Contributions in Ethnobiology

Secwepemc People and Plants: Research Papers in Shuswap Ethnobotany

Edited by
Marianne B. Ignace, Nancy J. Turner, and Sandra L. Peacock

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Cover photo: Julienne Melmenetkwe Ignace digging ***skwenkwinem*** (*Claytonia lanceolata*) on the slopes of Mount Lolo near Kamloops. Photographer: Marianne Ignace.

Dedication

To our mothers

Anna Boelscher (1921–2013),

Gracia Jane Chapman (1917–2010),

Margaret Methven Peacock (1933–2010),

and to all the Secwepemc Elders who shared their knowledge with us.

Table of Contents

Acknowledgements

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In addition, we acknowledge the following elders from many Secwepemc communities: Victorine and Willie Alphonse, Julie Antoine, Marie Antoine, Antoinette Archie, Elsie Archie, Eliza Archie, Jacob Archie, Bill Arnouse, Mary Arnouse, Louisa Basil, Daniel and Leona Calhoun, Clara Camille, Nancy Camille, Sam Camille, Clara Charlie, Bridget Dan, Sarah Deneault, Cecilia DeRose, Garlene Dodson, Lizette Donald, Eddie Fortier, Laura Harry, Greg Ignace, George Keener, Annie May Jules, Clarence and Delores Jules, Leslie Jules, Mona Jules, Selina Jules, Hilda Jules, Joe Lebourdais, Ida Matthew, Louis Matthew, Joe Michel, Emily Morgan, Mary Palmantier, Annie Parker, Daniel Seymour, Christine Simon, Amy Slater, Josephine Wenlock, Isaac Willard, Adeline Willard, Clarence William, Edna William, Jean William, Les Williams, Marge and Ox Eugene.

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We also thank the Shuswap Nation Tribal Council, the Northern Shuswap Tribal Council (formerly Cariboo Tribal Council), the Secwepemc Cultural Education Society and all seventeen Secwepemc communities for supporting our research throughout the years. We are also grateful to our universities who supported our research, in particular Simon Fraser University, University of Victoria (School of Environmental Studies), The Centre for Nutrition and the Environment of Indigenous Peoples (CINE) at McGill University, and University of British Columbia, Okanagan campus.

Funding for our research projects in Secwepemc ethnobotany and ethnoecology was supported over the years by several Research Grants from the Social Sciences and Humanities Research Council of Canada (Standard Research Grants No. 410-91-0550, 410-94-1555, 410-2000-1166, 410-2005-1741, 410-2010-0877, Nancy Turner, PI; SRG No. 435-2006-0632, Marianne Ignace, PI; Insight Grant No. 435-2012-0984, Marianne Ignace, PI; and SSHRC Partnership Grant No. 895-2012-1029, Marianne Ignace, Director). Additional support was received from the Living Landscapes Project, Royal British Columbia Museum and the Phillips Fund, American Philosophical Society. The language documentation work of Skeetchestn Elders in 2009–15 was supported by grants from the Aboriginal Languages Initiative (Department of Canadian Heritage) and the BC Languages Initiative.

Finally, we are grateful to the General Series Editors of Contributions in Ethnobiology, especially Dr. Dana Lepofsky, Dr. Marsha Quinlan, and Dr. Justin Nolan, for their help and encouragement to bring together this volume, and we also thank our anonymous reviewers for valuable comments and suggestions. Finally, we very much appreciate the careful editing work that Katie Flores and Cheryl Takahashi did for us.

Voucher specimens of all Secwepemc plants that are mentioned in this volume were housed at the Simon Fraser University Kamloops program between 1991 and 2010, and upon closure of the SFU Kamloops program were transferred to the Secwepemc Museum on the Tk̓emlupsemc te Secwepemc Reserve.

NOTE OF CAUTION

The plants described in this publication, particularly those used traditionally for medicine, are not recommended for use, except under the advice of a physician or recognized herbal specialist. The Secwepemc people who have identified and used these plants are themselves deeply concerned that they should not be misused. Their traditional use was strictly controlled and prescribed by the knowledge of herbal specialists, and supported by the wisdom and experience of many generations. Many of the medicines are potentially toxic, some extremely so. They can cause illness, even death, if used improperly. Even the foods can be harmful if not properly identified or prepared. The Secwepemc elders are also concerned that many of these plants are not as common or easily available as they were formerly. If you wish to sample these plants, please respect them and respect the knowledge of the elders. Please follow the protocols for careful and proper harvesting, so that these plants and all the life that depends on them will continue long into the future.

Also, follow the protocols of seeking permission to lands held in common and stewarded by particular Secwepemc bands as caretakers on behalf of the Secwepemc Nation.

A Note on Copyright and Intellectual Property Rights

The authors, SNTC and the Society of Ethnobiology declare that the Secwepemc people, as represented by the seventeen Secwepemc Communities of the Secwépemc Nation, have inherent cultural rights and ownership of all oral histories and cultural information on the Secwepemc contained in this volume, and further claim first rights to any intellectual property arising from the cultural knowledge as derived from Secwepemc elders and other Secwepemc cultural specialists.

We also respectfully acknowledge that the oral histories and cultural information from other Indigenous peoples that we cite in this book in the same manner represents the intellectual property of these respective Nations.

Preface

Chief Ronald E. Ignace (Stsmél̓qen)

This collection of research papers on Secwepemc ethnobotany marks a milestone in that it presents decades of fruitful collaboration between Secwepemc plant experts, many of them now deceased, and academic researchers. With this volume, we honour the remarkable knowledge and resilient practices of our elders and many past generations of Secwepemc people as they continued to harvest and use plants on our land, Secwepemcúl̓ecw, and to think and talk about the role of plants in our environment.

Our ***stsptekwll***, or oral histories, tell us how Secwepemc engagement with plants harkens back to the beginning of our existence in Secwepemcúl̓ecw, when Sk̓elép (Coyote), took a tree for a wife, thus showing the interconnection of us as people with trees, creating a relationship of reciprocity between humans, trees, and all other plants as living beings who mutually interact, and have to be accountable to one another. Moreover, Sk̓elép's deed reminds us that trees themselves nurture and protect the medicinal and food plants beneath them, and nurture the ecosystem. They give us air to breathe and protect our water. Thus, when we say "***xwexwéyt ren k̓wséseltkten***" or "All My Relations" we refer not only to our human relatives but include the ecological relations with and on the land, and our relationship of reciprocal accountability with the land.

Many other foundational ***stsptekwll*** connect us to the life-world of plants, and remind us of how plants became established in our environment, and how our ancestors began interacting with them to harvest them for food, medicine, technological, and spiritual purposes. Out of these oral histories of human-plant interactions, we can draw out the laws of conduct that sustained Secwepemc society in our connection to the living land and its ecology. Thus, the epic journey of Qweq̓wile, "Hog Fennel" (*Lomatium macrocarpum*) speaks not only to the aphrodisiac powers of the plant, but teaches us to train for strength to overcome adversity, and connects the cultures of the Interior Salish nations by way of connecting the habitat of this once important root plant to the extent of the territories of our peoples. Another transformer epic, that of Tlli7sa and his brothers, has the brothers vanquishing the once "people-eating" tobacco tree (actually, according to the late Lilly Harry, *Rhus glabra* rather than a *Nicotiana* species), which now serves us as a powerful medicine. In addition, during their journey demarcating Secwepemcúl̓ecw the brothers deployed the physical properties of many other plants to harness other "people-eaters" on the land, as did Sk̓elép and other ancient powerful people.

Beyond the life of plants in our stories, throughout our people's 10,000 years of existence in our land, our ancestors gained detailed practical knowledge of how hundreds of plants that grow in our diverse and beautiful homeland give themselves to us to provide nutrition, keep us healthy, cure diseases or alleviate symptoms, keep us sheltered, and provided a multitude of implements, clothing, fuel, and other necessities. As our elders, in addressing the role of plants in the environment and in their livelihood stated to then-Prime Minister Sir Wilfrid Laurier in 1910,

> When they first came amongst us there were only Indians here. They found the people of each tribe supreme in their own territory, and having tribal boundaries known and recognized by all. The country of each tribe was just the same as a very large farm or **ranch** (belonging to all the people of the tribe) from which they gathered their food and clothing, etc., fish which they got in plenty for food, grass and vegetation on which their horses grazed and the game lived, and much of which furnished materials for pipes, utensils and tools, etc…. You will see the **ranch** of each tribe was the same as its life, and without it the people could not have lived. (*Interior Chiefs, Memorial to Sir Wilfrid Laurier, Prime Minister of Canada*, presented at Kamloops, 25 August 1910)

Most importantly, in their 1910 Memorial to Prime Minister Sir Wilfrid Laurier, our ancestors laid out their grievances over the impacts on our livelihood that were wrought on us since the 1850s, when thousands of goldseekers, followed by cattle-herders and settlers poured into our country, changing the landscape, and fencing us out of many of our most cherished food producing areas which we had tended for countless generations. Settlers' land pre-emptions—which the colonial and subsequently provincial government of British Columbia supported at our exclusion—made our people poor in our own land, and in the twentieth century diminished our ability to harvest our own foods. After the 1920s and 1930s, the loss of access to many parts of our lands was exacerbated by the loss of skills and know-how about how to harvest and process plants, let alone even talking about them in our own language, Secwepemctsin, as our culture and language was literally beaten out of many generations of our children in Indian Residential Schools between the 1920s and 1970s. The compulsory attendance at these schools also kept several generations of our people in school for ten to eleven months of the year, thus having very limited opportunities to experience the Secwepemc seasonal rounds of growth and harvesting, and the intricate techniques of gathering plants, fishing, and hunting, let alone the spiritual belief system of reciprocal accountability and respect that are their underpinnings.

I myself am a survivor of the Kamloops Indian Residential School, although I was lucky in my upbringing: As a young child, I was "taken in" or adopted by my great-grandparents Chief Edward Eneas and Julienne Eneas, who, like her mother, was a t'kwilc or medicine woman. Both of them born in the late 1870s, they resiliently continued to harvest plants through agriculture and ancient ways of procuring "wild" roots and berries off the land, and they taught me how to fish and hunt alongside other elders. Even though landscape burning had been criminalized by the BC Ministry of Forests since the early decades of the twentieth century, Old Edward defiantly found ways to continue this important practice. Old Julienne refused to speak English with us, thus grounding myself, my aunts, and uncle in ways of speaking about our land in our own language.

Thus, in spite of the dispossession from our land and livelihood at the hands of settler society and enforced by government policy, our elders were resilient and defiant in continuing to value and practice ways of harvesting plants and animals, and ways of maintaining traditional ecological knowledge. We are thus grateful that Dr. Nancy Turner began recording ethnobotanical knowledge from elders in some of our communities in the 1970s, when few of our own community members, devastated by the trauma of Residential Schools, were in a position to record the knowledge of our elders.

Then, in 1990, as our own people were becoming interested in re-stitching the broken basket of our cultural knowledge, practices, and laws, we succeeded, through collaboration between Nancy Turner and my wife, Marianne Ignace, in launching a long-term comprehensive research project on Secwepemc ethnobotany and ethnoecology supported by our nation. Through sustained research funding from a series of grants from the Social Sciences and Humanities Research Council of Canada, our ethnobotanical research engaged elders from every community in our nation, along with many of our own community members who trained in ethnobotanical methods and analysis as research assistants and through the many ethnobotany courses in our territory that have instilled in hundreds of people from within and outside of Secwepemcúl̓ecw a deep appreciation and knowledge of our people's interactions with plants. As other academic researchers (Harriet Kuhnlein, and George Nicholas) joined the fold, a good number of graduate students (Brian Compton, Kelly Bannister, Sandy Peacock, Ann Garibaldi, Dawn Loewen, Michèle Wollstonecroft, Stu Crawford, Nancy Jules, Nola Markey), carried out their own research and made important and substantial contributions to the collaborative and respectful study of Secwepemc plant knowledge and ecological knowledge. They have now gone on to continue to make important contributions to the field of ethnobotany, some as academic researchers, and others as applied ethnobotanists.

In the aftermath of past incidences of our cultural knowledge having been stolen and appropriated, the Secwepemc elders who shared their knowledge, including Mary Thomas, Ida William, Nelly Taylor, Lilly Harry, Laura Harry, Bill Arnouse, Bridget Dan, Cecilia DeRose, Clara Camille, Aimee August, Sarah Deneault, and many others, took risks in sharing their knowledge. However, I am proud to say that our joint ethnobotanical enterprise, on the advice of these elders, was guided by innovative ways of maintaining and respecting our Secwepemc intellectual and cultural property rights and copyright to our ancestors' knowledge. This is exemplified in the statement on IPR and copyright at the onset of this volume. In sharing their practical and spiritual knowledge about how our people interacted with plants on our land, our elders showed us how important it is to transmit and share our knowledge so that it may guide our existence on our land in the present and future.

In the twenty-five years since we launched this Secwepemc ethnobotany and ethnoecology project, our people's ability to live off our land like our ancestors did has seen unprecedented challenges: Clear-cut logging and open cattle range, along with a recent pine-beetle infestation in much of the interior has altered our landscape, and the health of our environment. In addition, urban sprawl, industrial development, and most recently large mining projects are continuing to impede our ability to have *quiet enjoyment* of Secwepemcúl̓ecw as our right to the undisturbed use of the land we never ceded. Given the adversities we face, it is all the more important that we continue to maintain our connection with our land by responsibly protecting and harvesting its resources, and securing that quiet enjoyment for future generations. In the Secwepemc language, we have a term, ***x7ensq̓t***. Our elders translate it as "the land (and sky) will turn on you" if you treat the land with disrespect. As we face fast-paced resource extraction projects, we need to remind ourselves of our responsibilities of protecting our homeland, lest it will turn against us and those who break our indigenous legal tradition (***stsq̓ey̓***) of reciprocal accountability with the land and all beings on it. This is the legacy our ancestors left us as we face the challenges of the future in dealing with the pervasive damage to our land and the unknown future that climate change will bring.

Amidst these concerns, as ethnobotanical research and education are helping us to re-build and re-awaken our connections with the land, we came to think of the strawberry, ***tqitq̓e***, as symbolizing and manifesting how ideas and energy spread, take new roots, and spread again, in the same way that the strawberry plant propagates through its runners. We need to re-inspire people, to go back and look at the environment through different eyes, through the eyes of our ancestors. We need to pick up their knowledge and their stories about the land and begin telling them again. Moreover, we need to take our stories from where our ancestors left off, and to begin adding our stories about the land to those of our ancestors. That is what this book is helping to do.

Xwexwéyt ren k̓wséseltkten – All My Relations

Chapter 1. Introduction to the Volume

Nancy J. Turner[†], Marianne B. Ignace[‡], and Sandra L. Peacock[§]

Introduction

This volume had its beginnings several decades ago, as focused interest in Secwepemc ethnobotany developed during the 1970s. During her graduate training in ethnobiology in the early 1970s, Nancy Turner carried out ethnobotanical research with a number of Interior Plateau plant experts, including Eliza Archie at Canim Lake. She also collaborated with other researchers—Randy Bouchard and Dorothy Kennedy, Gary Palmer, and Aert Kuipers—in identifying plants and plant names collected from their work in the Neskonlith area with Aimee August, Adeline Willard, and Ike Willard (cf. Bouchard and Kennedy unpublished notes, Jan.–March 1974; Palmer 1975), and in Canim Lake with Eliza Archie, Jacob Archie, and others (cf. Bouchard, unpublished notes 1974, and Kuipers 1974). Separate from this initial work, in 1984 Marianne Ignace began researching Secwepemc elders' knowledge of plants as part of a larger project on Secwepemc traditional land use, initially working closely with elders in Simpcw (North Thompson), Skeetchestn, and St'uxtews (Bonaparte), and by the late 1980s expanding her ethnographic work to numerous other communities at the request of the Shuswap Nation Tribal Council. In 1990, Nancy Turner, Marianne Ignace, and her husband Ron Ignace, for many years (and at present) elected Chief of Skeetchestn Indian Band and in the early 1990s also the Chair of the Shuswap Nation Tribal Council, decided to combine their research efforts and establish a systematic research agenda, developed in collaboration with several Secwepemc cultural experts and elders, and also with then-PhD student Brian D. Compton, linguist Dwight Gardiner, and Dr. George Nicholas, towards an in-depth study of Secwepemc ethnobotany and ethnoecology.

Through a series of grants from the Social Sciences and Humanities Research Council of Canada (SSHRC) between 1991 and 2003 (listed in Acknowledgements), this project became a model in collaborative community research involving all 17 communities within the Secwepemc Aboriginal Nation. In 2006–2009, and since 2012, additional SSHRC grants to Marianne Ignace with various Secwepemc collaborators enabled the transcription, translation, and analysis, among other things, of a large body of Secwepemc language recordings that dealt with Secwepemc ecology, place names, connection to landscape, knowledge of, and access to, resources. Throughout this time, these grants supported some 20 undergraduate and graduate students as research assistants. On a

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variety of projects, it engaged First Nations students and non-Aboriginal science-trained researchers in working together with elders, including authors of several of the chapters in this volume. The work brought elders from many different Secwepemc communities together to share their knowledge with younger generations from their Nation, and with outside researchers who in turn learned indelible lessons about sharing traditional knowledge and its constraints, and who were able to match and connect elders' botanical and ecological knowledge with scientific paradigms.

In this volume, a number of academic researchers who collaborated with Secwepemc elders and communities (co-)present their findings about such diverse topics as the archaeology of plant use, the chemistry and nutritional composition of plants, the role of plants in traditional resource management, intellectual property rights issues associated with plants, how Secwepemc people have been affected by the destruction of plant habitats in their traditional territory, how their narratives have embodied and provided enduring lessons on the essential features of their environments and landscapes, and finally, how their collective "traditional" knowledge and wisdom has provided them with fundamental principles and practices on which to base future relationships with their homeland, Secwepemcúl̓ecw.

As we embarked on collaborative ethnobotanical research driven by the interests and needs of elders, community members and students, our Secwepemc ethnobotany project also became a decolonizing and indigenizing experience for participants. Beginning with Linda Tuhiwai Smith's *Decolonizing Methodologies* (1999), recent years have seen a growing body of literature that addresses and celebrates indigenous research methodologies. They have aptly critiqued the "positional superiority of Western knowledge" (Tuhiwai Smith 1999:59) established during the historical process of imperialism and colonialism that relegated indigenous peoples' lives and knowledges as mere objects of research for the consumption and benefit of non-Indigenous researchers. Indigenous and decolonizing methodologies (see also Denzin et al. 2008) have called into question the inequitable and ethnocentric foundations of the production of knowledge by generations of researchers who were often not accountable to, let alone part of, the indigenous community. In order to indigenize research, Tuhiwai Smith proposed 25 indigenous projects, among them remembering, revitalizing, connecting, reframing, restoring, protecting, creating, and sharing. While researchers from inter- and multi-disciplinary fields, including ethnobotany, have explored and practised collaborative approaches with indigenous communities since the 1970s (Bishop 1996; Harrison 2001; Turner et al. 1983, 1990, 2012, 2014), recent works by Indigenous scholars and their collaborators (see, e.g., Absolon 2011; Atleo 2011; Brown and Strega 2005; Ignace 2008; Kovach 2009; Thompson 2012; Wilson 2008) have further explored indigenized ways of carrying out research that takes into account the needs, interests, epistemologies and ontologies of indigenous communities viz-a-viz indigenous researchers but also their non-indigenous collaborators.

Through praxis and on the ground methodologies, this project anticipated and engaged indigenous research. From the onset, Secwepemc elders and knowledge keepers from various Secwepemc communities, notably Lilly Harry, Joe Michel, Mary Palmantier, and Dr. Mary Thomas—all now deceased—as well as Bridget Dan, Cecilia DeRose, Mona Jules, and Ron Ignace participated as colleagues in research design, student training and data gathering with their own elders and peers. Together with Secwepemc elders and community members, they injected their sense of research protocols, and especially their ways of perceiving and experiencing knowledge of plants and environment through the lens of their lived experience and knowledge of Secwepemctsín, the Shuswap language. In addition, the training of indigenous students throughout the project, including, among others, Darrell Eustache, Nancy Jules (Bonneau), Gladys Baptiste, Brenda Walkem, Arnold Baptiste, Evelyn Camille, Nola Markey, Tracy Ned, Jessica Arnouse, and Lorna Billy, built capacity for ethnobotanical knowledge, research and teaching among younger generations in the Shuswap Nation. Last, not least, it connected these students with elders from their own and other Secwepemc communities, and connected them as colleagues and collaborators with non-indigenous graduate students who participated in this project, including Brian Compton, Kelly Bannister, Ann Garibaldi, Dawn Loewen, Sandra Peacock, and Stuart Crawford. In this volume, the many papers co-authored by teams of academic researchers, students and/or elder collaborators speak to this approach.

Researching Secwepemc ethnobotany also engaged the teaching and learning of Secwepemc plant knowledge and ethnoecological knowledge by new generations of Secwepemc people, and continues to do so. Since 1996, Marianne Ignace has taught Secwepemc ethnobotany courses, usually in tandem with elders who had participated in the research project in a number of Secwepemc communities, including Tk̓emlúps, Xats'úll (Soda Creek) and Williams Lake, Skeetchestn and Adams Lake, jointly engaging elders and students to not only share knowledge but also to revitalize the gathering, processing, and consumption of plants like wild ***skwenkwínem*** or "mountain potatoes" (*Claytonia lanceolata*), ***qwléwe*** or wild onions (*Allium cernuum*), ***tsétsʼelq*** or balsamroot (*Balsamorhiza sagittata*), and various medicinal plants. Pitcooking during ethnobotany courses led to course participants subsequently reviving the art of pitcooking in their home communities, and summer science and culture camps in various Secwepemc communities, usually co-led by past students of ethnobotany courses and elders, along with curricula of several local First Nations Schools, have (re)-connected youth with gathering and tasting traditional plant foods and harvesting and using medicinal plants. Plant use and ethnobotany have also been important in Traditional Use Studies and land use and occupancy studies (see Markey 2001; Ignace 1994, 1997; Ignace and Ignace 2011; Ignace et al. 2009, 2014; Turner and Peacock 1995). As well, many of us have given guest talks and workshops on the importance of plants and environments, both in Secwepemc communities, and at Universities (cf. Eustache et al. 1996; Ignace 2006, 2011; Turner 1997, 1998, 1999, 2000, 2003, 2006, 2012; Turner et al. 1996a, 1996b, 1996c; among many others).

The Secwepemc People and Their Lands

The Secwepemc are the northernmost Salish-speaking occupants of the Interior Plateau region of northwestern North America. Their traditional territory comprises an area of approximately 156,000 square kilometres in the south central interior of what is now British Columbia (Ignace 2008; Ignace and Ignace 2013; Palmer 1975b; Teit 1909) (Maps, Figures 1a and 1b). This overall territory encompasses the homeland of seventeen Indigenous communities, many of which amalgamated from even more dispersed villages that existed in the mid-1800s, before the populations were decimated by smallpox and other disease epidemics introduced by European newcomers starting around 1780 (Ignace 2008).

