas-fir forests evolved only in the last 4000 years as open grass and sagebrush communities essentially disappeared and spruce (possibly *Picea engelmannii*), combined with Douglas-fir, birch and pine to form the closed forest. The climate was relatively cool and moist (Hebda 1995).

Chatters (1995:382) views the development of mixed forests of lodgepole pine, ponderosa pine (*Pinus ponderosa*) and Douglas-fir, accompanied by a decline in fire frequencies between 3900 to 2400 BP, as indicative of cooler or wetter conditions. However, he suggests increase in abundance of cold-adapted trees, such as whitebark (*Pinus albicaulis*) or limber pine (*Pinus flexilis*), spruce and fir at several sites is indicative of a colder climate.

Modern vegetation was established after 2400 BP, the result of a warming and drying trend (relative to the preceding 2000 years) which ushered in modern climatic conditions (Chatters 1998; Chatters and Pokotylo 1998). Hebda (1995) suggests grasslands expanded during this time. There is evidence for the management of upland ecosystems with fire during this period. According to Chatters (1998:46):

> Where fire frequencies have been considered, such as at Blue Lake (Smith 1983), and sites in the eastern Rockies (Hemphill 1983; Mehringer et al. 1977), fires are more frequent, but less severe in the past 1000 to 2000 years than at other times in forest histories. Human efforts to maintain the seral vegetation and promote production of game and fruits are the probable causes of this phenomenon.

Modern climate and vegetation persisted throughout the Plateau, with little significant change, throughout the last 2000 years.

Summary: Although the nature and timing of climatic variation and the subsequent changes in vegetation vary somewhat from region to region, periods of "marked, approximately synchronous transitions" occur throughout the Canadian and Columbia Plateau at several points during the Holocene: 8500 to 8000 BP, 5400 to 5700 BP, 4000 BP, and 2500 to 2000 BP (Chatters 1998). Of particular interest to this discussion is the cooling trend which began 5500 years ago, and more specifically the abrupt drop in temperatures which occurred approximately 3900 years ago. This sudden, dramatic decline ushered in a 2000 year period generally conceded to be the coldest and wettest phase of the Holocene. Such conditions persisted until approximately 2000 years ago when "modern" climate and vegetation regimes were established. These states and trends correspond well with Holocene climatic changes elsewhere in North America, particularly in eastern Canada where the 4000 BP horizon is also associated with significant change (Hebda 1995:77).

This has important implications for understandings of Late Prehistoric cultural adaptations. The key point is this: the modern climate (*i.e.,* after 2000 BP) of the Canadian Plateau is characterized by long, cold winters, and short, hot summers. As a result, the availability and productivity of resources fluctuates seasonally, creating prolonged periods of resource dearth during winter months. It seems reasonable to suggest, therefore, that the colder, wetter conditions between 3900 and 2200 BP represented a time when winters were more severe (*i.e.,* colder and longer), and the periods of resource scarcity longer, than those observed ethnographically.

8.3 The Cultural-Historical Context for Root Food Production

By 4500 years ago, significant cultural changes also were occurring on the Canadian Plateau. In this section, I examine the archaeological evidence for shifts in subsistence and settlement strategies during the Late Prehistoric Period (4500 to 200 BP). It is not meant as an exhaustive account of Plateau culture-history. It seeks to identify patterns in the archaeological record relevant to the cultural context for root food production and draws upon information from a wide variety of sources, including published materials, consultants' reports on file at the Archaeology Branch, British Columbia Ministry of Small Business, Tourism and Trade, and unpublished manuscripts

(Peacock, n.d.). Readers are referred to the summaries of Canadian Plateau prehistory (*e.g.*, Fladmark 1982; Richards and Rousseau 1987; Pokotylo and Mitchell 1998, and the sources cited therein, for details.

For discussion purposes, the Late Prehistoric Period is divided simply into three broad chronological units: Late Prehistoric I (ca. 4500 to 2500 BP); Late Prehistoric II (ca. 2500 to 1500 BP); and Late Prehistoric III (ca. 1500 to 200 BP). These correspond to those used by Chatters and Pokotylo (1998) and represent periods during which similar or complementary trends can be seen in the cultural development of the region. The relationship of this scheme to other regional culture-historical sequences and broader integrative schemes is outlined in Figure 8.2.

A brief examination of the Early (11,000 to 7000 BP) and Middle Prehistoric (7000 to 4500) Periods provides the context for the discussion of the subsistence and settlement changes of the Late Prehistoric.

The Early Prehistoric Period (11,000 to 7000 BP)

Little is known regarding the lifeways of the earliest inhabitants of the Canadian Plateau. Archaeological evidence is scarce, restricted largely to surface finds of diagnostic projectile points from a range of habitats and representing a number of early traditions. However, the limited evidence suggests the first peoples were highly mobile foragers (*sensu* Binford 1980) with a generalized subsistence strategy (Rousseau et al. 1991; Rousseau 1993; Stryd and Rousseau 1996; Chatters and Pokotylo 1998).

The earliest excavated faunal assemblage, from the Landels Site (EdRi 11) in the Oregon Jack Creek Valley, suggests ungulates were an important component of diets by

<table>
<tr><th>Years BP</th><th>This Study</th><th>Thompson River/Shuswap Lake (Richards & Rousseau 1982)</th><th>Mid-Fraser (Stryd 1973)</th><th>Richards & Rousseau 1987; Stryd & Rousseau 1996</th></tr>
<tr><td>200</td><td rowspan="2">Late Prehistoric III</td><td rowspan="2">Kamloops</td><td rowspan="2">Fountain</td><td rowspan="8">Plateau Pithouse Tradition</td></tr>
<tr><td>1000</td></tr>
<tr><td>1500</td><td rowspan="3">Late Prehistoric II</td><td rowspan="3">Thompson</td><td rowspan="3">Lillooet</td></tr>
<tr><td>2000</td></tr>
<tr><td>2500</td></tr>
<tr><td>3000</td><td rowspan="4">Late Prehistoric I</td><td rowspan="3">Shuswap</td><td rowspan="3">Kettlebrook</td></tr>
<tr><td>3500</td></tr>
<tr><td>4000</td></tr>
<tr><td>4500</td><td colspan="2">Lochnore</td><td rowspan="9">Nesikep Tradition</td></tr>
<tr><td>5000</td><td rowspan="5">Middle Prehistoric</td><td colspan="2" rowspan="2">Lehman</td></tr>
<tr><td>5500</td></tr>
<tr><td>6000</td><td colspan="2" rowspan="6">Early Nesikep</td></tr>
<tr><td>6500</td></tr>
<tr><td>7000</td></tr>
<tr><td>7500</td><td rowspan="6">Early Prehistoric</td></tr>
<tr><td>8000</td></tr>
<tr><td>8500</td></tr>
<tr><td>9000</td><td colspan="3" rowspan="3">Mixed Early Traditions</td></tr>
<tr><td>9500</td></tr>
<tr><td>10,000</td></tr>
</table>

Figure 8.2: Culture-historical sequences for the Mid-Fraser/Thompson River regions.

approximately 8400 BP (Rousseau et al. 1991; Rousseau 1993). This interpretation is supported by stable isotopic analysis of the Gore Creek "burial" near Kamloops dated to 8250 ± 115 BP which indicates this individual obtained 80% of the protein in his diet from terrestrial sources and approximately 18% from marine sources (Chisholm and Nelson 1983).

The Middle Prehistoric Period (7000 to 4500 BP)

The Middle Prehistoric Period is better represented (Stryd and Rousseau 1996, Table 1). Numerous sites with excavated components dating to this period are found throughout the entire Mid-Fraser and Thompson River drainage (*e.g.,* Sanger 1966, 1968a,b, 1970; Stryd 1972, 1973; Lawhead et al. 1986; Rousseau et al. 1991). These sites occur on upper terraces along the sides of major river valleys, especially at the confluences of major tributaries, but as well in mid-altitude valleys near lakes and streams. The former may represent residential camps with repeated occupations while the latter are interpreted as resource extraction camps used for short durations at different times throughout the year (Rousseau et al. 1991).

Subsistence data from excavated components indicate a diversified hunting-fishing-gathering economy. Large ungulates, including deer and elk, were the main dietary items, supplemented by small mammals and rodents, freshwater fish, and birds (Lawhead and Stryd 1985; Rousseau et al. 1991; Sanger 1969, 1970; Stryd 1972; Pokotylo and Mitchell 1998). Freshwater mussels may have been a significant component of the diet (Lawhead and Stryd 1985).

Salmon bones have been recovered from archaeological contexts; however, there is not evidence for intensive use of this resource. Analysis of stable carbon isotope ratios of two individuals buried near Clinton (EiRm 1) and dated to 4950 ± 170 BP indicates foods of marine origin supplied 37±10% and 38 ± 10% of dietary protein (Chisholm 1986; Lovell et al. 1986).

In sum, the subsistence and settlement data for this period suggest people were highly mobile, utilizing a broad range of resources located in both riverine and upland locations in a patterned and repeated manner.

The Late Prehistoric Period I (4500 to 2500 BP)

As presently understood, the transition between the Middle and Late Prehistoric Periods is thought to have occurred between 4500 and 3500 BP, marked by the appearance of semi-subterranean pithouse dwellings, one of the main defining characteristics.

Excavations at the Baker Site (EdQx 43), on the South Thompson River east of Kamloops, revealed three semi-subterranean dwellings with radiocarbon age estimates ranging from 4450 ± 100 to 4145 ± 205 BP (Wilson et al. 1992; Wilson 1993). All three house depressions are round to oval in shape, from 3 to 4.5m in diameter, and at 35-50cm in depth, are relatively shallow. Each has a central hearth and interior pits, which have been identified as food storage pits on the basis of refuse, including articulated salmon vertebrae (Wilson et al. 1992). These pithouses represent the earliest evidence for such structures on the Canadian Plateau and are older than other known sites by 1000 years. They are interpreted as winter residences and as evidence for community seasonal sedentism.

Chatters and Pokotylo (1998:76), suggest "this brief affair with sedentism ended or became extremely rare" after approximately 4500 BP. There is a paucity of evidence for semi-subterranean dwellings for up to 500 years afterwards as well as a lack of excavated materials (Rousseau et al. 1991; Chatters and Pokotylo 1998; Pokotylo and Mitchell 1998). The reasons for this are unclear although it has been suggested this period is one of population decline (Chatters 1995) and/or population redistribution (Ames and Marshall 1980).

After 3500 BP, there is increased evidence for semi-subterranean winter dwellings, which are grouped into small villages and widely distributed along the major river valleys and tributaries, and next to lakes and rivers in upland areas. Housepit depressions tend to be large, averaging 11m in diameter. They are circular to oval in plan and are typically flat-bottomed with steep walls. Hearths, internal storage pits and cooking pits are common, with external storage or cooking pits more frequent after 3000 BP. In addition, there is often evidence of one or more occupational episodes (Richards and Rousseau 1987; Rousseau et al. 1991) suggesting greater settlement permanence (Chatters and Pokotylo 1998).

Food procurement and processing technologies include a series of large and medium-sized shouldered, stemmed and basally "eared" projectile points which resemble the Oxbow-McKean-Duncan-Hanna series from the Plains (Richards and Rousseau 1985). "Where good preservation prevails," there is evidence of a well-developed antler and bone industry, which includes bilaterally barbed bone points and composite toggling harpoon valves (Richards and Rousseau 1987:27). Hammerstones and net sinkers are also present in small quantities.

Subsistence data for this period are scant (Richards and Rousseau 1987). The faunal materials from the Van Male site (EeRb 10), a housepit village near Kamloops (Richards and Rousseau 1982; Wilson 1980), remains the largest excavated assemblage. Species identified from this and several other housepit sites include large ungulates such as elk, deer, and mountain sheep, as well as black bear, a variety of canids, and such small mammals as beaver and snowshoe hare. Freshwater mussels and fish, waterfowl and salmon are also represented.

The small earth oven feature from the Parker site (EdRi 25) in Oregon Jack Creek Valley, dated to 3130 ± 100 BP, provides the earliest direct evidence of plant resource procurement and processing on the Plateau, as discussed in Chapter 7. The multi-component campsite at Komkanetwka (EeRb 98) is also assigned to this period and is associated with the remains of earth ovens, one in particular (EeRb 98-4) bearing strong resemblances to the Parker site specimen.

Pecked and ground stone pestles are present in small quantities. On the Columbia Plateau, pestles are linked to food processing, specifically the grinding of tough, fibrous roots (Reid 1991; Chatters and Pokotylo 1998) and these artifacts may have served a similar purpose on the Canadian Plateau. Pestles have not been recovered from later contexts (Richards and Rousseau 1987:89, Table 8).

Settlement patterns of this period are considered representative of small, moderately mobile bands of extended families with established residential base camps on valley bottoms in locations where resources were "available, abundant and varied" (Rousseau et al. 1991). This period is viewed as one of decreasing residential mobility and increasing individual task-group mobility. Chatters and Pokotylo (1998:76) characterize this period as a shift in adaptations from "non-storage-dependent foragerlike strategies to storage-dependent collector strategies."

Late Prehistoric Period II (2500 to 1500 BP)

Changes in settlement patterns and subsistence technologies after 2500 BP represent a continuation and elaboration of those patterns observed in the preceding period. Pithouse villages located in the major river valleys continue to be important for overwintering, however there is increased evidence for numerous small field camps and resource extraction camps in mid- to high-altitudes. The number and diversity of excavated sites exceeds those of earlier times, suggesting a wider range of economic activities.

Shifting settlement strategies are reflected in winter villages, which decrease in number, but increase in size, with up to 100 houses present at some sites (Richards and Rousseau 1987; Pokotylo and Mitchell 1998). These sites are concentrated on the lower reaches of the major rivers and were continuously reoccupied, suggesting these were semi-permanent residences (Rousseau et al. 1991; Chatters and Pokotylo 1998). The pithouse dwellings are smaller than those of earlier and later periods, averaging 5 to 7m in diameter; however, there is evidence for a few very large houses at certain sites along the Mid-Fraser (Stryd 1973; Hayden et al. 1985; Hayden and Spafford 1993; Hayden and Ryder 1991) (see discussion below). Birch bark sheets and rolls recovered from small circular and oval depressions in housepits suggest these features served as "earth ovens, storage pits, and refuse receptacles" (Richards and Rousseau 1987:34).

Subsistence data indicate people continued to exploit a wide range of terrestrial, riverine and lacustrine resources. Faunal remains recovered from sites are virtually identical to those of the preceding period and indicate a wide range of ungulates, large and small mammals, birds, freshwater fish and mussels and salmon continued to be exploited (Richards and Rousseau 1987, Table 11).

Root resource intensification is well underway in the upland areas by this time. Richards and Rousseau (1987:39) interpret the appearance of earth ovens as the "commencement of intensive exploitation of mid-altitude root resources" and suggest this marked "the most significant observed change over the preceding [period]." At the time of writing, the earliest dates from earth ovens in the Upper Hat Creek Valley placed the beginnings of root food processing at approximately 2300 years BP. Although it now appears root food production was underway by 3100 years ago, the archaeological evidence for earth ovens in upland root collecting and processing locales is better documented for this period of the Late Prehistoric. Antler digging stick handles recovered from EeRc 44 near Kamloops are associated with this period (Eldridge and Stryd 1983).

Populations are believed to have increased during this time, as reflected by the large village sites and the greater number of sites in upland areas. Rousseau et al. (1991) suggest this period is marked by a decrease in the mobility of the village group and increased reliance on small task groups to exploit the mid- and high-altitude resources throughout the seasons.

<u>Late Prehistoric Period III (1500 to 200 BP)</u>

While the basic subsistence and settlement patterns of the preceding periods remain the same, there are changes in the scale and intensity with which these strategies are practiced during the last 1500 years of the Late Prehistoric Period.

For example, after 1500 BP there appears to be greater variation in the size of pithouses within villages, a pattern thought to reflect significant differences in the socioeconomic status of households (Stryd 1971, 1973; Hayden and Ryder 1991; Hayden et al. 1985; Hayden and Spafford 1993; Hayden 1997).

Socioeconomic inequalities are also represented by the quantity, quality and exotic nature of grave goods associated with burials throughout the Mid-Fraser (Sanger 1968b; Stryd 1973, 1981) and Thompson River Valleys (Sanger 1968a; Pokotylo et al. 1987). Schulting's (1995) recent synthesis and analysis of mortuary variability on the Canadian and Columbian Plateaus attempts to quantify changes in socioeconomic status through comparison of grave goods. Unfortunately, the sample available for analysis from Canadian Plateau is small (three sites, with a total of 49 burials) and suffers from lack of spatial (two of the locales represent a composite of several closely related sites) and temporal control (only one radiocarbon age estimate). As a result, his conclusions concerning changes in patterns of Late Prehistoric social status are more "impressionistic" than quantitative (see also Curtin 1997). Nonetheless, on the basis of his statistical analysis and a review of a number other burial features from the region, Schulting (1995:180) notes:

> While the database is thus far quite meagre and any conclusions must remain tentative, it appears at present that there is a near total absence of grave inclusions in burials dating to before ca. 1500 BP on the Canadian Plateau.

In contrast, he suggests grave inclusions appear "quite common" from ca. 1500 BP onwards (see Pokotylo et al. 1987; Schulting 1993; Stryd 1973) and concludes:

> Thus we have an early period in which material culture was relatively simple compared to later times, and either lacked or had very limited quantities of many of the items that may be thought of as primitive valuables, together with mortuary practices that did not place emphasis on the inclusion of non-perishable objects of any kind in graves. This was followed by a period exhibiting considerably more diverse material culture, incorporating many items brought from long distances and/or manufactured with intensive effort and skill, combined with an increase in final deposition of these items in burial contexts. It seems reasonable to suggest that the two are related, and that it was the need to display wealth and status, both in life and in death, that fuelled the elaboration of material culture and intensification of trade contacts in the area at this time.

In sum, these artifacts are thought to reflect ascribed rather than achieved status and point to the emergence of socioeconomic inequality (Schulting 1995; Chatters and Pokotylo 1998; Pokotylo and Mitchell 1998).

There are also several important changes in food procurement technologies during this period. The introduction of the bow and arrow after 1500 BP signals a shift in hunting technology. Fishing tackle also appears to have undergone some elaboration as bone and antler leisters, unilaterally and bilaterally barbed points and harpoons, composite toggling harpoons, fish hook barbs and small bipoints become increasingly common after 1500 BP. However, this apparent elaboration may be the result of differential preservation and/or sampling (Richards and Rousseau 1987).

The impact of these technological changes on subsistence practices is not well understood. Again, faunal analyses of assemblages dated to this period are limited and show a continued reliance on ungulates, small mammals, waterfowl, freshwater fish and salmon. There appear to be lesser amounts of freshwater mussel closer to the historic period.

The apparent elaboration of fishing technology is taken as evidence of an increased reliance on salmon resources (Kuijt 1989; Richards and Rousseau 1987). Stable carbon isotope analysis indicates that marine protein (salmon and steelhead trout) constituted, on average, from 40 to 60% of the dietary protein (Chisholm 1986; Lovell et al. 1986). Further, studies indicate the percentage of marine-origin protein in the diet decreases slightly with increased distances up the Fraser and Thompson drainages. For example, peoples living around Lillooet on the mid-Fraser consumed approximately 60% marine protein, while those along the South Thompson averaged approximately 48% (Chisholm 1986; Lovell et al. 1986).

Evidence from upland root collecting locales indicates root processing continued to play an important role in prehistoric economies. Analysis of palaeobotanical remains from several housepits at Keatley Creek provides further evidence of plant food and materials (Lepofsky et al. 1996). Food remains include seeds of saskatoon (*Amelanchier alnifolia)*, kinnikinnick, red-osier dogwood (*Cornus sericea*), prickly pear (*Opuntia* sp.) cherry (*Prunus* sp.), rose (*Rosa* cf. *woodsii*). These are concentrated around the hearths on the housepit floors suggesting the hearth was "repeatedly used for plant processing or (less likely) was the regular discard area for all plant foods used in the pithouse" (Lepofsky et al. 1996:44).

8.4 Summing up the Sequence: Patterns of the Late Prehistoric Period

Efforts to reconstruct a complete and accurate picture of subsistence and settlement patterns for the Late Prehistoric on the Canadian Plateau are limited by the fact that the majority of archaeological efforts have been driven by mitigation projects concentrated along the major rivers of the Plateau. Consequently, riverine sites, particularly pithouse villages, are well represented in the archaeological record, while there is comparatively little information concerning seasonal, short-term activity sites in upland areas. As a result, culture-historical sequences and interpretations are biased towards artifacts, faunal assemblages, palaeobotanical remains and features typically associated with winter residences (Fladmark 1982; Richards and Rousseau 1987). As Pokotylo and Mitchell (1998:81) observe:

> Investigation of housepit sites at the expense of other site types has overemphasized the last 4000 years in prehistoric cultural sequences and has stressed the winter subsistence and settlement aspects of the annual round.