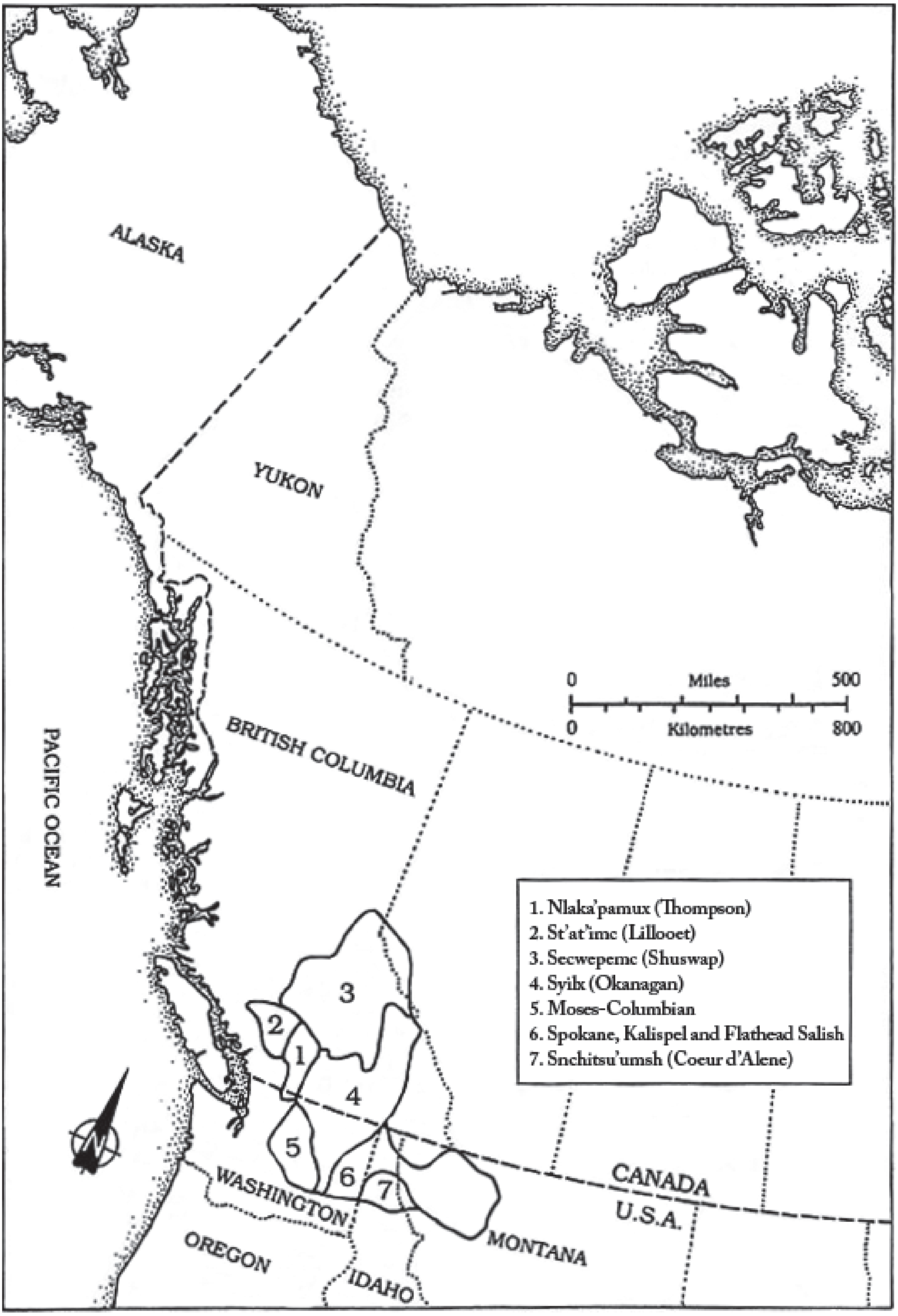

Figure 1a. Secwepemc Territory as situated in Northwestern North America.

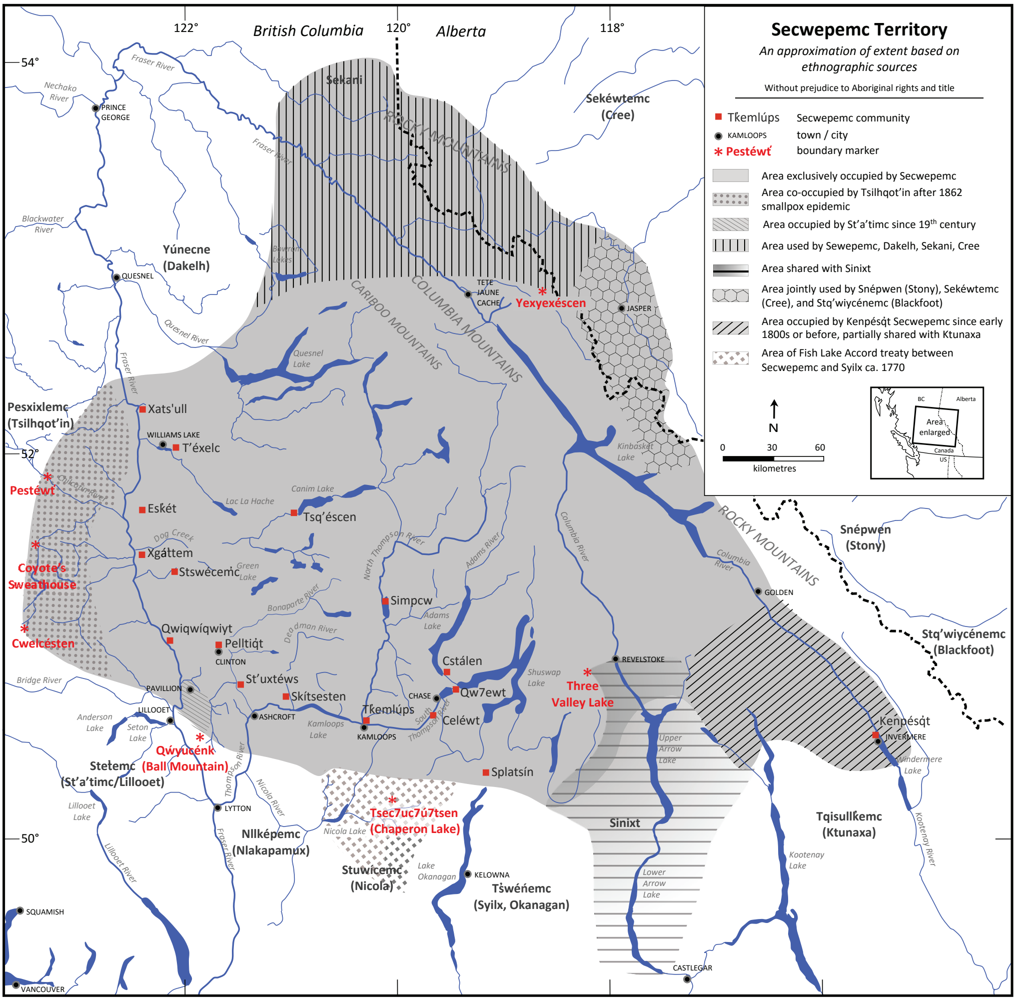

Figure 1b. Map of Secwepemc Territory based on ethnographic and ethnohistoric sources.

Indigenous neighbours of the Secwepemc include the Syilx (Okanagan) and Sinixst or Lakes to the south, Nlaka'pamux (Thompson) to the southwest, and St'at'imc (Fraser River Lillooet) to the west, all Interior Salish speaking groups. To the north and northeast are Tsilhqot'in, Dakelh (Carrier), and Ts'eyk'eni—all Athapaskan, as well as Cree and even Six Nations peoples who had come into the region during the fur trade era. Across the Rocky Mountains to the east are the Stony, Blackfoot, and to the southeast, the Ktunaxa (Kootenay).

The Secwepemc lands are also among the most diverse—geographically, ecologically, and ethnobotanically—of any First Peoples' territory in British Columbia. At the core of Secwepemc territory is the drainage system of the North, South, and Main Thompson rivers and the Fraser River and their tributaries. The southeastern portion, around Windermere, the Canoe River, and the northern Arrow Lakes, is situated in the watershed of the Columbia River. From the valleys and canyon bottoms to the mountain peaks, every part of the landscape has contributed to Secwepemc lifeways and sustenance.

Included within Secwepemc territory is a rich diversity of landscapes, incorporating at least nine Biogeoclimatic Zones, defined on the basis of climatic, geographic and biological features: Alpine Tundra; Sub-Boreal Pine – Spruce; Sub-Boreal Spruce; Engelmann Spruce – Subalpine Fir; Montane Spruce; Bunchgrass; Ponderosa Pine; Interior Douglas-fir; Interior Cedar – Hemlock (Meidinger and Pojar 1991; Parish et al. 1996). Of these, all except Alpine Tundra and Bunchgrass are characterized by woodlands or forests with characteristic tree species, after which they are named. These ecosystems and the habitats embedded within them are dynamic; the biological communities, soils, and other features change over time in response to forest growth, human impacts, and environmental disturbances. However, each is typified by a "climax" stage, representing an advanced point of successional development with a more or less predictable suite of trees and understory species. Within each major zone are numerous habitats, determined by topography, elevation, and soil type, each with its own microclimate and communities of plants and animals: wetlands, dry gravelly outwashes, steep rocky scree slopes and cliffs, open prairies, or dense forest. All of these are important to the Secwepemc as sources of particular types of resources.

Plants and the Secwepemc

The terrestrial environments provide a wealth of plant foods—greens such as cow parsnip (*Heracleum maximum*; syn. *H. lanatum*), roots such as yellow glacier lily (*Erythronium grandiflorum*), spring beauty (*Claytonia lanceolata*), and balsamroot (*Balsamorhiza sagittata*), berries such as saskatoons (*Amelanchier alnifolia*), various blueberries and huckleberries (*Vaccinium* spp.), wild raspberries (*Rubus idaeus*), and others, seeds such as hazelnuts (*Corylus cornuta*), and inner bark of trees such as lodgepole pine (*Pinus contorta*) and Ponderosa Pine (*Pinus ponderosa*)—and game animals, as well as dozens of material, medicine, and ceremonial plant species. In addition, the terrestrial environments provide large and small game. The lakes, rivers, and other wetlands yield fish and game birds, and a host of other culturally valuable plants, including edible roots, like wapato (*Sagittaria latifolia*), water parsnip (*Sium suave*), and cattail (*Typha latifolia*), as well as medicinal and aromatic plants, such as field mint (*Mentha arvensis*), and plants used in technology: cattail leaves for mats and seed fluff for baby diapers and tinder; Indian hemp (*Apocynum cannabinum*) for its stem fibre, and willows (*Salix* spp.) for their fibrous inner bark.

The dry valleys and sidehills, lakes and rivers, the rolling grasslands, the extensive upland plateaus, and the high mountain ranges all contribute substantially to the health and wellbeing of the Secwepemc people, and have done so since time immemorial (Figures 2, 3, 4). There is significant variation across the Secwepemc territorial expanse, so that some people have had access to certain resources that are unavailable to other communities, except through trade and exchange. For example, the western part of Secwepemc territory, along the Fraser River and Kamloops area falls within the rain shadow of the Coast and Cascade Mountain ranges. This rain shadow has produced a wide belt of relatively dry landscape running in a general north-south direction in the central interior of British Columbia. Known as the Interior Dry Belt, this dry landscape is bordered on the east by the Monashee, Purcell, and Selkirk ranges. On the windward side, these mountains and their upland valleys have a moister climate, although on their leeward side the climate is again dry-

Figure 2. Shuswap Lake in the eastern part of Secwepemc territory. Photo by Nancy Turner.

Figure 3. Upland plateau along the Fraser River near Dog Creek, Secwepemc territory. Photo by Nancy Turner.

Figure 4. Flower meadows, Trophy Mountain, Secwepemc territory. Photo by Nancy Turner.

er. Most of the lands of the Columbia and associated drainages in the eastern part of Secwepemc territory, however, fall into a region of relatively high precipitation known as the Interior Wet Belt, where some of the species of the coastal temperate rainforest occur, including western redcedar (*Thuja plicata*), western hemlock (*Tsuga heterophylla*), and Pacific yew (*Taxus brevifolia*).

Virtually every tree and shrub species occurring in Secwepemc territory has its own indigenous name, and sometimes many different cultural roles and applications. Many herbaceous flowering plants and grasses, as well as a number of fungi, lichens, mosses, and ferns, also have Secwepemc names and cultural uses in one or more parts of the territory.

Across the Secwepemc language area, there is dialectic variation – reflected in plant names and other vocabulary—between West and East, and sometimes between South and North regions, although by our estimate, at least 90% of plant terms are based on identical root lexemes. Secwepemctsin, the language of the Secwepemc people, is related to the languages of their neighbours, to the south and west—the Syilx (Okanagan), Sinixt, Nlaka'pamux, and St'at'imc (Lillooet)—and in many cases, the names of plants reflect common origins with these species in one or more other Salishan languages (cf. Turner 2014; Turner et al. 1998).

Traveling and Dwelling in the Landscape

In the past, and for some people still today, families traveled around their territories in a patterned seasonal round, stopping and camping, sometimes for weeks at a time at places like Neskonlith

Meadows or Blackdome Mountain to harvest and preserve the meat, roots, berries, and other resources they needed for year 'round living. Before horses arrived, people traveled by canoe and on foot, sometimes with their dogs. Around 1750—before Europeans actually arrived in Secwepemc country—horses had entered the Secwepemc culture and economy through trade, and were quickly adopted by the Secwepemc and their neighbours (Hunn 1992; Ignace 2008). The introduction of horses must have brought many changes to the Secwepemc lifeways and their use of plants. These animals allowed easier travel over the land, making certain harvesting sites more readily available. They also provided more efficient transportation of foods and other resources from harvest sites to camps and winter village sites, as well as to centres for trading and exchanging goods with neighbouring peoples. Elders recalled that there were horse trails—which probably followed people's original foot trails—up to Tod Mountain from Neskonlith, to Ck̓emqenétkwe (Scheidam Flats) (Figure 5) and Pencentén (see Figure 13, Chapter 5) from Kamloops, and to virtually all the major gathering spots from major winter villages. Entire families would go with their horses, the children riding home on the backs of the horses, atop baskets and sacks full of roots and berries, as remembered by Neskonlith Elder Mary Thomas and many other elders from their own childhood.

The Secwepemc seasonal harvests were neither random nor simply extractive. People were conscious of their place in the environment and of their responsibilities to the places and the other species they depended upon. Guided by their deeply held values of reciprocity and spiritual connections with the places they lived, traveled, and harvested their resources, and with the other lifeforms that sustained them, and by their own experiences and shared observations, they de-

Figure 5. Ck̓emqenétkwe (Scheidam Flats), near Kamloops. Photo by Nancy Turner.

veloped methods, strategies, and technologies to maintain and enhance the species and habitats, to make them more productive and more diverse (cf. Ignace et al. this volume; Peacock et al. this volume).

Living with Change

The landscapes and plants of Secwepemc territory have not remained static. Scientists like paleoecologist Richard Hebda have studied pollen and other plant remains from cores taken in lake bottoms and bogs, and have shown that some trees, like lodgepole pine (*Pinus contorta*) (Figure 6), Rocky Mountain juniper (*Juniperus scopulorum*), and trembling aspen (*Populus tremuloides*) have been common and widespread throughout the Interior since the time of the ice retreat from the last glaciation around 10,000 years ago. Douglas-fir (*Pseudotsuga menziesii*) also came into the region relatively early, probably within the last 8,000 to 10,000 years ago, and, starting around 6,000 years ago, began to replace lodgepole pine in many areas. Western red-cedar (*Thuja plicata*) apparently arrived considerably more recently in Secwepemc territory, possibly 2,500 years ago. Projects are underway to look more closely at the history of climate and plants in the entire region, and to try to understand how the changing landscapes have influenced the lifeways of Secwepemc and other First Peoples.

Changes, including some changes in use of plants, have certainly been rapid and intense within the period since Europeans entered North America. With the entry of horses, for example, people paid attention to the plants horses like to eat, and in some cases, started to experiment with and extend their medicines to treat their horses' ailments. Treatments for the rash of new diseases, from influenza to measles and smallpox, had to be developed through the extension of existing medicines or development of new ones through experimentation and exchange of knowledge. New foods were incorporated into the diet and into the language: potatoes, rice, and apples, for example. Within a short time of Europeans arriving among them in the early 1800s, the Secwepemc began to grow potato crops, and by the late nineteen hundreds, were adept at planting a variety of crops, in part helped by their own indigenous plant propagation techniques, and also by the policies of the Department of Indian Affairs, which tried to establish peasant style farming and ranching in the Interior of BC and other areas throughout Canada. As Secwepemc started planting gardens and ranching, they worked these activities into their continuing traditional lifeways of fishing, hunting, and plant food production.

Food and Feasting

Given the ethnographic categorization of Interior Plateau Indigenous peoples as "hunter-fisher-gatherers," the importance of plants as food for the Secwepemc and other Interior Salish peoples is often overlooked. However, if stories, discourse, and peoples' day-to-day activities are examined, everywhere one turns there is evidence of just how significant plant foods have been in the Secwepemc food system. When Simon Fraser and his crew traveled to the mouth of the Fraser

Figure 6a. *(Above)* Rocky Mountain juniper *(Juniperus scopulorum)*. Photo by Nancy Turner.

Figure 6b. *(Right)* Lodgepole Pine (*Pinus contorta*). Photo by Nancy Turner.

River in 1808, for example, they were escorted through a stretch of Secwepemc territory along the mid-Fraser River, between Xats'ull (Soda Creek near Alexandria and T'it'q'et (Lillooet), where their Secwepemc guide and protector, Chief Cllecwúsem (Xlosem) from Soda Creek, handed Fraser's party over to the St'at'imc. Both descending and ascending the river, Fraser and his men were hosted by the Secwepemc, and were given feasts that included, almost invariably, plant foods, especially "roots" and "berries." For example, on Tuesday, July 25, 1808, Fraser, returning upriver, recorded in his journal, "The [Secwepemc] Indians … gave us a plentiful feast made up of venison, onions, roots, etc." (Lamb 1960:124). Just two decades later in 1827, at Kamloops, Hudson's Bay Company governor George Simpson (McDonald 1827:228) provided an inventory of food products the Thompson's River Post had purchased from the local Secwepemc at Tk'emlups (Kamloops)—see Table 2, Chapter 2). Along with large amounts of salmon, venison, geese, and other game, were 1171 quarts of berries, 48 gallons of roots, and 5 gallons of nuts. The "nuts" were presumably hazelnuts (*Corylus cornuta*). The "roots" may have included spring beauty (*Clayonia lanceolata*) corms, glacier lily (*Erythronium grandiflorum*), and riceroot (*Fritillaria affinis*) bulbs, and possibly balsamroot (*Balsamorhiza sagittata*) among others. The "berries" were probably mostly saskatoons (*Amelanchier alnifolia*), but could have included many other types, from wild strawberries (*Fragaria* spp.) to huckleberries and blueberries (*Vaccinium* spp.), to chokecherries (*Prunus virginiana*). In any case, the very fact that these foods were being traded to the HBC fort is evidence of their high cultural and nutritional profile.

Further evidence of the importance and complementary role of plant foods in the Secwepemc food system is from the account of the Chief Factor of the Hudson's Bay Company, Archibald McDonald, of an immense feast hosted at Kamloops by Secwepemc chief "Court Apath," attended by McDonald, held at a large pithouse at Tk'emlups, the confluence of North and South Thompson Rivers, on Wednesday 20th, December 1826. Noting that "roots of every description peculiar to this part of the country ready for distribution" were being prepared (McDonald 2001:54) for the feast, McDonald continued

> Every man was furnished with the cheekbone of salmon for his spoon, & the soup kettles, consisting of **berries, roots**, grease, pounded fish, salmon roe, &c &c being planted here & there among them [the chiefs and others attending the feast], they fell to & soon emptied their dishes…. The next course was each a lump of suet, after which the Beaver & venison with a raw piece of bear's fat; & **lastly the roots**. (ibid. *emphasis added*)

The Volume Unfolds

Ron Ignace, one of the original inspirations for the Secwepemc Ethnobotany Project (Figure 7), set the stage for this volume with his Preface. His chapter contribution (Chapter 2), entitled ***Re Tsúwet.s-kucw ne Secwepemcúĺecw***—Secwepemc Resource Use and Sense of Landscape, coauthored with Marianne Ignace, is drawn from his recent (2008) doctoral dissertation and additional research in Secwepemc communities by Marianne Ignace and both authors (Ignace and

Figure 7. Dr. Ron Ignace, one of the original inspirations for the Secwepemc Ethnobotany Project, with Marianne Ignace and Dog Creek elder Lilly Harry. Photo by Nancy Turner.

Ignace in press). In providing a context for the other research results, from a Secwepemc perspective, Ron and Marianne Ignace bring the landscape to life, giving names to the places and habitats where the people have lived, recognizing the cultural history and dynamics, and honouring the ancestors and the Elders who shared their stories and experiences with them.

The history of the Secwepemc Nation, and perhaps of the ancient non-Salish ancestors of the Secwepemc (Ignace 2008) before, can be grasped in part from oral traditions. Another way of creating a window into the past, including the ways in which the ancestors related to plants, is through careful archaeological investigations. Chapter 3 by George Nicholas, Nancy Jules Bonneau, and Leisl Westfall, and Chapter 4 by Michèle Wollstonecroft provide some initial results of archaeobotanical investigations into long-term Secwepemc plant use. Using techniques of flotation for recovery of plant materials, with special attention to the context of samples and to the microscopic details of plant seeds, charcoal bits, and fragments of charred needles and fruits, these researchers have found important clues to peoples' everyday lives, food processing and storage practices, to technologies of plant material use, and to possible travels and exchanges with others met along the way. Nicholas, Bonneau, and Westfall cover a group of sites around the confluence of the North and South Thompson Rivers at Kamloops, and Wollstonecroft focuses on the details of one of these sites, EeRB 140, and how ethnobotanical knowledge from contemporary times can help inform past relationships with plants.