Nonetheless, a composite picture derived from a cautious interpretation of the archaeological evidence for the Late Prehistoric reveals several trends of relevance to this discussion of the cultural context of root food production. These are outlined below.

Settlement Patterns: The beginning of the Late Prehistoric is thought to mark a significant shift in settlement patterns. The "forager" adaptive pattern of the Middle Prehistoric, characterized by high group mobility was replaced by a "logistically organized" system based on repeated winter concentrations of populations in villages along the major river valleys. The shift to seasonal sedentism was accompanied by a decrease in community mobility and increase in task group mobility. Populations are seen as "tethered" to the winter villages, radiating from these points in small groups to exploit specific resource locales throughout the year. This transition began approximately 4500 years ago, as indicated by the initial appearance of semi-subterranean pithouses, and was well established after 3500 BP.

The notion of sedentism is particularly problematic. Typically, it is viewed as a "type" of settlement pattern and societies or cultural groups are classified as one settlement type or another based upon the presence or absence of certain traits (*e.g.*, Rafferty 1985). This typological approach precludes consideration of the *degree* of sedentariness, a point cogently argued by Mitchell (1994) with reference to the peoples of the Northwest Coast whose communities, he suggests were not sedentary or even semi-sedentary, but highly mobile, characterized by the movement of entire villages -- house planks and possessions -- from spot to spot throughout the seasons. In light of this, he suggests a more useful approach to discussions of sedentariness would be to address mobility or sedentariness as a variable whose values can be scaled. Mitchell (1994:9) explains:

> What is apparent from examination of the typological distinctions is that there are several dimensions to the notion of fixity. We may be concerned with relative permanence of residence or relative permanence of residences. We may want to know how many people move, or how far, or how often. Matson (1985:246) was making this same distinction between type and variable when he noted that the proper question was "not whether a society is sedentary [that would be a typological approach], but how sedentary or how mobile [a variable approach]."

Mitchell proposes a number of factors which might be taken into account in measuring fixity from ethnographic evidence. However, he is less optimistic about the abilities of researchers to recognize sedentism in the archaeological record of the Northwest Coast and elsewhere.

On the Canadian Plateau, archaeologists have adopted a typological approach to the investigation of sedentism, equating the presence of semi-subterranean pithouses, and the repeated occupations of these structures, with a semi-sedentary settlement pattern. However, if semi-sedentism is simply repeated occupation of a residential location, then there is evidence for this in the Middle Prehistoric prior to the appearance of pithouses. Overwintering in the same structure is also seen as evidence of semi-sedentism. However, ethnographic evidence shows that people frequently wintered at one village in one year, and at another the next. Further, the ethnographic record indicates that Secwepemc settlement exhibited a range of sedentariness, with northern populations highly mobile, and those on Fraser River nearly sedentary. All, however, lived in pithouses during the winter. None of these examples fit within the traditional definition of semi-sedentism. Ames and Marshall (1980:26) observe:

> . . . villages represent one of several alternative strategies which is followed under the conjunction of the appropriate environmental, demographic and social processes. While these processes may be universal, they will operate through local scale mechanisms. Thus societies within the same cultural tradition may display differing degrees of sedentism, as on the southern [Columbia] plateau. . . We also expect the same fluctuation in the degree of sedentism through time. . . Thus the appearance of structures, such as pit houses, does not mean a permanent shift to sedentism.

In sum, I suggest the presence or absence of pithouses, which are essentially a specific "style" of house structure, is not good indicator of sedentism, nor necessarily is the repeated use of these structures. Clearly, there is a need to clarify concepts associated with the issue of sedentism as it pertains to Canadian Plateau peoples. Specifically, we need to move, as Mitchell (1994) has suggested, to discussions of degrees of mobility and sedentariness and establish variables for measuring the fixity of Plateau communities.

With these provisos in mind, trends in Late Prehistoric settlement may be summarized as follows. The appearance of semi-subterranean pithouses 4500 years ago, and widespread use of these structures after 3500 BP, represents a shift in housing style, likely in response to colder, wetter conditions (Chatters and Pokotylo 1998). It does not indicate that communities became less mobile, but rather that they were perhaps more comfortable in winter (see Hayden et al. 1996 for discussion of the thermal properties of housepits). In fact, there is little evidence to suggest the basic pattern of peoples' movements across the landscape was altered significantly during this period. River valleys and mid- to high-altitude environments, which were occupied and utilized from earliest times, continued to be important to seasonal resource procurement. However, there does appear to be an increase in scale and intensity with which these areas are utilized, particularly after 2500 BP. The degree of sedentariness may have also changed, but resolution of this issue awaits the definition and assessment of reliable archaeological indicators.

Subsistence patterns: The lack of detailed faunal analyses and a virtual absence of palaeobotanical studies for all periods on the Canadian Plateau makes it extremely difficult to assess changes in resource utilization through time. Analyses of faunal remains consist largely of the identification of species, skeletal elements and the calculation of the minimum number of individuals at sites (Richards and Rousseau 1987 (see Driver 1993 for a discussion of the difficulties of MNI and NISP and Mitchell 1990 for a partial solution to the problem). Thus it is difficult to determine the relative contributions of various faunal resources to the diet, despite the inferences drawn by many archaeologists.

The same may be said for attempts to reconstruct the role of plant resources in subsistence economies. With several notable exceptions (Pokotylo and Froese 1983;

Simonsen 1994; Lepofsky et al. 1996; Nicholas 1997; Wollstonecroft and Baptiste 1997), the recovery and identification of plant materials from archaeological contexts have been largely neglected. Therefore, discussions concerning the relative contribution of plant foods to past diets, and how this may have changed through time, are difficult.

Nonetheless, two points are relevant to this discussion. First, ungulates and anadromous fish, in varying proportions, have been part of subsistence strategies since the Early Prehistoric Period. Unfortunately, the current data preclude any conclusive statements concerning changes in the relative importance of these through time. Stable isotope analyses suggest a trend towards increased consumption of marine-origin protein throughout the last 8000 years. However, on average marine proteins contribute from 40 to 60% of the protein in the diet, which means that ungulates, and other terrestrial mammals, were equally as important, even in the Late Prehistoric Period.

Secondly, as per the suggestions of earlier researchers, the appearance of earth ovens marks the most significant observed change in Late Prehistoric subsistence strategies. As proxies for root food production, the archaeological remains of earth ovens currently represent the best evidence for resource intensification on the Canadian Plateau during the last 3500 years.

Storage Patterns: Changes in storage technologies occur in conjunction with the appearance of winter pithouse dwellings and the intensification of food procurement efforts. The evidence for more permanent storage facilities at the Baker Site suggests food storage was important to subsistence strategies by 4500 years ago and became increasingly important after 3500 BP at winter villages where storage features are associated with pithouses. In addition, there is evidence for storage facilities at productive root processing locales, such as Komkanetkwa, by 2000 BP.

While it is frequently implied that foragers of the Middle Prehistoric made little or no use of storage (*e.g.*, immediate-versus delayed-consumption strategies), I suspect probably storage containers, such as baskets, were commonly employed throughout the Early and Middle Prehistoric Periods. The point then, is that shift from mobile, and probably small scale storage, to permanent, large scale storage occurs during the Late Prehistoric.

Socioeconomic patterns: The appearance of prestige items, grave goods and differences in the size of residential structures during the last 2000 years suggest increasing social stratification and a level of socio-economic inequality that differs from the traditional egalitarian models of Plateau social organization (Pokotylo and Mitchell 1998). This is thought to represent increasing complexity (Stryd 1971, 1973; Hayden 1992, 1997; Hayden et al. 1996; Schulting 1995).

However, it should be noted that "complexity" is another problematic construct in hunter-gatherer studies. The term "complexity" is used to summarize a variety of socio-cultural traits and processes, yet there is widespread disagreement over both its definition and application (Binford 1990; Gamble 1993; McGuire 1983; Rowlands 1989).

Discussions of complexity on the Canadian Plateau have concentrated on the identification of social inequalities as reflected in material culture, particularly the size of winter dwellings, presence of prestige items and of artifacts associated with burials. Such approaches have been criticized by a number of researchers (*e.g.*, McGuire 1983;

Paynter 1989) who point out a correlation between economic inequality and "complexity" is often assumed rather than demonstrated.

Population patterns: The increase in the number, frequency, diversity and size of archaeological sites throughout the Late Prehistoric Period, and particularly after 2500 BP, is presumed to reflect increases in prehistoric populations. This period is typically viewed as one of population growth. However, as Ames and Marshall (1980) note, it is often difficult to determine whether observed patterns represent general population increases or changes in population dispersion on the landscape. Further, as Chatters' (1995) recent discussion and analysis of radiocarbon age estimates for pithouse sites on the Columbia Plateau illustrates, the methods archaeologists commonly use to generate past population figures are frequently flawed and tend to support interpretations of exponential population growth during the Late Prehistoric.

As Chatters (1995) observes, many Columbian Plateau researchers have relied on frequencies of radiocarbon age estimates from archaeological contexts as proxies of human population densities in prehistory, reasoning that:

> . . . the larger the population of an area, the greater the amount of archaeological carbon deposited. As time passes, the geological, biological and cultural processes act to destroy the organics left in earlier times, random soundings into the sediments will be more likely to encounter datable debris from more densely populated eras than less densely populated ones, assuming differential expression of the process of burial and erosion can be controlled for (Chatters 1995:378).

However, as Chatters argues, literal interpretation of such proxy data without acknowledging site formation and preservation processes, is misleading. As the numbers of sites and artifacts left during any time period are gradually destroyed through time, older carbon has a lower chance of surviving to be discovered and "dated" than younger carbon. Chatters' solution is to correct for the progressive destruction of carbon by modifying the raw data by a set "decay rate." The population proxy curve produced by this method is not exponential, but displays distinct peaks and valleys (Figure 8.3).

Chatters (1995:379) summaries his results as follows:

> The population curve is flat from 6000 to 4200 BP, after which it abruptly rises to the first of three modes. After a precipitous decline at 3900 BP, numbers rise slowly to a second plateau between 2800 and 3000 BP. The second decline, punctuated by a peak at around 2200 BP, coincides with the geographic expansion into upland areas that marked the end of Pithouse II and emergence of an adaptation closely resembling the ethnographic record.

Chatters' (1995) analysis illustrates past population growth for the Columbia Plateau has not been exponential but instead punctuated by points of population declines, several of which occur during the last 4500 years. While his analysis suggests populations during the Late Prehistoric were on average higher than those of preceding periods, it also emphasizes the need for a cautious approach to interpreting data for prehistoric populations.

Figure 8.4 depicts the frequency distribution of 195 radiocarbon age estimates from archaeological sites in the Mid-Fraser/Thompson River region. These were obtained from the British Columbia archaeological site database and bibliography at the Archaeology Branch, British Columbia Ministry of Small Business, Tourism and Trade, as well as published materials from Richards and Rousseau (1987, Table 12) and Stryd and Rousseau (1996, Table 1) and several other scattered sources (*e.g.*, consultants' reports, journal articles). The figure includes all available radiocarbon age estimates, regardless of feature type. Multiple estimates from the same site are also included.

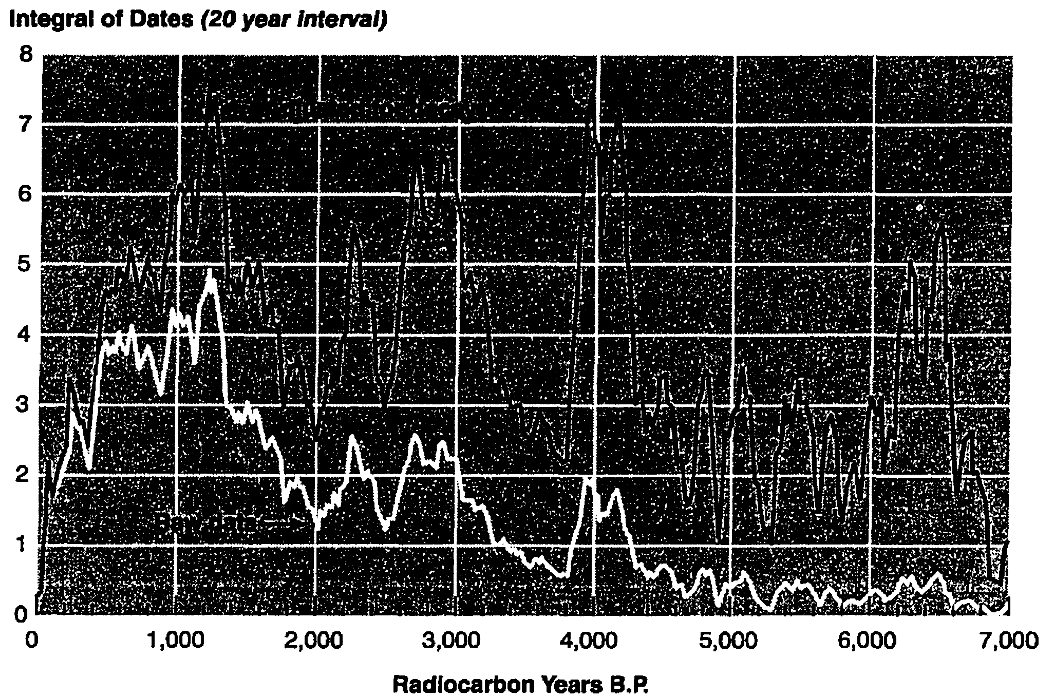

Figure 8.3: Distribution of radiocarbon age estimates on charcoal and bone from the Columbia Plateau (redrawn from Chatters 1995). Data are presented as an integral of time of the normal distribution of each date based on raw data (white line) and data corrected for progressive destruction and masking (black line). The black line is used as a proxy for ordinal population change over the past 6000 years.

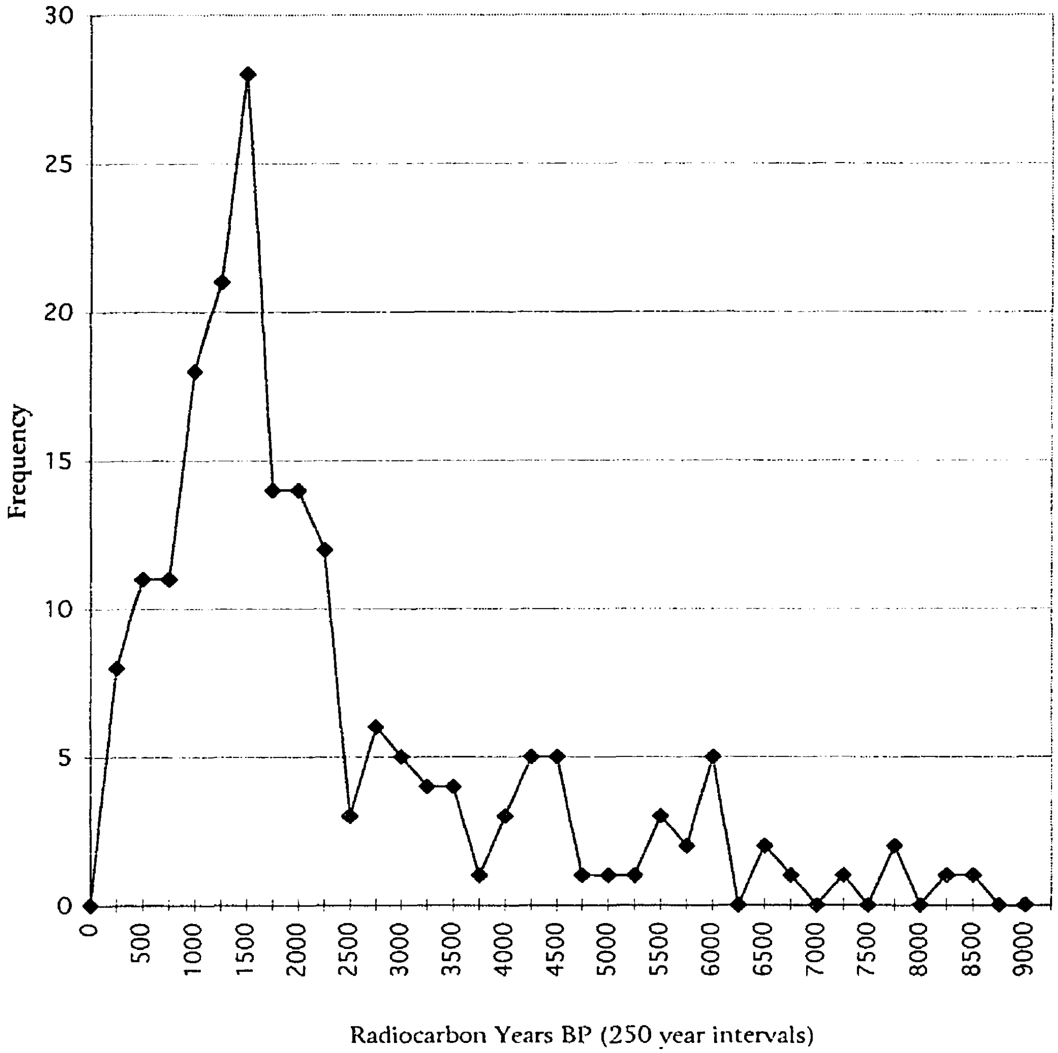

Figure 8.4: Frequency of radiocarbon age estimates for sites from the Mid-Fraser and Thompson River regions of the Canadian Plateau (n=195).

This database is admittedly incomplete, and the analysis is perhaps methodologically unsophisticated, but is comparable to other published efforts (*e.g.*, Richards and Rousseau 1987, Table 13) and serves as a rough indication of trends. These data are unadjusted; that is, I have made no attempt to correct for the loss of older carbon.

Interpretation of Figure 8.4 is based on the (tenuous?) assumption, outlined above, that more charcoal represents more people. Several trends are apparent. First, as Chatters predicts, the unadjusted data exhibit an exponential growth pattern. (It is worth noting here, that one site (the Bell site, EeRk 4) contributes 12 of 21 dates in the 1125-1375 year category). In addition, periods of growth are punctuated by periods of decline.

Using Chatters' adjusted curve as a guideline, a cautious interpretation of the evidence points to a population increase during the Late Prehistoric relative to preceding periods. However, this growth is not constant. The frequency of radiocarbon age estimates peaks between 4500 and 4000, declines until approximately 3500, rises and experiences a slight decline at 2500. After 2500 BP, there is a steady increase to a maximum at 1500 BP, followed by progressive decline (c.f. Richards and Rousseau 1987, Figure 24). If these data were adjusted, as per Chatters' example, then we might also expect an increase in the frequency of dates prior to 4500, and the periods of growth and decline to be more marked as they are in Figure 8.3. There should be a net increase in the frequency of charcoal, and hence the density of population, through time as we approach the present.

8.5 Summary: The "Roots" of Root Food Production

In summary, the "roots" of root food production on the Canadian Plateau lie in a period of environmental and cultural change. A dramatic decline in temperatures 3900 years ago, coupled with high levels of precipitation (relative to today), led to the coldest, wettest period of the Holocene, and more important, to the beginnings of longer, colder winters and prolonged periods of seasonal resource availability and scarcity.

At the same time, Canadian Plateau people began adjusting subsistence and settlement strategies which had remained essentially unchanged for thousands of years. These changes are reflected in the appearance of semi-permanent pithouses for overwintering and the establishment of winter villages in river valleys, the continuation of a highly mobile settlement pattern with more intensive use of upland areas, periods of population growth punctuated by declines, a trend towards socioeconomic inequality, and the intensification of abundant, storable resources. In short, this represents the emergence of the ethnographic pattern.

In several respects, these changes represent an elaboration of late Middle Prehistoric adaptive strategies. This is particularly true of subsistence regimes, with one exception -- the "introduction" of earth ovens 3000 years ago. While evidence suggests both terrestrial and marine-origin resources -- notably ungulates and salmon -- were important contributors to subsistence economies throughout the Early, Middle and Late periods, the development of large-scale root resource processing appears, on the basis of current evidence, to be a new adaptive strategy. Further I suggest that it is not until the appearance of earth ovens, and hence root food production, that the "ethnographic pattern" with its characteristic mix of ungulate, salmon *and* root resources -- is established on the Canadian Plateau.

Chapter 9: The Beginnings of Root Food Production

9.1 Introduction

The archaeological and paleoenviromental data reviewed in Chapters 7 and 8 suggest that the Interior Salish peoples of the Canadian Plateau have been collecting, processing and storing roots in a manner generally consistent with the ethnographic record for the last 3100 years. Further, the beginnings of these systems of root food production appears to coincide with a period of significant environmental and cultural change which began approximately 4500 years ago and culminated in the ethnographic pattern. What inferences can be drawn from these diverse lines of evidence regarding the conditions, components, and correlates of root food production on the Canadian Plateau?