The Secwepemc, like other Indigenous peoples throughout northwestern North America, actively managed their resources. In fact, through the practices of landscape burning and wide-scale influences on plant and animal populations they created what has been called a "domesticated landscape" (Anderson 2005; Boyd 1999; Deur and Turner 2005; Minnis and Elisens 2000). In Chapter 5, on Secwepemc Stewardship of Land and Resources, Sandra Peacock, Nancy Turner, and Marianne Ignace describe some of the ways in which people maintained and promoted the resources on which they depended, through a range of practices performed at various scales of time and space. Some were very specific to a plant population in one site at one particular time, whereas others were broad in scale, based on overarching values and approaches enshrined in cultural teachings (Ignace 2008; Peacock and Turner 2000; Turner and Berkes 2006; Turner and Lepofsky 2013; Turner et al. 2013).

The next four chapters, 6 through 10, provide detailed accounts of specific Secwepemc plant foods, including experimental data combined with qualitative interview and narrative-based accounts of the intricate relationships between people, plants, and plant compounds that serve as nutrients and help to maintain people's general health. Chapter 6, by nutritionist Harriet Kuhnlein and colleagues, presents some of the key nutrients that are provided by plants in the Secwepemc Food System. Some of the foods that were analyzed are little used today, but the plants themselves and the nutrients they contain still exist, and may possibly be utilized to a greater extent in the future. The Secwepemc and other Indigenous peoples are realizing that some of the contemporary highly processed foods from the global market economy, such as refined sugar, white flour, and deep fried potatoes, are not particularly healthy. There is a movement both locally and globally to reclaim and start to revitalize some of the nutritious foods of the original diets, for health and enhanced cultural identity (Morrison 2007; Kuhnlein et al. 2006, 2009, 2013; Turner and Turner 2008; Turner et al. 2009, 2013A, 2013B). The evidence from the Kuhnlein et al. chapter, and the succeeding chapters—on ***scwicw*** (yellow glacier lily, *Erythronium grandiflorum*) by Dawn Loewen, Nancy Turner, and Secwepemc plant and cultural specialist Mary Thomas, on ***wíla (wíle)*** (black tree lichen, *Bryoria fremontii*) and its use by Stuart Crawford (also drawing on the knowledge and experiences of Mary Thomas among other Elders), and on ***tsétsʼelq*** (balsamroot or spring sunflower, *Balsamorhiza sagittata*), by Kelly Bannister and Mary Thomas—all points to a sophisticated and longstanding familiarity with the details of changes in taste, edibility, and medicinal qualities of plants over seasons and with different treatments and types of processing. In short, as the evidence shows, the Secwepemc figured out the practical chemistry of how sun-curing and cooking enhanced the nutritional value of staple plants thousands of years ago.

The Secwepemc and other Indigenous peoples in British Columbia and across North America have always lived with and adapted to change. Ever since they first spread out over the landscape they now call their homeland, the Secwepemc have endured long term shifts in climate, from warmer and drier to colder and wetter and vice versa, over centuries and millennia (see Ignace 2008:Chapter 2). They have experienced climate change, sudden and precipitous storms, landslides, floods, and forest fires. There have been years when the salmon did not appear at their usual spawning places in the rivers, years when the Saskatoon berries were sparse or non-existent, years when the winter snows were deep and treacherous, and years when the summer sun was too hot and the roots became too dry and shriveled. In other words, climate change has been a facet of Secwepemc existence since their arrival in the Interior—possibly as early as 10,000 years ago.

Life has always been dynamic, but with the coming of the Europeans, first the fur traders, then the missionaries and colonial officials, who in turn enabled the settlers' taking possession of Secwepemc lands, laying claim to their resources, and changing their language, culture and lifeways irrevocably, the changes were frequently destructive, with one bad situation piling on top of another. For example, today, many of the original Secwepemc trails—both foot and horse trails—and campsites as well, have been obscured by clearcutting, construction of logging roads and highways, urbanization, and industrial development. As Clarence William noted in talking about the Maiden Creek area north of Hat Creek and Pavilion Mountain, "They started a bunch of roads in there, you know, and we couldn't find them old trails, horse riding up there." On one such occasion he recalled that they had to let the horses find the old trails themselves (Ignace 1994:7–8). Throughout the twentieth century and into the twenty-first century, root-digging grounds have been impacted by cattle grazing, and wetlands by draining and filling. In Chapter 10, Mary Thomas gives testimony of her first-hand experiences and observations of the devastating impacts on Secwepemc peoples' lives and environments wrought by the newcomers, as recorded by Nancy Turner and Ann Garibaldi. It is a sad and disturbing story of loss—one that has to be told, however, if some of these impacts are to be rectified, if habitats are to be restored, and suppressed language and culture are to be revitalized (Turner et al. 2008).

Storytelling is one of the most effective means of communicating cultural knowledge and values, and conveying lessons for life to children and people of all ages. Chapter 11 by Marianne Ignace, Nancy Turner, and Ron Ignace features Simpcw Elder Ida William's telling of a story about Coyote "juggling his eyes." This narrative, with variations on the theme recounted across many different Interior Plateau languages and beyond, brings lessons about ecological diversity and ecological knowledge, as told within the conventions of Secwepemc people of the past who intimately *knew* their landscape, and thus could tell stories about it through the mere mentioning of places, animals, and plants whose habitats were known among all Secwepemc resource users. In particular, this narrative incorporates in the plot information on how different trees and shrubs have particular ecological requirements, and can be used as indicators of geographic and topographic position. This story is just one example of many that provide detailed information about plants and their cultural and ecological roles.

Chapter 12, the final chapter before the Conclusions, describes the Secwepemc environmental knowledge system commonly known as Traditional Ecological Knowledge and Wisdom (TEKW) (Ford and Martinez 2000). In this chapter, we (Ignace, Ignace, and Turner) present and explain, with examples, a schematic diagram representing the different features and components of TEKW (see also Turner et al. 2000). This system is a holistic and complex blending of knowledge, practice, belief, and modes of communication and transmission, of which ethnobotanical knowledge is a major element, inextricably linked with the cultural practices, belief system, language and environment.

Intellectual Property Rights and Ethnobotanical Knowledge

The chapters in this volume all provide lines of evidence for the high profile of plants in Secwepemc lifeways and food systems in particular, going far back into the past and extending to the present day. We believe the information presented here—and the detailed knowledge of plant names and uses to be included in the subsequent book on Secwepemc ethnobotany—is highly relevant and important, first and foremost for the Secwepemc people, then more broadly to other Indigenous peoples, and finally to humanity in general, including scholars, students, and others attempting to understand our world.

A critical issue each of us has faced in the work we have undertaken, however, is the potential for abuse and misuse of the information we have collectively documented. As stated explicitly in the preliminary pages of this volume, we acknowledge the inherent rights and ownership of the Secwépemc people to all their oral histories and cultural information documented in this volume, as their own intellectual property, now and in the future, and the rights of other Indigenous peoples to their respective cultural knowledge. This is a fundamental principle, and is in congruence with the United Nations Convention on Biological Diversity and the United Nations Declaration on the Rights of Indigenous Peoples (Greaves 1999; United Nations 1992, 2007), among other international documents.

One meeting with Secwepemc Elders at Kamloops was particularly pivotal for Kelly Bannister. She was just beginning her research on Secwepemc medicinal plant use as part of the Secwepemc Ethnobotany project. With training in microbiology and a deep interest in medicines and plants, Bannister was seeking a role in research that would serve the Secwepemc community and make a contribution to a broader understanding of the importance of traditional healing. The words of one elder present at the meeting where Kelly Bannister presented her project, however, struck her deeply: *They [white people] have taken everything away from us, and now they want to take our medicines too!* (paraphrased). All of us who were there at that meeting were affected by these words, pronounced from the perspective of an elder who had suffered greatly from the terrible injustices that Secwepemc and other Indigenous peoples endured at the hand of colonial oppressors and the dominant society: loss of land, loss of language, and institutionalized efforts to erase peoples' sense of pride in their culture and their identity as Indigenous people, through many different means, from the Indian Act to residential schools, to land confiscation. (Some of these losses are described in Chapter 9 by Mary Thomas et al.).

These words of the Elder changed the course of Bannister's entire research path. Although she continued to work in experimental antibiotic screening of medicinal plants, and, with Mary Thomas, focusing on the biochemistry of balsamroot, Bannister started to seriously question the impacts of such research—and of ethnobotanical research in general—on Indigenous Peoples' rights. She saw inequities and injustices in the way indigenous knowledge was being used, not necessarily by the researchers who were documenting this knowledge, but by third party economic interests who used, and in some cases, abused, ethnobotanical information that was published, without knowledge, consent, recognition, or compensation of the original knowledge holders.

Alongside her research on plant knowledge and use, Bannister started investigating the potential impacts of such research. She started to meet and work with others in the international community who were addressing these problems, and became a major collaborator in drawing up a Code of Ethics for the International Society of Ethnobiology (ISE 2006), based on the pioneering work in this area by Darrell Posey and colleagues (ISE 1988; Posey 1999; Posey and Dutfield 1996). This Code of Ethics details 17 Principles or fundamental assumptions that "embrace, support and embody the concept and implementation of traditional resource rights" of Indigenous

Peoples, and also provides Practical Guidelines for academics and others wishing to undertake ethnical research in ethnobiology and related fields. Bannister also deliberated on these concerns with the other research team members, and raised our collective consciousness about the potential abuse of our research and publications, not only relating to medicinal plants, but to all aspects of ethnobotanical and ethnoecological research—from archaeology to food plants (Bannister 2000, 2005; Bannister and Barrett 2001, 2004, 2006; Bannister and Thomas, this volume).

At the same time, we recognized through discussions with Ron Ignace and Elders including Mary Thomas and Nellie Taylor, that there was tremendous value in what we were documenting, and that much of the knowledge held by the older generations was in danger of being lost if it wasn't written down. Based on generations and generations of accumulated wisdom, observation and practice, once lost this knowledge could not easily be recovered or reacquired. Ron Ignace advised us that undertaking careful meticulous research, and publicizing it with proper attribution under the guidance of the collective control of Secwepemc communities, including elders and leaders, actually helped to validate not only the Secwepemc people's ownership of the knowledge, but also their rights to the places where this knowledge was enacted and where practices were situated—the Secwepemc lands and territories. Further, documenting the details of Secwepemc knowledge and use of plants and other resources gave strength to their claims to use and manage these resources.

These dilemmas—to balance and reconcile the importance of publicizing and acknowledging Traditional Ecological Knowledge and Wisdom with the risks of its abuse by others—continue to be debated, and certainly, there are no definitive solutions. But, through the efforts of Kelly Bannister, Marianne and Ron Ignace, George Nicholas, and many other colleagues including Indigenous scholars, as reflected in the ISE Code and many other publications, the much higher profile of the issues around intellectual property rights of Indigenous peoples, and the rights to recognition of the knowledge holders, to meaningful consultation about how research is undertaken, to how research results are disseminated, and to realizing any benefits derived from their knowledge, are now first and foremost in many ethnobotanical and anthropological research programs (cf. Bannister and Barrett 2001, 2004; Battiste and Henderson 2000; Bell and Napoleon 2008; Carlson and Maffi 2004; Ford 1999; Ignace and Ignace 2008; Menzies 2006; Moran 1999; Nicholas 2013; Nicholas et al. 2010; Stephenson 1999). For example, a special issue of *Cultural Survival Quarterly* was devoted to articles based on a session on Indigenous Knowledge and Intellectual Property Rights at the 1999 meeting of the American Anthropological Association in Chicago (*Cultural Survival Quarterly* 2001).

From the beginning of this research project, we have made an effort to follow the research protocols established through the Secwepemc Nation Tribal Council, as well as through the ethics requirements now well established by the Social Sciences and Humanities Research Council of Canada, our major funding agency for the project. For example, Ida William's story about Coyote juggling his eyes featured in Chapter 11 was at one point prepared for a book to be published through the Smithsonian Institution. However, the publication had no mechanisms in place to recognize the nature of narratives as cultural and intellectual property, and required sole copyright of the materials. We had no choice but to withdraw the article from this venue. Its publication in the present volume, with complete attribution and recognition of Ida William as storyteller, and of joint copyright with the Shuswap Nation Tribal Council, of which the late storyteller's community is a member, seems more fitting.

This situation with the Smithsonian reflects a continuing mismatch between the tools used of western legal systems to protect knowledge and intellectual property—copyrights, patents, trademarks, and trade secrets—and the ethical imperatives to recognize and affirm the rights of communities to their individual and collective intellectual property on an ongoing basis. None of these mechanisms actually addresses the fundamental issues behind Indigenous intellectual property, which is often: qualitative—as opposed to quantifiable and easily delineated; oral—as opposed to being committed to the written page; communally and intergenerationally held—as opposed to belonging solely to one individual; overlapping across different communities—as opposed to restricted to one entity; and long-standing—as opposed to short term and therefore patentable.

Indigenous knowledge deserves greater recognition and deeper appreciation, particularly in our struggles to curtail and reverse our damage to the Earth and its rich biodiversity. However, as Carlson and Maffi (1999:5) state,

> The conservation of biological diversity and the maintenance of healthy ecosystems should proceed hand in hand with support for the survival, health and continued development of the indigenous and traditional societies that live within and directly depend on these ecosystems.

We sincerely hope that we have helped to contribute to the survival, health, and continued development of the Secwepemc Nation and its homeland.

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Chapter 2. *Re tsúwet.s-kucw ne Secwepemcúl̓ecw*: Secwepemc Resource Use and Sense of Place

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Abstract

This chapter presents a Secwepemc perspective on Secwepemcúl̓ecw, our land, as our ancestors and elders experienced it and told us about it. Beginning with an overview of the peopling of our land according to oral histories (stsptekwll) and archaeological information, we describe Secwepemc conceptualizations of our landscape, including the way we talk and think about its history, its ecology, and its living beings. We then describe our past and continuing ways of harvesting the plants and animals that give themselves to us as we interact with them. We include a description of the Secwepemc seasonal round and the crucial connection of plant and animal harvesting to the notion of respect and reciprocity as expressed in our Indigenous laws, values, and beliefs. Since the latter part of the nineteenth century, Canadian settler society has seriously impacted on, and interfered with, the way we live off and with our land, and we describe the impacts and consequences our people's dispossession from our land. In the face of this, we maintained our sense of place, and we show how in our language we talk about our landscape, its topographical features, and commemorate our history on the land in place names told in story and song.

Keywords: *Secwepemc; Plateau ethnobiology; Indigenous sense of place; ethnogeography; resource management.*

Introduction

The word ***Secwépemc*** (from ***s*** = nominalizer + ***cwep*** = "spread out" + ***emc/mec*** = "people"—see Ignace 1998, 2008; Kuipers 2002) means "the spread-out people." Throughout the last several thousand years, the ancestors of the contemporary Secwépemc spread out from an ancient homeland in the South Central interior of British Columbia. They moved from the south and main Thompson River areas along the valleys and upriver areas of the Fraser River to the area beyond Xats'úll (Soda Creek), wintering on both sides of the river (Teit 1909), and to the Quesnel Highlands and beyond. They moved far up Simpcwétkwe, the North Thompson River, across the Yel-

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lowhead Pass, and to the Jasper area. Some moved even further to the upper reaches of the Canoe and Columbia Rivers, along the continental divide. In the same way that at some point around 5,000 years ago, Interior Salish, and eventually Secwepemctsín (our Shuswap language) appears to have emerged from an influx of Coast Salish immigrants into the Interior (Ignace 2008; Ignace and Ignace in press; Stryd and Rousseau 1996), we, the Secwepemc and our neighbours, became Salish-speaking, as we expanded our territory. Throughout this process, our ancestors, the "Coyote People," who were already living in our ancient homeland, very likely mixed with some of the people who came upstream from the coast (see Cybulski 2007) by way of the Fraser River, Harrison Lake, and the Squamish area (Ignace 2008). Our ancient oral histories or ***stsptékwll*** tell us about the work of the ***tellqel̓mucw*** or "transformers"—some of whom came into the Interior from the Coast, and some of whom came from within our territory, moving outwards. Through their deeds and travels, these ***tellqel̓mucw*** defined the boundaries of ***Secwepemcúl̓ecw***, our homeland, and made it hospitable and habitable for our people (see Ignace 2008:52).

By the early nineteenth century, a group of Secwépemc people from the North Thompson, led by their Chief ***Kenpésq̓t*** ("Kinbasket") had moved from the upper reaches of the Columbia and across the mountain passes east of Revelstoke down the Columbia River into the area around what is now Windermere and Athalmer, and settled near and among Ktunaxa people, making a peace treaty with the ***Snépwen*** (Stony). In the Arrow Lakes area, our Secwépemc ancestors hunted along with ***Ts'wén̓emc*** (Okanagan people) and with the group known as the ***Sinaixt*** (Pryce 1999). In the south, after centuries of warfare with the ***Ts'wen̓emc*** (Okanagan) between 1500 or earlier and the late 1700s AD (Teit 1930; Ignace and Ignace forthcoming), the Secwepemc and Okanagan settled on their boundary and access to hunting grounds, plant gathering areas and fishing lakes by way of treaties among nations (Ignace 2008; Ignace and Ignace forthcoming; Teit 1930).

Secwepemcúl̓ecw, our homeland, was not a static entity. It grew and shrank over a period of several thousand years as our ancestors became Salish-speaking some 5,000 years ago, and as they subsequently developed separate cultural, political, and linguistic identities. Like many other nations, the boundaries of our homeland were dynamic, defined by changes in ecology and economy, as well as by changing political and social conditions. The external boundaries and internal "divisions" of ***Secwepemcúl̓ecw*** as they existed during the first half of the nineteenth century, and before the massive influx of European colonizers, were documented by fur traders during the late 18th and early 19th centuries, and are detailed in ethnographer James Teit's 1909 ethnography and accompanying map, comprising some 165,000 km^2 (see map of Secwepemc Territory, Chapter 1).

Although at its core, the landscape and ecology of ***Secwepemcúl̓ecw*** are characterized by the dry, arid landscape of the Interior dry belt and the adjacent rolling hills of the Interior Plateau, our Secwepemc homeland consists of as many as nine diverse biogeoclimatic zones: The river valleys at the core of ***Secwepemcúl̓ecw***, in the Thompson and Mid-Fraser regions, are shaped by the dry bunchgrass (BG) and Ponderosa Pine (PP) zones, with prickly-pear cactus, (*Opuntia* spp., especially *fragilis*) and big sagebrush (*Artemisia tridentata*); indeed our homeland includes the very northern outlier of the Great Sonoran Desert that begins in the Southwest of the North American continent. Along the mid-Fraser river and adjacent watersheds, the rolling, grass-covered hills of the Cariboo, with their slightly cooler temperatures, continue this habitat, reflected in the term ***St̓emcúl̓ecw***, "the cleared grass-lands." Away from the Thompson and Fraser rivers, however, the valleys give way to rolling plateaus covered by a succession of Douglas-fir (*Pseudotsuga menziesii*—IDF), and Sub-boreal Lodgepole Pine and Spruce forests (*Pinus contorta, Picea* spp.—SBPS, SBS). In the highest areas of the wooded Interior Plateaus, at around 1,500 m [5,000 feet], the Lodgepole Pine belt eventually gives way to montane Engelmann Spruce and Subalpine Fir forests (*Picea engelmannii, Abies lasiocarpa*—ESSF zone). Above the tree line is the Alpine zone (AT), with low-growing vegetation adapted to severe climatic conditions. Our people call this succession of biogeoclimatic zones marked by indicator species such as "***ne tsq̓ellp***"—"in the Douglas-fir [area]," "***ne qweqelí7t***"—"in the lodgepole pine," "***ne melánllp***"—"in the subalpine fir," "***ne skwelk̓welt7úw̓i***"—"in the alpine"—thus reflecting a good sense of how they exist in ecology and succession. As Chapter 11 shows, stories (***stsptekwll***) commemorate the way in which ecological knowledge about areas in our homeland was and continues to be connected to events of moral-social-political concern.

The western, northern, and eastern parts of ***Secwepemcúl̓ecw*** are framed by the snow-capped high peaks of the Coastal Mountains, Columbia, Selkirk, Monashee, and Rocky Mountains with their montane spruce parklands, subalpine fir forests, subalpine meadows, and alpine areas. The wetter and cooler slopes and richer soils of the Shuswap and Adams Lake highlands in the west, and also the Quesnel Highlands in the North sustain a belt of western redcedar and western hemlock forests (*Thuja plicata, Tsuga heterophylla*—ICH), along with stands of Pacific yew (*Taxus brevifolia*) and an array of herbaceous plants and shrubs that thrive in these wetter climates.

Throughout these broader environmental zones, specific micro-habitats exist – although many of these are currently threatened—created by a combination of water, sun exposure, soil type, and existing flora. Such micro-habitats were well known to Secwépemc people throughout the ages as they often produce dense populations of certain plants not usually found at such elevations and in such places. Some examples of this kind of micro-habitat are the Neskonlith Meadows above Chase, ***Seseléltkwe*** (Two Springs) at Upper Hat Creek, and ***Qwiq̓wiyélst*** in Skeetchestn, where specific conditions of soil, hydrology, and climate produced by exposure and terrain create unusual and optimal conditions for the growth of plants normally not associated with the environment of the area.

While ***Secwepemcúl̓ecw*** thus includes a vast geographic area and diversity of biogeoclimatic zones, it represents by and large a shared habitat, in that ***nearly all people from throughout Secwepemcúl̓ecw had access to, and developed detailed ecological knowledge of, these diverse environments.*** What made and makes us a people is the collective memory and wisdom of living in our homeland, knowing and using its landforms and resources, and talking about these activities in our language, Secwepemctsin. The story of "Coyote Juggles his Eyes" presented in Chapter 11 of this volume provides us with an example of how we, as Secwepemc people, communicated with each other about biogeoclimatic zones and traditional ecological knowledge through our stories.

Secwepemc Resources and Resource Use

Between more than 8,500 years ago—and very likely, as early as 10,000 years ago—and some 4,500 years ago, the ancient ancestors of the Secwépemc and other Plateau peoples relied on game hunting in the higher plateaus, supported by gathering fruits, seeds, roots, vegetables and other edible species like freshwater mussels. By around 4,500 years ago, as the archaeological record shows, the resource use of the Secwépemc and neighbouring Interior Plateau First Peoples was based not only on hunting of ungulates supplemented by small game but increasingly, on the harvesting of anadromous fish, specifically four species of salmon that were abundant in the Thompson-Fraser River system, along with various non-anadromous fish. In addition, the use of an extensive variety of plants, especially carbohydrate yielding root plants from various species, became a crucial and significant part of our people's sustenance. As several chapters in this volume show, the sustained management and harvest of these roots and bulbs that provided good quality carbohydrates and other nutrients were a key feature of the Plateau economy, and figured prominently in the diet of the Secwépemc. The archaeological record (Lepofsky and Peacock 2004; Peacock 1998; Peacock and Turner 1995; Pokotylo 1998) reveals that around 2,500 years ago, underground cooking pits, or "earth ovens" that entail a method we call ***tsq̓elstém***, entered the picture, revolutionizing the ways in which carbohydrates from various root plants could be utilized.