To address this question, I briefly return the model of root food production developed in Chapter 6. This provides a basis for assessing the fit between the model and the archaeological evidence, as well as a framework around which I present my explanation of the emergence of root food production on Canadian Plateau. I conclude this chapter with a brief discussion of the implications of these findings to current reconstructions of Late Prehistoric culture change on the Canadian Plateau.

9.2. The Model of Root Food Production Revisited

As modelled, ethnographically-documented systems of root food production may be summarized as follows:

Conditions: Root resource production occurred under conditions of marked seasonal change with resource abundance during a relatively short, hot summer and resource scarcity during a long, cold winter. These conditions often led to recurrent resource stress amongst the Secwepemc peoples.

Components: The components of root food production systems include:

- the collection and management of root foods through a variety of horticultural practices;
- the processing of large quantities of roots in earth ovens;
- and the storage of root resources for winter.

Plant management, processing and storage, acted individually, and in concert with one another, to increase the productivity and availability of culturally significant root resources by:

- intentionally and incidentally increasing the density and distribution of root species, and thus enhancing the long-term productivity of root harvesting grounds;

- transforming indigestible root resources, particulary those containing inulin, into readily digestible, sweet-tasting food sources high in carbohydrate energy;

- and extending the availability of root resources from the season of abundance into the season of resource scarcity through preservation and storage.

Correlates: Historically, root food production existed amongst the Secwepemc peoples as one component of a socioeconomic system characterized by:

- a diversified subsistence economy which emphasized hunting, fishing and plant food production to varying degrees at different points throughout the year;

- a seasonally transhumant population that was highly mobile throughout the productive seasons, and seasonally sedentary during the winter months, living in villages along the major river valleys;

- and varying degrees of social stratification and status differentiation.

Expectations: In Chapter 6, I outlined a number of expectations regarding the initial appearance of past systems of root food production. In particular, I proposed the beginnings of root food production should be in response to recurrent resource stress triggered by prolonged periods of resource scarcity which would result under conditions characterized by long, cold winters. Under these conditions, people sought to ensure an adequate supply of carbohydrates for overwintering, lessening the possibility of resource stress.

In addition, I proposed that root management, processing and storage would be set within a broader socioeconomic context similar to that of the "ethnographic pattern" detailed above. As modelled, the correlates of this include increases in sedentism, population and social complexity through time (*i.e.*, from the beginnings of root food production to the proto-historic period). How then do the patterns observed in the archaeological and paleoenvironmental records of the Canadian Plateau fit with the specific model of root food production?

9.3. The Fit between Expected and Observed:

Conditions: Paleoenvironmental data from the Canadian Plateau indicate conditions favouring the beginnings of root food production -- long, cold winters and prolonged periods of resource scarcity -- were established by approximately 4000 years ago. Winters between 4000 and 2000 BP were likely longer (due to increased snowfall) and more severe (due to decreased temperature) than those experienced historically. Modern vegetation, and, therefore, the plant communities ethnographically important for root resource use were established at this time, although there may have been minor altitudinal fluctuations in the distribution of species throughout Late Prehistoric. Changes in temperature and precipitation may have favoured the growth of certain economically important root species.

Did these climatic changes create "resource stress," or the perception of resource stress? This is difficult to address directly given the nature of the extant archaeological data. The transition between the Middle and Late Prehistoric periods is not well understood. However, as outlined in Chapter 8, some developments may be linked to deteriorating environmental conditions. People adopted a new, more thermally-efficient style of winter dwelling; permanent storage facilities appear for the first time; and, the apparent paucity of sites between 4500 and 3500 on the Canadian Plateau (see Figure 8.4) may be indicative of a population "crash" similar to the one proposed for the Columbia Plateau (Chatters 1995), it may represent a period of population redistribution (Ames and Marshall 1980), or both. The matter of archaeological sampling methodologies must also be considered.

Components: On current evidence, the beginnings of root food production, as represented by the archaeological remains of the Parker site earth oven, appear approximately 3100 years ago on the Canadian Plateau, some 800 years after the onset of colder, wetter conditions. There are several possible explanations for this "lag". I am inclined to attribute it to the small sample size of dated earth ovens on the Canadian Plateau (n=30 or approximately 7% of all recorded ovens). Earth ovens are not uncommon at sites on the Columbia Plateau after 4000 BP (Thoms 1989). Thoms (1989), for example, shows an increase in the frequency of earth ovens in the Calispell Valley after 3500 BP (see Figure 7.13). We might expect a similar pattern on the Canadian Plateau.

Alternatively, the paucity of ovens between 3900 and 3100 BP may be indicative of low populations or differing settlement patterns as archaeological sites of ***all*** types are rare during this period on the Canadian Plateau. As has been suggested, this may be a time of readjustment and experimentation as populations cope with changing environmental conditions. Under such circumstances, a lag between the initial and perhaps irregular use of earth ovens and their regular, patterned use is to be expected (see also Section 9.4). This scenario might also account for the difference in the size and morphology of the early Parker site oven and later earth ovens which more closely approximate those documented ethnographically.

Nonetheless, after 2500 BP, the archaeological record indicates people were collecting, processing and storing roots in a manner directly comparable to the ethnographic pattern and continued to do so throughout the remainder of the Late Prehistoric period. These activities were concentrated in upland areas where people had access to economically important plant species, as well as fuel, water and materials necessary for the construction and use of earth ovens. Base camps established in these mid- to upper-elevation locales served multiple purposes and were repeatedly occupied. The radiocarbon age estimates (see Figure 7.18) suggest a peak in root processing activity between 2375 and 1625 BP.

As for direct evidence of the other components of root food production -- root management and root storage -- these are not as visible archaeologically. Bone and antler digging stick handles, which may represent certain plant management processes (*i.e.*, selecting harvesting, digging, tending, weeding), are associated with housepits and burials after 2500 BP (see Hayden and Schulting 1997 and references therein).

There is presently no archaeological evidence for such community-level land management practices as landscape burning on the Canadian Plateau. This reflects the lack of investigation into such issues rather than the absence of these practices prehistorically. Where studies have explicitly addressed this question (Smith 1983; Lepofsky et al. 1998), there is evidence to suggest burning becomes more frequent in upland areas after 2500 BP.

Evidence for root food storage is difficult to distinguish from evidence for food storage in general. As mentioned above, the earliest permanent storage facilities on the Canadian Plateau are associated with the pithouses at the Baker Site occupied approximately 4500 years ago. Storage facilities are commonly associated with pithouses in winter villages after 3500 BP. The cache pits at Komkanetkwa (ca. 2000 BP) are unique in that they occur at an upland root processing locale and were likely used for the storage of root resources. However this can not yet be claimed with certainty. Cache pits thought to have been used for root storage are also present at sites in the Potato Mountains.

Correlates: As mentioned, we might expect the socioeconomic context associated with the beginnings of root food production similar to that documented ethnographically. The correlates of this pattern include increases in sedentism, social complexity and population.

"Sedentism" is probably the most difficult of three correlates to assess archaeologically. There is evidence of winter pithouse dwellings by 4500 BP, although these are not considered "typical" of the ethnographically-documented style for the

Canadian Plateau. Structures consistent with this style appear after 3500 BP in clusters at winter villages. Whether people overwintering in these locations became less mobile at this time is difficult to assess. If we assume the degree of sedentariness was equivalent to that of the ethnographic period, then settlement patterns would still have involved a high degree seasonal mobility.

Attempts to reconstruct past subsistence economies have been hindered by a lack of detailed floral and faunal analyses. Nonetheless, available data indicate ungulates and anadromous fish resources, in varying proportions, have been a part of subsistence since the early prehistoric period. Although many researchers suggest an increase in the importance of salmon to diets throughout the Late Prehistoric Period, marine-source proteins contribute approximately 40 to 60% of the protein in the diet, which suggests that collectively, ungulates, terrestrial mammals and birds were equally as important. It is not until the appearance of earth ovens and the beginning of root food production 3100 years ago that the "triad" of resources -- salmon, ungulates *and* roots -- characteristic of the "ethnographic pattern" is assembled. In short, archaeological data indicate a variety of resources were important throughout most of the Late Prehistoric Period.

Archaeological evidence for social complexity, as measured by economic inequality, is virtually non-existent prior to 1500 BP. After this point, the differential size of house structures, the presence of prestige items and the inclusion of grave goods in some burials indicates varying degrees of social stratification on the Canadian Plateau. Unfortunately, discussions concerning changes in the degrees of "complexity" through time are hindered by small sample sizes and the lack of spatial and temporal control.

Several researchers (Pokotylo and Mitchell 1998) have suggested, however, that economic inequality may have been more pronounced in the past than during the historic period.

Past population changes are probably the most easily investigated through the use of archaeological data. The data presented in Chapter 8 suggest Late Prehistoric populations did not experience steady growth. Rather, population numbers appear to climb after 2500 BP and peak at approximately 1500 BP. After this, they decline. This is similar to the pattern reconstructed by Chatters (1995) for the Columbia Plateau. The peak in population occurs after the appearance of root food production at 3100 BP, but coincides with the increased activity in earth oven use after 2350 BP.

Summary: The review of archeological and paleoecological data reveals varying degrees of "fit" between the specific model of root food production and the expression of these variables throughout the Late Prehistoric Period. This is evident in Figure 9.1, which depicts the various lines of evidence examined in this discussion.

There is good evidence for the onset of colder, wetter conditions which resulted in prolonged periods of resource scarcity, particularly between 4000 and 2000 BP. The beginnings of root food production, as represented by the appearance of earth ovens, follows this initial decline at 3900 BP, and thus, may represent a response to these environmental changes. However, this position would be strengthened by the discovery of earth ovens dated to the "lag" period between 3900 and 3100 BP and between 3100 and 2500 BP.

The archaeological record of earth ovens from the Canadian Plateau suggests people have been processing root foods in a manner consistent with the ethnographic

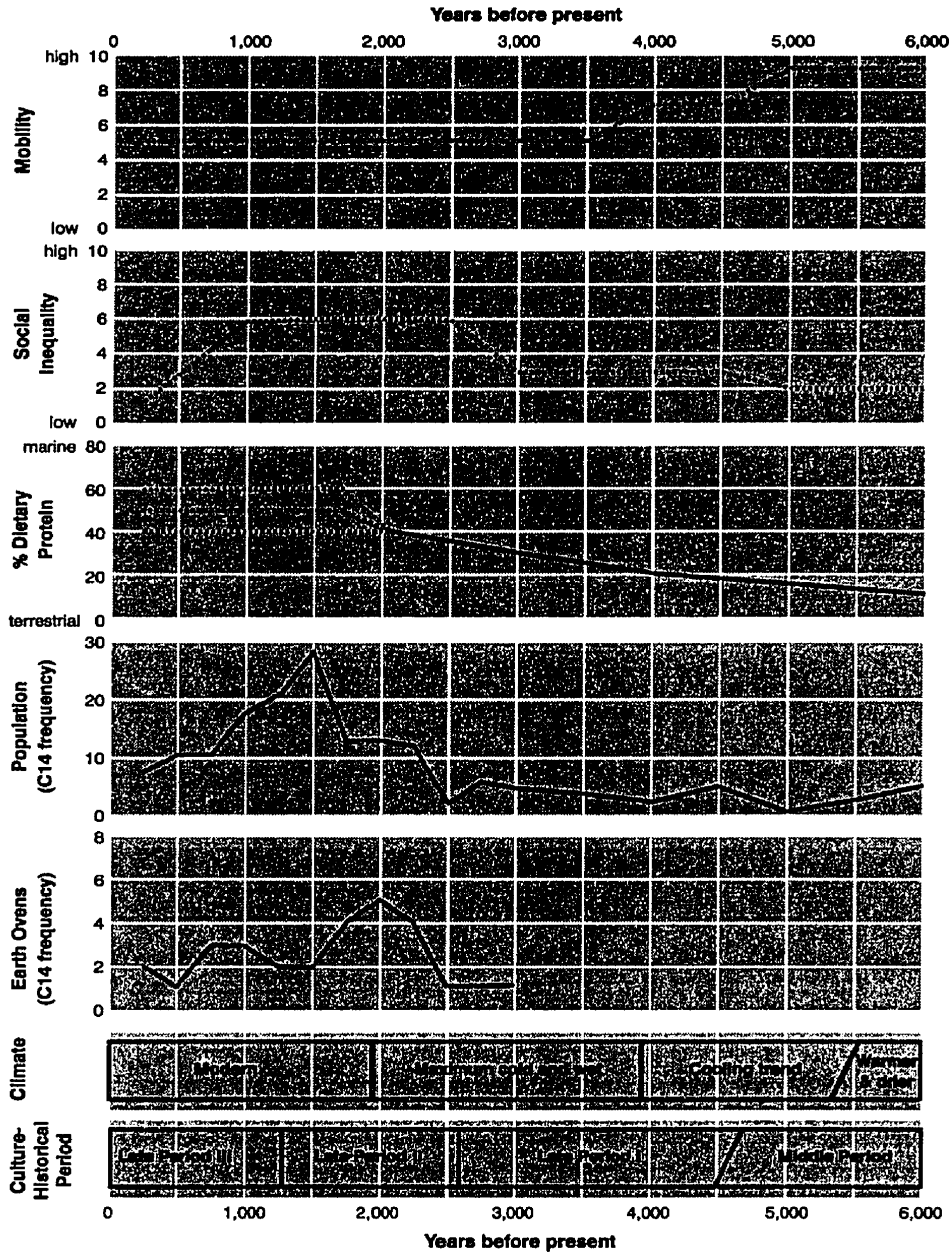

Figure 9.1: Schematic diagram summarizing the various lines of archaeological and paleoenvironmental data presented in Chapters 7 and 8. Note, the dotted graph lines for mobility and social inequality represent hypothetical relationships. For dietary protein, the graph lines after 2000 BP indicate fluctuating values for marine proteins of 40 to 60%.

pattern at least 2500 years. If the Parker site earth oven, with its rather distinct morphology is considered, root processing activities were underway by 3100 BP. These activities were concentrated in upland areas where people had access to economically important species, as well as fuel, water and materials necessary for the construction and use of earth ovens. Base camps established in these mid- to upper-elevation locales served multiple purposes and were repeatedly occupied. The other activities associated with root food production -- plant management and plant storage -- are not as visible archaeologically and thus, not well documented. However, these are assumed to have occurred in conjunction with root processing, as outlined in the specific model. Slight inter-regional variations are evident but do not detract from the broad pattern of root food production identified here.

Subsistence and settlement patterns associated with the beginnings of root food production are generally consistent with expectations. The evidence indicates a mix of riverine, lacustrine and terrestrial resources continued to be important through the Late Prehistoric, and by 3500 BP, the land use patterns characterized by seasonal mobility and overwintering in villages in major river valleys was established.

The fit between the modelled correlates and those observed archaeologically is not strong. This is due, in part, to the conceptual difficulties associated with such terms as "sedentism" and "complexity." It is also due to the lack of available data. Consequently, it is difficult to make meaningful inferences regarding trends in sedentism, social complexity and population growth on the basis of the current evidence. Certainly, there does not appear to be a *consistent* increase in social inequality or population growth throughout the Late Prehistoric Period; in fact, both appear to decline towards the historic period. As for increasing sedentariness, this may or may not have occurred; it is difficult to specify with any certainty.

In summary, the data presented in this study suggest that systems of wild root food production were developing on the Canadian Plateau by at least 3100 BP. Further, the evidence indicates that the conditions, components and consequences of the systems are generally consistent with the specific model of root food production, and by inference, the general model of plant food production. It is more difficult to make any meaningful inferences concerning changes in the degrees of sedentism, population densities and social complexity through time. On the basis of the current evidence, there do not appear to be consistent increases in any of these variables during the Late Prehistoric Period, contrary to expectations. However, as these are correlates, not consequences of root food production, the lack of congruence between the observed and expected does not detract from the validity or the utility of the model.

In the following section, I synthesize the various lines of evidence discussed in this study and present my explanation for the appearance and development of systems of root food production during the Late Prehistoric Period on the Canadian Plateau.

9.4 A Well-Rooted Explanation: The Emergence of Root Food Production on the Canadian Plateau

An Age of Uncertainty: The beginnings of root food production on the Canadian Plateau are best understood as a risk reduction strategy to cope with resource stress created by the deteriorating climatic conditions of the Late Holocene, particularly the decline in temperatures at 3900 BP. This seemingly sudden shift to colder and wetter climates resulted in prolonged winter conditions and thus, periods of resource scarcity similar to, or perhaps more severe than those observed historically.

In response, people began to alter adaptive strategies which had remained relatively consistent throughout the Middle Prehistoric and by 3500 BP, the fundamentals of Late Prehistoric subsistence and settlement patterns were established. One of the most significant changes during this transition was a shift from "positioning" to "productivity" strategies which increased the resiliency of populations by ensuring sufficient supplies of critical resources for overwintering.

The Beginnings of Root Food Production: Root food production represents one of the key components of this new "productivity" strategy. It is reasonable to presume Plateau peoples were harvesting roots in limited quantities from earliest times. However, with the onset of colder, wetter conditions and a prolonged period of resource scarcity, there was a need to harvest, process and store larger quantities of roots for overwintering. The establishment of modern plant communities at this time may have increased habitat for certain root species, making them more available to human populations.

Based on current evidence, the production of root foods begins approximately 3100 years ago on the Canadian Plateau. This date may be pushed back based on information from the Calispell Valley where root processing in earth ovens is an occasional component of subsistence strategies for at least 2000 years prior to the regular use of these features after 3500 BP.

Why Roots? While roots are often regarded as a low-ranked, costly choice or as the least desirable option on a list of subsistence alternatives after ungulates and salmon this is only so if, following Thoms (1989), one adheres to optimal foraging theory. In contrast, the ethnographic evidence indicates root resources were highly valued, culturally desired and played an important complementary role in traditional subsistence regimes. Balsamroot, for example, served as a food, a medicine and as a spiritual helper to the Secwepemc people and there are numerous other examples of these "multi-purpose" plants.

The nutritional and ecological data also emphasize the potential of roots as food staples. Roots represent a dense source of carbohydrate energy and thus are a good food choice. However, processing is often required to transform those carbohydrates into readily digestible sources of energy. This is especially true of roots which contain inulin as their major carbohydrate (versus starchy roots). Heat treatment in earth ovens not only makes them more digestible and nutritious (*i.e.*, increases the caloric value), but it also improves the organoleptic properties creating a sweet-tasting staple. As Johns (1990) points out, humans have an innate craving for sweet-tasting food items because these signal food energy, and energy is our most basic need. Thus, Plateau peoples were not harvesting and processing plants for carbohydrates *per se*, but were selecting foods valued for their taste and their ability to satiate hunger (tastes great, more filling!).

Roots also represent a reliable resource. They are restricted in their spatial and temporal availability, but predictably so. They are "rooted" resources in that they are available in the same place and at approximately the same time from year to year. Further, they are not subject to the annual fluctuations in productivity to the same extent as berries, ungulates and salmon. Reproductive strategies permit plants to remain dormant, waiting for optimum conditions. Therefore, while the plant itself may be temporarily out of sight, the roots are never out of reach.

The ecological properties of roots also make them attractive as a staple. Plant ecological data demonstrate that root resources, if managed properly, are able to withstand sustained harvesting. In fact, evidence indicates Indigenous harvesting and management practices actually served to enhance the density and distribution of roots and other culturally valued plants. Therefore instead of depleting the resource, traditional root resource collection and management could contribute to increasing the productivity of those species through time (*cf.* Hayden 1992:535). In other words, use can ensure abundance.

In sum, roots make good sense as a food staple: they are high in carbohydrate energy, are reliable, predictable, intensifiable, and are easily stored. When people began to harvest and store larger quantities of root resources which were already part of their subsistence repertoire, it set in motion a symbiotic process whereby the collection and management of roots ensured their abundance and availability. This system of positive feedback would encourage continued use of roots as reliable, productive resource while at the same time increasing the populations of those species.

Early root utilization: People of the Canadian Plateau were presumably using root resources, in limited quantities, from the earliest times. Unfortunately, there is as yet no direct archaeological evidence of root use prior to 3100 years ago. However, I suggest these early stages of root utilization might be represented archaeologically by the presence of pestles or other types of grinding and pounding equipment (*e.g.*, edge-ground cobbles), although the former are not commonly recovered from Canadian Plateau sites (where plant processing sites tend to be under-represented). Stone pestles, mauls, grinding slabs and hopper-mortars are associated with plant processing on the Columbia

Plateau as early as 4500 years ago (Ames and Marshall 1980; Thoms 1989). Thoms (1989) suggests hopper-mortar bases may represent the processing of starch-rich root foods.