Salmon were, and still are caught by Secwépemc with a variety of indigenous methods highly suited to the particular species, and nature of the river. In the fast flowing, muddy waters of the Fraser River, they used dip-nets (***stúkwtsen***), made of the hard wood of juniper (*Juniperus scopulorum*), yew, or Douglas-fir saplings.

In the clear and relatively shallow waters of the main Thompson and tributaries of the North Thompson, gaffs (***up̓s***) and three-pronged spears (***wewtsk***) supported by long poles were the most efficient fishing methods. For catching large and heavy fish like spring (Chinook) salmon (*Oncorhynchus tsawytscha*), single- or double-pronged harpoon spears (***menép***) were the chosen method.

In the North and South Thompson River and in the Fraser River and its tributaries, we have evidence of large fishing weirs (***mu7***), traps, and dams (***tselmin̓***) that required organized community labour (see Nicholas et al. Chapter 3). In the relatively still waters of the South Thompson and main Thompson Rivers, our ancestors also developed the method of lighting pitch-wood fires on canoes in order to attract the salmon, and then spearing the fish from dug-out cottonwood (*Populus balsamifera* ssp. *trichocarpa*) canoes or rafts. Steelhead were also caught by this method, known as ***tsétsk̓wem*** ("pitch-lamping"). All of these methods required plant fibres and materials of various kinds to do the work. In order to spot and then spear the approaching salmon in the river, fishers built platforms on the banks, and dropped white stones into the river, thus making the fish more visible in the water. Besides relying on the natural conditions produced by back eddies, prolific fishing grounds thus involved an aspect of human labour and maintenance, and it was the individuals or families who built up and maintained such fishing areas or fishing rocks who were the first to harvest fish there.

In addition, with the help of the strong fibers of ***spéts7en*** (Indian hemp, *Apocynum cannabinum*), our ancestors learned to make not only dip-nets but also make gill nets set across back-eddies in rivers, held up by floats made from animal bladders, and anchored by round rocks as sinkers. The analysis of prehistoric marine protein in human remains from the Interior dated at around 5000 BP shows that by that time, at least 30–40% of the diet of the Secwepemc ancestors consisted of salmon (Lovell, Chisholm et al. 1986). As Laura Harry from ***Esk̓ét*** (Alkali Lake)

Figure 1. ***Tsq̓elstém*** (Pitcooking). Photo by Nancy Turner.

Figure 2. Terry Deneault gaffing salmon near the mouth of Deadman Creek with the main Thompson River. Photo by Marianne Ignace.

Figure 3. Desmond Peters, Sr., with his ***spétsʼen*** (hemp dogbane) dipnet, 1998. Photo by Nola Markey.

Figure 4. Esk̓ét Elder Laura Harry and her sister Bridget Dan recording Secwepemc plant terms with Marianne Ignace, 1997. Photo by Marianne Ignace.

remarked to Ron Ignace, "***Re sqlélten, yiri7 re sxetéqst.s te stsmémelt-kt***"—"salmon are our first children" (Laura Harry, Ron Ignace Interview 1998).

Archaeological sites attest to our ancestors consuming a variety of large ungulates, including elk, deer, mountain goat and sheep, and caribou, along with small game like rabbit, marmot, ground hog, gophers, and others. Deer and elk were hunted in the ***t7iweltk***, the montane parklands of the Interior Plateau, usually 1,200–1,500 m [4,000–5,000 feet] above the river levels. They were often tracked with hunting dogs whose mouths and furs had been washed with ***secwsqéqxe7ten*** ("bathe-dog-in-stuff"), or Hudson Bay Tea or Trappers' Tea (*Rhododendron groenlandicum* or *Rhododendron columbianum*). In strategic areas between deer trails, deer licks, and travel corridors, deer were driven into built deer fences, which, as man-made contraptions, were considered to be the property of the builder. Caribou were hunted in the high mountain ranges throughout the higher coastal mountain and Rockies (Alexander 1992; Ignace 1998; Teit 1909). Caribou and marmots were hunted in the higher subalpine and alpine areas of the area called ***skwelk̓wélt***, the snow-covered mountains.

A group of hunters, accompanied by their families, would stay out on hunting expeditions for two to three weeks at a time, establish a base camp, where their wives and families would camp, snare small game, and gather plants. The men would travel into the montane parklands and subalpine areas to track game and make kills, then bring it down to the base camp, where the meat would be partially dried by women. Thus, throughout two thirds of the year, people were "on the go."

In Secwepemctsín, the concept of dwelling or "living" in a place, ***mut*** (singular) or ***tsyem*** (plural), entails the idea of not only living in a fixed abode; instead, wherever people *stay* is where they "live," including the periods of time they "camp" at stable, annually visited resource-producing locations throughout the seasonal round. This is in contrast to the concept of ***yist***, "camping overnight" *en route* to a location (see, e.g., Lilly Harry's narrative about the Secwépemc seasonal round in Ignace 2008 and in Ignace and Ignace in press).

At different elevations, the environments of Secwepemcúl̓ecw sustain a variety of plants of different plant families whose underground parts in their raw state contain either inulin (a complex sugar) or undigestible starches (Kuhnlein and Turner 1991; Loewen 1998; see also Chapters 6 and 7, this volume). The most prominent among these were: ***tséts'elq*** (*Balsamorhiza sagittata*, balsamroot or spring sunflower), ***scwicw*** (*Erythronium grandiflorum*, yellow glacier lily), ***qwléwe*** (*Allium cernuum*, nodding onion), ***qéq̓me*** (*Fritillaria affinis*, chocolate lily), and ***qweq̓wíle*** (*Lomatium macrocarpum*, hogfennel or biscuit root), the plant associated with the "transformer" who explored the boundaries of Secwépemc and Salish territory (Ignace 2008). As is explained in detail in Loewen et al.'s chapter (7), while ***tséts'elq***, ***scwicw***, ***qwléwe***, ***qéq̓me,*** and ***qweq̓wile*** are members of different plant families, they have in common that their main carbohydrates require the human intervention of sun drying, and, more importantly, underground steam cooking to make the plant nutritionally useful and palatable.

Secwépemc and Stat'emc (St'at'imc/Fraser River Lillooet) elders report that long time ago, Grizzly Bears taught people how to harvest and prepare ***scwicw*** to make the bulbs digestible and sweet-tasting: Given that archaeological evidence points to pit-cooking having existed for at least 2,500 years, at some point in that long-ago past, hunters in the subalpine areas of the Plateau observed how Grizzly Bears would dig up ***scwicw***, but instead of eating them immediately, they would leave

Figure 5a. Labrador Tea. Photo by Marianne Ignace.

Figure 5b. Trapper's Tea. Photo by Marianne Ignace.

Figure 6. Interior Plateau root plants and lichen. Left to right: Chocolate lily, tigerlily, nodding onion, spring beauty, yellow glacier lily. Above is black tree lichen. Photo by Nancy Turner.

them to dry in the sun for a few days, then return to eat them. As Mary Thomas showed Dawn Loewen, who then chemically measured starch and sugar composition, ***scwicw*** bulbs get the optimal combination of sweetness and high edible starch content through a complex process that involves time of harvest, then sun-curing, followed by slow pressure steaming in underground pit-ovens (Ignace and Ignace 2004; Loewen 1998; see Loewen et al., Chapter 7, this volume).

Likewise, the taproots of ***tséts’elq*** or balsamroot only become digestible and palatable in the process of pit-cooking, as the chemistry of the pit oven converts the root’s inulin (a complex sugar not digestible for humans) into edible, digestible fructose and fructans, and also destroys the turpentine-like pitch that oozes from its surface (see Bannister and Thomas, Chapter 9, this volume). Just recently, in 2014, our aunt Edna William (pers. comm. to M. Ignace November 2014) reported that she had observed black bears at Seseléltkwe (Upper Hat Creek) digging what would have been balsamroot, then leaving the roots to wilt, and coming back a few days later to consume them.

Other important root plants included ***skwenkwínem*** (*Claytonia lanceolata,* spring beauty or “Indian potatoes”), which grows at higher elevations (~1,200–1,500 m) and ***llek̓wpín*** (*Lewisia rediviva,* bitterroot), which grows in select areas in the dry, bunchgrass habitat just above the river valley floor, and was a coveted trade item for one of the “national dishes” of the Secwépemc and surrounding peoples, a pudding called ***scpet̓ám*** made of Saskatoon berries (*Amelanchier alnifolia,* ***stséqwem*** variety), bitterroot, fish-eggs, and other roots and berries (Ignace and Ignace 2013; Turner, Ignace, and Loewen, forthcoming).

In order to ensure a good enough supply of energy-rich foods for the winter, families would harvest and process several hundred pounds of root vegetables for the winter months, while they were camped at central root-processing areas in low-to-mid elevations, such as ***Petpúťmen*** (Upper Hat Creek, west of Cache Creek—see Figure 1, Chapter 5), ***Cḱemqenétkwe*** (Scheidam Flats above Kamloops—see Figure 5, Chapter 1), or ***Ḱécse7ten*** (Back Valley above Skeetchestn). In the mid-1970s, Ike Willard estimated that when he was young (in the early 1900s), a household would harvest 500 pounds (~225 kg) of ***scwicw*** to last for the winter months (Palmer 1975a) Since during his youth, families were already growing potatoes and other vegetables in gardens, the harvest of edible roots before the arrival of market carbohydrate foods would have been much higher. Eugene Hunn (1992) estimates that in the Southern Plateau where camas (*Camassia quamash*) was the most important root plant, up to 50% of the diet derived from root plants.

Plant harvesting techniques furthermore involved detailed *management regimes*, ***yecwmenúl̓ecwem***, best characterized as *stewardship*, such as landscape burning to create nutrients for new growth, the replanting of immature bulbs, tilling and loosening of soil during harvests, and the re-planting of the corms of bulbs (see Chapter 5, this volume).

In addition to roots, Secwépemc people harvested a large variety of fruits and green vegetables throughout the spring to fall months. The green shoots of various plants, including "Indian Rhubarb" (*Heracleum maximum*), fireweed (*Chamerion angustifolium*), and balsamroot budstalks, provided minerals and vitamins in early spring. The cambium of lodgepole pine and Ponderosa Pine (***st7íq̓wel̓qw***) was and is valued for its aromatic sweet taste, but also provided vitamins, minerals, and acted as a laxative detoxifier, enabling our bodies' "spring cleansing" (Dilbone 2013).

Figure 7. Ron Ignace harvesting lodgepole pine cambium. Photo by Marianne Ignace.

Hazelnuts (*Corylus cornuta*), pine nuts (*Pinus* spp.), and numerous species of berries harvested at different elevations throughout the summer rounded off the diet. Important fruit plants included several species of *Vaccinium* (huckleberries, highbush and low bush blueberries, dwarf blueberries) and Saskatoon berries (*Amelanchier alnifolia*). The latter are distinguished as three different named varieties: ***speqpeq7úw̓i***, recognized by our people as the "berry par excellence," or "real/ordinary berries," grows on relatively low bushes, often on old flood plains, and has small seeds and a nutty flavour; ***stséqwem*** grows on tall, straight-limbed bushes in drier gullies and is very sweet, but has large seeds; ***sencweséllp*** is an intermediate variety that grows in the mid-Fraser River area.

Additional important fruits were strawberries (*Fragaria* spp.), raspberries (*Rubus idaeus*), gooseberries (e.g., *Ribes* spp.), red and black currants (*Ribes* spp.), blackcaps (*Rubus leucodermis*), high-bush cranberries (*Viburnum edule, V. opulus*), chokecherries (*Prunus virginiana*), black hawthorn (*Crataegus douglasii*), and even Oregon grape (*Mahonia aquifolium*), and kinnikinnick berries (*Arctostaphylos uva-ursi*), which were fried in bear grease. Of particular significance was, and continues to be, ***sxúsem*** or soapberry (*Shepherdia canadensis*—see Figure 6, Chapter 5), a bitter fruit high in vitamin C and iron, which is beaten off the bush ("***spem***") rather than picked (***q̓wléwem***) and made into a thirst-quenching beverage, or whipped into "Indian ice cream", a favorite confection.

Another integral part of the diet of Secwépemc and other Interior peoples was ***wíle*** or black tree lichen (*Bryoria fremontii*), which our people raked off Douglas-fir, lodgepole pine or sub-alpine fir trees at mid to higher elevations in early fall. After being washed to remove its outer layer of vulpinic acid, it was pit-cooked, shaped into loaves or cakes, and then dried for future use (Turner 1997; Turner, Ignace and Loewen, forthcoming; Chapter 9 this volume).

The dietary importance of ***wíle*** was long considered to lie in its capacity to be an always available "starvation food." However, we are only just beginning to uncover the culinary chemical knowledge of our ancestors: Experimental graduate research by Crawford (see Chapter 8, this volume) has shown that in pit-cooking ovens, ***wíle*** acted as an absorbent to "trap" carbohydrates given off by root plants during the slow-cooking process.

More than 150 plants were used medicinally, most of them gathered in the high plateau we call ***t7iweltk*** and in subalpine meadow areas nearest to village communities, or while people were much further afield on hunting trips. Medicinal plants included plants that were physical and spiritual cleansers like Rocky Mountain juniper (*Juniperus scopulorum*, ***punllp***) and rosebush (*Rosa spp.*, ***sk̓eplén̓llp***), tonics and cleansing teas, such as those made from ***sxúsem*** (*Shepherdia canadensis*, soapberry) sticks, ***melánllp*** (*Abies lasiocarpa,* subalpine fir) bark, and ***secwsqéqxe7ten*** (Labrador tea, *Ledum groenlandicum* and *L. glandulosum*), but also highly potent and toxic medicinal plants like ***tnílmen*** (*Veratrum viride,* false hellebore), ***kets'e7éllp*** (*Oplopanax horridum,* devil's club), and many others (Turner, Ignace, and Loewen, forthcoming).

Our elders accompanied the harvesting of plant and animal resources with detailed regimes of plant management strategies. These included landscape burning to enhance the growth of animal forage, and berry and root plant growth, but also to maintain trails, and reduce pests and insects (Turner 1991; Turner and Ignace, nd.). Other plant management regimes included the replanting of immature bulbs and corms to propagate root plant species; the pruning of berry bushes, in the

Figure 8a. Bridget Dan with the ***sencweséllp*** variety of saskatoon berry. Photo by Cindy Charleyboy.

Figure 8b. The ***stséqwem*** variety of Saskatoon berry. Photo by Sandra Peacock.

Figure 9. A culturally modified subalpine fir tree, which has had a piece of bark stripped off for medicinal use without causing lasting damage to the tree. Photo by Nancy Turner.

process of harvesting (especially ***sxúsem***); the tilling or loosening of the soil with the digging stick to provide better habitat; and the re-planting of young bulbs and tubers in such prepared soil to propagate root-plant species. Our elder Mary Thomas, in fact, referred to Secwépemc plant management and harvesting as "just like a garden" (Peacock and Turner 2000; see also Turner et al. 2000), defying the separation between "cultivators" and "foragers" so often expounded by settler society since the late nineteenth century in order to denounce our use of the land as "primitive" and thus illegitimate (R. Ignace 2008). Chapters 5 and 12 of this volume details concepts and practices of plant management and stewardship.

The Traditional Seasonal Round

The months in the Secwépemc Calendar (Dawson 1892; Ignace 2008; Ignace and Jules 1997; Teit 1909) reflect the seasonal activities shared by Secwépemc people. Our ancestors measured the years in the numbers of "snows" (***swucwt***) or winters experienced by someone.

A seasonal round or single "snow" consists of 13 lunar months and started with the late fall "entering" into winter-homes and a stay-at-home period (Dawson 1892:40; Teit 1909:517–18), when, nonetheless, men using snowshoes hunted for game, and helped by hunting dogs, trapped for different fur-bearing animals. They also went ice fishing in the lakes or by the ***tsétskw̓em*** method (described previously) from canoes. In mid to late spring, our people harvested different root plants at increasingly higher elevations, as the snow melted at higher and higher elevations between March and late May. During this time, they pursued large cutthroat trout (*Oncorhynchus clarkii)* and rainbow (*Oncorhynchus mykiss*) trout runs at lakes in the middle to high plateaus, including ***Xixyúm*** (Hi-hium Lake), Green Lake (***Ctáltsenten***), ***Tsp̓éten*** (Gustafson Lake), ***Q'eséten*** (Loon Lake), ***Sp̓estwécwemstem*** (Bonaparte Lake), ***Pipsell*** (Jacko Lake), and many other lakes. The time of the late spring freshet in the rivers marked the beginning of salmon fishing, which began with Spring salmon (*Oncorhynchus tshawytscha*), followed by Sockeye (*O. nerka*) until early fall; coho (*O. kisutch*) was fished mainly in the tributaries, in mid to late fall. Besides yielding fresh protein between March and October, significant portions of the catch from high-yield salmon and trout were dried for winter use. Throughout early to late summer, berries were picked as they ripened at higher and higher places on the plateaus. ***Sxúsem***, for example, ripen in the lower part of their range (1,200 m; 3,500 feet) in early July, but are ripe in the highest parts of their range (1,670 m; 5,500 feet) as late as the end of August. During the same time, people used to get marmots in the snowy mountains. The late summer to early fall period was the time for large-scale hunting of large ungulates, much of the meat of which was dried for winter use.

Table 1 shows the association between Secwépemc months and resources associated with that time of the year throughout the annual seasonal round.

It involves the places most often habitually travelled by people in the Skeetchestn area, and includes the valley and shores of the Thompson River and Kamloops Lake, the plateaus on the south side of Kamloops Lake and Thompson River, the Deadman Creek Valley; they travelled the valleys, plateaus and the mid-elevation mountains that frame it, along with the high plateaus

Table 1. Secwépemc Calendar and Seasonal Round.

Secwépemc name	English translation	Month (approximate)	Subsistence activities
Pellc7ellcw7ú7llcwten̓	"Entering month"	November	People enter into their winter homes; animals enter their dens. Elk hunting.
Pelltetéq̓em	"Cross-over month"	December	Winter solstice; people live on stored provisions; trapping.
Pell7émtmin̓ ***Pellk̓well7emtmín***	"Stay at home month;" "stay underneath month"	January	People live on stored provisions; some ice fishing; trapping.
Pelltsípwen̓ten	"Cache pit month"	February	People live on stored provisions; ice fishing; fishing for steelhead with torch lights in mainstem rivers; trapping.
Pellsqépts	"Chinook wind month"	March	Early lower elevation lake trout fishery; spring hunting; first plant shoots come out at lower elevations.
Pesll7éw̓ten	"Melting month"	April	Snow melts at higher elevations. More fresh shoots of plants are ready, digging for nodding onion, yellow bells, balsamroot and desert parsley; spring hunting.
Pell7é7llqten	"Root-digging month"	May	Gathering of yellow glacier lily, balsam root, desert parsley and other roots and bulbs; lodgepole pine cambium ready; Chinook salmon run into larger creeks; fishing at higher elevation lakes.
Pelltspántsk	"Mid-summer month"	June	First berries ripe at end of month; root digging at higher elevations; lodgepole pine cambium at higher elevations; chinook salmon run.
Pelltqwelq̓wél̓temc	"Getting-ripe month"	July	Many species of berries ripe, root and medicinal plant gathering. Salmon fishing in Fraser and Thompson Rivers.
Pesqelqlélten	"Many salmon month"	August	Sockeye Salmon fishing in Thompson and Fraser Rivers; blueberries and other berries harvested at higher elevations; chocolate lily ready; more medicinal plant gathering at high elevations. Main fall hunting starts.
Pelltemllík̓t	"Spawned out month"	September	Hunting season and drying of meat for winter months. Black tree lichen harvested. More sockeye salmon fishing.
Pesllwélsten	"Abandoning month"	October	Continuing hunting season and drying of meat for winter months; tanning hides. Coho salmon fishing in creeks.

(***t7iweltk***) of the highest areas around Hi-hium Lake (at 1,500 m/ 5,000 ft. elevation), and Battle Mountain. As part of the seasonal round, our people also hunt(ed) in the watershed of the upper Bonaparte River and Bonaparte Lake (***Sp̓estwécwemstem***). For travel into the higher mountains, our people would travel further afield to the north, east, and west. In addition, travels of hunting and camping with relatives would take our people to other areas of ***Secwepemcúl̓ecw***, although not as frequently.

For the people from ***Xgat̓tem̓***, the Dog Creek area on the Fraser, the annual seasonal round involved similar migration between ecological zones, as detailed in Lilly Harry's narratives (M. Jules 1994, Kuipers 1989), and the same kind of seasonal round that accommodates river fishing, highland hunting, trout fishing in upper lakes, and plant and medicine gathering in diverse vegetation zones is attested by Mary Thomas, Sarah Deneault, Lena Bell, and other elders from the Eastern (Sexqeltkemc) Secwepemc area.

In often elliptical form and mere allusions, the months of the Secwepemc Calendar express the annual round of subsistence and the cyclical nature of the resource activities entailed in a year, called ***swucwt*** (a "snow") in Secwepemctsin. As Ron Ignace (2008:149) notes about the Secwépemc seasonal round, referring to research with Secwépemc elders during the 1990s:

> The elders whom I interviewed continued this sense of seasonal round throughout their lifetime, travelling between and among resource harvesting locations in the mountains, the high plateaus, the highland lakes, valleys, creeks and rivers. Our people continued to go on long camping trips to pick berries, riding on horseback up the mountains to the higher elevations, several thousand feet high. While women went on horseback picking huckleberries and blueberries, as well as ***sxúsem***, often snacking on raspberries, strawberries along the way, the men accompanied them and then traveled further to go hunting.

Although the division of labour, as described above, entailed women doing the plant gathering and processing, while men carried out hunting and fishing. However, on closer inspection, ethnographic observations and memories by twentieth century elders show that each community had one or more women who engaged in large game hunting as well as fishing, and boys and men frequently took part in berry picking and root digging expeditions throughout their lives. Men also played an important role as ***yecwmin̓men*** (resource "caretakers") who monitored the health and productivity of berry patches and root digging areas, the occurrence of game and the proclivity of salmon runs, as well as maintaining trails. In addition, as ethnographer James Teit noted (1909:573) community chiefs took an active role in allocating berry picking areas ready for picking in a given year, and in rotating the use of berry patches and root gathering areas. The role of women, including older women, in gathering firewood, and thus keeping the forest floor free of debris, and their active role sharing their local experience and activities in monitoring and harvesting resources, needs to be mentioned. The processing of foods, including the cooking and drying of fish and meat, and the often complex tasks involved in plant processing (see Chapters 6, 7, and 8, this volume) were by and large women's work.