The early stages of root resource use also may have included limited pitcooking or roasting of foods. It is reasonable to suggest this processing technique existed prior to the beginnings of large-scale root food production. The Calispell Valley evidence suggests camas processing was an occasional component of subsistence strategies prior to intensification after 3500 BP (Thoms 1989). As Thoms (1989:341) explains, the existing data are not likely to represent the oldest ovens *per se*, but "the time periods when earth ovens were built and used regularly enough to leave a patterned record."

Why earth ovens? In this context, the appearance of earth ovens 3100 years ago represents not only a technology that enabled large-scale processing of root foods, but one which may have allowed the use of a wider range of root resources (*i.e.*, those containing inulin) to serve as staples. Earth ovens, with the combination of heat, moisture and volatile organic acids, appear uniquely suited to this task. Earth ovens then, enabled cooking of large quantities of roots, increased the caloric productivity of those resources, and may signal the incorporation of new types of root resources (*i.e.*, inulin-rich roots), or at least larger quantities of such foods, into traditional diets.

Trends in Root Food Production through Late Prehistoric: Radiocarbon age estimates from earth ovens at various locales across the Canadian Plateau indicate the use of these features continued throughout the Late Prehistoric Period. Unfortunately, the inferences that can be drawn from these data regarding changes to root food production strategies over the last 3100 years are limited due to small sample sizes. Yet, one interesting pattern does emerge -- the tendency for earth ovens to decrease in size through time.

There is a correlation between the age and the rim crest diameters of earth ovens. If the largest earth ovens are the oldest, as present data suggest, then root resources may have been much more important in the past than they were ethnographically. This point was first raised by Pokotylo and Froese (1983), and later by Thoms (1989), who suggest that the decrease in the rim size of the earth ovens through time represents a substantial decline in root utilization during the Late Prehistoric period.

A decrease in earth oven size throughout the Late Prehistoric appears contrary to what one would expect if root resources were being intensified during this time. However, size alone is not the issue. The frequency of earth ovens must also be taken into consideration. If there is an increase in the absolute frequency of the smaller ovens through the Late Prehistoric, then a case could be made for the continued importance of root resources.

A much larger sample of dated earth oven features of all sizes is needed to adequately test this hypothesis. However, a brief review of several lines of evidence presented earlier may help to resolve this issue. Figure 7.14 presented the rim crest diameter data for earth ovens from the Canadian Plateau. There are few large earth ovens (greater than 5m), numerous medium-sized ones (3 to 5m), and relatively few small ones (less than 3m). As discussed, there is a moderate correlation between earth oven age and rim crest diameter (see Figure 7.15). If one accepts this correlation between age and size, then it is reasonable to suggest that the distribution of rim crest diameters represents a few old earth ovens, many middle-aged ones, and a few younger ones. Given this, there appears to be a peak of activity as represented by the large number of mid-sized, "middle-aged" earth ovens. The question then becomes, does this apparent peak in effort represent more roots for more people, or does it represent more roots for the same number of people?

To address this issue, we return to the population data, which must be interpreted with caution. In Figure 8.4, population is relatively low prior to 2500 BP, increases steadily from this point to approximately 1500 BP, after which time it appears to decline. It could be argued, then, that the peak in activity in root processing corresponds to the increase in population between 2500 and 1500 BP. This fits with the frequency of radiocarbon age estimates from earth oven features, which suggests a peak in activity between 2350 and 1650 years ago (Figure 7.18).

In summary, while there is a trend towards smaller earth ovens through time, it is not at all clear what this trend represents. It may, as Pokotylo and Froese (1983) suggest, reflect a decrease in the relative importance of root resources through time. If so, this would emphasize the critical role root foods played as an overwintering staple during the coldest, wettest stage of the Holocene (ca. 3900 to 2000 BP). Alternatively, the decreased size may be a function of changing features of society (*i.e.*, household sizes) during the Late Prehistoric Period. However, clarification of the first issue awaits a larger sample of radiocarbon age estimates from excavated earth ovens. Additional information on Late Prehistoric demographic patterns is required to address the second.

The Implications of Root Food Production: Systems of root food production served to increase the productivity of root resources, to create food sources high in carbohydrate energy, and to extend the availability of those foods through seasons of resource scarcity. What, then, are the implications of these activities for reconstructions of Late Prehistoric culture change?

Systems of root food production produced an assured supply of storable food energy for overwintering and in doing so, reduced the possibility of resource stress in late winter/early spring. This has obvious implications for population survival and growth. As Leibig's Law of the Minimum states, it is not the resources available during times of abundance, but those available during periods of scarcity which limit populations. Root food production, then, ensured the successful overwintering of populations and thus may have been a critical variable in population growth during the Late Prehistoric. The data presented in Chapter 8 indicate there was no significant increase in populations prior to beginnings of root food production. Rather, the increase occurs after 2500 BP, when systems of root food production are well-established.

The supply of reliable, storable carbohydrates created by root food production also may have enabled the increased use of lean proteins, derived from ungulates and dried salmon, throughout the winter. Carbohydrates are essential to the efficient metabolism of lean proteins. Therefore, the trend towards increased salmon consumption during the last 2000 years (Chisholm and Nelson 1983; Chisholm 1986; Lovell et al. 1986) may have been enabled by the carbohydrates supplied through root food production.

Ames and Marshall (1980:45) take a slightly different approach to this argument, suggesting salmon were not intensified until after populations reached a critical level necessary for efficient mass processing of this resource:

> Roots provided the critical storable resource necessary for villages, with supplemental protein coming from fish and mammals which might be continuously taken throughout the year. Roots were intensified because of certain intrinsic qualities of the roots themselves, and because population levels were too low to make salmon intensification a practical subsistence strategy.

Ethnographic evidence indicates the harvesting of root resources clearly influenced peoples' movements across the landscape in spring and summer, but these activities also may have influenced the location of winter settlements. Ames and Marshall (1980:41) note that "the local availability of early spring plant resources was the critical variable controlling winter settlement locations and local, winter population densities" on the southern Columbia Plateau. There does appear to be a relationship between the location of winter villages and traditional root digging locales on the Canadian Plateau (*e.g.*, Kamloops and Komkanetkwa, Keatley Creek and Upper Hat Creek, Chase and Neskonlith Meadows). This lends tentative support to Ames and Marshall's suggestion, but more important, emphasizes the need to consider multiple variables in interpretations of past settlement patterns.

Finally, it is important to note that traces of root food production visible archaeologically represent the patterns of women's work on the landscape and to acknowledge women's contributions to traditional subsistence economies through plant gathering generally (Hunn 1981) and root food production specifically. Further, although patterns of plant management are somewhat less visible, it is important to acknowledge the role women and children possibly played in shaping the landscapes of the past.

In summary, systems of root food production were an integral component of

Late Prehistoric subsistence strategies and as such, played a role in the emergence of the ethnographic pattern. I suggest Plateau people were not simply plant gatherers, but plant food producers who through sophisticated management and processing strategies increased the productivity and availability of a wide variety of root resources. These strategies provided carbohydrates necessary for overwintering, reducing the threat of recurrent resource stress. Therefore, an understanding of the role of root food production in past lifeways is essential to developing more accurate pictures of past lifeways on the Canadian Plateau.

This assertion challenges the prevailing wisdom which attributes Late Prehistoric culture change primarily to the intensification of salmon resources. Although recent discussions stress the importance of a triad of resources -- roots, ungulates *and* salmon -- in understanding the patterns of the past (Chatters and Pokotylo 1998), fluctuations in the availability and utilization of salmon continue to play a major explanatory role in reconstructions of culture change (Fladmark 1975, 1982; Hayden 1992; Hayden et al. 1985; Richards and Rousseau 1987; Kuijt 1989; Stryd and Rousseau 1996).

This approach is exemplified by Richards and Rousseau's (1987) definition of the Plateau Pithouse Tradition, as a 4000-year cultural tradition "characterized by semi-sedentary, pithouse dwelling hunter-gatherer, logistically organized, band level societies that relied heavily on anadromous fish for subsistence" (Richards and Rousseau 1987:21). Similarly, Stryd and Rousseau (1988:16-20) proposed the Sqlelten Tradition (5500 to 200 BP) a "river-oriented adaptive pattern" resulting from the expansion of Salishan peoples from the south coast to the southern interior, where, following the Fraser River drainages, they exploited improving salmon resources. The name "sqlelten," the Secwepemc word for salmon, was applied to this tradition to reflect this hypothesized emphasis on anadromous salmon (Stryd and Rousseau 1988:17). The Sqlelten Tradition is thought to represent a 5500-year cultural continuum in the Mid-Fraser/Thompson River Region, which culminated in the historic Interior Salishan peoples. More recently, Stryd and Rousseau (1996) appear to have abandoned the term "Sqlelten Tradition," but not the basic concept. In characterizing the transition to the Late Prehistoric, Stryd and Rousseau (1996:197) state:

> The differences between the later [Middle Prehistoric] and the Late Period seem to be mainly one of scale and intensity, with larger pithouse villages, more intensive salmon utilization, a greater reliance on salmon storage, a better developed salmon procurement technology . . . .

This emphasis on salmon to the apparent exclusion of other resources is unwarranted in light of the extensive ethnological and archaeological evidence for the importance of roots (and other plant and animal resources) summarized in this research and elsewhere. Further, as several authors have noted, much of this "model building" has occurred in the absence of any empirical evidence for salmon intensification during the Late Prehistoric (Ames and Marshall 1980; Pokotylo and Froese 1983; Pokotylo and Mitchell 1998).

It is not my intent to dismiss the importance of salmon to prehistoric economies, or to suggest salmon may not have been intensified during the Late Prehistoric. However, salmon was not the only "game" in town, and models relying solely on salmon intensification as an explanation of culture change are in need of revision. Revisions to such models need to incorporate the role of root resources and systems of root food production, which in conjunction with the fishing and hunting, contributed to emergence of the ethnographic pattern. I concur with Ames and Marshall (1980:41), who state:

> We believe potential variation in plant resources to be as important for understanding regional population history as salmon, which is generally treated as *the* resource by regional researchers, but which, ironically, is not much better documented prehistorically than are plant resources.

However, I would suggest that the evidence for root food production on the Canadian Plateau is in fact, much more thoroughly documented and convincing than the current evidence for salmon intensification.

To conclude, I reiterate the need to revise current models of Late Prehistoric culture change to incorporate root resources specifically, and plant resources generally, as important contributors. Perhaps, as Pokotylo and Froese (1983:12) suggest,

> In the absence of archaeological evidence of fishing technology and/or salmon productivity in the late prehistoric period, it is plausible that the additional stored subsistence resources required by the larger pithouse villages were obtained not from further intensification of the salmon fishery but by intensified collecting and processing of root crops in upland locations.

9.5 The Strength of the Interpretation

The strength of this interpretation lies in its interdisciplinary approach and theoretical foundations. It examines the issue of root resource use on the Canadian Plateau from the broader theoretical context of systems of plant food production. By doing so, it demonstrates that Plateau peoples were not "gatherers" adapting to the environment, but plant food "producers" who may have modified and managed critical resources and environments for at least 3100 years. This represents a significant shift in perceptions of Late Prehistoric culture change and challenges archaeologists to move away from the model building which has dominated discussions to date.

The model of root food production presented here specifies conditions which acted as a "push," or in this instance, a "nudge," for the beginnings of root food production, something earlier discussions lacked (*cf.* Ames and Marshall 1980; Pokotylo and Froese 1983). Root food production is viewed as a risk reduction strategy adopted by Plateau peoples to deal with the possibility of recurrent resource stress brought about by the shift to longer, colder winters and prolonged periods of resource scarcity after 3900 BP. The model does not invoke major environmental crises (although the climatic change does appear to have been fairly abrupt) for as Minnis (1985) notes, it is often the perception of resource stress which motivates people to adjust food-acquiring strategies.

The model also identifies the properties of root resources which make them attractive as a food staple (*i.e.*, they are dense sources of carbohydrate energy) and amenable to intensification. Further, it outlines a process by which intensification could occur, emphasizing the symbiotic nature of people-plant interactions and the fact that human harvesting has both intentional and incidental consequences. By doing so, the model avoids the "let's invent agriculture" syndrome. Thus, it makes good ecological sense.

The model of root food production makes good nutritional sense, too, in that it considers more than the caloric contributions of root foods. It demonstrates that earth oven technology is essential in converting certain complex carbohydrates, such as inulin, into readily digestible food sources high in energy. Further, it emphasizes the synergistic relationship between carbohydrates and proteins, and shows how the former are necessary to the efficient metabolism of lean proteins such as might be consumed during late winter and early spring by hunter-gatherers in temperate regions.

The model of root food production also "fits" the broader paleoenviromental and cultural patterns of the Late Prehistoric period on the Canadian Plateau. It incorporates and accommodates diverse lines of archaeological and ethnological evidence in an interpretation which contributes to our understandings of the emergence of the ethnographic pattern. It does not resort to population migrations and assimilation, or view salmon as the sole catalyst of culture change. Rather, it situates root food production as one risk reduction strategy in a diversified economy which relied on other natural and cultural resources to achieve a goal of resiliency. Root food production is viewed as an *in situ* development out of systems in place in the Early and Middle Prehistoric Periods. Thus, the model makes good archaeological sense.

It is also important to recognize that the model proposed here builds and expands upon early and influential articles by Ames and Marshall (1980) and Pokotylo and Froese (1983). In fact, this research was inspired to a large extent by these seminal publications. The scenario outlined here also fits with the patterns of root food production identified in the Calispell Valley and the Pacific Northwest by Thoms (1989), although I disagree with some of his interpretations. He approaches the issue from an optimal-foraging perspective, proposing population pressure as the catalyst for resource intensification and on the basis of a cost-benefit analyses, suggests roots were intensified only after ungulates and salmon. Given the current data on environmental and population changes over the last 5000 years, I suggest Thoms' data (see Figure 7.13) actually lend support to my interpretations outlined here.

Finally, the nature and timing of the emergence of root food production on the Canadian Plateau is consistent with evidence for the use of earth ovens for root processing between 4000 and 3000 years ago in such geographically dispersed locales as Australia (Lourandos 1985), Argentina (G. Politas, pers. com. 1998) and the American Southwest (Fish 1997). The climatic conditions, as modelled here, also appear to coincide with a global cooling event at approximately 4000 BP (Bryson 1994; R. Mathewes, pers. com. 1998).

As Flannery (1986:5) has observed:

> Perhaps no model will achieve much acceptability until it effectively includes both the universality of the biological principles and the specificity to tie it into the human cultural pattern for a given region.

I suggest the model of rood food production for the Canadian Plateau, which is derived from the broader, theoretical perspective of people-plant interactions and built upon a foundation of ethnology, ethnobotany, archaeology and ecology, moves reconstructions of Canadian Plateau prehistory a step closer to acceptability and emphasizes the importance of root food production to our understandings of the past.

Chapter 10: Concluding Remarks

10.1 Komkanetkwa Revisited

To conclude, we return to Komkanetkwa. At the beginning of this study, I suggested the abundance of root resources in the valley was the product of generations of use and management by the Secwepemc peoples. We see now how this is possible. As the evidence presented here indicates, the Secwepemc and other Interior Salish peoples were not simply plant food "gatherers", but wild plant food "producers", who, through a variety of horticultural techniques, enhanced the density and diversity of culturally-valued plant resources, and in doing so, "cultivated" a variety of landscapes throughout the Canadian Plateau.

I suggested, too, that the earth ovens of Komkanetkwa held clues to the significance and duration of these people-plant interactions, and they do. Earth ovens, with their unique ability to transform inedible resources into storable food energy, were key components of root food production and their archaeological remains represent a direct link between past subsistence strategies and present ethnobotanical knowledge. Investigation of these earth ovens allowed us to trace the beginnings of wild plant food production on the Canadian Plateau. Further, analyses of the size, shape and antiquity of theses features identified broad patterns of root resource use within the context of Late Prehistoric Period cultural adaptations. Inter-regional variations to these patterns were also evident, although these are not well understood.

In sum, the root resources and roasting pits of Komkanetkwa and similar locales across the Canadian Plateau serve as enduring legacies of the long-term use of upland areas by the Interior Salish and other peoples. Earth ovens must no longer be viewed as the camp kitchens of foragers, or as the task sites of logistically-organized collectors. Rather, as this research has shown, they are the archaeological manifestation of a fundamental shift in the processes of people-plant interactions -- the transition from foraging to wild plant food production which occurred on the Canadian Plateau at least 3100 years ago.

The strength of this study lies in its interdisciplinary approach and the linking of diverse lines of evidence to generate a plausible explanation of past lifeways. The value of the study, I believe, lies in its efforts to expand our understandings of people-plant interactions, both past and present, on the Canadian Plateau and elsewhere. Specifically, this research stresses the importance of plants to the subsistence economies of the Interior Salish peoples, a fact too often overlooked in reconstructions of the past. More important, the study situates the issue of plant use in the broader ecological and evolutionary perspective offered by models of plant food production. By doing so, it articulates processes by which plant resources could be intensified and identifies possible conditions, components and consequences of these activities. In addition, this investigation sheds light on a lesser-known portion of the spectrum of people-plant interactions. It demonstrates that wild plant food production is more than simply a stepping stone in an evolutionary pathway to agriculture, but a successful long-term adaptation that took other than agrarian directions.

Last, but not least, this research acknowledges the strength and duration of the relationship between the people and the plants of the Canadian Plateau. This was not a vast "wilderness", but a cultivated landscape shaped through generations of the wise use and management of plants by the Secwepemc people and their neighbours. These practices created ecologically-heterogenous mosaics and enhanced the diversity of the environment. This has important implications to issues of land tenure currently facing First Nations peoples and points to the link between cultural and biological diversity, and the need to conserve both.

References Cited

Ackermann, L.
1994 Nonunilinear descent groups in the Plateau culture area. *American Ethnologist* 221(2):286-309.

Alexander, D. and R.G. Matson
1987 Report of the Potato Mountain Archaeological Project (1985). Permit 1985-11. Report on file, Ministry Library, Ministry of Small Business, Tourism and Culture,Victoria, B.C.

Alexander, D. R. Tyhurst, R.G. Matson and L. Burnard
1985 A preliminary ethnoarchaeological investigation of the Potato Mountain Range and the Eagle Lake area. Report prepared for the Heritage Conservation Branch of B.C. (Permit No. 1984-14), the Canadian Ethnic Studies Program and the Nemiah Valley Indian Band Council.

Ames, Kenneth M.
1985 Hierarchies, stress, and logistical strategies among hunter-gatherers in northwestern North America. In *Prehistoric hunter-gatherers: The emergence of cultural complexity*, edited by T. Douglas Price and James A. Brown, pp. 155-180. Toronto: Academic Press.

1994 The Northwest Coast: complex hunter-gatherers, ecology, and social evolution. *Annual Review of Anthropology* 23: 209-29.

Ames, K.M. and A.G. Marshall
1980 Villages, demography and subsistence intensification on the southern Columbia Plateau. *North American Archaeologist* 2(1):25-52.

Anastasio, A.
1972 The southern Plateau: An ecological analysis of intergroup relations. *Northwest Anthropological Research Notes* 6(2):109-229.

Anderson, E.N.
1996 *Ecologies of the heart. Emotion, belief and the environment.* New York: Oxford University Press.

Anderson, M.K.
1990 California Indian horticulture. *Fremontia* 2: 7-14.

1991a California Indian horticulture: management and use of redbud by the Southern Sierra Miwok. *Journal of Ethnobiology* 11(1):145-157.

1991b Wild plant management: Cross-cultural example of the small farmers of Jaumave, Mexico, and the Southern Miwok of Yosemite region. *Arid Lands Newsletter* 31:18-23.

1993a The experimental approach to assessment of the potential ecological effects of horticultural practices by Indigenous peoples on California wildlands. Ph.D. dissertation, Wildland Resource Science, University of California, Berkeley.

1993b Native Californians as ancient and contemporary cultivators. In *Before the wilderness. Environmental management by Native Californians,* edited by T.C. Blackburn and M.K. Anderson, pp. 151-174. Menlo Park, California: Ballena Press.

1993c California Indian horticulture: Management and use of redbud by the Southern Sierra Miwok. *Journal of Ethnobiology* 11 (1): 145-157.

1996a Tending the wilderness. *Restoration and Management Notes* 14(2):154-166.

1996 The ethnobotany of deergrass, *Muhlenbergia rigens* (Poaceae): Its uses and fire management by California Indian tribes. *Economic Botany* 50(4):409-422.

1997 From tillage to table: The Indigenous cultivation of geophytes for food in California. *Journal of Ethnobiology* 17(2):149-169.

Arcas Consulting Archaeologists Ltd.
1990 Preliminary archaeological impact assessment, proposed golf course and residential subdivision development, Scheidam Flats, B.C. Consultant's report on file, Ministry Library, Ministry of Small Business, Tourism and Culture, Victoria, B.C.

Baker, J.
1975 Report on archaeological research done in the Lytton region, May to August 1974. Report on file, Ministry Library, Ministry of Small Business, Tourism and Culture, Victoria, B.C.

Bannister, K. and S. Peacock
1998 The bite is in the bark: pitcooked balsamroot and the food-medicine continuum. Paper presented at the 21st Annual Conference, Society of Ethnobiology, University of Nevada, Reno, Nevada, April 1998.

Bailey, H.P.
1960 A method of determining the warmth and temperateness of climate. *Geografiska Annaler* 43(1):1-16.

Beirne, P.D. and D.L. Pokotylo
1979 Hat Creek Project: inventory, assessment and evaluation of the cultural heritage resources. British Columbia Hydro and Power Authority, Vancouver.

Binford, L.R.
1968 Post-pleistocene adaptations. In *New Perspectives in Archaeology*, edited by Sally R. Binford and Lewis R. Binford. Chicago: Aldine Publishing Company.

1978 Dimensional analysis of behavior and site structure: learning from an Eskimo hunting stand. *American Antiquity* 43:330-361.

1980 Willow smoke and dogs' tails: Hunter-gatherer settlement systems and archaeological site formation. *American Antiquity* 45(1):4-20.

1983 *In pursuit of the past: Decoding the archaeological record.* New York: Thames and Hudson.

1990 Mobility, housing, and environment: a comparative study. *The Journal of Anthropological Research*: 119-52.

Blackburn, T.C. and M.K. Anderson (editors)
1993 *Before the wilderness. Environmental management by Native Californians.* Menlo Park, California: Ballena Press.

Boas, F.
1891 Second report on the Indians of British Columbia. In *60th Annual Report of the British Association for the Advancement of Science*, 1890. London. Reprinted in *Northwest Anthropological Research Notes*, 8:98-174.

1890 On the basketry of the Shuswap Indians. Memoirs of the American Museum of Natural History, 4, Publications of the Jesup North Pacific Expedition, 2:292-300.

Boserup, E.
1965 *The conditions of agricultural growth.* London: Allen and Unwin.

Botkin, D.B.
1990 *Discordant harmonies: A new ecology for the twenty-first century.* New York: Oxford University Press.

Boyd, R.
1986 Strategies of Indian burning in the Willamette Valley. *Canadian Journal of Anthropology; Revue Canadienne d'Anthropologie* 5(1): 65-77.

Braidwood, R.
1960 Prehistoric investigations in Iraqi Kurdistan. *Studies in Ancient Oriental Civilization 31*. Chicago: University of Chicago Press.

British Columbia Ministry of Forests
1988 Biogeoclimatic zones of British Columbia 1988. (Annotated map). Research Branch, Ministry of Forests, Victoria, British Columbia.

Bryson, R.
1994 On integrating climatic change and culture change studies. *Human Ecology* 22(1):115-128.

Chatters, J.C.
1995 Population growth, climatic cooling, and the development of collector strategies on the southern Plateau, western North America. *Journal of World Prehistory* 9(3):341-400.

1998 Environment. In *Plateau*, Volume 12, *Handbook of North American Indians*, edited by D.E. Walker (W.C. Sturtevant, General Editor), pp. 29-48. Washington, D.C.: Smithsonian Institution.

Chatters, J.C. and D.L. Pokotylo
1998
Prehistory: Introduction. In *Plateau*, Volume 12, *Handbook of North American Indians*, edited by D.E. Walker (W.C. Sturtevant, General Editor), pp. 73-80. Washington, D.C.: Smithsonian Institution.

Childe, V. G.
1934 *New light on the most ancient East*. London: Kegan Paul, Trench, Trubner & Co. Ltd.

1936 *Man makes himself*. London: C.A. Watts & Co. Ltd.

1942 *What happened in history*. New York: Penguin Books Ltd.

Chisholm, B.
1986 Reconstruction of prehistoric diet in British Columbia using stable-carbon isotopic analysis. Ph.D. dissertation, Department of Archaeology, Simon Fraser University, Burnaby, B.C.

Chisholm, B. and D.E. Nelson
1983 An early human skeleton from south central British Columbia: Dietary inference from carbon isotope evidence. *Canadian Journal of Archaeology* 7(1):85-86.

Choquette, W.
1985 Salvage excavations at DiQj 18: A test model of Upper Columbia basin human settlement dynamics. Permit 1984-10. Report on file, Ministry of Small Business, Tourism and Culture, Victoria, B.C.

Cohen, M.N.
1977 *The food crisis in prehistory*. New Haven: Yale University Press.

Crockford, S.
1994 Faunal analysis of materials from the Scheidam Flats locale. In Report on the results of archaeological investigations in the Scheidam Flats locale near Kamloops. Report prepared by B. Simonsen, The Bastion Group Heritage Consultants for Mandell Pinder, Barristers and Solicitors, Vancouver, B.C.

Cronon, W.
1983 *Changes in the land: Indians, colonists and the ecology of New England*. New York: Hill and Wang.

Curtin, J.
1997 Status, offerings and human remains. A review of mortuary variability and status differentiation on the Columbia-Fraser Plateau by Rick J. Schulting. *The Midden* 29(4):10-11.

Dawson, G. M.
1891 Notes on the Shuswap People of British Columbia, *Transactions of the Royal Society of Canada*, Section II, 3-46.

Davidson, J.
1915 Botanical exploration of the province. Headwaters of Skoonkon, Botanie, Laluwissin, Murray, and Twaal Creeks, between the South Thompson and Fraser Rivers. In: *Second Annual Report of the Botanical Office*, Vancouver, B.C., pp. 44-46.

1916 Botanical exploration of the bitter-root grounds and "Three Sisters" Valley, between Spences Bridge and Ashcroft. In: *Third Annual Report of the Botanical Office*, Vancouver, B.C., pp. 134-136.

Day, G.M.
1953 The Indian as an ecological factor in the northeastern forest. *Ecology* 34(2):329-346.

Denevan, W.M.
1992 The Americas before and after 1492: Current geographical research. *Annals of the Association of American Geographers* 82(3):369-385.

Dobyns, H.F.
1983 *Their numbers became thinned: Native American population dynamics in eastern North America.* Knoxville: University of Tennessee Press.

Driver, J.
1993 Zooarchaeology in British Columbia. *B.C. Studies*, Special Issue, 99:77-105.

Driver, H.E. and W.C. Massey
1957 Comparative studies of North American Indians. *Transactions of the American Philosophical Society* 46:163-456.

Eldridge, M.
1984 Vallican archaeoloigcal site (DjQj 1): A synthesis and management report. Non-permit report on file, Ministry of Small Business, Tourism and Culture, Victoria, B.C.

Eldridge, M. and A.H. Stryd
1983 CN Rail railyard expansion project, heritage mitigation study, Kamloops junction, B.C. Report on file, Ministry Library, Ministry of Small Business, Tourism and Culture, Victoria, B.C.

Fish, S.K.
1997 North American aboriginal farming and field systems: A southwestern perspective. Paper presented at the Annual Meeting and Science Innovation Exposition, American Association for the Advancement of Science, Seattle, Washington, February 16.

Fish, S., P. Fish, C. Miksicek and J. Madsen
1986 Prehistoric Agave cultivation in southern Arizona. *Desert Plants* 7:2:107-12, 100.

Fladmark, K.R.
1975 *A palaeoecological model for Northwest Coast prehistory.* National Museum of Man Mercury Series, Archaeological Survey of Canada Paper 43, Ottawa.

1982 An introduction to the prehistory of British Columbia. *Canadian Journal of Archaeology* 6:95-156.

Flannery, K..
1968 Archaeological systems theory and early Mesoamerica. In *Anthropological Archaeology in the Americas*, edited by B.J. Meggers, pp. 67-87. Washington, D.C.: Anthropological Society of Washington.

1969 Origins and ecological effects of early domestication in Iran and the Near East. In *The Domestication and Exploitation of Plants and Animals*, edited by P.J.

Ucko, G.W. Dimbley, pp. 73-100. London: Duckworth.

1973 The Origins of Agriculture. *Annual Review of Anthropology* 2: 271-310.

Flannery, K.V. (editor)
1986a *Quila Naquitz: Archaic foraging and early agriculture in Oaxaca, Mexico,* edited by K.V. Flannery.

1986b The Research Problem. In *Quila Naquitz: Archaic foraging and early agriculture in Oaxaca, Mexico*, edited by K.V. Flannery, pp. 3-18. New York: Academic Press.

Forbis, R.
1982 Comments. *Current Anthropology* 23(5):530-531.

Ford, R.I.
1981 Gardening and farming before A.D. 1000: Patterns of prehistoric cultivation north of Mexico. *Journal of Ethnobiology* 1(1):6-27.

1985 The processes of plant food production in prehistoric North America. In *Prehistoric food production in North America*, edited by R. I. Ford, pp. 1-18. University of Michigan Museum of Anthropology, Anthropological Papers No. 75, Ann Arbor, Michigan.

Fowler, C., L. Housley, W.J. Cannon, S. Eiselt and K. Gupta
1998 Pit roasting *Valeriana edulis*, a root food of the Surprise Valley Paiute. Paper presented at the 21st Annual Conference, Society of Ethnobiology, University of Nevada, Reno, April 1998.

Fowler, C. and N.J. Turner.
In press
Indigenous knowledge systems: Other ways of knowing. In *Cambridge encyclopedia of hunters and gatherers*, edited by Richard B. Lee and Richard H. Daly. U.K.: Cambridge University Press.

Gadgil, M., F. Berkes and C. Folke
1993 Indigenous knowledge for biodiversity conservation. *Ambio* 22 (2-3): 151-156.

Gamble, C.S.
1993 The centre at the edge. In *From Kostenki to Clovis: Upper Palaeolithic -- Palaeo-Indian Adaptations*, edited by O. Soffer and N.D. Praslov, pp. 313-321. New York: Plenum.

Gill, W.W.
1880 *Savage life in Polynesia*. Wellington: George Didsbury.

Gott, B.
1983 Murnong -- a Victorian staple food: Some nutritional implications. In *Archaeology at Anzaas*, edited by Graeme K. Ward, pp. 111-115. Canberra: Australian Institute of Aboriginal Studies.

1984 Murnong -- *Microseris scapigera*: A study of a staple food of Victorian Aborigines. *Australian Aboriginal Studies* No. 2:2-18.

Gottesfeld, L. M. Johnson
1994a Aboriginal burning for vegetation management in northwest British Columbia. *Human Ecology* 22(2):171-188.

1994b Conservation, Territory, and traditional beliefs: An analysis of Gitksan and Wet'suwet'en subsistence, northwest British Columbia, Canada. *Human Ecology* 22(4):443-465.

Gould, R.A.
1985 "Now let's invent agriculture . . .": A critical review of concepts of complexity among hunter-gatherers. In *Prehistoric Hunter-Gatherers: The Emergence of Cultural Complexity,* edited by T.D. Price and J.A. Brown, pp. 427-435. Toronto: Academic Press.

Harlan, J.R.
1971 Agricultural origins: Centres and noncentres. *Science* 174:468-73.

1992 Indigenous African agriculture. In *The origins of agriculture*, edited by C.W. Cowan and P.J. Watson, pp. 71-100. Washington, D.C.: Smithsonian Institution Press.

Harlan, J.R. and J.M. de Wet
1973 On the quality of evidence for origin and dispersal of cultivated plants. *Current Anthropology* 14:51-55.

Harris, D.R.
1977 Alternative pathways toward agriculture. In *Origins of agriculture*, edited by C. A. Reed, pp. 179-244. The Hague: Mouton.

1989 An evolutionary continuum of people-plant interactions. In: *Foraging and farming: The evolution of plant exploitation,* edited by D.R. Harris and G.C. Hillman, pp. 11-26. London: Unwin, Hyman.

Hassan, F.
1981 *Demographic archaeology*. New York: Academic Press.

Hayden, B.
1982 Comments. *Current Anthropology* 23(5):531.

1990 Nimrods, piscators, pluckers, and planters: The emergence of food production. *Journal of Anthropological Archaeology* 9:31-69.

1995 Pathways to power: Principles for creating socioeconomic inequalities. In *Foundations of Social Inequality*, edited by T.D. Price and G. Feinman, pp. 15-85. New York: Plenum Press.

1997 *The pithouses of Keatley Creek: Complex hunter-gatherers of the northwest Plateau*. Case Studies in Archaeology Series, edited by Jeffrey Quilter. Toronto: Harcourt Brace College Publishers.

1998 Conversation with the author at Simon Fraser University, March 1998.

Hayden, B. (editor)
1992 *Complex cultures of the British Columbia Plateau: Traditional Stl'atl'imx resource use*. Vancouver: University of British Columbia Press.

Hayden, B. and J.M. Ryder
1991 Prehistoric cultural collapse in the Lillooet Area. *American Antiquity* 56 (1):50-65.

Hayden, B. and J. Spafford
1993 The Keatley Creek site and corporate group archaeology. *B.C. Studies* 99:106-139.

Hayden, B. and R. Schulting
1997 The Plateau interaction sphere and late prehistoric cultural complexity. *American Antiquity* 62(1):51-85.

Hayden, B. M. Eldridge, A. Eldridge and A. Cannon
1985 Complex hunter-gatherers in interior British Columbia. In *Prehistoric hunter-gatherers: The emergence of cultural complexity*, edited by T.D. Price and J.A. Brown, pp. 181-199. Toronto: Academic Press.

Hayden, B., G. A. Reinhardt, R. MacDonald, D. Holmberg, and D. Crellin
1996 *People who lived in big houses: Archaeological perspectives on large domestic structures*, edited by G. Coupland and E. Banning, pp. 151-164. Madison, Wisconsin: Prehistory Press.

Hebda, R.J.

1982 Postglacial history of grasslands of southern British Columbia and adjacent regions. In: *Grassland ecology and classification symposium proceedings*, edited by A.C. Nicholson, A. McLean and T.E. Baker. British Columbia Ministry of Forests, Victoria.

1995 British Columbia vegetation and climate history with focus on 6 KA BP. *Géographie physique et Quaternaire* 49(1):55-79.

Hebda, R. and G. Allen

1984 Plant macrofloral remains from the EeRb series of sites on Paul Creek, northeast of Kamloops, British Columbia. In: Report on the results of archaeological investigations in the Scheidam Flats locale near Kamloops. Report prepared by B. Simonsen, The Bastion Group Heritage Consultants for Mandell Pinder, Barristers and Solicitors, Vancouver, B.C.

Hemphill, M.L.

1983 Fire, vegetation and people: Charcoal and pollen analysis of Sheep Mountain Bog, Montana, the last 2800 years. M.A. thesis, Department of Anthropology, Washington State University, Pullman.

Hill-Tout, C.

1978 *The Salish People.* Volume I. *The Thompson and Okanagan*, edited by Ralph Maud. Vancouver: Talonbooks.

Holland, S. S.

1964 Landforms of British Columbia: A physiographic outline. British Columbia Department of Mines and Petroleum Resources Bulletin 48. Victoria, B.C.

Hunn, E.

1981 On the relative contribution of men and women to subsistence among hunter-gatherers on the Columbia Plateau: a comparison with Ethnographic Atlas summaries. *Journal of Ethnobiology* 1(1):124-134.

Hunn, E.S., with James Selam and family

1990 *Nch'i-Wana. "The Big River." Mid-Columbia Indians and their land.* Seattle, Washington: University of Washington Press.

Hunn, E.S., N.J. Turner, and D.H. French.

1998 Ethnobiology and subsistence. In: *Plateau*, Volume 12 *Handbook of North American Indians*, edited by D.E. Walker, (W.C. Sturtevant, General Editor), pp. 525-545. Washington, D.C.: Smithsonian Institution.

Ignace, M. B.
1996 Conversation with author, Society for Ethnobiology Annual Meeting, Santa Barbara, California, March 1996.

1998 Shuswap. In *Plateau*, Volume 12, *Handbook of North American Indians*, edited by D.E. Walker (William C. Sturtevant, General Editor), pp. 203-219. Washington, D.C.: Smithsonian Institution.

Incoll, L.D. and G.D. Bonnett
1996 Fructans in the Compositae: A short review. In *Compositae: Biology and utilization. Proceedings of the International Compositae Conference, Volume 2*, edited by P.D.S. Caligari and D.J.N. Hind, pp. 401-413. Kew: Royal Botanic Gardens.

Ingold, T.
1982 Comments. *Current Anthropology* 23(5):531-532.

International Dairy Federation
1993 *International IDF standard 20B. Determination of nitrogen content.* International Dairy Federation, Brussels, Belgium.

Johns, T.
1990 *With bitter herbs they shall eat it: Chemical Ecology and the origins of human diet and medicine.* Tucson: University of Arizona Press.

Joyal, E.
1994 Palm ethnoecology in the Saripiqui region of Costa Rica. *Journal of Ethnobiology* 14(2):161-172.

Konlande, J.E. And J.R. K. Robson
1972 The nutritive value of cooked camas as consumed by Flathead Indians. In *Ecology of food and nutrition*, Volume 2, pp. 193-195. Philadelphia: Gordon Breach Science Publishers, Ltd.

Kroeber, A.L.
1939 *Cultural and natural areas in Native North America.* University of California Publications in American Archaeology and Ethnology 38.

Kuhnlein, H.V. and N.J. Turner
1991 *Traditional plant foods of Canadian Indigenous peoples. Nutrition, botany and use.* In Food and nutrition in history and anthropology, Volume 8, edited by Solomon Katz. Philadelphia: Gordon and Breach Science Publishers.

Kuhnlein, H., N.J. Turner, M. Ignace, S. Peacock and D Loewen
1997 The nutrient content of Secwepemc plant foods. Poster presented at the 20th

Annual Conference, Society of Ethnobiology, University of Georgia, Athens, Georgia, March 1997.

Kuijt, I.
1989 Subsistence resource variability and culture change during the middle-late prehistoric cultural transition on the Canadian Plateau. *Canadian Journal ofArchaeology* 13:97-118.

Kuipers, A.
1983 *Shuswap-English Dictionary*. Leuven, Belgium: Peeters.

Lawhead, S. and A.H. Stryd
1985 Excavations at the Rattlesnake Hill Site (EeRh 61), Ashcroft, British Columbia. Permit Number 1984-2. Report on file, Ministry Library, Ministry of Small Business, Tourism and Culture,Victoria, B.C.

Lawhead, S., A.H. Stryd and A.J. Curtin
1986 Excavations at Valley Mine, Highland, British Columbia. Permit Number 1985-5. Report on file, Ministry Library, Ministry of Small Business, Tourism and Culture,Victoria, B.C.

Lee, R.B.
1968 What hunters do for a living, or, how to make out on scarce resources. In *Man the hunter*, edited by R.B. Lee and I. Devore, pp. 30-48. Chicago, IL: Aldine Publishing Company.

Lee, R.B. and I. Devore (editors)
1968a *Man the hunter*. Chicago, IL: Aldine Publishing Company.

1968b Introduction: Problems in the study of hunter-gatherers. In *Man the hunter*, edited by R.B. Lee and I. Devore, pp. 3-12. Chicago, IL: Aldine Publishing Company.

Lepofsky, D.
1996 Conversation with the author at Simon Fraser University, September 1996.

Lepofsky, D., K.D. Kusmer, B. Hayden and K.P. Lertzman
1996 Reconstructing prehistoric socioeconomies from paleoethnobotanical and zooarchaeological data: An example from the British Columbia Plateau. *Journal of Ethnobiology* 16(1):31-62.

Lepofsky, D., D. Hallett, K. Washbrook, S. McHalsie, K. Lertzman and R. Mathewes
1998 Documenting the history of prescribed burning among the Sto:lo of the Fraser Valley, British Columbia. Paper presented at the 21st Annual Conference, Society of Ethnobiology, Reno, Nevada, April 16, 1998.

Lewis, H.T.
1973 Patterns of Indian burning in California. *Ecology and Ethnohistory.* Anthropological Papers No. 1., Socorro, California: Ballena Press.

1977 Maskuta: The ecology of Indian fires in northern Alberta. *The Western Canadian Journal of Anthropology* 7(1):15-52.

1982 *A Time for burning.* Occasional Publication No. 17, Boreal Institute for Northern Studies, The University of Alberta, Edmonton, Alberta.

1989 Ecological and technological knowledge of fire: Aborigines versus park rangers in northern Australia. *American Anthropologist* 91:940-961.

Lewis, H.T. and T.A. Ferguson
1988 Yards, corridors, and mosaics: How to burn a boreal forest. *Human Ecology* 16(1):57-77.