The Secwépemc and other Plateau peoples also had detailed teachings and practices around the consequences of using resources unwisely or carelessly. In the Secwépemc belief system, there is a concept central to the relationship between an animal and the fisher or hunter who "bags" the animal. This revolves around the concept that the animal gives itself to the fisher or hunter, ***kecmentsút***. The hunter thus has to approach the animal with a clean mind and body, which includes having a ***sq̓ilye*** (sweat) before the hunt, thus ensuring spiritual cleanliness, but also physical cleanliness by getting rid of one's human scent. Animals will often give themselves up to the hunter because they take pity on humans, especially during times of bereavement, or in times of need. In our communities, we have many stories of events when deer and moose gave themselves up to take pity on the mourners by not fleeing, being found in unusual places. Ida Matthew explained it as follows,

> My mom would tell us that we were never to [play with animal parts]. We had to have respect, ***me7 eyemstéc we7stémes*** (you have to respect everything) because that's what we ate, so that we weren't allowed to play with it…. It was pitiful enough that we had to kill them. She instilled in us that we were not to waste the food, that we had to kill the poor animal.
>
> With any kind of animal that we would hunt and eat, you have to respect them, too… We lived on a lot of fish-heads when we were kids. [My mother] would never allow you to play with the fish-heads or any part of that. She didn't spill any of the ***éḱwen*** (fish eggs)" (Interview Marianne Boelscher Ignace, 1986).

Another essential aspect of all resource gathering was the sharing of resources and labour, expressed in Secwepemctsin as ***knucwentwécw*** ("helping one another"). Members of interrelated families, including young children, would go on hunting, fishing, and plant gathering trips, adults helping one another, sharing resources, and jointly providing for their families.

Figure 10. Simpcw elder Ida Matthew, here seen scraping a deerhide. Photo by Marianne Ignace.

This is how Skeetchestn elder Theresa Jules explained it:

> ***Re m-yews mé7e m-cketscemnúcwes* cú7tsem re *sq̓wléwem te wenéx...***
> When the time came again to pick huckleberries
>
> ***yerí7 cú7tsem tl7élye re nuxwnúxwenxw t̓7en xílem... tektékl̓em ri7.***
> Again the women did the same thing, they made their lunches.
>
> ***.....t̓lu7 m-w7ec m-qwelq̓wléwem... qwelq̓wléwem.***
> They would be out there picking berries, picking berries.
>
> ***Telri7 re s7i7llcw m-xewentés re sq̓wléwems e cw7ítes.***
> Some of them dried their berries, if they picked lots.
>
> ***Ell ye7éne m-c7í7elcmens ri7.***
> And this they shared with others.
>
> ***Ye7éne t̓7en ts'ílem te m-c7í7elcmens lu7...m-ciláp.***
> With the whole works they did the same, each with an equal share all around.
>
> ***Ec cú7tsem t̓ri7 m- t̓7en s7i7llcw cú7tsem t̓kllu7 m-tcúsem***
> Again they would go about, some would go looking for more
>
> ***tcúsem t̓ri7 t̓hé7en te speqpéq.***
> looking here and there for berries.
>
> ***Swéti7 k xexé7 m-penstsíllen...m-cwiye7entwécw.***
> Whoever was smart enough to find food, they invited one another along
>
> ***Yerí7 ucw m-sqwetséts.s ucw.***
> So then off they'd go.
>
> ***Re sxelxélwes t̓lu7 m-w7ec, m-pexpíxem ell ri7.***
> Their husbands were there, they also went hunting.
>
> ***Ta7 ri7 k stelt̓íltes.***
> They never stayed in one place.
> (Theresa Jules interview with Ron Ignace, September 1997)

In Secwepemc culture and Plateau culture in general, there existed a fine balance between the self-sufficiency required of individuals so they were not a burden or "nuisance" (***yéwyut***) to society, and the need to help one another. Young people practised looking after themselves and not be a nuisance to others, not to beg and "freeload" through everyday tasks and work, and particularly in their étsxem, or spirit guardian quest. At the same time, there was a strong ethic not to be stingy (***xwexwiyélesem***), especially with food, to share it out (***c7í7lcmen***), and to be generous, connected to the idea of ***knucwentwécw***. Fishers and hunters who were "stingy" with their catch would experience not only social sanctions, but would also experience spiritual sanctions

Figure 11. Skeetchestn elder Theresa Jules. Photo by Marianne Ignace.

Figure 12. Skeetchestn elder Nellie Taylor shown here gathering “punky” or rotten Douglas-fir wood for use in smoking deer hides. Photo by Marianne Ignace.

from the animals, who would subsequently refuse to give themselves to them. The sanctions for disrespectful behaviour thus connect people to resources and vice-versa.

Nellie Taylor often told of how she and her partner, Cecilia Peters, went to Hi-hium Lake (***Xixyum***) to fish for rainbow trout. [On one occasion] two young men had set up camp and were roasting the fish they had caught without offering any to the Elders. "After that, the fish just quit running for them. They never caught any more," she remarked wryly. By violating the norm of sharing [especially with Elders] they had acted inappropriately and had brought about supernatural sanction of their behavior in that the fish stopped running for them (Ignace and Ignace 2013:386).

Secwepemc Resource Tenure

> [The first white people] found the people of each tribe supreme in their own territory, and having tribal boundaries known and recognized by all. The country of each tribe was just the same as a very large farm or ranch (belonging to all the people of the tribe) from which they gathered their food and clothing, etc., fish which they got in plenty for food, grass and vegetation on which their horses grazed and the game lived, and much of which furnished materials for pipes, utensils and tools, etc., trees which furnished firewood, materials for houses and utensils, plants, roots, seeds, nuts and berries which grew abundantly and were gathered in their season just the same as the crops on a ranch, and used for food; minerals and shells, etc., which were used for ornaments and for plants, etc., water which was free to all. Thus, fire, water, food, clothing, and all the necessaries of life were obtained in abundance from the lands of each tribe, and all the people had equal rights of access to everything they required. You will see the ranch of each tribe was the same as its life, and without it the people could not have lived (Memorial to Sir Wilfrid Laurier, 1910).

Ethnographer James Teit (1909) explained the Secwepemc concept of land tenure—largely shared with the other Interior Nations—as follows:

> All the land and hunting grounds were looked upon as tribal property all parts of which were open to every member of the tribe. Of course, every band had its common recognized hunting, trapping and fishing places, but members of other bands were allowed to use them whenever they desired…Fishing places were also tribal property, including salmon-stations… At the lakes everyone had the privilege of trapping trout and erecting weirs (p. 572).

Teit (1909) also noted that: "berry patches were tribal property, but picking was under tribal control. All the large and valuable berry spots were *looked after* by the chief of the band in whose district they were situated" (p. 573, emphasis ours). Of root digging grounds, Teit noted that they were also "common tribal property. Some people of the Northern Fraser River bands laid a claim on the root-digging grounds of Quesnel Lake, where very large lily-roots [*Lilium columbianum*] grow, but these claims were not recognized by the rest of the tribe" (p. 582).

As the chiefs of 1910 did, Teit (1909) emphasized a tribal or Secwépemc wide system of land tenure and access to resources. Within this system, the chiefs of local bands, on behalf of their communities, acted as resource stewards or caretakers for the benefit of all people of the nation, assisted by various kinds of appointed resource caretakers or resource "chiefs", as Teit called them. "Thus, it was NOT the indigenous communities or 'bands,' that had exclusive rights over resources, but, by descent or blood, all the members of a nation had access to the resources within the nation" (Ignace 2008). Local communities, headed by their chiefs and specifically appointed resource stewards called ***yecwmin̓men***, were considered to be the caretakers, over resources and tracts of lands where their people lived.

As we previously noted, Teit's discussion of Nlakaʻpamux land tenure, which he regarded as identical to Secwépemc land tenure, verifies this analysis:

> Of course each [Nlakaʻpamux] band had their usual hunting-places, naturally those parts of the country nearest to their respective homes; but Indians from other villages, or other divisions of the tribe, frequently hunted in each other's hunting-grounds without being considered intruders; and sometimes hunting-parties representing two or three tribal divisions would hunt over the summer hunting-grounds of another division without rousing any feelings of resentment (Teit 1909:293).

After citing an instance of such resource use, he concludes,

> The hunting-territory seems to have been common property of the whole tribe. Among the Spence's Bridge and Nicola Bands any member of the Shuswap and Okanogan tribes who was related to them by blood was allowed full access to their hunting-grounds, the same as one of themselves; … If, however, a person who was not related to a Thompson Indian were caught hunting trapping or gathering bark or roots, within the recognized limits of the tribal territory, he was liable to forfeit his life (Teit 1900:293).

In addition, Teit (1909:572) cites a case of the Northern Secwépemc trying to assert exclusive control of their hunting areas at some point in the past, likely during the early 1800s. The southern Secwépemc—notably the Tk̓emlupsemc—challenged them on this attempt, causing the Northern Secwépemc to abandon their claim to exclusive ownership of a part of ***Secwepemcúl̓ecw***. According to Teit (1909), this insistence on exclusive control over hunting grounds by a smaller group within the nation coexisted with the Northern Secwépemc's adoption of a clan and crest system imported from the coastal tribe, apparently not long before the arrival of Europeans in our country (Teit 1909:575; see also Furniss 2004).

Franz Boas (1890:638), whose own Secwépemc research consisted of a few days of work with unknown informants while travelling through the Interior in 1888 and again in 1894 and 1897, thought that there were "family owned" hunting areas, and George M. Dawson (1892) also wrote of "family owned" hunting grounds, but it appears that he received this information from J. W. MacKay, the local Indian agent, and it is nowhere supported by examples or details (Ignace 2008). Given Teit's decades of residence, travel, and research among Interior Salish nations, his knowledge of the language and the general high quality of his ethnographic work, it strongly appears that he is the more accurate and reliable source on Secwépemc resource tenure.

Access to fishing resources was governed in the same way: All individuals who were born into a Nation, or who had ancestors from that Nation, were allowed to fish for salmon and other fish on the fishing grounds of that Nation. This extended to resource access on the basis of intermarriage. As the late elder, Sam Mitchell, from Fountain explained to Steven Romanoff about Bonaparte Secwépemc access to the productive ***Cacl̓ep*** (Fountain) Fishery on the Fraser River, "If the head guy has daughters who marry out, the sons-in-law live there because that's how they fish and gather. That's how they get grouped up .... That's how Shuswap came here. They came down and saw lots of fish and girls" (Romanoff 1992:251). Although, especially among the St'at'imc and some Fraser River Secwépemc, there is documented "family" ownership of fishing rocks (Romanoff 1992; Bouchard and Kennedy 1992), this individualized system of ownership could well be related to the high-maintenance efforts required of fishing rocks. These entail the building and maintenance of platforms, throwing white rocks into the river to create better visibility of fish where the water is clear, and the clean-up of the site. Sam Mitchell's testimony implies that the "owner" of a fishing rock was also its main caretaker, and allowed others the use of the fishing site after his family had harvested fish.

The Secwépemc system of land tenure and access to resources that extended to the entire Interior Plateau thus involved *joint access* to the common territory and resources of a Nation, based on blood and kinship ties, which then extended to the territories of other nations, in a secondary sense, by way of having relatives in those Nations whose birth and socialization provided access for their children.

Secwépemc elders who were interviewed about resource use and access during the 1970s to 1990s unequivocally shared this sense of common access: Thus, ***Esk̓ét*** (Alkali Lake) elders David Johnson, Alice Belleau, Pierre Squinahan, all born before 1900, stated to ethnographer James Brow, who had asked, "before the Europeans came, where was the boundary between Kamloops Shuswap and Shuswap territory?" "They didn't really have any boundary. The land belonged to all the Secwépemc and a man could hunt wherever he wanted. But each band had its own fishing places and villages where it stayed in the winter," [the latter referring to the habitual (but not exclusively owned) fishing places and ancestral villages of the indigenous bands].

Likewise, Secwépemc elder Dr. Mary Thomas of Neskonlith unequivocally referred to the same idea when she stated,

> We travelled a lot. There was no such thing as private property. All the Secwépemc dialect people shared the whole territory of the Secwépemc Nation.

> Nothing was private property: we always shared (In: Thomas 2001, *The Wisdom of Dr. Mary Thomas*).

In 1972, anthropologist Angelo Anastasio recognized how this system of resource use and access among Nations functioned to accommodate seasonal variations in game, plants, and fish by providing individuals and thus their extended families with a network of access to resources within their own Aboriginal nation of birth, but also to resources in other nations where they had ancestors and relatives, as long as these ties were kept alive and thus recognized.

Changes in Resources and Resource Harvesting during the Nineteenth and Twentieth Century

With the establishment during the early 1800s of fur trading posts in at Kamloops, Fort Alexandria on the Fraser and at Jasper House on the margins of Secwépemc territory, the Secwépemc supplemented their hunting, gathering and fishing subsistence activity with trapping, notably for beaver, marten and other smaller fur bearing animals. However, especially during the early years of the fur trade, as shown in Thompson's River (Kamloops) Post Chief Trader Archibald McDonald's 1827 report to George Simpson (Rich 1948), the fur traders not only relied on salmon supplied by the Secwépemc and neighbouring Interior Salish peoples for their livelihood, but also sold to them large quantities of berries, indigenous roots, and hazelnuts, along with venison and wild fowl.

Indeed, there is solid evidence that until the late 1850s, the Secwépemc maintained firm control over the harvesting of resources within their territory, despite the existence of fur trading posts (see Thomson and Ignace 2005). By the 1830s, the Secwépemc were selling garden potatoes to the Kamloops Hudson's Bay Company Post, and it was not until the early 1860s that the Kamloops HBC post was self-sufficient in providing food for its personnel.

Following the influx of settlers into the Interior with the 1858 gold rush and the establishment of Federal reserves during the 1870s—which allocated less than one percent of ***Secwepemcúl̓ecw*** as reserve land under the Canadian Indian Act—the Secwépemc increasingly supplemented their indigenous plant use with garden produce. As we noted above, garden potatoes were grown for local consumption and trade in certain locations as early as the 1830s. Contrary to the racist and condescending stereotypes of Indigenous people being stuck in the "primitive" evolutionary stage of hunters and gatherers, our people's easy incorporation of domestic gardening, which they called ***k̓wénllqem*** ("to try out plants or crops"), into the seasonal round, points to the close connection, in concept and practice, between our Secwepemc ancestors' "wild" plant management regimes (see Chapter 5, this volume) and domestic gardening (see also Ignace 2008; Ignace and Ignace 2013; Peacock and Turner 2000, Peacock et al., this volume).

Throughout the first half of the twentieth century, Secwepemc people effectively carried out a mixed economy that involved wage labour—often as ranch and farm hands—together with hunting and fishing, and the continuing gathering of wild foods, although the use of root vegetables

Table 2. Thompson's River Post Trade in Foods, 1826. Information from McDonald 1827.

Number of Persons	No. of Dried salmon	Fresh salmon	Lb. fresh venison	Lb. horse-flesh	No. of dogs	swans	geese	ducks	partridge	rabbits	badgers
3 officers 3 women 2 children	1,340	163	799	116		4	13	74	97	29	64
12 men	9,838	347	344	284	16						
8 women 10 children*	238	229	125								
Starving Indians**	670										
Total	12,086	739	1,268	400	16	4	13	74	97	29	64
Transferred	6,325										
Total	18,411										

* The original table states "no rations" (for non-officers' women and children) although the figures indicate some foods were provided or sold to the employees for their families.

Table 2 continued.

Number of Persons	Fresh trout	eggs	Gall. roots	Suet or grease	No. of beaver tails	Lb. dried beaver	Lb. fresh bear	Galleon of nuts	Quarts berries	Bushels of potatoes**
3 officers 3 women 2 children	19	300	10	25	6	4	25	5	372	20
12 men			23						645	20
8 women 10 children		270	15						154	
Starving Indians										
Total	19	570	48	25	6	4	25	5	1,171	40
Transferred										
Total	19	570	48	25	6	4	25	5	1,171	40

** According to various references in the HBC journals from the 1820s and 1830s, these are not Claytonia and other species which would have been under "galleons of roots", but were *Solanum tuberosum*.

declined as garden potatoes and other vegetables, along with store-bought flour and rice more and more replaced the former. The mixed economy of this period is well illustrated in a narrative by Mary Thomas about this period, and in Ida Matthew's childhood memories about accompanying her parents as they camped on the land while her father was working as a ranch hand, all the while supplying their food by gathering berries, catching gophers by flooding out gopher holes, catching fish in the Thompson River, and moreover drying surplus berries and gophers for later use (see Ignace and Ignace 2013). As they harvested game, fish, and plants throughout the seasons, Secwépemc people continued to use horses, or horse and buggy, for transportation. Domestic animals were added as travellers and passengers on trips to hunting, fishing, and berry-picking areas. Thus, Ron Ignace's great-grandmother would take chickens, tied up in a gunnysack, along on these expeditions, and Hilda and Elsie Hewitt reported how her parents would tie the family's milk cow to the back of the buggy as they went camping and berry picking at Six Mile on their way to visit relatives at ***Tk̓emlúps*** (Kamloops). As these elders remembered,

> We used to camp on the road, we used to camp by that big ranch at Cherry Creek. Well just on the other side of that little trailer, there is a spot in there, the road never used to go through that way, it used to go through up a steep little grade and down at the bottom there. That's where everybody used to camp, we used to camp there maybe stay there a day, or couple of days and dad would go hunting. And from there we would move on and maybe we go as far as ... any-how it took us about two days to get there by wagon. On the way dad and mum would go off and … and it was a lot of fun. But we did fishing though, cause there was no fences, and there was no homes the only home that was there was the Cherry Creek Ranch and there was nothing from there...Then we used to camp at … that little place before you get to Kamloops there. Around in there [Sleepy Hollow] we used to camp there too … we used to fish from there … trout, used to catch fish, a lot of them would camp around there and they'd go hunting. We used to smoke [the deer] and dry it there (quoted in Ignace 2008:158).

As they travelled to berry-picking grounds, Secwépemc people from ***Simpcw*** (the North Thompson) and other areas began to use the way-freight, a passenger train attached to the CN freight train, to travel to berry picking grounds, hauling back large quantities of blueberries and huckleberries from the Upper North Thompson to their home communities, often trading berries along the way-stations for flour, sugar, salt, and other staples. As one elder proudly commented, "in those days, the way-freight smelled sour of our berries!" (Ida Matthew, pers. comm. to M. Ignace).

Figure 13. Skeetchestn elder Hilda Jules and Ron Ignace, 2013. Photo by Marianne Ignace, 2013.

It was not until the 1960s and 1970s that the use of indigenous resources severely declined, in part brought about by the decline of knowledge transfer caused by generations of Residential School attendance, and the increasing reliance on wage labour on the one hand, and market foods on the other. Since the 1970s, dwindling salmon stocks—due to commercial and other kinds of over-fishing in the North Pacific and near the Fraser River estuary—have disabled

Secwepemc people from fishing like our ancestors did, and have turned our staple species into a scarce commodity. This, in spite of numerous Supreme Court of Canada decisions, including the Sparrow case, which affirmed the Aboriginal right to fish. In recent decades, as is explained in detail in Chapter 10 (M. Thomas, Turner, and Garibaldi, this volume) increasing urban sprawl, the effects of cattle ranging, logging, mining, and other forms of industrial development. While throughout the twentieth century, Secwépemc people had experienced how increasingly, settlers and newcomers, sanctioned by the property laws of government, had impeded their access to resources by berry-picking, hunting, fishing, and camping areas suddenly being fenced off, the construction of the new provincial highway system in the late 1960s saw further fences going up.

Secwepemc Sense of Place and Landscape

As they travelled and lived throughout the different ecological zones of ***Secwepemcúl̓ecw*** for generations and generations, the Secwepemc developed a keen sense of understanding of locations where resources are harvested, the ecological zones connected to them, and the geographic features and general topography of ***Secwepemcúl̓ecw***. The living landscape of ***Secwepemcúl̓ecw*** is commemorated in stories (see for example Chapter 11, this volume) handed down from generations, which combine ecological messages with moral and social messages of events that happened in specific places associated with environments known to all Secwépemc (at least those of the past). Another important aspect of the knowledge, or cognitive map, that combines places and resources is Secwépemc topographic knowledge. In this section we will explore how Secwepemctsín encodes knowledge of landscape, in particular in relationship to plant and general resource use. As we maintain, the Secwépemc sense of landscape goes hand in hand with the way in which the indigenous language names and classifies the world around us. The language thus shapes in the mind our perception of landscape.

Terms for Landforms

In addition to the knowledge about geographic regions or "districts" and biogeoclimatic zones, an important way in which Secwépemc speakers orient themselves in the landscape includes the numerous terms for landscape forms, or generic toponyms, which refer to places at different elevations, in different ecological areas and geographic formations. For the ancestors of contemporary Secwépemc, who learned to live in this changing, but intimately known landscape for hundreds of generations, the generic toponyms are more than speech labels for geographic locations. They imply an entire system of references and relationship in the landscape, where one term invokes the other, and people can predict what kinds of landforms they will encounter throughout their travels, and what kinds of animals and plants, sources of water and shelter can be found at or near this place, and what ecological indicators for all of these they will encounter.

For example, as elders explained to us in mapping out these generic landscape terms, you know that a plateau lake will have an outflow, where you usually find trout after break-up in spring. As forest ecologists and our elders know, you will find certain plants on the sunny (south-west) side of mountains, others on the moister northeast side. Forested areas in the Plateau will include moist meadows ***(ckweltam̓*)** that will, in turn, provide pasture for horses, a nearby creek, and a good overnight camping location. Along the rivers, back-eddies exist in predictable locations near out-croppings and, as we have seen, are the locations for salmon fishing.

Figure 14 presents a sketch of the generic Secwépemc landscape as it exists in the ***Stk̓emlúpsemc*** division—the people of the Skeetchestn and Kamloops area. The generic landscapes of the Cariboo region, or the damper and more mountainous North Thompson or Shuswap Lake areas are slightly different, but still recognizable in this sketch.

Generic toponyms or Secwépemc terms for landforms, in addition to place names (specific toponyms), consist of a series of lexemes like "lake," "river," "mountain," etc. In addition, by way of lexical suffixes that derive from those for shapes of the human (or animate) body, toponyms inscribe the shapes of living things into the landscape. Rounded hills resemble the shapes of curved bellies, the bottom of hills are their buttocks, the mouth of rivers is like the opening of a mouth, a pointed landform is a "nose," and a ridge is like the "back" of an animal.

Table 3 below lists the most common Secwépemc generic toponyms (landscape terms) and their lexical and morphological composition, along with their English meanings.

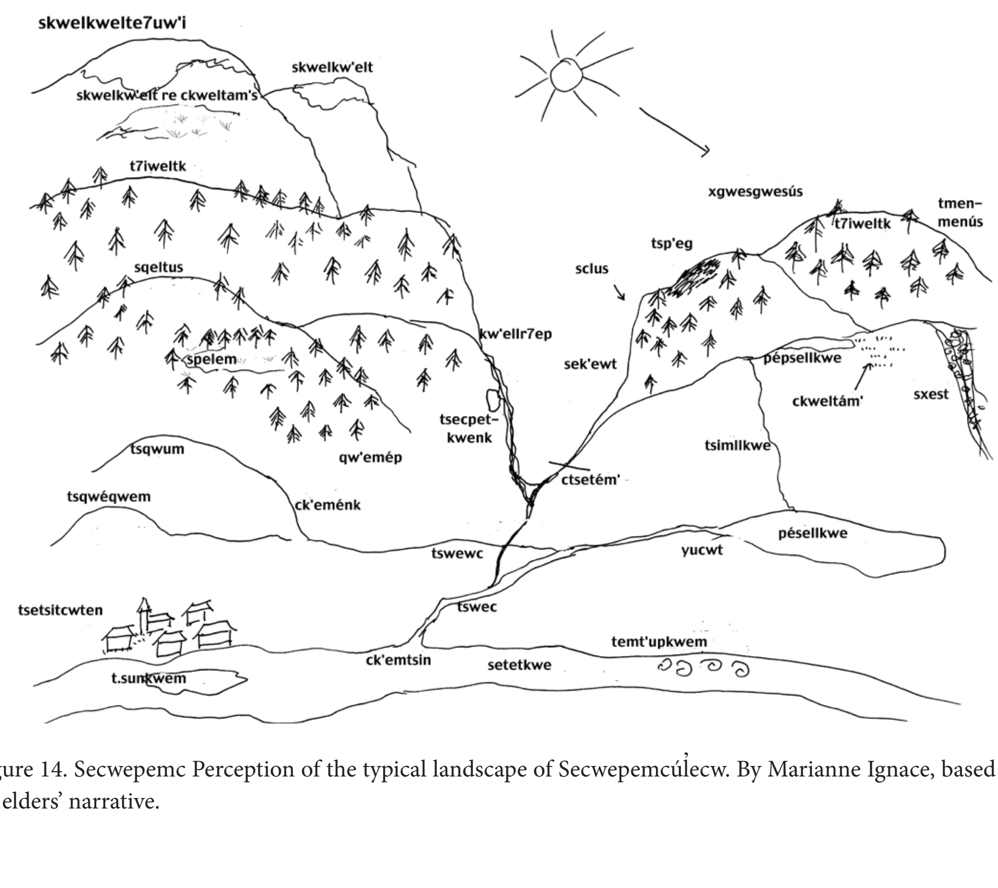

Figure 14. Secwepemc Perception of the typical landscape of Secwepemcúl̓ecw. By Marianne Ignace, based on elders' narrative.

Table 3. Secwépemc Landscape Terms (Generic Toponyms).

Landscape terms	
skwelk̓welte7úw̓i	Alpine area—***’kwelt*** = pl. redup. + ***uw’i*** “par excellence”
skwelk̓wélt re ckweltám̓s	alpine meadow (literally)
t7íweltk	on the high plateau, in the mountains
sqeltús	Mountain—***s*** + ***qel*** + ***t*** + ***-us*** = face
tsqwum	hill—a mound, domed shape—***ts*** = perpetual + ***qwm*** = mound shape + activity
tsqwéqwem	little hill; a knoll—***ts*** = perpetual + mound + reduplication for diminutitve + activity
spélem	prairie, clearing—***s*** = nominalizer + pel (root) + activity
ckweltám̓	meadow; green + bottom of valley—***c*** = inside + ***kwel*** = green + ***tam̓*** = bottom, valley
k̓wellr7ép	waterfall; underneath of where it stands up—***k’well*** = underneath, among + ***r7ep*** = stand up vertically
tsecpetkwénk	Cave—***tsec***-perpetual + ***petkw*** = hole + ***enk*** = belly-shaped
ck̓menk	sidehill—***c*** = inside of + ***k’em*** = two things coming together at an angle + -***enk*** = belly/curved shape
sek̓éwt	gully, canyon—***sek̓*** / + ***ewt*** = animal back (i.e., not upright ridge but horizontal ridge)
tsp̓eg	***ts*** = perpetual + ***p̓eg*** = burnt off area on the mountain-side (through landscape burning)
sxest	rock-slide—***s***-nominalizer + ***xest*** = rocky
xgwesgwesús	sunny side/south side (of a mountain) ***gwes*** = sun shines on a place
tmenmenús	shady side/north side of mountain—***men*** = shadow; —***us*** = face of
ctsetém̓	valley—***c*** = inside of; ***tset*** = ? + ***tem̓*** = at the bottom of
pésellkwe	lake—this seems to come from ***sewllkwe*** = water + ***pes***/***pell*** = “has”
pépsellkwe	little lake—consonant reduplicated form of ***pésellkwe***
yucwt	out-flow, drainage creek of lake—the root ***yucw***—indicates the flushing out of something from above. The Northern Secwépemc also use the term ***yucwt*** to talk about giving birth (otherwise ***k̓ult*** in Secwépemctsin), thus indicating the flushing out movement of a child out of the womb.
ctsímllkwe	melt-water run-off—***c*** = inside, ***tsim*** = melt + ***ll*** = perpetual? + ***kwe*** = water
ck̓emtsín	mouth of river—***c*** = inside + ***k̓em*** = two surfaces come together at an angle + ***tsin*** = mouth
setétkwe	river—this may derive from an “unduplication” and de-glottalization of ***set̓***, the word for a deep canyon river (e.g., mid-Fraser River, Chilcotin Canyon).
t.súnkwem	island
tswec, tswewc	creek, small creek
q̓wemtsín	shore—***q̓wem*** = edge + ***tsin*** = mouth
Lexical Suffixe (Kuipers 1974)	*Several lexical suffixes that occur in place names and names for geographic features derive from lexical suffixes that denote parts of the human or animal body:*
-qin	head, at the top of; dome-shape at the top
-ekst	shape of hand with fingers

Table 3 continued.

Landscape terms	
-tsin	mouth (of a creek into a river)
-eqs	nose (nose-shape)
-us	face; a steep edge or side of a mountain
-éles	Shoulder
-íken/-ikeṅ	back (ridge of a mountain)
-éws	middle, waist, side, elevated surface
-enk	belly shaped, vertically curved, like a round hill-side
-ep	at the bottom of
-upe7	tail, bottom end
-ups	pointed buttock shape; confluence
Other lexical suffixes	*These prominently occur in place names and gene:*
-éllile	bushy area
-éscen	Rock, mineral
-étkwe/kwe	water
-ewt	place, position
-min/min'	instrumental: place where you do something *with* something
-taṁ/teṁ	valley bottom; inside underneath (as in a pithouse)
-ten	instrumental: place where you do something; place for x

In addition, it lists the set of lexical suffixes commonly used for landforms, among them several lexical suffixes derived from human body part suffixes used metaphorically to designate shapes in the landscape. It also lists several lexical suffixes that specifically pertain to landscape forms.

Specific Toponyms—Place Names

Specific Secwepemc place names identify specific locations within Secwepemcúl̓ecw, and connect geographic locations with memories of past events that occurred there, and with knowledge of environment and landscape. They anchor Secwepemc history in the land (see Palmer 2005), including its landscape, in ways that connect people to the history of long ago. They provide oral maps of the land, as past tricksters and transformers like ***Sk̓elép, Qweq̓wíle***, and ***Tll̓i7sa*** and his brothers (see Ignace 2008) shaped it. Many place names throughout Secwepemcúl̓ecw still remind present generations of what happened there long time ago during the travels of the transformers, although sadly, the features on the land left by the transformers have been destroyed or defaced in some instances.

Other place names, such as ***Sekewemctét7us, Tsq̓elentwécwten, Kélentem, Snine7éllcw,*** or ***Tseq.qin*** commemorate more recent events of warfare and altercations between Secwépemc and outsiders, often through mere allusion to what happened, thus inviting the stories to be retold again and again, to keep the events in memory.

Figure 15. ***Sq̓ásca***, known as Hoffman's Bluff in English, where the transformer Tlli7sa vanquished a supernatural marmot. Photo by Marianne Ignace.

During his geological survey of the Interior in the 1880s, George M. Dawson (1892) recorded some 220 Interior Salish place names, many of which he subsequently entered onto his topographic maps of the BC Interior. During various research projects led by Marianne Ignace, Ron Ignace and other researchers in Secwépemc communities and for the Shuswap Nation Tribal Council, further place names were recorded since the late 1980s. Dawson's 220 names represent but a very small portion (probably less than 10%) of the names that Secwepemc people had for places in ***Secwepemcúl̓ecw*** when Europeans came into the land.

Anthropologist Keith Basso reminded us that the connection between places, naming, stories, remembering, and imagining is not only about the past, but about the present and future:

> It is clear [however] that remembering often provides a basis for imagining. What is remembered about a particular place - including, prominently, verbal and visual accounts of what has transpired there – guides and constrains how it will be imagined by delimiting a field of workable possibilities. These possibilities are then exploited by acts of conjecture and speculation which build upon them and go beyond them to create possibilities of a new and original sort, thus producing a fresh and expanded picture of how things might have been. Essentially then, instances of place-making consist in the adventitious fleshing out of historical material that culminated in a posited state of affairs, a particular universe of objects and events—in short, a *place world*—wherein portions of the past are brought into being (Basso 1996:6).

As our people lived and travelled throughout our lands, they made history not only by naming places of heroic events; in addition, they named places after the resources, including game, fish, and plants, they knew they could harvest there: ***Pellcílcel*** ("has silverweed") reminds us of the occurrence of an important indigenous root plant, *Potentilla anserina*. ***Pellskwenkwinem*** reminds us of the Indian potatoes (*Claytonia lanceolata*) associated with this place, although it has become ranchland and homesteads devoid of *Claytonia*. ***Pellqweq̓wile*** ("has desert parsley," qweq̓wile) is the name for the flats near the mouth of Tranquille River west of Kamloops, but several decades ago the site became a large tuberculosis sanatorium, and the desert parsley is long gone. ***Ts'otinéntkwe***, "rattlesnake lake;" ***Pestsets'úye***, "has porcupines;" and ***Pelltnilmen***, "has false hellebore," are further examples of place names that give clues to past animals and plants found there, although, with logging, mining, urban development, and other changes to the land, these resources have disappeared especially from the areas in the path of settler society.

Yet other place names give hints about what we ***DO*** there, referring to the plants and animals we harvested in strategic, ecologically suitable locations: ***Cllumim̓en*** ("stabbing place") is our harpooning place across from the mouth of Deadman's Creek; ***C7emtsin̓ten*** on the North Thompson near Clearwater is the place where people "sat at the shore" catching Spring salmon. ***C7emtústen*** is a cliff where people did their étsxem or guardian spirit questing. ***K̓écse7ten***, "drying meat place"

Figure 16. ***Pellqweq̓wíle*** today (2015). The slopes above the mouth of Tranquille Creek near Kamloops were once a valued harvesting area for large fruited desert parsley (***qweq̓wile***, *Lomatium macrocarpum*). When a sanatorium was established here in the early 1900s, the site was re-planted with European trees, shrubs, and other non-native plants. After it closed down in 1983, introduced weeds also became prominent and little is left of its native flora. Photo by Marianne Ignace.

is a place at the northern boundary of Skeetchestn reserve where, on a southern exposure, our people dried the meat from their fall hunting. It was also a village site, as several depressions still show us, and a tool-making area, as the evidence of large amounts of lithic flakes on the flat at ***K̓écse7ten*** show. It is in the shorthand of the mere allusion to activities, that we remember among ourselves what our ancestors did there, and what we should continue to do there.

The names of these places connect the past with the present, not only pointing to how we used resources since time immemorial, but also reminding us of our history of dispossession. As the resources have disappeared, giving way to logging, mining, and urban development, we continue to remember what we did there, as long as we keep telling those stories. The effects of colonization and dispossession, and the struggle to overcome them by fighting for our rights get flesh from the memories of what we did on our land. As our chiefs told the Minister of the Interior, Frank Oliver, in 1911, asking him to settle the land question,

> If a person takes possession of something belonging to you, surely you know it, and he knows it, and land is a thing which cannot be taken away, and hidden. We see it constantly, and everything done with it must be more or less in view (Memorial to Frank Oliver 1911).

Finally, in conjunction with terms for geographic features, many place names give visual and relational clues to the shapes of geographical features and serve as a way in which, for countless generations, our ancestors oriented themselves in a landscape that had similar and predictable ecological and geological features throughout. There is history in this: As our people, over thousands of years, learned to use, know, and find their way in the environment during their seasonal rounds, the names for landscape features came to evoke memories and sentiments for the contours, the smells, the activities associated with the land, and of course the previous generations who experienced that landscape.

Certain place names that refer not to generic features but precise spots on the land are ways to commemorate distinct and particular places in the landscape, according to things that happened in this place, or the resources harvested at this location. Many, if not the majority of, Secwépemc place names employ the opportunities offered by roots, prefixes, and suffixes to indicate particular places in Secwépemc territory by their geological shapes, the habitat of plants and animals, and in the end the memories of ancestors traveling this land that they evoke among those of us who can relate to that, or learn it. In short, our sense of ***Secwpemcúl̓ecw*** as organized in place-names and land-forms, is tied up in our aesthetic experience of shapes, and in the memories of living and traveling in a landscape of aesthetically organized shapes, and thus in our sense of history. Here are some examples:

The Secwépemc word for Kamloops, ***Tk̓emlúps***, usually translated as "confluence" or "meeting of the waters," has a visually vivid and interesting meaning, and gives us clues about our ancestors' perception of shape and space: ***t*** = on top of; ***k̓em*** = two things coming together at an angle; + ***l/ll*** = perpetual + ***ups*** = pointed buttocks. The word invokes the kind of young girl buttocks shape that our ancestors saw in the very shape of the confluence of the North and South Thompson Rivers, still visible from either a bird's eye, or an air plane, or, staying on land, from the vantage point of what is now the Panorama Hotel in Kamloops. ***Tk̓emlúps***, the village at the confluence, more recently the "rez", in turn, has been the "meeting place" where Secwépemc from different communities congregated, traded, camped among relatives and friends, and later met white people.

Our favorites among place names in our community's surroundings are the terms that evoke travel, landscape and the very intricacies of our language. The place name ***Pet̓mém̓nus*** (***pet̓*** = to come out into the open + ***men̓*** = instrumental/ something you use to do something with + ***-us*** = the face of)—marks the place near the northeast boundary of the Skeetchestn reserve, where our ancestors "came out into the open" as the valley opened up when they left the community and began to travel "up the valley." As we noted above, there was joy in coming home off the mountains: The valley of our community is a long, narrow, north-south valley framed by two mid-elevation mountain ridges. Our elder Christine Simon has called the Deadman Creek valley and its east and west ridges the "arms that stretch out to us when we come home into our valley from travels." Those ridges draw us home, and every side-hill reminds us of traveling there in the company of people who told us their stories of the land.

Another place name that bears this deeply embedded, complex connection with the past is ***Ck̓emqenétkwe*** (see Figure 5, Chapter 1), in English referred to as Scheidam Flats, after its initial pre-emptor. It is a place above ***Tk̓emlúps*** whose name evokes its geographic features: the flat, head shape at the top, where two things (bodies of water) come together at an angle (***c*** = inside of

Figure 17. ***Tk̓emlúps***—the Confluence of North and South Thompson Rivers. The Tk̓emlupsemc te Secwepemc (Kamloops Indian Band) reserve is in the centre, surrounded by the city of Kamloops on the north and south shores of the river. Photo by Marianne Ignace.

+ ***k̓em*** = where two things come together at an angle + ***qen*** = head + ***etkwe*** = water). There is no better way, including in many subordinate sentences in English, to describe what ***Ck̓emqenétkwe*** portrays: A place, and once you are there, you are on the inside of it as it extends before you, and it features the coming together of waters (creeks) at an angle, and it is on top, above other places. In tightly compressed visual images, it marks the coming together of creeks (Coal Creek and Paul Creek) to form the "water tap" of the ***Tk̓emlúpsemc.*** Beyond the tight-knit image of its strategic geography that is commemorated in the place name, ***Ck̓emqenétkwe*** also commemorates our people's connection to land and our people's history of resisting settlers' appropriation. Like so many European settler names in our lands, its English name Scheidam Flats bears the mark of the settler, the European pre-emptor who quickly left his mark on the landscape – but left to sell his interests for profit in the 1860s, as our people struggled to have lands allocated that would sustain us, let alone never wavering about not having surrendered the rest of our lands. Chief Louis ***Clexlíxqen***, Chief of the ***Tk̓emlúpsemc*** between the 1850s and until his death in 1915, continually alerted provincial and federal governments to the fact that ***Ck̓emqenétkwe*** represented the "hole in the table" of the ***Tk̓emlúpsemc***. Based on his unwaivering raising of this issue, and Kamloops Indian Band's pursuit of its title to this land, the Band was eventually able to re-incorporate ***Ck̓emqenétkwe*** into its reserve. A good part of the land dispute surrounding it did not involve the few acres that Kamloops Indian Band members successfully argued they had continued to occupy, graze their animals on, and live, camp, and exist there. Indeed, it involved the Kamloops people insisting on their water rights, and the integrity of their watershed.

Figure 18. ***Petm̓émnus***—where the valley opens at Skeetchestn. Photo by Marianne Ignace.

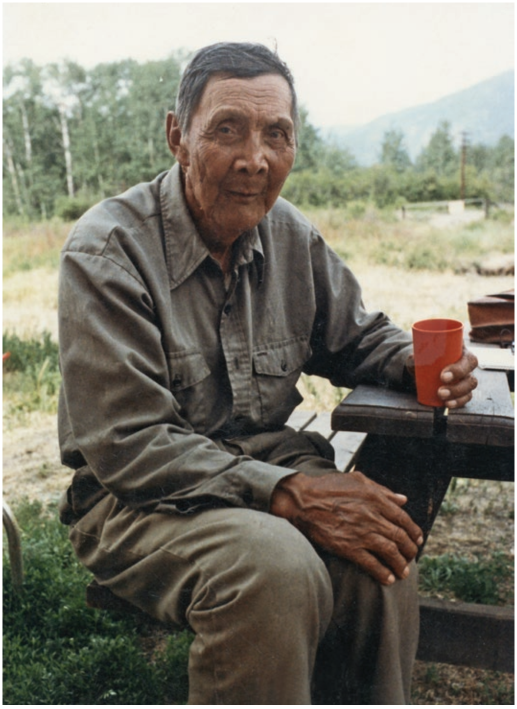

Figure 19. Simpcw elder Chris Donald, 1985. Photo by Marianne Ignace.

Place names, thus, are inextricably linked to the geography but also history of specific places. More than this, they are connected to travel on the land. In the mid-1980s, the late Chris Donald from ***Simpcw*** (North Thompson) approached the topic of place names in the North Thompson valleys and mountains by going on a mental journey from the reserve at Chu Chua up the North Thompson River to its upper reaches and to Mount Robson, naming places along the way. This was later followed by physical journeys where he reiterated the names for places, and remembered additional ones. His sense of naming the land consisted of identifying a chain of place names throughout his familiar territory, accompanied by the stories of resources, wars, hunting and trapping expeditions, mishaps that had happened to past individuals, shapes of the landscapes that give meaning to the names. Likewise, Andie Diane Palmer (2005) has shown how the Secwépemc elders at ***Esk̓ét*** used narratives of personal and historical experience on the land to provide oral and mental maps corresponding to the landscape.

Toponymy, in its connection to geographic and ecological knowledge and experience, and to the memories of past generations' experiences on the land, represents an indigenous concept of *deeds* to land: Place names, not as isolated spots but in the chain of "connected dots" they represent, confirm not only our emotional and historical connection to land, but are our evidence of *owning* the land we call ***Secwpemcúl̓ecw***, and having *title* to our land, as our ancestors continued to claim once they were shut out of our own lands in the latter half of the nineteenth century.

Oh, re sekseke̓́wt, re pespésellkwe,
Oh, the gullies, the lakes,

K̓elél̓nmentiye re iswell.
Listen to the loon

Oh, cmump-ken nukw.
I am so lonesome (i.e. homesick).

Yerí7 re spút̓em-kt te sek̓éwt,
Here we come out of the gully.

Yerí7 re skitsc-kt ne setétkwe.
Here we arrive at the river.

Ne7élye me7 yístet.
This is where we camp.
(from Secwépemc anthem by Nels Mitchell from Tk̓emlúps)

Figure 20. The late Nels Mitchell from Tk̓emlúps. He was a well known singer and storyteller, and recordings of his Secwepemc songs are well known throughout the Nation.

In explaining and feeling the Secwépemc connection to our land, the above words of deceased elder and singer Nels Mitchell come to mind. His songs connect Secwépemc people who know and remember the landscape and traditional seasonal round in its connection to our land, our resources, our experience of the landscape and its places, and, as we maintain, our *deed* to that land. Away from the mountains, river, and lakes while performing this song as it was recorded on tape, Nels Mitchell also expressed his loneliness or homesickness, connecting it at the same time to the memory of the haunting call of the loon. Like the sparse language of the stories that are aimed at an audience that knows the land, Nels Mitchell's lines have an economy of language: He mentions and thereby evokes memories and images of the most salient features of the Plateau landscape: the river (***setétkwe***), the gullies (***seksek̓éwt)***, the small lakes (***pespésellkwe***) are all prominent features of the higher plateaus. They also are the habitat of loons. As the lines and the song proceed, he imagines riding down the mountain like the many generations before him when they came home through the gullies from plant gathering and hunting, eventually descending to the river, where the village is, where home is.

Notes

1. Translation: "Our activities on the land."
2. Moose did not arrive in the south-central Interior until the early part of the twentieth century, and since that time have become an important resource to our people.
3. To mind comes the Secwepemc story of "Coyote and His Hosts," where Beaver serves Coyote "bark" to feast him. In this case the bark or cambium is that of Ponderosa Pine, although at least in Secwepemc people's recent generations, lodgepole pine cambium, derived from higher elevations, is the preferred kind. The recent Mountain Pine Beetle infestation in the forests of the Interior has wreaked havoc with our supply of cambium. Until the large "wildfires" in the Interior of BC in 2003, the British Columbia Ministry of Forests had for decades denounced and criminalized our ancient fire management regimes, to the extent that young people have not been raised in the intricate science of landscape burning. Ron Ignace was for-

tunate to have learned some of these techniques from his great-grandfather and other elders who raised him.