Loewen, D.
1998 Ecological, Ethnobotanical, and Nutritional Aspects of Yellow Glacier Lily, *Erythronium grandiflorum*, Pursh (Liliaceae), in Western Canada. M.Sc. thesis, Department of Biology, University of Victoria, Victoria.

Loewen, D. and J. Mullin
1997 Seasonal and anthropogenic carbohydrate changes in bulbs of yellow glacier lily, *Erythronium grandiflorum* Pursh. Poster presented at the 20th Annual Conference, Society of Ethnobiology, University of Georgia, March 1997.

Lourandos, H.
1985 Intensification and Australian prehistory. In *Prehistoric Hunter-Gatherers: The Emergence of Cultural Complexity,* edited by T.D. Price and J.A. Brown, pp. 427-435. Toronto: Academic Press.

Lovell, N.C., B.S. Chisholm, D.E. Nelson and H.P. Schwarz
1986 Prehistoric salmon consumption in interior British Columbia. *Canadian Journal of Archaeology* 10:9-106.

MacNeish, R.S
1992 *The origins of agriculture and settled life.* Norman: University of Oklahoma Press.

Magne, M.P.R. and R.G. Matson
1988 The Eagle Lake Project and the Athapaskan Migration. In: *Ethnicity and Culture,* edited by R. Auger, M. Glass, S. MacEachearn and P. H. McCartney, pp. 227-242. Proceedings of the 19th Chacmool Conference, Archaeological Association of the University of Calgary, Calgary.

Marshall, A. G.
1977 Nez Perce social groups: An ecological interpretation. Ph.D. dissertation, Washington State University, Department of Anthropology, Pullman, Washington.

Mason, A.
1994 Lithic analysis of materials recovered from the Scheidam Flats locale. In: Report on the results of archaeological investigations in the Scheidam Flats locale near Kamloops. Report prepared by B. Simonsen, The Bastion Group Heritage Consultants, for Mandell Pinder, Barristers and Solicitors, Vancouver, B.C.

Matson, R.G. and D. Alexander
1990 Potato Mountain: The archaeology of alpine root resource procurement. Paper presented at the Canadian Archaeological Association Meetings, Whitehorse, May 1990.

Matson, R.G., M. Magne, D. Ludowics and D.L. Pokotylo
1980 The Eagle Lake Archaeological Project: Report on the 1979 season. Manuscript on file, Archaeology Laboratory, University of British Columbia, Vancouver, B.C.

Mehringer, P.J., S.F. Arno and K.L. Peterson
1977 Postglacial history of Lost Trail Pass Bog, Bitterroot Mountains, Montana. *Arctic and Alpine Research* 9(4):345-368.

Meidinger, D. and J. Pojar (editors)
1991 *Ecosystems of British Columbia.* Victoria: British Columbia Ministry of Forests.

Mccleary, B.V., Solah, V. and T.S. Gibson
1994 Quantitative measurement of total starch in cereal flours and products. *Journal of Cereal Science* 20:51-58.

McClenaghan, L.R. and A.C. Beauchamp
1986 Low genic differentiation among isolated populations of the California fan palm (*Washingtonia filifera*). *Evolution* 40(2):315-322.

McGuire, R.H.
1983 Breaking down cultural complexity: inequality and heterogeneity. In *Advances in Archaeological Method and Theory, Volume 6*, edited by M. Schiffer, pp. 91-142. London: Academic Press.

Millennia Research
1996 Final report of the archaeological impact assessment for the Murray and Skoonka watersheds. Report on file, Ministry Library, Ministry of Small

Business, Tourism and Culture, Victoria, B.C.

1997 Final report of the archaeological impact assessment for the Twaal Creek watershed. Report on file, Ministry Library, Ministry of Small Business, Tourism and Culture, Victoria, B.C.

Minnis, P.
1985 *Social adaptations to food stress: A prehistoric southwestern example.* Chicago: University of Chicago Press.

Minnis, P. and W. Elisens (editors)
In press, 1998
Biodiversity and Native North America, edited by Paul Minnis and Wayne Elisens. Norman: University of Oklahoma Press.

Minnis, P. and S. Plog
1976 A study of the site specific distribution of *Agave parryi* in east central Arizona. *The Kiva* 41:299-308.

Mitchell, D.H.
1990 Coast Salish subsistence studies and a methodological barrier. *Northwest Anthropological Research Notes* 24(2):239-247.

1994 House and household mobility on the Northwest Coast of North America. Paper presented at: An International Symposium: Complex Hunter-Gatherers of the World, University of California, Institute of Archaeology, April 1994.

Mitchell, W.R. and R.E. Green
1981 *Identification and interpretation of ecosystems of the western Kamloops Forest Region. First approximation.* Land Management Handbook No. 2, Volume 1. Very Dry Climatic Region. Ministry of Forests, Province of British Columbia, Victoria.

Mohs, G.
1982 Final report on excavations at (DjQj 1), Slocan Valley, British Columbia. Report on file, Ministry of Small Business, Tourism and Culture, Victoria, B.C.

Mongeau, R. and R. Brassard
1990 Determination of insoluble, soluble and total dietary fibre: collaborative study of a rapid gravimetric method. *Cereal Foods World* 35:319-324.

Mullin, J., S.L. Peacock, D.C. Loewen and N.J. Turner
In press, 1997
Macronutrient content of balsamroot and yellow glacier lily: Crops used by precontact Indigenous Peoples of North America. *Food Science and*

Technology (Lebensmittel-Wissenschaft und-Technologie).

Mullin, W.J., L. Robichon-Hunt, D.C. Loewen, S.L. Peacock and N. J. Turner
1997 Yellow glacier lily (*Erythronium grandiflorum*) and balsamroot (*Balsamorhiza sagittata*): Sources of fructooligosaccharides and inulin in the diets of precontact Indigenous Peoples of the Canadian Plateau. Poster presentation, International Congress of Nutrition, Montreal, Quebec. July 1997.

Mullin, J.
1997 Personal and written communication to Sandra Peacock, Victoria, B.C., March, 1997.

Nabhan, G.
1995 Cultural Parallax in Viewing North American Habitats. In *Reinventing nature: Responses to Postmodern deconstruction*, edited by Michael E. Soulé and Gary Lease, pp. 87-101. Washington, D.C.: Island Press.

Nabhan, G.P., A.M. Rea, K.L. Reichardt, E. Mellink and C.F. Hutchinson
1983 Papago influences on habitat and biotic diversity: Quitovac oasis ethnoecology. *Journal of Ethnobiology* 2(2):124-143.

Nicholas, G. P.
1997 Long-term Secwepemc plant use: Archaeobotanical investigations in the interior Plateau, British Columbia. Paper presented at the 20th Annual Conference, Society of Ethnobiology, University of Georgia, March 1997.

Norton, H.
1979 The association between anthropogenic prairies and important food plants in western Washington. *Northwest Anthropological Research Notes* 13:175-200.

Nuxalk Food and Nutrition Program
1984 *Nuxalk Food and Nutrition Handbook*. Bella Coola, British Columbia.

Palmer, G.
1975a Cultural ecology in the Canadian Plateau: Pre-contact to the early contact period in the territory of the southern Shuswap Indians of British Columbia. *Northwest Anthropological Research Notes* 9 (2):199-245.

1975b Shuswap Indian ethnobotany. *Syesis* 8: 29-81.

Parish, R., R. Coupe and D. Lloyd (editors)
1991 *Plants of southern interior British Columbia*. Victoria: British Columbia Ministry of Forests and Vancouver: Lone Pine Publishing.

Parsons, J. R. and M. H. Parsons
1990 *Maguey utilization in highland Mexico: An archaeological ethnography.* Anthropological Papers, Museum of Anthropology, University of Michigan, No. 82. Ann Arbor, Michigan.

Paynter, R.
1989 The archaeology of equality and inequality. *Annual Review of Anthropology* 18:369-99.

Peacock, S.L.
1992 Piikáni ethnobotany: Traditional plant knowledge of the Piikáni Peoples of the northwestern Plains. Master of Arts thesis, Department of Archaeology, University of Calgary, Calgary, Alberta.

1996 It's the pits: Innovations in Plateau plant processing. Paper presented at the 29th Annual Chacmool Conference, University of Calgary Archaeological Association in Calgary, Alberta, November 1996.

1997 Creating carbohydrates: Inulin and the chemistry of pitcooking. Paper presented at the 20th Annual Conference, Society of Ethnobiology, University of Georgia, Athens, Georgia, March 1997.

1998 Perusing the pits: Root resource productivity and production on the Plateau. Paper presented at the Canadian Archaeological Association Annual Meeting, Victoria, British Columbia, May 1998.

n.d. Plateau prehistory: A synthetic view. Unpublished manuscript in possession of author.

In review, 1998
The archaeology and ethnobotany of traditional root resource use on the Canadian Plateau. In: *The archaeobotany of hunter-gatherers in temperate regions,* edited by J. Hather and S. Mason, London, UK: Institute of Archaeology.

Peacock, S.L. and N. J. Turner
1995 Putting down roots: Edible roots, black holes and Plateau prehistory. Paper presented at the 18th Annual Conference, Society of Ethnobiology, Tucson, Arizona, March 1995.

1996 Taproots, taboos and transformations: The mystery of *Balsamorhiza sagittata* a former root food staple on the Canadian Plateau. Paper presented at the 19th Annual Conference, Society of Ethnobiology, Santa Barbara, California, March 1996.

In press, 1998
"Just like a garden": Traditional plant resource management and biodiversity conservation on the British Columbia Plateau. In *Biodiversity and Native North America*, edited by P. Minnis and W. Elisens, Norman: University of Oklahoma Press.

Pearsall, D.
1988 *Palaeoethnobotany: A handbook of procedures.* San Diego, CA: Academic Press.

Pickett, S.T.A., V.T. Parker and P.L. Fiedler
1992 The new paradigm in ecology: Implications for conservation biology above the species level. In: *Conservation biology: The Theory and practice of nature conservation*, edited by P.L. Fiedler and S.K. Jain, pp. 65-88. New York: Chapman and Hall.

Pokotylo, D. L.
1978 Lithic technology and settlement patterns in the Upper Hat Creek Valley, B.C. Ph.D. dissertation, Department of Anthropology and Sociology, University of British Columbia, Vancouver.

1981 Towards an understanding of prehistoric upland settlement behavior in the British Columbia southern interior Plateau. In: *Networks of the Past: Regional Interaction in Archaeology*, edited by P.D. Francis, F.J. Kense and P.G. Duke, pp. 379-396. Calgary, Alberta: The Archaeological Association of the University of Calgary.

Pokotylo, D. L. and P. D. Froese
1983 Archaeological evidence for prehistoric root gathering on the southern interior Plateau of British Columbia: A case study from Upper Hat Creek Valley. *Canadian Journal of Archaeology* 7(2),127-157.

Pokotylo, D. and D. Mitchell
1998
Prehistory of the Northern Plateau. In: *Plateau*, Volume 12 , *Handbook of North American Indians*, edited by D.E. Walker, (W.C. Sturtevant, General Editor), pp. 81-102. Washington, D.C.: Smithsonian Institution.

Pokotylo, D., M.E. Binkley and A.J. Curtin
1987 The Cache Creek Burial Site (EeRh 1), British Columbia. *British Columbia Provincial Museum Contributions to Human History* 1. Victoria.

Politas, G.
1998 Conversation with the author at the Annual Meeting, Canadian Archaeological Association, Victoria, British Columbia, May 1998.

Pollock, C.J. and N.J. Chatterton

1988 Fructans. In: *The biochemistry of plants*, Vol. 14, *Carbohydrates*, edited by J. Preiss, pp. 109-140. San Diego, CA: Academic Press.

Posey, D.A.

1990 The science of the Mebêngôkre. *Orion Nature Quarterly* 9 (3): 16-23.

Posey, D.A. and W. Balee (editors)

1989 *Resource management in Amazonia: Indigenous folk strategies*. Bronx, New York: New York Botanical Garden.

Price, T. D. and J. A. Brown (editors)

1985a *Prehistoric hunter-gatherers: The emergence of cultural complexity.* Toronto, ON: Academic Press.

1985b Aspects of hunter-gatherer complexity. In: *Prehistoric hunter-gatherers: The emergence of cultural complexity,* edited by T.D. Price and J.A. Brown, pp. 3-20. Toronto: Academic Press.

1985c Complex hunter-gatherers: Retrospect and prospect. In: *Prehistoric hunter-gatherers: The emergence of cultural complexity*, edited by T.D. Price and J.A. Brown, pp. 435-442. Toronto, ON: Academic Press.

Rafferty, J.E.

1985 The archaeological record on sedentariness: Recognition, development and implications. *Advances in Archaeological Method and Theory*, Volume 8, edited by M.B. Schiffer, pp. 13-156. New York: Academic Press.

Rappaport, R.A.

1984 *Pigs for the Ancestors*, 2nd edition. New Haven, CN: Yale University Press.

Ray, V.

1932 The Sanpoil and Nespelem: Salishan peoples of northeastern Washington. *University of Washington Publications in Anthropology* 5:1-237.

1939 *Cultural relations in the Plateau of northwestern America* Publications of the Frederick Hodge Anniversary Publication Fund, Vol. 3, Los Angeles, CA: Southwest Museum.

Reeves, B.O.K. and S.L. Peacock

In press, 1998

"Our mountains are our pillows": An ethnographic overview of Glacier National Park. Cultural Resource Selections Series, U.S. National Park Service, Intermontane Region, Denver, Colorado.

Reid, K.C.
1991 Prehistory and paleoenvironments at Pittsburg Landing: Data recovery and test excavations at six sites in Hells Canyon National Recreation Area, west central Idaho. *Centre for Northwest Anthroplogy Project Report* No. 15. Pullman: Washington State University.

Richards, T. and M. Rousseau
1982 Archaeological investigations on Kamloops Indian Reserve Number 1, Kamloops, British Columbia. Permit 1980-8. Report on file, Ministry Library, Ministry of Small Business, Tourism and Culture, Victoria.

1987 Late prehistoric cultural horizons on the Canadian Plateau. *Department of Archaeology Publication No. 16.* Burnaby, B.C.: Simon Fraser University.

Ridington, R.
1982 Technology, world view, and adaptive strategy in a northern hunting society. *Canadian Review of Sociology and Anthropology* 19 (4):469-481.

Rindos, D.
1984 *The origins of agriculture: An evolutionary perspective.* New York: Academic Press.

Ritchie, B.
1971 Burning Mountainsides for Better Crops. In *Lillooet Phonology, Texts and Dictionary*, by Leo John Swoboda, pp. 182-191. Master of Arts thesis, Department of Linguistics, University of British Columbia, Vancouver, British Columbia.

Roberfroid, M.
1993 Dietary fibre, inulin, and oligofructose: A review comparing their physiological effects. *Critical Reviews in Food Science and Nutrition,* 33(2):103-148.

Rousseau, M.
1993 Early prehistoric occupation of south-central British Columbia: A review of the evidence and recommendations for future research. In: *B.C. Studies,* Special Issue 99:140-183.

Rousseau, M. and G. Howe
1987 Scheidam Flats: A prehistoric root roasting area near Kamloops. *The Midden* 19(2):7-10.

Rousseau, M., R. Muir, D. Alexander, J. Breffitt, S. Woods, K. Berry and T. Van Gaalen
1991 Results of the 1989 archaeological investigations conducted in the Oregon Jack Creek locality, Thompson River region, south-central British Columbia. Permit No. 1989-76. Report on file, Ministry Library, Ministry of Small Business, Tourism and Culture, Victoria, B.C.

Rowlands, M.
1989 A question of complexity. In *Domination and resistance*, edited by D. Miller, M. Rowlands and C. Tilley, pp. 29-40, London, UK: Unwin Hyman.

Sahlins, M.
1968 Notes on the original affluent society. In *Man the hunter*, edited by R. B Lee and I. Devore, pp. 85-89. Chicago, IL: Aldine Publishing Company.

Sauer, C.O.
1936 American Agricultural Origins. In *Essays in American Anthropology*, edited by R.H. Lowie. Berkeley: University of California Press.

1947 Early relations of man to plants. *Geographical Review* 37:1-25.

1952 *Agricultural origins and dispersals*. New York: American Geographical Society.

Sanger, D.
1966 Excavations in the Lochnore-Nesikep locality, B.C. *National Museum of Canada, Anthropology Papers* No. 12.

1968a The Chase Burial Site, EeQw-1. In Contributions to Anthropology VI: Archaeology and Physical Anthropology, *National Museums of Canada Bulletin* 224:86-185. Ottawa.

1968b The Texas Creek burial site assemblage, British Columbia. *National Museum of Canada, Anthropology Papers*, 17. Ottawa.

1969 Cultural traditions in the interior of B.C. *Syesis* 2:189-200.

1970 The archaeology of the Lochnore-Nesikep locality, B.C. *Syesis* 3, Supplement 1.

Schulting, R. J.
1995 *Mortuary variability and status differentiation on the Columbia-Fraser Plateau.* Burnaby, B.C.: Archaeology Press, Department of Archaeology, Simon Fraser University.

Schurmann, S.
1969 Report to the Archaeology Sites Advisory Board on site survey done in the Kamloops District from June 4 to July 4, 1969. Report on file, Ministry Library, Ministry of Small Business, Tourism and Culture, Victoria, B.C.

Secwepemc Cultural Education Society (SCES)
1992 *The SecQepemc Calendar, July 1992-December 1993.* Compiled by Marianne and Ron Ignace. Kamloops, B.C.: Secwepemc Cultural Education Society,

Language Department.

1994 *Sptékwles Re Qelmúcs: Stories of the People.* Edited by M. Antoine, M. Eugene, X Eugene, J. Michel, E. Theodore and M. Palmantier. Kamloops, B.C.: Secwepemc Cultural Education Society, Language Department.

n.d. Plants of the Secwepemc (Shuswap) People. Unpublished manuscript of the Secwepemc Ethnobotany Project, 1993-1997, on file with author.

Scientific Panel for Sustainable Forest Practices in Clayoquot Sound.
1995 First Nations' perspectives on forest practices in Clayoquot Sound, Report 3, Victoria, British Columbia.

Shipek, F.C.
1989 An example of intensive plant husbandry: The Kumeyaay of southern California. In: *Foraging and farming: The evolution of plant exploitation*, edited by D. Harris and G. Hillman, pp. 159-170. London, UK: Unwin Hyman.

Simonsen, B.
1994 Report on the results of archaeological investigations in the Scheidam Flats locale near Kamloops, B.C. Report prepared by The Bastion Group Heritage Consultants for Mandell Pinder, Barristers and Solicitors, Vancouver, B.C.

Simonsen, B., S. Peacock and J. Haggerty
1997 Final report of the First Nations Cultural Heritage Impact Assessment and consultation component: Bamberton Town Development Project. Submitted to The First Nations Management Committee, The Environmental Assessment Office, Province of British Columbia, and Greystone Properties Ltd.

Smith, B.
1995 *The Emergence of Agriculture.* New York: Scientific American Library, WH Freeman and Company.

1997 Identifying low-level food producing economies: The Northwest Coast and elsewhere. Paper presented at the symposium: Was the Northwest Coast "Agricultural"?: Aboriginal Plant Use Reconsidered, organized by K. Mathewson and D. Deur at the Annual Meeting of the American Association for the Advancement of Science, Seattle, Washington, February 16, 1997.

In press , 1998
An evolutionary perspective on low-level food producing societies. In *"Keeping it living": Plant tending and cultivation on the Northwest Coast*, edited by D. Deur and N.J. Turner, Seattle: University of Washington Press.

Speth, J.D. and K.A. Spielmann
1983 Energy source, protein metabolism, and hunter-gatherer subsistence strategies. *Journal of Anthropological Archaeology* 2(1):1-31.

Spinden, H.J.
1964 The Nez Perce Indians. *Memoirs of the American Anthropological Association* 11(3):165-274.

Stahl, A.B.
1989 Plant-food processing: implications for dietary quality. In *Foraging and Farming: The evolution of plant exploitation*, edited by D.R. Harris and G.C. Hillman, pp. 171-194. London, UK: Unwin Hyman.

Steedman, E.V.
1930 The ethnobotany of the Thompson Indians of British Columbia [based on field notes of J.A. Teit]. *Bureau of American Ethnology, 45th Annual Report*, 1927-28. Washington, D.C.: Smithsonian Institution.

Stefansson, V.
1944 *Arctic manual*. New York: Macmillan.

Stevens, M.
1997 The contribution of traditional resource management of white root (*Carex barbarae*) to cultural and ecological restoration. Paper presented at the 20th Annual Conference, Society of Ethnobiology, University of Georgia, March 1997.