4. The names of Secwépemc months expressing the seasonal round were re-elicited by Marianne Ignace and Ron Ignace with various elders between 1992 and 1997, and cross-checked with versions of the Secwépemc calendar recorded a century earlier by George M. Dawson (Dawson 1892) and James Teit (1909). After that, this reconstructed Secwépemc calendar was included in various editions of annual print calendars issued by the Secwépemc Cultural Education Society Language Department during the late 1990s, and has been included in school and university course curricula.
5. While the Sparrow decision (1991) has been upheld in Canadian courts, nonetheless at lower courts, the Canadian government, represented by the Department of Fisheries and Oceans and the Department of Justice, has sought to constrain the Secwepemc aboriginal right to fish, asking to limit it to fishing at or near local reserves, rather than according to the collective right to fish anywhere in Secwepemcul'ecw asserted by the Secwepemc according to traditional laws and protocols of access and land tenure.
6. In her excellent work Maps of Experience (2005), based on her PhD dissertation researched among Esk̓étemc (Alkali Lake Secwepemc), Andie Diane Palmer (2005) discusses how the Northern Secwépemc sense of place is articulated in discourse, as she travelled with elders and friends to and between berry picking locations and remembered places. While Palmer does not include a detailed discussion of the way we speak about the landscape, we see our discussion here as adding to her work.
7. See Marsden (2008) for a discussion of the concept of deed in Gitksan and Tsimshian adaawx or oral histories.

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Chapter 3. Archaeological Approaches to Long-term Secwépemc Plant Use in the Interior Plateau, British Columbia

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Abstract

This chapter describes the evidence of past Secwépemc plant used derived from more than a decade of archaeological investigations at a series of open-air sites located on the floodplain and terraces of the South Thompson River on the Kamloops Indian Reserve. A systematic survey uncovered 60 archaeological sites spanning more than 6,000 years. Intensive testing, excavations, and archaeobotanical analyses were conducted at four of these sites: EeRb 130, 140, 144, and 149. Researchers identified a variety of seeds and other botanical remains associated with plant collecting and processing, cache pits associated with food storage, and significant quantities of birch bark, thought to represent the manufacture of a variety of items. Recovery of organic materials from these dry, open sites was far greater than expected and demonstrates that archaeobotanical data, if systematically collected from a range of contexts, can provide new, more complete insights into an array of activities—particularly those of women—associated with past Secwépemc land and resource use.

Keywords: *Archaeobotany, systematic sampling, open-air sites, plant processing, Secwepemc heritage resources, Plateau archaeology*

Introduction

> At last Old-One came to the woman, who was sitting looking at the ground, and asked her what she was gazing at. She, also, answered in the same manner as the men had done. He told her to shut her eyes, and, when she opened them again, a large plant had grown up before her. He asked her to go to the birch tree, and, after saying to it, "O friend! I require you," to strip off its bark. This she did, brought the bark to him, and he rolled the plant in it. Now he told her to travel along the hillside, and throw away pieces of the plant. She did as

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> directed, and, each time she put her hand in the roll, she pulled out a different kind of bulb or seed. Thus she sowed all the different kinds of plants used by the Indians for food or medicine; and from these sprang up many, and they spread over the whole country… When the plants had all been distributed, Old-One made the roll of bark into a basket. Henceforth… women will dig roots, and make baskets (recorded by James Teit 1912:326–327).

The pre-contact history of the Interior Plateau in British Columbia is best known from the numerous pithouse villages that are found along the major rivers and lakes of the Interior Plateau. These sites represent a seasonally sedentary way of life, revolving around annual runs of salmon, that dates to within the last 4,500 years or so (Richards and Rousseau 1987). In part, because these sites are relatively easy to find—one can literally fall into a house pit—the archaeological record in this region is accordingly skewed to a temporally and spatially restricted view of past human land use.

What was going on with non-sedentary hunter-gatherers on the Interior Plateau before 4,500 years ago and away from the flood plains in terms of their subsistence practices and land-use patterns? To this end, extensive and systematic archaeological and archaeobotanical investigations were conducted annually between 1991 and 2004 by the Secwépemc Cultural Education Society-Simon Fraser University (SCES-SFU) Archaeology Field School under the direction of George Nicholas. Fieldwork focused on the glacial lake terraces above the South Thompson River on the Kamloops Indian Reserve (see Nicholas 1997, 2009; Nicholas and Tryon 1999) and on the adjacent floodplain (Nicholas 1999, 2002). These studies are expanding and refining our knowledge of past lifeways in the Interior Plateau, as well as filling in gaps in that knowledge, such as relating to plants.

Evidence of plant use by the Secwépemc and other Interior Plateau peoples is relatively well documented in both traditional knowledge sources and ethnographic accounts (e.g., Alexander 1992a, 1992b; Peacock 1998, 2002; Teit 1909; Turner 1988; Turner and Peacock 1995; also see other chapters in this volume). The big unknown in this regard, however, is the antiquity of some of the plant uses recorded in these accounts (although archaeological studies reveal use of earth ovens in the Kamloops area by about 2,400 years ago [Peacock 2002]). There are several reasons for this. First, cultural systems are dynamic, and whether by cultural preference or personal choice, changes in diet, resource selection, and resource use did occur over time. Second, the environment of the Interior Plateau has itself changed appreciably over time (Hebda 1982, 1995), with shifts in climatic regime, precipitation patterns, and extent of forest cover undoubtedly influencing local plant availability, quality, and quantity. Archaeological investigations therefore provide an important means to illuminate not only practices of plant use at any point in time, but also the processes by which those patterns changed over time—both of which may differ from those of the historic Sécwepemc.

One of the principal goals of the archaeological investigations directed by Nicholas has been to intensively explore these issues in one small portion of the Secwépemc homeland. Our field investigations to date have revealed an archaeological record of considerable antiquity based on an assessment of 60 archaeological sites identified and tested by the SCES-SFU Archaeology Field

School on the Kamloops Indian Reserve, plus other sites previously known in this area. This study reveals a relatively continuous record of human land-use for the period both before and after people settled into pithouse villages, as well as seasonal and special activity sites associated with nearby pithouse villages when those were occupied. These sites range in age from just several hundred years ago to over 6,000 radiocarbon years (and perhaps to as much as 8,000 or 9,000 years ago based on diagnostic artifact styles). Some are large, multi-purpose, and reoccupied sites at lower to intermediate elevations, others are small, special purpose sites at higher elevations. Overall, a very good sample of local land-use data representing a significant amount of time is thus available.

What is the evidence of plant use at these sites? And to what degree does it reflect the patterns known today? Information contained in ethnographic accounts provides at least a reflection of plant use during the later prehistoric period. For example, in 1899, Charles Hill-Tout (in Maud 1978:58) wrote of the Nlaka'pamux (Thompson) people:

> The summer dwellings were extremely simple, consisting merely of a framework of light poles covered with mats or wattling, and all cooking was done in the open air. The food supplies of the central Thompson were invariably stored in caches, i.e., holes in the ground, which were roofed with poles or boards, and then again covered with earth or sand. The food was commonly protected by bark. Remains of these caches or cellars, with rolls of birch bark and other bark in them, may be seen at any of the old camp sites. [Many of these are now filled with sand to the level of the surrounding ground.]

Similar observations are found elsewhere in both ethnographic and traditional ecological knowledge accounts. Archaeological studies also conducted a century ago reveal evidence of plant use, such as a wood-covered burial excavated by Harlan Smith (1900) (see below). Unfortunately, the record of early archaeological work is not only sparse, but also lacking in the rigor of contemporary methodology. Generally very little is thus known about how cache pits, for extample, were actually constructed, although the impression one gets from accounts like Hill-Tout's is that they were relatively simple affairs. Writing of the Shuswap, James Teit (1909:495) does note their effectiveness for storage:

> The most common cache, especially among the southern bands, was the circular cellar, as among the Thompson tribe. Probably they were most used in the south because of the dryness of the climate and the sandy nature of the soil. Fish and other food kept fresher in them than in any other kind of cache.

Systematic, problem-oriented archaeological field studies provide the most direct means to increase our knowledge of pre-ethnographic period plant use. This evidence may take several forms, including: *artifacts*, such as grinding stones that may have been used to process seeds, roots, and other foods; *features*, such as hearths and storage pits; *macrofossils*, ranging in size from large pieces of wood or bark to small seeds; and *microfossils*, such as pollen grains, spores, or phytoliths. Generally, very little investigation oriented towards recovering evidence of plant use has been instigated in the Interior Plateau, but this is changing. Such work as Lepofsky et al.'s (1996) identification of the plant remains from pithouses at the Keatley Creek site, near Lillooet, and various studies of roasting pits near Cache Creek (Pokotylo and Froese 1983) and Kamloops (Peacock 1998, 2002) clearly indicate the potential for recovering organic materials or identifying processing areas. Away from the relatively obvious roasting pits and pithouse villages, however, there has been virtually no systematic exploration of the potential for plant materials in the Interior Plateau region. Yet, as Lepofsky and Peacock (2004) argue, an understanding of the role of plant foods is vital to understanding the nature of Plateau social, economic, and demographic patterning.

This chapter describes evidence of past Secwépemc plant use derived from archaeological investigations conducted by Nicholas and colleagues on the Kamloops Indian Reserve between 1991 and 2004. The sites tested represent open-air locations not directly associated with pithouse villages or roasting pit areas, and thus provide new information on past Secwépemc land use derived from limited testing at many sites and from extensive excavation of two terrace sites, EeRb 144 and EeRb 140, and one floodplain site, EeRb 77. Here we summarize the archaeological investigations conducted at these and other sites in the project area, and also discuss various archaeobotanical data recovered. The latter includes a summary of research on the plant remains from EeRb 140 by Michèle Wollstonecroft and Gladys Baptiste (2000; also Chapter 4 of this volume), and the preliminary results of studies on the birch bark recovered at EeRb-144 by Leisl Westfall and at EeRb 140 by Nancy Jules.

Research Design

The study of prehistoric Secwépemc plant use reported on here is one component of a more extensive, ongoing study of long-term Secwépemc land use directed by Nicholas. The primary orientation of this project (1991–2004) has been:

1. Systematic survey and testing of late Pleistocene through middle Holocene-aged landforms to locate archaeological sites dating from the initial postglacial colonization of the region to about 4,500 years ago. This work on the glacial lake terraces along the Thompson River valley (Figure 1) should contribute to a better understanding of the poorly known Early and Middle Periods in the southern interior of British Columbia;
2. Investigation of long-term patterns of land use. The results of such studies will determine how the ancestral Secwépemc and utilized the various landscapes that developed within the Thompson River Valley in different ways over the last 10,000 years; and
3. Examination of non-pithouse archaeological sites. The archaeology of the southern interior is dominated by the pithouse villages of the late Holocene. Fieldwork directed to other types of sites will provide a more representative view of the range of lifeways once present.

The tripartite scheme presented here has allowed us to accomplish several things. First, it provided the research focus of a university-based archaeology field school program oriented to First

Figure 1. View of glaciolacustrine terraces (center right), north side of South Thompson River, Kamloops, BC. Photo by George P. Nicholas.

Nations students—the only one of its kind in Canada (Nicholas 1997).[1] Second, it has contributed scientific knowledge to illuminate the long human occupation of the region, supplementing or expanding traditional Secwépemc knowledge through archaeology. Finally, it has provided archaeological information that contemporary Secwépemc people can utilize, in conjunction with oral traditions, to write their own history.

One other dimension of this project is notable. Beginning in 1991, Nicholas worked closely with the Kamloops Indian Band in identifying archaeological sites throughout the reserve to help them address their ongoing land-use needs. This led to mitigative work in several parts of the reserve, including all of the work reported here. In 1996, the Kamloops Indian Band (now Tk̓emlups te Secwepemc Indian Band) and the Sun Rivers Corporation began a joint venture to develop a large housing development and golf course on the terraces above the KIB Administrative Centre. This is the area that the SCES-SFU field school worked on between 1991 and 2004. Subsequently, Nicholas intensified field investigations at EeRb 130, 140, and 144. The Kamloops Indian Band recognized the importance of these sites, and for several years, provided a moratorium on disturbance on EeRb 140 and 144. Also, as part of the mitigation of the Sun Rivers Development area, the Kamloops Indian Band instigated a separate intensive site survey and testing program of Sun Rivers Development area, which was conducted by the Bastion Group in 1996. That study verified all of the sites we had previously identified and mapped, and located only two additional, very small lithic scatter sites (Monty Mitchell, pers. comm. 1996).

Research Challenges and Opportunities

Although plant harvesting for food, medicine, and utilitarian purposes has had a vital role within the Plateau culture area (Hunn et al. 1998; Turner 1997; Turner et al. 1980, 1990), archaeological indicators of plant use are sparse. This is, to some degree, due to problems of preservation, but far more so to the absence of archaeobotanical sampling (Lepofsky 2004). However, as our work at EeRb-140 and 144 demonstrates, preservation may be remarkably good, at least at some Interior Plateau sites. Until the issue of inadequate sampling has been addressed, our understanding of past lifeways in this region will remain incomplete.

Even more fundamental has been a bias in archaeological practices towards presumed male-oriented activities (e.g., hunting, tool manufacture). There are a variety of reasons for this (see Gero and Conkey 1991; Nelson 2006 for overviews), but what is notable here is that historically little attention has been paid to women's activities. This has not only made women largely invisible in the archaeological record, but also relegated to the background the crucial contributions of plant foods and resources in hunting and gathering societies (Hunn 1991; Kelly 1995). Fortunately, in the past two decades there have been concerted efforts to make approaches to, and interpretations of the archaeological data more representative by demonstrating, amongst other things, the role of women in tool manufacturing (e.g., Gero 1991) and plant domestication (e.g., Watson and Kennedy 1998). In the Interior Plateau, such efforts bring the archaeological record more in line with what is expected ethnographically (e.g., Peacock 2002). At the same time, we also need to be cautious of the ethnographic record (Wobst 1978), especially with increasing time, as there may be certain social or economic behaviors or technologies that have no ethnographic correlates.

A primary goal of paleoethnobotany is to link the archaeological record to the ethnobotanical practices and knowledge utilized by people in the past and, in turn, to link these to the ethnographic present to identify similarities and differences (see Gremillion 1997; Hastorf and Popper 1988). Underlying this study is the desire to determine how far into the past the ethnographic pattern is visible, and to identify any pre-contact Secwépemc plant use that is ethnographically unknown. We also hope to identify evidence of divergence or changes in Secwépemc plant use. Although our investigations are far from complete, it is evident that the sites discovered and samples collected are already yielding important insights. In sum, the key elements of the research design of this project have been designed to contribute to an archaeology that is more representative of the variety of past lifeways once present in this region and more relevant to the living descendants of those earlier peoples.

Description and History of Project Area

The focus of the archaeological investigations discussed here has been the glaciolacustrine terraces located on the north side of the South Thompson River on the Kamloops Indian Reserve (Figures 1 and 2). These terraces were created during the late glacial period following the drainage of the lakes that had formed in this valley during the late Pleistocene. While the history of the glacial lake sequence outlined by Fulton (1969) and others has not been dated per se, Johnsen and Brennand's (2004) more recent study suggests one major drainage episode happened before 10,210–9740 BP (2004:1380). More generally, it has been presumed on the basis of several pollen diagrams that the sequence of successive lake stages ended by perhaps 11,500 to 11,000 years ago, or even earlier (Richard Hebda, pers. comm. 1996). Work by Carlson and Klein (1996) on partially fossilized salmon from Kamloops Lake, however, hints at ice-free conditions in Kamloops between 18,000

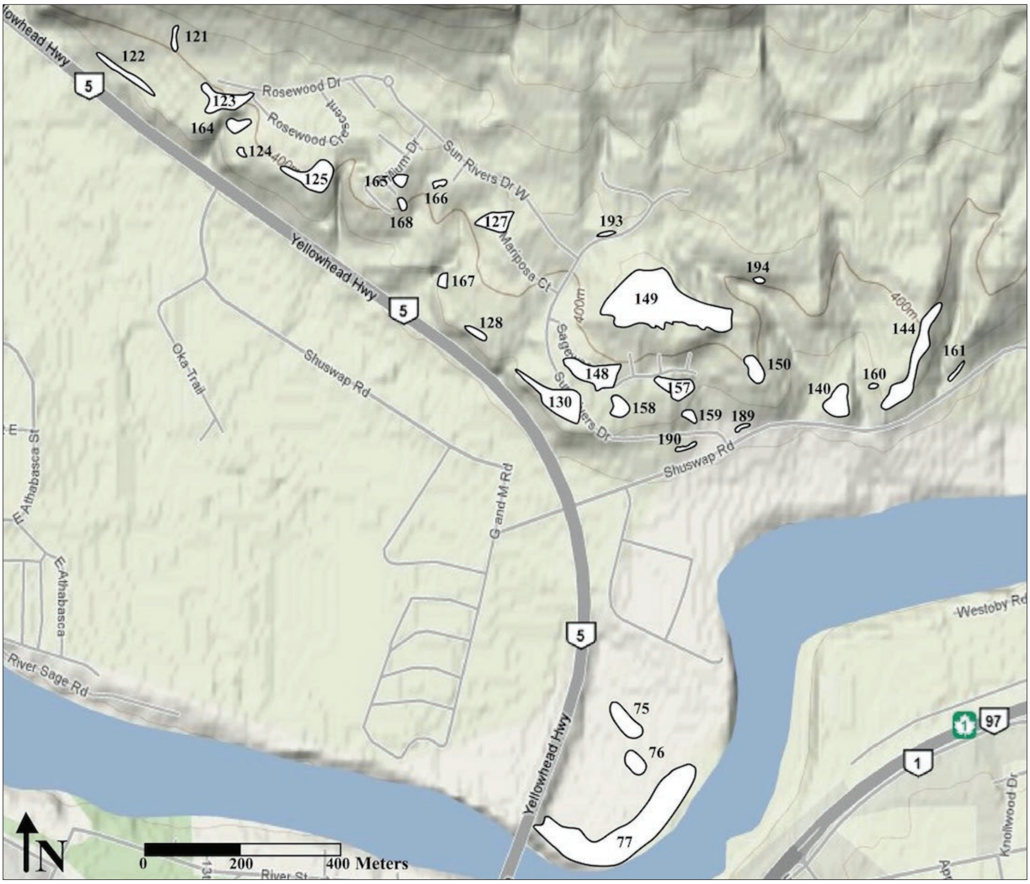


Figure 2. Distribution of archaeological sites on lower terraces, western project area, identified by the SCES-SFU Archaeology Field School. Map by George P. Nicholas.

and 16,000 years ago. Once the valley became ice-free, the developing Thompson River system began to down-cut and meander across the former lakebed. The result was the creation of the current Thompson Valley landscape, consisting of the contemporary flood plain, bordered by intermediate and high terraces[2] (the former lake bottoms) that flank both sides of the South Thompson River valley. These terraces consist of glaciolacustrine fine silts and sands deposited into the glacial lake that once existed at this location, and are capped by aeolian sediments. Deeply incised intermittent stream channels that run roughly perpendicular to the course of the river transect these terraces.

The vegetation of this area has changed significantly over the course of the last 10,000 years. According to Hebda (1982, 1995), forests consisting of pine (*Pinus* spp.), alder (*Alnus* spp.), and poplar (*Populus* spp.) developed in the southern British Columbia interior under cool and moist conditions between 12,000 and 10,000 BP (before present) in upland areas, while sagebrush (*Artemisia tridentata*) and grasses were present throughout the valleys. Around 10,500 BP, conditions began to change due to a prolonged, continent-wide climatic episode known as the Hypsithermal, when conditions were warmer and dryer than today. Pine populations declined, while Douglas-fir (*Pseudotsuga menziesii*), grasses, and sagebrush all increased. By about 7000 BP, conditions became progressively cooler and wetter. Subsequently, grasslands decreased in extent, and sagebrush became less abundant; Douglas-fir and Ponderosa Pine (*Pinus ponderosa*) became the primary forest species. After about 4,500 years ago, modern climatic conditions were established.

Culture History

The culture history of the Interior Plateau is now relatively well known, based on the work of Richards and Rousseau (1987), Rousseau (2004), Sanger (1969), Stryd and Rousseau (1996), Wilson and Carlson (1980), and many others. The basic sequence is divided into the Early, Middle, and Late Periods.

The Early Period dates from early postglacial human colonization to about 7,000 years ago, generally coinciding with the end of the Hypsithermal. All five of the known early regional cultural traditions (i.e., Fluted Point, Northwest Coast Microblade, Pebble Tool, Stemmed Point, and Plano [see Carlson 1996]) are represented in the interior (Stryd and Rousseau 1996). Archaeological land-use patterns at this time indicate an orientation to a broad subsistence base focusing on terrestrial resources that included large and small game and other resources, with some fishing (Stryd and Rousseau 1996), as well as, presumably, a range of plant foods. Stable-carbon isotopic values for "Gore Creek Man," at 8400 years BP, the earliest known human skeleton in the Interior, located approximately 30 km to the east of Kamloops, indicate that his diet was based mostly on terrestrial foods, with marine-based protein (i.e., anadromous salmon) making up only 8–10% of the protein in his diet (Chisolm and Nelson 1983). The absence of evidence of plant use at any Early Period sites in British Columbia is undoubtedly the result of poor preservation and the lack of archaeobotanical sampling.

The Middle Period spans the time between the post-Hypsithermal shift towards more modern climatic conditions and the start of the semi-sedentary way of life associated with pithouse villages that began about 5,000 to 4,500 years ago (Rousseau 2004:13; also Huculak 2004). Subsistence patterns are generally similar to those of the preceding period, with a terrestrial orientation; again, riverine resources were exploited but not to the degree evidenced subsequently. While the remains of salmon and other species are found at archaeological sites, the intensity of fishing during this period remains uncertain. Salmon fishing on the Columbia River began to intensify by 6800 BP (Lovell et al. 1986), and may have done the same throughout British Columbia, notably on the Fraser River and its tributaries by or soon after that date. This is supported by isotopic analysis of two skeletons excavated near Clinton that date to about 5000 BP; the results indicate marine protein values of 38% (Chisholm 1986). Again, evidence of plant use during this time is absent.

The Late Period in the Interior Plateau is marked by a significant change in settlement patterns, technology, and subsistence. It is during this period that a heavy reliance upon riverine resources, particularly salmon, becomes evident. Stable-carbon isotopic values of human remains indicate high proportions (40–60%) for marine protein (Lovell et al. 1986). This is contemporaneous with a shift to a semi-sedentary lifestyle associated with riverside pithouse villages (Richards and Rousseau 1987; Stryd and Rousseau 1996). The four recognized divisions in the Late Period in the Kamloops area (Rousseau 2004)—Lochnore Phase (ca. 5000–3500); Shuswap Horizon (about 3500–

2400 BP); Plateau Horizon (2400–1200 BP); and Kamloops Horizon (1200–200 BP)—together constitute the Plateau Pithouse Tradition. The archaeological record of this period is strongly associated with the ethnographic patterns recorded by Boas (1891), Teit (1900, 1909), and other early observers, and by modern ethnobotanists (Turner 1992) and ethnographers (Ignace 1998).