Stryd, A.H.
1971 The 1971 archaeological investigations near Lillooet, B.C. Permit 1971. Report on file, Ministry Library, Ministry of Small Business, Tourism and Culture, Victoria, British Columbia.

1972 Housepit archaeology at Lillooet, B.C.: The 1970 field season. *B.C. Studies* 14:17-46.

1973 The later prehistory of the Lillooet area, B.C. Ph.D. dissertation, Department of Archaeology, University of Calgary.

1980 The 1980 investigations of the Monte Creek archaeological site (EdQx 15). Permit 1980-11. Report on file, Ministry Library, Ministry of Small Business, Tourism and Culture, Victoria, British Columbia.

1995 Archaeological evidence for Aboriginal use of Scheidam Flats near Kamloops, B.C. Report prepared for Legal Services Branch, Ministry of Attorney General, Province of British Columbia and Department of Justice, Government of

Canada.

Stryd, A.H. and M. Rousseau
1988 The early prehistory of the Mid Fraser-Thompson River area of British Columbia. Paper presented, in part, before the 21st Annual Meeting of the Canadian Archaeological Association, Early Man in British Columbia Symposium, May 12, 1988, Whistler, B.C. Manuscript on file, Ministry Library, Ministry of Small Business, Tourism and Culture, Victoria, B.C.

1996 The Early prehistory of the Mid Fraser-Thompson River area of British Columbia. In *Early human occupation in British Columbia,* edited by R.L. Carlson and L. Dalla Bona, pp. 177-204. Vancouver: University of British Columbia Press.

Suttles, W.
1960 Affinal ties, subsistence and prestige among the Coast Salish. *American Anthropologist* 62:296-305.

1962 Variation in habitat and culture on the Northwest Coast. *Atken des 34 Internationalen Amerikanistenkongresses, Wein,* 1960:522-37.

1968 Coping with abundance: Subsistence on the Northwest Coast. In: *Man the hunter*, edited by R.B. Lee and I. Devore, pp. 56-68. Chicago, IL: Aldine Publishing Company,

Teit, J.
1900 *The Thompson Indians of British Columbia.* Memoir of the American Museum of Natural History, Vol. I, Part IV, 163-392. New York: G.E. Stechert and Co.

1906 *The Lillooet Indians.* Memoir of the American Museum of Natural History, Vol. II, Part VI. New York: G.E. Stechert and Co.

1909 *The Shuswap.* Memoir of the American Museum of Natural History, Vol. II, Part VII, pp. 443-789. New York: G.E. Stechert and Co.

1912 *Mythology of the Thompson Indians.* Vol. VII, Part II. The Jesup North Pacific Expedition, Edited by Franz Boas. Memoir of the American Museum of Natural History, New York: G.E. Stechert and Co.

Testart, A.
1982 The significance of food storage among hunter-gatherers: Residence Patterns, Population densities, and social inequalities. *Current Anthropology* 23(5):523-537.

Thoms, A.
1989 The northern roots of hunter-gatherer intensification: Camas and the Pacific Northwest. Ph.D. dissertation, Department of Anthropology, Washington State University, Pullman, Washington.

Timbrook, J., J.R. Johnson, and D.D. Earle
1982 Vegetation burning by the Chumash. *Journal of California and Great Basin Anthropology* 4(2):163-186.

Turner, N.J.
1975 *Food Plants of British Columbia Indians*. Part 1. *Coastal peoples*. Handbook No. 34. Victoria: British Columbia Provincial Museum.

1978 *Food plants of British Columbia Indians*. Part 2. *Interior peoples*. Handbook No. 36. Victoria: British Columbia Provincial Museum.

1979 *Plants in British Columbia Indian technology*. Handbook No. 38, Victoria: British Columbia Provincial Museum.

1991 "Burning mountain sides for better crops": Aboriginal landscape burning in British Columbia. In *Archaeology in Montana*, Special Issue, Volume 32, Number 2, edited by K.P. Canon, pp. 57-73. Bozeman, Montana: Montana Archaeological Society.

1992 Plant resources of the Stl'atl'imx (Fraser River Lillooet) people: A window into the past. In *Complex cultures of the British Columbia Plateau: Traditional Stl'atl'imx resource use*, edited by B. Hayden, pp. 405-469. Vancouver: University of British Columbia Press.

1995 *Food plants of coastal first peoples*. Revised edition. Victoria: Royal British Columbia Museum and Vancouver: University of British Columbia Press.

1997 *Food plants of interior first peoples*. Revised edition. Victoria: Royal British Columbia Museum and Vancouver: University of British Columbia Press.

Turner, N.J. and A. Davis
1993 "When everything was scarce": The role of plants as famine foods in northwestern North America. *Journal of Ethnobiology* 13(2):1-28.

Turner, N.J. and B. Efrat
1982 *Ethnobotany of the Hesquiat Indians of Vancouver Island*. Cultural Recovery Paper No. 2. Victoria: British Columbia Provincial Museum.

Turner, N. J. and H.V. Kuhnlein
1982 Two important "root" foods of the Northwest Coast Indians: Springbank

clover (*Trifolium wormskioldii*) and Pacific silverweed (*Potentilla anserina* ssp. *pacifica*). *Economic Botany* 36(4):411-432.

1983 Camas (*Camassia* spp.) and riceroot (*Fritillaria* spp.): Two liliaceous "root" foods of the Northwest Coast Indians. *Ecology of Food and Nutrition* 13:199-219.

Turner, N.J. and S.L. Peacock

1995 Traditional plant resource use of the Komkanetkwa region (including Scheidam Flats) by the Kamloops Secwepemc people. Report to Rush, Crane, Guenther and Associates, Vancouver, B.C. and the Kamloops Indian Band, Kamloops, B.C. (99 pp.).

In press Anthropogenic plant communities of the Northwest Coast: An ethnobotanical perspective. In *"Keeping it living": Plant tending and cultivation on the Northwest Coast*, edited by D. Deur and N.J. Turner, Seattle: University of Washington Press.

Turner, N.J., R. Bouchard, and D.I.D. Kennedy.

1980 *Ethnobotany of the Okanagan-Colville Indians of British Columbia and Washington.* British Columbia Provincial Museum (now Royal British Columbia Museum) Occasional Paper No. 21, Victoria, British Columbia.

Turner, N.J., J. Thomas, B. Carlson and R.T. Ogilvie

1983 *Ethnobotany of the Nitinaht Indians of Vancouver Island.* Occasional Paper No. 24. Victoria: British Columbia Provincial Museum.

Turner, N.J., L.C. Thompson, M.T. Thompson and A. Z. York

1990 Thompson Ethnobotany: Knowledge and usage of plants by the Thompson Indians of British Columbia. *Royal British Columbia Museum Memoir No. 3.* Royal British Columbia Museum, Victoria, B.C.

Ucko, P.

1989 Foreword. In *Foraging and Farming: The Evolution of Plant Exploitation*, edited by D. Harris and G. Hillman, pp. ix-xviii. London, UK: Unwin Hyman.

Van Loo, J., P. Coussement, L. De Leenheer, H. Hoebregs and G. Smith

1995 On the presence of inulin and oligofructose as natural ingredients in the western diet. *Critical Reviews in Food Science and Nutrition* 35(6):525-552.

Vavilov, N.I.

1926 Studies on the origins of cultivated plants. *Bulletin of Applied Botany and Plant Breeding* 16:1-245.

Wandsnider, L.
1997 The Roasted and the boiled: Food composition and heat treatment with special emphasis on pit-hearth cooking. *Journal of Anthropological Archaeology* (16):1-48.

Walker, D. (editor)
1998 *Plateau*, Volume 12 , *Handbook of North American Indians*, edited by D.E. Walker, (W.C. Sturtevant, General Editor). Washington, D.C.: Smithsonian Institution.

Watson, P.J.
1976 In pursuit of prehistoric subsistence: A comparative account of some contemporary flotation techniques. *Midcontinental Journal of Archaeology* 1:77-100.

Wilson, I.R.
1993 Excavations at the Baker Site, EdQx 43, Monte Creek. Report on file, Ministry Library, Ministry of Small Business, Tourism and Culture, Victoria, B.C.

Wilson, I.R., B. Smart, N. Heap, J. Warner, T. Ryals, S. Woods and S. Macnab
1992 Excavations at the Baker Site, EdQx 43, Monte Creek, Permit 91-107. I.R. Wilson Consultants Ltd. Report on file, Ministry Library, Ministry of Small Business, Tourism and Culture, Victoria, B.C.

Wilson, R. L.
1980 Archaeological investigations near Kamloops. In *The Archaeology of Kamloops*, Department of Archaeology Occasional Papers No. 7, Burnaby, B.C.: Simon Fraser University.

Winterhalder, B. and C. Goland
1997 An evolutionary ecology perspective on diet choice, risk and plant domestication. In: *People, plants, and landscapes*, edited by K.J. Gremillion, pp. 123-160. Tuscaloosa: University of Alabama Press.

Wollstonecroft, M. and G. Baptiste
1997 Prehistoric plant remains from Site EeRb 140, a multi-component site within present-day Secwepemc territory, British Columbia. Paper presented at the 20th Annual Conference, Society of Ethnobiology, University of Georgia, March 1997.

Woodburn, J.
1968 An introduction to Hadza ecology. In *Man the hunter*, edited by R.B. Lee and I. Devore, pp. 49-55. Chicago, IL: Aldine Publishing Company.

1980 Hunters and gatherers today and reconstructions of the past. In *Soviet and*

Western Anthropology, edited by E. Gellner, pp. 95-117. London, UK: Duckworth Publishers.

1982 Egalitarian societies. *Man* 17:431-451.

Yanovsky, R. and R.M. Kingsbury
1931 New sources of inulin. *Journal of the American Chemical Society* 53:1597-1601.

1938 Analyses of some Indian plant foods. *Journal of the Association of Official Agricultural Chemists* 221(4):648-665.

Yesner, D. R.
1994 Seasonality and resource "stress" among hunter-gatherers: archaeological signatures. In *Key Issues in Hunter-Gatherer Research*, edited by E.S. Burch, Jr. and L.J. Ellanna, pp. 151-167. Oxford, UK: Berg Publishers.

Appendix 1: Earth Oven Data

Appendix I, Table 1: Summary of data from archaeological sites identified at Komkanetkwa

(for additional details, see Archaeological Site Inventory Forms, Archaeology Branch, Ministry of Small Business, Tourism & Culture, Victoria, British Columbia; Simonsen 1994; Stryd 1995)

Site No.	Site Type	Features	Site Size (l x w)	Comments
EeRa 9	RP	CD-1	6 x 6	
EeRb 8	RP	CD-12	160 x 40	Shovel tests (n=3) yielded 14 basalt flakes, 3 bone frags; Earth oven (CD#5) excavated (controlled & backhoe) in 1992 -- 9 small, unidentifiable bone frags recovered; dates of 70±70 BP and 80 ± 70 BP; Earth oven (CD#7) excavated in 1996, Douglas-fir wood charcoal identified; see text for details.
EeRb 15	RP & LS	CD-9	130 x 120	Shovel tests (n=7); lithic scatter test excavated in 1992, see text for details; Earth oven (CD#4) excavated in 1996; 1060 ± 80 BP; see text for details.
EeRb 34	RP	CD-1	5 x 5	
EeRb 35	RP	CD-2	30 x 20	
EeRb 36	RP	CD-5	50 x 30	Surface scatter of FCR and one utilized basalt flake approx. 45 m south of earth oven (CD-1);
EeRb 37	RP	CD-4	50 x 20	
EeRb 38	RP	CD-7	100 x 50	Two areas of lithic scatter of basalt flakes;
EeRb 39	RP	CD-3	80 x 25	One basalt flake on surface;
EeRb 40	RP & CP	CD-6	75 x 75	Lithic scatter of several basalt flakes;
EeRb 41	RP	CD-3	200 x 40	
EeRb 43	RP	CD-2	35 x 10	
EeRb 44	RP	CD-1	50 x 30	Isolated find -- chipped slate biface preform; Shovel tests (n=3) with cultural material to depths of 30 cm including basalt flakes, animal bone and 3 fish vertebrae; Earth oven (CD#1) excavated (controlled & backhoe) in 1992; recovered: 2 retouched flakes and debitage (n=25); carbonized apical buds (*?Populus* sp.); 2360 ± 150 BP and 1660 ± 90 BP on charcoal, see text for details.
EeRb 45	RP	CD-2	90 x 15	Earth oven (CD#2) excavated (controlled & backhoe) in 1992; recovered: retouched cortex spall tool; one stone bead artifact; fish bones (n=15) from outside rim of earth oven; carbonized apical buds (*?Populus* sp.); 1300 ± 50 BP on charcoal, see text for details;
EeRb 46	RP	CD-3	n/a	

Site#	Site Type	Features	Site Size (l x w)	Comments
EeRb 47	RP	CD-5	55 x 10	
EeRb 48	RP	CD-1	50 x 20	
EeRb 50	RP	CD-3	45 x 15	
EeRb 51	RP	CD-3	n/a	
EeRb 54	RP	CD-3	150 x 100	lithic scatter consisting of several basalt flakes, with densest concentration at eastern end of site; no diagnostics;
EeRb 57	RP	CD-3	60 x 30	Earth oven (CD#1) excavated in 1996, see text for details;
EeRb 58	RP	CD-5	50 x 25	Earth oven (CD#1) excavated 1996; cottonwood and/or aspen wood charcoal identified 160 ± 60 BP on charcoal; see text for details;
EeRb 59	RP	CD-8	120 x 70	
EeRb 60	RP & LS	CD-9	160 x 40	Lithic scatter widely dispersed, consists largely of basalt flakes; no formed tools observed; Shovel tests (n=15) inside & outside cultural depressions: one contained 43 basalt flakes, a chert scraper, shell and over 100 burnt bone frags to a depth of 35 cm bs.
EeRb 79	CP	CD-19	125 x 60	Lithic scatters, Cache Creek basalt; brown jasper biface recovered in shovel test at 11 cm bs; Shovel tests (n=40); Cache pits (CD#7 & 8) excavated (controlled & backhoe) in 1992 recovered: 6 birch bark rolls, 5 to 10 cm in length; 2010 ± 110 BP on charcoal;
EeRb 82	RP	CD-1	5 x 5	
EeRb 84	RP	CD-8	90 x 35	Lithic scatter at west end of site, all Cache Creek basalt; proximal end of a concave-based, stemmed projectile point manufactured of fine-grained basalt;
EeRb 85	RP	CD-2	25 x 15	
EeRb 89	RP	CD-3	50 x 25	Earth oven (CD#) excavated in 1996; 1830 ± 60 BP on charcoal; see text for details;
EeRb 90-	RP	CD-3	40 x 25	Lithic scatters; 3 basalt flakes and possible basalt core in shovel tests;
EeRb 91	RP	CD-3	150 x 100	Surface collected: 1 Plateau Horizon corner-notched basalt projectile point surface collected; 1 basalt biface (medial section); 1 basalt ?preform; 1 flake Walhachin green chert; Shovel test: 4 basalt flakes, 1 basalt bipolar core, 3 bone frags; Earth oven (CD#1) excavated in 1992;one basalt flake & 14 pieces of basalt debitage; bone frags & fish vertebrae; two distinct heating elements; upper element 870 ± 50 BP on charcoal; see text for details;

Site No.	Site Type	Features	Site Size (l x w)	Comments
EeRb 92	LS		40 x 35	Surface collected: 1 basalt biface frag; Shovel tests yielded 42 basalt flakes, 8 chalcedony flakes, 2 chert flakes; 1 ?quartzite flake; 7 bone frags; lithics and faunal remains in excavations, see text. Controlled excavation in 1992, see text for details;
EeRb 93	RP	CD-4	105 x 25	Surface collected: 1 yellow jasper thumbnail scraper; basalt flakes; Shovel tests: 3 basalt flakes; 1 ?siltstone flake;
EeRb 94	RP	CD-2	35 x 20	
EeRb 95	RP	CD-1	12 x 8	
EeRb 96	RP	CD-1	5 x 5	
EeRb 97	RP	CD-1	7 x 7	
EeRb 98	RP & CS	CD-4		Campsite excavated in 1992, see text for details; Earth oven (CF#4) excavated in 1996; two basalt bifaces recovered from bottom of oven; see text for details;
EeRb 99	RP	CD-1?	110 x 50	Lithic scatter, less than 25 debitage elements, all basalt; Shovel test yielded four flakes; Shovel test in CD# yielded 2 bone frags, possible basalt flake and FCR;
EeRb 100	RP	CD-1	5 x 5	
EeRb 101	LS		115 x 70	Surface collected: basalt convex endscraper; Shovel tests (n=7) yielded 3 bone frags, FCR, mussel shell frags; 21 basalt flakes, 1 brown jasper flake; 2 grey chert, 1 siltstone flake;
EeRb 102	Historic		30 x 12	wreckage of a badly-mired wagon beside creek;
EeRb 103	LS		20 x 15	One basalt debitage element and isolated flake on surface; shovel test -- 3 small basalt flakes;
EeRb 104	LS		10 x 5	Two basalt flakes;
EeRb 105	LS		30 x 15	Three basalt flakes;
EeRb 106	RP	CD-2	15 x 15	
EeRb 107	RP	CD-1	10 x 10	
EeRb 108	RP	CD-2	20 x 25	
EeRb 109	RP	CD-2	80 x 10	
EeRb 110	RP	CD-2	95 x 10	
EeRb 111	RP	CD-1	8 x 8	
EeRb 112	LS		50 x 20	Lithic scatter, less than 15 basalt debitage elements and dark grey chert unimarginal retouched flake;

Site No.	Site Type	Features	Site Size (l x w)	Comments
EeRb 113	RP & LS	CD-1	150 x 80	Small lithic scatter; 1 utilized basalt flake; 5 or 6 basalt debitage elements;
EeRb 114	LS		30 x 25	Lithic scatter, approx. 20 basalt debitage elements jasper flake and a pinkish-grey siltstone flake;
EeRb 115	RP & LS	CD-4	60 x 15	Lithic scatter of 21 basalt debitage items;
EeRb 116	RP	CD-3	25 x 20	
EeRb 117	LS		30 x 15	Lithic scatter with 5 debitage elements, 3 basalt, 1 of coarse-grained green igneous rock and 1 of pink chert;
EeRb 118	RP	CD-1	7 x 7	
EeRb 119	RP	CD-1	8 x 8	
EeRb 120	RP	CD-1	10 x 10	
EeRb 132	RP	CD-2	10 x 20	
EeRb 133	LS		10 x 7	Lithic scatter; basalt biface fragment and two basalt flakes; 3 shovel tests yielded three small basalt flakes, burned bone and FCR;
EeRb 134	RP	CD-6	60 x 80	
EeRb 135	RP	CD-5	35 x 50	
EeRb 136	RP	CD-5	30 x 50	
EeRb 137	RP	CD-1	10 x 10	
EeRb 138	RP	CD-1	20 x 30	Surface find -- biface frag (projectile tip?);
EeRb 139	RP	CD-2	20 x 15	
EeRb 141	RP	CD-1	10 x 10	
EeRb 142	LS		7 x 7	Lithic scatter of basalt flakes; basalt flake recovered from shovel test at 15 cm bs;
EeRb 143	RP & LS	CD-2	45 x 12	Lithic scatter, 3 surface flakes; shovel tests yielded 53 flakes, mostly basalt, one greyish chert; 4 bone fragments also recovered;
EeRb 145	RP	CD-2	20 x 30	
EeRb 146	RP	CD-2	15 x 20	
EeRb 147	RC	12	200 x 75	

CD = cultural depression;
RP = roasting pit;
CP = cache pit;
LS = lithic scatter;
CS = campsite;
RC = rock cairns;

Appendix 1, Table 2: Earth Oven Data from Komkanetkwa

Site & Feature#	# of Earth Ovens	Rim Crest Length (m)	Rim Crest Width (m)	Basin Depth (m)	Average Rim Crest Diameter (m)	Rim Base Length (m)	Rim Base Width (m)
EeRa 9 - 1	1	3.8	3.1	0.2	3.45	6.3	6
EeRb 8 - 1		2.9	2.8	0.22	2.85		
EeRb 8 - 2		4	4	0.46	4		
EeRb 8 - 3		3.1	2.8	0.36	2.95		
EeRb 8 - 4		1.6	1.4	0.16	1.5		
EeRb 8 - 5		2.6	2.4	0.28	2.5	5.7	5.2
EeRb 8 - 6		2.4	2.4	0.3	2.4		
EeRb 8 - 7		3.9	3.8	0.42	3.85		
EeRb 8 - 8		3.2	3	0.34	3.1		
EeRb 8 - 9		1.6	1.6	0.12	1.6		
EeRb 8 - 10		3.6	3.5	0.44	3.55		
EeRb 8 - 11		2.8	2.8	0.47	2.8		
EeRb 8 - 12	12	4.1	3.7	0.24	3.9		
EeRb 15 - 1		3.5	3.4	0.49	3.45		
EeRb 15 - 2		3	2.9	0.49	2.95		
EeRb 15 - 3		3.5	3.4	0.2	3.45		
EeRb 15 - 4		6.75	4.9	0.44	5.825		
EeRb 15 - 5		3.7	3.6	0.48	3.65		
EeRb 15 - 6		2.9	2.3		2.6		
EeRb 15 - 7		3.3	2.4	0.2	2.85	4.4	4.1
EeRb 15 - 8		3.1	2.9	0.15	3	4.6	4.5
EeRb 15 - 9	9	3.2	2.8	0.15	3	5.1	4.6
EeRb 34 - 1	1	5	4.1		4.55	8.6	7.1
EeRb 35 - 1	1	4.5	4	0.65	4.25	7	6.5
EeRb 36 - 1		5	5	0.28	5	8.5	7.5
EeRb 36 - 2		5	4	0.48	4.5	7	
EeRb 36 - 3	3	3.6	3.2	0.25	3.4		

Site & Feature#	# of Earth Ovens	Rim Crest Length (m)	Rim Crest Width (m)	Basin Depth (m)	Average Rim Crest Diameter (m)	Rim Base Length (m)	Rim Base Width (m)
EeRb 37 - 1		5	3.25	0.8	4.125	6	5
EeRb 37 - 2		4	4	0.48	4	7.5	6
EeRb 37 - 3		1.6	1.25		1.425	5	
EeRb 37 - 4	4			0.11			
EeRb 38 - 1		4.9	4.3	0.37	4.6		
EeRb 38 - 2		2.1	2	0.12	2.05		
EeRb 38 - 3		3.1	2.7	0.26	2.9	4.1	3.7
EeRb 38 - 4		3.1	2.3	0.35	2.7		
EeRb 38 - 5		2.5	2	0.19	2.25		
EeRb 38 - 6		2	2	0.11	2	3.7	3.6
EeRb 38 - 7	7	3.5	2.7		3.1	7.3	4.5
EeRb 39 - 1		4.8	4.5	0.37	4.65		
EeRb 39 - 4		2.7	2.5	0.26	2.6		
EeRb 39 - 5	3	2	1.9	0.19	1.95		
EeRb 40 - 1		2	2	0.3	2		
EeRb 40 - 2		2	2	0.3	2		
EeRb 40 - 3	3	2	2	0.3	2		
EeRb 41 - 1		5.3	5.2	0.44	5.25		
EeRb 41 - 2		4.9	4.8	0.22	4.85		
EeRb 41 - 3	3	2.2	2.2	0.18	2.2	3.7	3.3
EeRb 43 - 1		2.1	2.2	0.1	2.15		
EeRb 43 - 2	2	1.7	1.5		1.6		
EeRb 44 - 1	1	7.1	4.5	0.45	5.8		
EeRb 45 - 1		3.8	3.6	0.51	3.7		
EeRb 45 - 2	2	5.2	5.1	0.51	5.15		
EeRb 46 - 1		4.3	4.2	0.72	4.25	7.1	
EeRb 46 - 2		4.9	4.8	0.48	4.85		
EeRb 46 - 3	3	3.5	3.1	0.31	3.3		
EeRb 47 - 1		4.2	4.1	0.38	4.15		

Site & Feature#	# of Earth Ovens	Rim Crest Length (m)	Rim Crest Width (m)	Basin Depth (m)	Average Rim Crest Diameter (m)	Rim Base Length (m)	Rim Base Width (m)
EeRb 47 - 2		4.8	4.6	0.48	4.7		
EeRb 47 - 3		3.6	3.4	0.2	3.5		
EeRb 47 - 4		3.6	3.4	0.4	3.5		
EeRb 47 - 5	5	2.8	1.8	0.08	2.3	3.4	3.3
EeRb 48 - 1	1	5	4.9	0.39	4.95	8.8	8.1
EeRb 50 - 1		2.2	2.1	0.21	2.15	4.3	4.2
EeEb 50 - 2		3	2.8	0.41	2.9		
EeRb 50 - 3	3						
EeRb 51 - 1							
EeRb 51 - 2							
EeRb 51 - 3	3	4.3	3.9	0.18	4.1		
EeRb 54 - 2							
EeRb 54 - 3	2	3.5	3.4	0.52	3.45		
EeRb 57 - 1		7	6.3	0.49	6.65		
EeRb 57 - 2	2	2.4	2.3	0.24	2.35	4.9	4.8
EeRb 58 - 1		5.7	5.5	0.28	5.6		
EeRb 58 - 2		2.75	2.5	0.09	2.625		
EeRb 58 - 4		2.6	2.4	0.18	2.5		
EeRb 58 - 5	4	3.1	2.9	0.34	3		
EeRb 59 - 1		3	2.8	0.42	2.9		
EeRb 59 - 2		3.1	2.9	0.36	3		
EeRb 59 - 3		5.2	5	0.5	5.1		
EeRb 59 - 4		4.1	3.8	0.37	3.95		
EeRb 59 - 5		2.5	2.2	0.33	2.35		
EeRb 59 - 6							
EeRb 59 - 7		3.4	2.5	0.08	2.95	5.1	4.4
EeRb 59 - 8	8					8	6.3
EeRb 60 - 1							
EeRb 60 - 2							

Site & Feature#	# of Earth Ovens	Rim Crest Length (m)	Rim Crest Width (m)	Basin Depth (m)	Average Rim Crest Diameter (m)	Rim Base Length (m)	Rim Base Width (m)
EeRb 60 - 3							
EeRb 60 - 4							
EeRb 60 - 5							
EeRb 60 - 6							
EeRb 60 - 7							
EeRb 60 - 8							
EeRb 60 - 9	9						
EeRb 82 - 1	1	5	4.9	0.46	4.95		
EeRb 83 - 1	1	4.4	3.6	0.28	4		
EeRb 84 - 3	1	3.4	3.3	0.38	3.35		
EeRb 85 - 1		4.5	4.5	0.3	4.5		
EeRb 85 - 2	2						
EeRb 89 - 1		4.8	4.2	0.2	4.5		
EeRb 89 - 2		2.2	2.1		2.15		
EeRb 89 - 3	3	4.2	3.5	0.46	3.85		
EeRb 90 - 2	1	3.6	3.4	0.28	3.5		
EeRb 91 - 1		3	2.9	0.34	2.95		
Eerb 91 - 2		4.1	4	0.31	4.05		
EeRb 91 - 3	3	5	4.9	0.46	4.95		
EeRb 93 - 2		3.3	3.3	0.18	3.3		
EeRb 93 - 3		4.1	2.9		3.5		
EeRb 93 - 4	3	4.1	4	0.66	4.05		
EeRb 94 - 1		3.4	3.3	0.39	3.35		
EeRb 94 - 2		2.6	2.4	0.27	2.5		
EeRb 94 - 3	3						
EeRb 95 - 1*	1						
EeRb 96 - 1	1	2.6	2.6	0.23	2.6		
EeRb 97 - 1	1	2.9	2.9	0.46	2.9		
EeRb 98 - 1		4.8	4.6	0.4	4.7		

Site & Feature#	# of Earth Ovens	Rim Crest Length (m)	Rim Crest Width (m)	Basin Depth (m)	Average Rim Crest Diameter (m)	Rim Base Length (m)	Rim Base Width (m)
EeRb 98 - 2		3	3		3		
EeRb 98 - 3		3.7	3.6	0.34	3.65		
EeRb 98 - 4		2.8	2.5	0.18	2.65		
EeRb 98 - 5		3.6	2.9	0.15	3.25	4.5	4.1
EeRb 98 - 6	6	2.8	2.2	0.15	2.5	3.2	2.8
EeRb 99 - 1		6	6	0.5	6	6	
EeRb 99 - 2	2	5	5		5	5	
EeRb 100 - 1	1	1.5	1.4		1.45	3.5	3.4
EeRb 106 - 1	1	7	7	0.35	7		
EeRb 107 -1	1	3.6	3	0.3	3.3		
EeRb 108 - 1		4.7	4.3	0.35	4.5	8.4	8.2
EeRb 108 - 2	2	2.9	2.8	0.32	2.85		
EeRb 109 - 1		3.8	3.2	0.24	3.5	6.3	5.7
EeRb 109 - 2	2	4.4	4	0.3	4.2	7.3	5.7
EeRb 110 - 1		3.3	3.3	0.15	3.3	6.2	6.1
EeRb 110 - 2	2	3.1	2.8	0.25	2.95	4.5	3.9
EeRb 111 - 1	1	5	4.6	0.24	4.8	7.3	6.8
EeRb 115 - 1		3.5	3	0.24	3.25	4.9	4.3
EeRb 115 - 2		3.3	2.9	0.26	3.1	3.8	3.6
EeRb 115 - 3		3.6	2.6	0.25	3.1	4.5	3.3
EeRb 115 - 4	4	3.6	3.4	0.25	3.5	5.3	4.7
EeRb 116 - 1		4	3.3	0.24	3.65	9.4	6
EeRb 116 - 2		4.3	3.5	0.26	3.9	8.7	5.2
EeRb 116 - 3	3	3.4	3.2	0.28	3.3	6	5.3
EeRb 118 - 1	1	4	3.6	0.18	3.8	6.6	6.5
EeRb 119 - 1	1	4.5	3.6	0.3	4.05	6.6	5.4
EeRb 120 - 1	1	4.8	3.4	0.5	4.1	7.9	7.1
EeRb 132 - 1		2.8	2.7	0.18	2.75	5.9	4
EeRb 132 - 2	2	3.9	3.8		3.85	3.9	3.8

Site & Feature#	# of Earth Ovens	Rim Crest Length (m)	Rim Crest Width (m)	Basin Depth (m)	Average Rim Crest Diameter (m)	Rim Base Length (m)	Rim Base Width (m)
EeRb 134 - 1		4.4	3.3	0.2	3.85	7.1	5.8
EeRb 134 - 2		3.4	2.9	0.1	3.15	5.8	5.6
EeRb 134 - 3		4.1	4.1	0.15	4.1	8.5	8.5
EeRb 134 - 4		3.8	3.8	0.36	3.8	5.3	5.3
EeRb 134 - 5		2.3	2.3	0.12	2.3	4.5	4.5
EeRb 134 - 6	6	2.9	2.9	0.15	2.9	5.3	5.3
EeRb 135 - 1		3.3	3.2	0.22	3.25		
EeRb 135 - 2		3.4	3.4	0.18	3.4	5.6	4.7
EeRb 135 - 3		4	3.7	0.17	3.85	7.3	7.1
EeRb 135 - 4		8.3	8.1		8.2	8.3	8.1
EeRb 135 - 5	5	8.6	8.6		8.6	8.6	8.6
EeRb 136 - 1		3.5	3.2	0.3	3.35		
EeRb 136 - 2		3.7	3.6	0.36	3.65		
EeRb 136 - 3		4	3	0.43	3.5	5.2	4.9
EeRb 136 - 4		3.9	3.7	0.35	3.8		
EeRb 136 - 5	5	3.5	3.1		3.3		
EeRb 137 - 1	1	2.2	2	0.21	2.1	4.4	4.4
EeRb 138 - 1	1						
EeRb 139 - 1		4.1	3.4	0.17	3.75	6	5.1
EeRb 139 - 2	2	4.7	2.7	0.32	3.7	6.3	
EeRb 141 - 1	1	3.3	3.1	0.19	3.2	5	
EeRb 143 - 1		1	1	0.1	1		
EeRb 143 - 2	2	1	1	0.1	1		
EeRb 145 - 1		4.7	4.5	0.37	4.6	7.9	
EeRb 145 - 2	2	4.2	4	0.32	4.1	7.7	
EeRb 146 - 1		3.9	3.7	0.32	3.8	6	5.4
EeRb 146 - 2	2	2.4	2.2	0.15	2.3	3.3	3.2

Appendix I, Table 3: Earth oven data from the Upper Hat Creek Valley (from Pokotylo and Froese 1983).

Site & Feature No.	Average Rim Crest Diameter (m)	Basin Depth (m)
EeRj 1-6	3.85	0.4
EeRj 1-8	5.95	0.36
EeRj 1-9	5.4	0.08
EeRj 1-15	4.15	0.22
EeRj 1-16	4.95	0.25
EeRj 1-17	6.65	0.37
EeRj 1-18	3.1	0.12
EeRj 1-19	6.3	0.23
EeRj 1-20	4.8	0.25
EeRj 1-22	4.25	0.89
EeRj 33-1	2.9	0.07
EeRj 33-2	5.3	0.09
EeRj 33-3	3.65	0.07
EeRj 46-1	5.2	0.36
EeRj 55-1	6.95	0.73
EeRj 55-2	3.6	0.09
EeRj 55-12	6.95	0.73
EeRj 55-20	3.6	0.09
EeRj 56-9	4.35	0.51
EeRj 56-10	5.15	0.4
EeRj 56-11	5.45	0.46
EeRj 57-21	3.5	0.2
EeRj 58-1	5.45	0.34
EeRj 58-3	2	0.08
EeRj 58-4	6.15	0.49
EeRj 58-15	2.2	0.21
EeRj 58-16	2.7	0.19

Site & Feature No.	Average Rim Crest Diameter (m)	Basin Depth (m)
EeRj 58-19	2.55	0.07
EeRj 58-22	2.55	0.07
EeRj 70-1	4.75	0.24
EeRj 71-1-1	5.55	0.29
EeRj 71-1-2	"	"
EeRj 78-1	5.55	0.29
EeRj 82-1	6.5	0.12
EeRj 83-1	4.75	0.2
EeRj 84-1	4	0.22
EeRj 85-1	6	0.26
EeRj 86-1	3.55	0.25
EeRj 93-1	3.65	0.18
EeRj 101-1	3.6	0.2
EeRj 105-1	1.65	0.13
EeRj 109-1	5.5	0.17
EeRj 159-1	5.1	0.52
EeRj 159-2	5.1	0.5
EeRj 159-3	4.35	0.52
EeRj 159-4	3.35	0.36
EeRj 159-5	2.15	0.12
EeRj 159-6	5.25	0.5
EeRj 163-1	3.35	0.09
EeRj 164-1	2.75	0.12
EeRj 172-1	3.65	0.35
EeRj 177-1	4.6	1.25
EeRj 178-1	4.2	0.24
EeRj 189-1	3.65	0.3
EeRj 189-2	3	0.21
EeRj 191-1	4.65	0.36

Site & Feature No.	Average Rim Crest Diameter (m)	Basin Depth (m)
EeRj 191-2	2.05	0.34
EeRj 197-1	3.6	0.11
EeRj 198-1	4.8	0.19
EeRj 201-1	3.2	0.28
EeRj 201-2	2.8	0.19
EeRj 201-3	5.4	0.29
EeRj 202-1	4.65	0.4
EeRj 202-2	5.55	0.27
EeRj 202-3	3.9	0.33
EeRj 203-1	4.6	0.46
EeRj 203-2	6.4	1.3
EdRj 2-1	4.7	0.45
EdRj 2-2	4.6	0.22
EdRj 3-1	3.9	0.35
EdRj 3-2	3.15	0.62
EdRk 35-1	3.35	0.24
EeRk 36-1	4.6	0.14
EeRk 37-1	3.4	0.36
EeRk 38-1	3.5	0.28
Eerk 38-2	2.8	0.23
EeRk 39-1	2.3	0.17
EeRk 40-1	6.25	0.38
EeRk 41-1	6.25	0.38
Eerk 42-1	6.15	0.33
EeRk 43-1	6.35	0.34
EeRk 52-1	3.5	0.35
EeRk 53-1	3.35	0.95
EeRk 53-2	2.65	0.11

Appendix I, Table 4: Earth oven data from the Oregon Jack Creek Valley (from Rousseau et al. 1991).

Site and Feature No.	Rim Crest Diameter (m)	Basin Depth (m)	RCD Range (m)	BD Range (m)
EdRi 11-1	6.5	0.5		
EdRi 11-2	3	0.3		
EdRi 11-3	3	0.4		
EdRi 11-4	7	0.4		
EdRi 11-5	5.5	0.4	6.0 x 5.0	
EdRi 11-6	4	0.4		
EdRi 11-7	3.75	0.4	4.0 x 3.5	
EdRi 12	2			
EdRi 13			2.0-7.0	0.2-0.8
EdRi 15			2.0-7.0	0.2-0.8
EdRi 16			2.0-7.0	0.2-0.8
EdRi 18			2.0-7.0	0.2-0.8
EdRi 19			2.0-7.0	0.2-0.8
EdRi 20			2.0-7.0	0.2-0.8
EdRi 21			2.0-7.0	0.2-0.8
EdRi 22			2.0-7.0	0.2-0.8
EdRi 23			2.0-7.0	0.2-0.8
EdRi 24			2.0-7.0	0.2-0.8
EdRi 25	1.5	0.5		
EdRi 27-1			2.0 - 4.0	0.30 - 0.50
EdRi 27-2			2.0 - 4.0	0.30 - 0.50
EdRi 27-3			2.0 - 4.0	0.30 - 0.50
EdRi 27-4			2.0 - 4.0	0.30 - 0.50
EdRi 27-5			2.0 - 4.0	0.30 - 0.50
EdRi 29-1	3.5	0.5		
EdRi 29-2	3	0.3		
EdRi 30-1	3.5	0.5		
EdRi 31-1	4	0.6		
EdRi 32 -1			2.75 - 6.0	0.3 - 0.75

Site and Feature No.	Rim Crest Diameter (m)	Basin Depth (m)	RCD Range (m)	BD Range (m)
EdRi 32-2			2.75 - 6.0	0.3 - 0.75
EdRi 32-3			2.75 - 6.0	0.3 - 0.75
EdRi 32-4			2.75 - 6.0	0.3 - 0.75
EdRi 32-5			2.75 - 6.0	0.3 - 0.75
EdRi 32-6			2.75 - 6.0	0.3 - 0.75
EdRi 32-7			2.75 - 6.0	0.3 - 0.75
EdRi 32-8			2.75 - 6.0	0.3 - 0.75
EdRi 32-9			2.75 - 6.0	0.3 - 0.75
EdRi 32-10			2.75 - 6.0	0.3 - 0.75
EdRi 33-1	4	0.4		
EdRi 33-2	5	0.3		
EdRi 34-1			4.0 - 5.0	0.3 - 0.5
EdRi 34-2			4.0 - 5.0	0.3 - 0.5
EdRi 34-3			4.0 - 5.0	0.3 - 0.5
EdRi 34-4			4.0 - 5.0	0.3 - 0.5
EdRi 34-5			4.0 - 5.0	0.3 - 0.5
EdRi 34-6			4.0 - 5.0	0.3 - 0.5
EdRi 37-1			3.0 - 4.5	0.25 - 0.5
EdRi 37-2			3.0 - 4.5	0.25 - 0.5
EdRi 37-3			3.0 - 4.5	0.25 - 0.5
EdRi 37-4			3.0 - 4.5	0.25 - 0.5
EdRi 37-5			3.0 - 4.5	0.25 - 0.5
EdRi 37-6			3.0 - 4.5	0.25 - 0.5
EdRi 38-1	4	0.75		
EdRi 38-2	4.5	0.75		
EdRi 38-3	2.5	0.5		
EdRi 40-1	3	0.4		
EdRi 41-1	4	0.8		
EdRi 41-2	4	0.5		
EdRi 42-1	3	0.4		
EdRi 43-1	4	0.25		
EdRi 44-1	2	0.5		
EdRi 44-2	4	0.5		

Site and Feature No.	Rim Crest Diameter (m)	Basin Depth (m)	RCD Range (m)	BD Range (m)
EdRi 44-3	3	0.5		
EdRi 45-1	4	0.5		
EdRi 45-2	3	0.4		
EdRi 45-3	3	0.4		
EdRi 45-4	3	0.4		
EdRi 46-1	3.5	0.4		
EdRi 47-1				
EdRi 47-2				
EdRi 47-3				
EdRi 48-1	3	0.25		
EdRi 59-1	3	0.75		
EdRi 59-2	1.5	0.25		
EdRi 59-4		0.25		
EdRi 60-1	2	0.25		
EdRi 61-1			2.5 - 3.0	0.25 - 0.75
EdRi 61-3			2.5 - 3.0	0.25 - 0.75
EdRi 61-4			2.5 - 3.0	0.25 - 0.75
EdRi 61-5			2.5 - 3.0	0.25 - 0.75
EdRi 61-6			2.5 - 3.0	0.25 - 0.75
EdRi 62-1	2.5	0.5		
EdRi 65-1	1.5	0.25		
EdRi 67-1	2	0.75		
EdRi 67-2	2	0.75		