Results of Field Investigations

This section summarizes the primary field methods utilized in this project, including those employed to locate and evaluate archaeological sites, and those used to recover archaeobotanical samples.

Archaeological Field Methods

Four data recovery strategies were employed in the course of investigations within the project area: surface survey and shovel-testing were used to identify sites and provide a preliminary assessment of site dimensions, depth, and possibly antiquity, while site testing and full-scale excavation provide much more extensive and detailed information. These are described briefly below.

Surface Survey

This consisted of a walk-over or examination of a particular area or land form to determine if there is any evidence of cultural materials that may have been left on the surface or exposed by erosion, rodent burrows, plowing, or similar agencies. In this region, such materials usually consist of debris (or debitage) representing stone tool manufacture, repair, or use (e.g., projectile points, cutting and scraping tools, flakes, and partially completed or broken tools) of basalt, chalcedony, chert, jasper, obsidian, and similar lithic materials. Other cultural material or evidence of past occupation includes fire-cracked rock, burnt animal bone, freshwater mussel shell, and evidence of cultural depressions.[3]

Shovel Testing

In areas with low surface visibility, or where there is the potential for buried cultural deposits, shovel test pits (STPs) were used to locate sites and to determine site size, depth, and stratigraphy (layering) of deposits on sites located by surface survey. This is a slow, labor-intensive practice used primarily in areas where archaeological sites are expected (or used to demonstrate their absence). STPs are usually 40 cm^2 in dimension and dug by shovel in 5- or 10-cm level increments to a depth of at least 1 meter. All removed dirt was screened through 3-mm mesh. STPs were normally arranged by transects (lines), with test units placed at regular intervals, most commonly 5 to 10 meters apart. Close-interval testing provides greater control in areas where relatively small sites or features may be located.

Site Evaluative Testing

Site testing involved STPs and/or 1 m^2 excavation units to provide more controlled data recovery on known archaeological sites. Excavation was done by 5 cm levels, with all excavated soils screened. While the final depth of these units was to below the last cultural levels (sometimes only 50 cm), in several terrace sites tested in the project area some units were excavated to a depth of 2 meters, and to over 4 meters at EeRb-77, the floodplain site. Site testing was conducted on a number of sites in the project area, specifically those that had the potential for early prehistoric materials, including EeRb-130, 140, 144, and 149 (see Figure 2). Depending upon the extent of testing, this strategy generally provides the type of information required to determine site significance.

Excavation

This generally involves the excavation of 1 m^2 or 2 m^2 units, often contiguous, on sites for which an intensive and spatially extensive data recovery effort is required. Excavation is a very slow process, and can be potentially very expensive in terms of field time and in the resultant artifact cataloguing and analysis. In those cases where a significant site will be impacted by development, a site may be partially or fully excavated (Figure 3).

Screen mesh size used during excavation was generally finer than that used during site identification and testing stages. Window-screen mesh inserts (0.11 mm) in the screening frames allowed very small materials to be recovered, including minute bones (e.g., fish vertebrae, otoliths) and shell fragments, as well as cultural material such as beads. Excavation of portions of EeRb-140 took place in 1994, 1996, 1997, and 2000; full-scale excavation of EeRb-144 took place from 1997 to 2000, with some additional fieldwork in 2001.

Figure 3. Site excavation underway at EeRb 144 in 1998. Photo by George P. Nicholas.

Archaeobotanical Field Sampling Methods

During the testing and excavation stages of fieldwork, several data recovery techniques were utilized. Some of these are standard, as in the collection of charcoal for radiocarbon dating. Other methods, such as those utilized for flotation samples, were developed for this project (see Wollstonecroft, Chapter 4, this volume).

To assist in the recovery of archaeobotanical remains, matrix samples were routinely taken from all features such as hearths. Samples were originally limited to 3–4 liters of soil removed from the feature; occasionally non-feature matrix material was also collected. These samples were subsequently processed using water flotation (see Pearsall [1989; Pearsall and Hastorf 2011] for review of methods), a technique by which the matrix is removed and two sets of samples are recovered: the "heavy fraction" consisting of materials that do not float (e.g., lithic artifacts and debitage, large bone, and rocks), and the "light fraction" consisting of those that do (e.g., charcoal, seeds, and other organic materials). While the utility of flotation is well documented, it has seldom been practiced in the Interior Plateau.

Between 1991 and 1994, matrix samples were collected and processed using techniques developed at the University of Missouri-Columbia for small-scale sampling (and utilized there by Nicholas). Approximately 325 samples (each about 3 liters), with an estimated total of about 900 liters, were collected from several of the sites then being investigated. Samples were processed in a window screen-lined, open-sided bucket that was immersed in a water-filled garbage can; the light fraction was removed using a fine-meshed tea strainer. The light and heavy fractions were subsequently laid out to dry on labeled sheets of newspaper, and later separated into individual classes of materials (e.g., seeds, charcoal, wood fragments, bone, insect remains). Most of this flotation was done using 0.701 screen mesh, which would not have captured many of the small seeds potentially present. However, larger seeds, such as saskatoon (*Amelanchier alnifolia*) or chokecherry (*Prunus virginiana*), were recovered in these samples from several sites (see below).

Beginning in 1995, archaeobotanical sampling was intensified and processing methods changed as the focus of excavations shifted to those sites that could potentially provide a record of past plant use. Processing methods changed appreciably based on the advice of individuals specializing in archaeobotany, including Cathy D'Andrea, Dana Lepofsky, and Michèle Wollstonecroft (all Simon Fraser University). The sample size at EeRb-140 was increased to 10 liters for every 5 cm level of each unit excavated, including both feature and non-feature units. At this time, only a portion of these samples has been processed and analyzed, given the tons of samples subsequently collected (now stored at the Archaeology Lab, SFU-Burnaby Campus).

Between 1995 and 2001, an estimated 9,000 liters of feature and non-feature matrix were collected. Approximately 1,000 liters from EeRb-140 have now been floated and analyzed; the remaining 7,000 liters were taken from EeRb-144. Flotation and processing of samples from EeRb-144 were undertaken primarily in 1999 (Figure 4). Almost all of the samples collected up to 1999 have been floated, as has a good percentage of those collected in 2000. To date, only light fraction samples recovered from EeRb 140 have been examined.

Figure 4. Flotation machine operated by Laurie Kennedy with Gladys Baptiste collecting samples. Photo by George P. Nicholas.

Summary Findings

Since 1991, more than 60 archaeological sites have been identified by the SCES-SFU Archaeology Field School on the Kamloops Indian Reserve. Approximately half of these are located on or near the lower terraces that overlook the broad floodplain upon which is situated the Kamloops Indian Band governmental center (Figure 2); the remaining sites are located on or adjacent to the high terraces and terrace gullies farther to the east. Based on both radiocarbon dates (Table 1) and diagnostic artifact types (i.e., artifact types or shapes are associated with specific time periods [Figure 5]) the oldest in the project area date to more than 6000 radiocarbon years BP. There are also indications of even earlier occupations at several of the sites, such as the Old Cordilleran-type point at EeRb 144, a style that dates to greater than 8000 BP (Carlson and Magne 2008).

The overall site distribution pattern indicates that this location was the focus of intermittent occupation over a long period of time. The terrace edges appear to have been utilized most frequently and intensively, based on the number and density of sites that we have identified; this patterning may be due to such factors as site function (e.g., hunting observation posts) or habitation criteria (e.g., nice view with a breeze). Sites have also been found well back from the terrace edge, although it appears that the number and density of sites decreases substantially as this distance increases. Water is available in the nearby South Thompson River about a kilometer away and in earlier times possibly by seasonal creeks closer by. Both site size and density diminish significantly once one moves onto the higher terraces, which are less accessible and

Table 1. Project area radiocarbon dates.

Sample	Lab no.	Unit/Depth[1]	Radiocarbon years BP[2]	Material/Association
EeRb-75				
1	Beta 49798	1	3360 ± 70 BP	Freshwater mussel shell midden
EeRb-77				
1	Beta 77134	1: 250 cm	5590 ± 100 BP	charcoal/hearth
EeRb-130				
1	Beta 90602	8: 19 cm	1490 ± 80 BP	charcoal/hearth
EeRb-140				
1	Beta 90603	14: 25–30 cm	210 ± 50 BP	charcoal/fire-cracked rock
2	Beta 94309	1/30: 70–80 cm	140 ± 50 BP	bark/cache pit
3	Beta 94312	28: 15 cm	210 ± 40 BP	charcoal/fire-cracked rock
4	Beta 94200	19: 65–70 cm	860 ± 60 BP	birch bark in unlined feature
5	Beta103585	32: 15 cm	160 ± 50 BP	charcoal/hearth above microblades
EeRb-144				
1	Beta 116172	N12E8: 20–30 cm	5250 ± 50 BP	charcoal
2	Beta 116173[3]	N11E8: 60–70 cm	5170 ± 70 BP	bird bone
3	Beta 149799	N10/E12: 15–20 cm	2310 ± 60 BP	charcoal/hearth
4	Beta 149800	N30/E27: 31–40 cm	6140 ± 50 BP	shell
5	149801	N12/E8: 15–20 cm + N12/E6	2140 ± 60 BP	charcoal/hearth
6	149802	N10/E11: 35–45 cm	4080 ± 80 BP	charcoal/hearth with microblades
EeRb-149				
1	906041	85–100 cm	1630 ± 90 BP	charcoal
2	9060512	85–100 cm	1950 ± 100 BP	charcoal
EeRb-190				
1	90606	11: 50–55 cm	6590 ± 80 BP	freshwater mussel shell cache
EdRa–41				
203	TO-9674	surface/subsurface	630 ± 70 BP	wood, fish weir stake
305	TO-9657	surface/subsurface	120 ± 60 BP	wood, fish weir stake
328	TO-9676	surface/subsurface	340 ± 50 BP	wood, fish weir stake
339	TO-9677	surface/subsurface	410 ± 60 BP	wood, fish weir stake
920	TO-9678	surface/subsurface	180 ± 50 BP	wood, fish weir stake
1001	TO-9679	surface/subsurface	1560 ± 50 BP	wood, fish weir stake
1105	TO-9680	surface/subsurface	260 ± 50 BP	wood, fish weir stake
1178	TO-9681	surface/subsurface	1520 ± 60 BP	wood, fish weir stake

[1] Depth below surface
[2] Before present
[3] AMS date

Figure 5. Diagnostic projectile points recovered from sites in project area: (from left) Early Period Old Cordilleran-style projectile point (EeRb 144); Lehman Phase; Lochnore Phase; Shuswap Horizon; Plateau Horizon; Kamloops Horizon. Photo by George P. Nicholas.

thus most likely the location of relatively specialized activities, such as resource gathering loci or lookouts.

Most of the sites in the project area are represented by materials found eroding from the surface. Limited subsurface testing throughout the western portion of our project area was done in 1991 and 1993 when cultural materials were found in several areas where no surface materials were visible, thus indicating the presence of buried sites. A total of 29 sites were found in this area. Of these, four were chosen for extensive testing and/or excavation—EeRb 130, 140, 144, and 149—as they possessed an archaeological record that extended back beyond the 4,500 years of the Late Period. These sites have now all been destroyed by development.

EeRb 130

This was a multiple-component site with clear evidence of occupation during the Middle and Late Periods, based on the recovery of several diagnostic projectile points. The site was located at the edge of a glaciolacustrine terrace to the southwest of Government Hill, which was the most prominent local landscape feature upon which was located site EeRb 149[4] (Figure 2). This site runs approximately 200 meters along the edge of the terrace, between two gullies, and 40 meters across the terrace; the removal of the front part of this terrace during highway construction destroyed an unknown portion of the site.

Fifteen STPs and eight 1 m^2 excavation units were used to define site boundaries and cultural chronology, and particularly to attempt to isolate the earlier components. Cultural materials recovered included basalt, chert, and chalcedony debitage, charcoal, fire-cracked rock, bone fragments, and freshwater mussel shell. Formed lithic artifacts recovered included a Middle Period Lochnore projectile point and ten Late Period points, along with one medium-sized notched cobble similar to those found at Middle Period sites elsewhere (Busey 1995; Huculak 2004). The substantial amounts of mammal bone and lesser quantities of bird and fish bone indicate evidence of food preparation, as well as extensive tool manufacture and repair activities.

A number of features were identified. Several consisted of depressions originally lined with or containing fire-cracked rock, with charcoal and/or charcoal-stained soil, burnt bone, and a variety of cultural items present (Figure 6). None of the features were clearly associated with the Middle Period occupation level, the depth of which is unknown. One feature near the south-central portion of the site where Late Period artifacts had been recovered provided a radiocarbon date of 1490 ± 80 years BP (Beta-9062), with chokecherry and saskatoon seeds recovered by flotation. Table 2 identifies the ethnographically recorded use of these and other plant taxa whose remains were recovered in our investigations. Forty-five meters northeast of the main part of the site was found an isolated hearth with charcoal staining (Figure 7). While clearly cultural in origin, it lacks the usual lithic debitage and burnt bones associated with similar features. No archaeobotanical remains were found in the soil samples processed from this feature.

EeRb 140

This larger terrace-edge site was occupied intermittently over a long period of time as revealed by an extensive, multi-year testing and excavation program. The site was initially investigated for evidence of early occupations in 1993 and 1994. Based on the results of the first two seasons, additional fieldwork was conducted in 1996 to help resolve questions about Middle Period occu-

Figure 6. Profile of hearth (Plateau Horizon 1200–2400 BP), EeRb 130. Photo by George P. Nicholas.

Table 2. Recorded ethnographic uses of archaeobotanical specimens.[1]

HERBACEOUS PLANTS REPRESENTED

Allium cernuum (Nodding Onion)—***qwléwe***

Recorded Uses

- Bulbs were eaten in the spring;
- Bulbs were bound together to dry, or twined together in mats, before pit-cooking. In some accounts (see Turner et al. 1987:118), the bulbs were "laid in the cooking pit interspersed with layers of shrubby penstemon (*Penstemon fruiticosus*) and alder leaves (*Alnus* sp.); red alder bark was then added to provide color, and pine needles placed on top of the alder leaves before steam-cooking overnight.

Archaeobotanical specimens

- Charred plant material resembling nodding onion recovered at EeRb 140.

Chenopodium capitatum (L.) Asch. (Strawberry-blite)

Recorded Uses

- Crushed fruit was used to make a red stain for body paint, and for clothes, wood, and skins.

Archaeobotanical specimens

- Seeds of this or related species recovered at EeRb 140.

Cyperaceae (Sedges) ***st̓ye7úw̓i*** (*Carex* spp.)

Recorded Uses

- Some sedges, such as *Carex obnupta* ("swamp hay"), were used to line moccasins; others like *Eriophorum angustifolium* were used for decoctions, according to Teit;
- *Scirpus* spp. (tule) was particularly important in the Interior Plateau, and had a wide variety of uses, including material for mats and lodge coverings.

Archaeobotanical specimens

- Seeds of *Carex* sp. recovered at EeRb 140.

Lithospermum ruderale (Stoneseed) ***tsgwúg̓wpe***

Recorded Uses

- Seeds used as decorative beads by Nlaka'pamux (Thompson);
- Used as a medicinal poultice for hemorrhoids and for other unspecified medicinal uses;
- Used as a charm to inflict sickness or bad luck; and to stop thunderstorms; possible ceremonial uses.

Archaeobotanical specimens

- Uncharred seeds recovered at EeRb 140, 144, and EeRb 175.

Poaceae (Grass, hay, or grass-like plants) ***kwlékwle***, ***skwelélecw***

Recorded Uses

- Some grasses dried and used as mats to wrap food or to dry berries on;
- Used in cooking pits (bluebunch, wheatgrass [*Agropyron spicatum*]).

Archaeobotanical specimens

- Grains recovered at EeRb 140.

SHRUBS REPRESENTED

Arctostaphylos uva-ursi (Kinnikinnick, Bearberry) ***elk***, ***elkéllp***

Recorded Uses

- Berries eaten; leaves used as tobacco and medicine;
- Berries picked in late September and October, stored fresh or mixed with moose grease for storage, and then fried until they split open.

Archaeobotanical specimens

- specimens recovered by Harlan Smith in burial excavated on Government Hill.

Table 2 continued.

Amelanchier alnifolia (Saskatoon, Service Berry) ***speqpeqéllp***

Recorded Uses

- Widely used by Interior Plateau peoples; among the first fruits to be picked in the summer;
- Usually dried and stored for use later in the year. Teit (1909:516) recorded that about half of the harvest was "boiled and made into cakes… the cakes of berries were spread on layers of leaves, dry pine-needles, or dry grass, supported on sticks; but more generally they were laid on mats woven of willow twigs or of grass, made for the purpose. Frames woven of slats of wood were used by a few people;"
- Wood used for spear shafts, digging sticks, arrows, drying racks, and canoe frame elements.

Archaeobotanical specimens

- Seeds recovered at EeRb 140, 149.

Cornus sericea (Red-osier Dogwood, or "red willow") ***tseqwtseqwéqwel̓qw***

Recorded Uses

- Berries eaten, seldom dried for winter use; eaten alone or mashed up with the "white" variety of saskatoon berry harvested earlier in the season;
- Berries mixed with saskatoons and dried on a rack over small fire; also reported to have been pounded up with choke cherries (seeds and all);
- Bark used for tobacco, also used for basketry material; sap used as arrowhead poison; wood leaves and bark boiled as decoction for medicinal uses; branches used as construction material for sweat lodges, drying racks, and other structures.

Archaeobotanical specimens

- Seeds recovered at EeRb 140.

Prunus virginiana (Choke Cherry) ***tkwlóse7, tkwlose7éllp***

Recorded Uses

- Fruit eaten fresh or dried and stored for winter;
- Wood for implement handles, especially for root digging sticks; shredded bark used as ornamentation for basket rims;
- Decoction of bark drunk as tonic and for colds, coughs, influenza, diarrhea, etc.

Archaeobotanical specimens

- Seeds recovered at EeRb 140, 149.

Ribes* spp.** (Gooseberry, Currant) ***stcwelcúcwel̓

Recorded Uses

- Fruit widely used by Interior Plateau peoples.

Archaeobotanical specimens

- Seeds recovered at EeRb 140.

Rubus* spp.** (Raspberry, Blackcap, Thimbleberry) ***s7éytsqwem; st'iqwem

Recorded Uses

- Berries widely used by Interior Plateau peoples;
- Leaves of thimbleberry (*R. parviflorus*) used as matting for pit-cooking and berry drying.

Archaeobotanical specimens

- Seeds recovered at EeRb 140.

Vaccinium* spp.** (Blueberry and/or Huckleberry) ***sesép, yegmín, set̓éqe7, wenéx

Recorded Uses

- Berries widely used by Interior Plateau peoples.

Archaeobotanical specimens

- Seeds possibly identified at EeRb 140.

Table 2 continued.

TREES REPRESENTED
Betula papyrifera (Paper Birch, White Birch) ***qwllin*** <u>Recorded Uses</u> • Widely utilized in Interior Plateau for baskets and containers, cradles, food wrapping, pit linings, canoe covering, and for many other purposes, as well as for fuel. <u>Archaeobotanical specimens</u> • Bark sheets and rolls recovered at EeRb 140, 144, 149. • Charcoal recovered at EeRb 140.
Pseudotsuga menziesii (Douglas-fir) ***tsq'ellp*** <u>Recorded Uses</u> • Wood used as construction material and fuel; • Boughs used in pit-cooking. <u>Archaeobotanical specimens</u> • Needles recovered at EeRb 140. • Charcoal recovered at EeRb 140.
Pinus ponderosa (Ponderosa pine) ***s7etqwllp*** <u>Recorded Uses</u> • Seeds and cambium eaten; • Wood used as construction material and fuel; • Boughs used in pit-cooking. <u>Archaeobotanical specimens</u> • Needles, seeds, and immature cone (?) recovered at EeRb 140. • Charcoal recovered at EeRb 140.
Populus balsamifera (Cottonwood) ***mulc*** <u>Recorded Uses</u> • Wood used as construction material for dugout canoes, cache poles, and for fuel. • Bark used for containers <u>Archaeobotanical specimens</u> • Charcoal recovered at EeRb 140.

[1] Teit 1900, 1909; Turner 1998; Turner et al. 1990.

Figure 7. Part of isolated hearth, vicinity of EeRb 130. Photo by George P. Nicholas.

pations and to recover additional archaeobotanical remains from all time periods represented at the site. In 2000, we returned to the site to intensively test several areas. A total of 65 m^2 of the site has been investigated (Figure 8). Units were excavated by 5 cm levels. Sediment samples consisted of 10 liters of matrix per 5 cm level per excavation unit, resulting in an estimated 2,250 liters of feature and non-feature samples collected from this site.

Results of the field studies indicate the site was extensively utilized during the past 4,000 years, as represented by numerous Kamloops, Plateau, and Shuswap-style points, bifacial and unifacial tools and retouched flakes, and a variety of features. Several bone artifacts were recovered, including a large bone awl, as well as notched and engraved bone artifacts, all of which probably relate to Late Period occupations. Both freshwater mussel shells, presumably local, and dentalium shell from the coast were found, the latter known ethnographically to have been utilized to decorate clothing and to be worn in strings as necklaces. Evidence of earlier, Middle Period (7,000–5,000 years ago) occupations is provided by several untyped projectile points, the presence of microblades, and the depth of cultural deposits. Over 1,000 microblades and one microblade core (Figure 9) were recovered from several units, with a wide variety of material types represented, including obsidian, chalcedony, and several different kinds of chert. The function of these sharp, parallel-sided blades is unknown. Suggestions have been made that these blades were used for processing fish but their form might be equally well suited for processing plant materials; indeed, similar blades have been found as sickles at Old World sites.[5] A use-wear study of the EeRb 140 and 144 microblades by Ryan Dickie (2015) revealed that those tools were used for a variety of tasks.

A substantial amount of fish and animal bone, plus a variety of plant remains, was taken from all excavation levels. A large number of small birch-bark rolls ($n = 1{,}567$), many partially burned, and sheets of birch bark were recovered from across the site. There was also evidence of several presumed food preparation areas in the form of extensive concentrations of fire-cracked rock, adding a new dimension to activities occurring here during the Late Period.

A variety of features were identified at this site, including concentrations of fire-cracked rock and charcoal, some representing discrete hearths, and a birch-bark and Ponderosa Pine-bark-lined cache pit (Unit 32). Several hearths or hearth-like features were identified, and are thought to be associated with domestic activities (Figure 10). Concentrations of fire-cracked rock and charcoal are more difficult to interpret, especially as some may represent hearths that were intentionally dismantled or disturbed by either natural or cultural agents. We suspect that the extensive concentration of fire-cracked rock and charcoal that extends across an area of about 30 m^2 in the southeastern portion of the site (Figure 8) represents a specialized activity area, although we are uncertain as to what type. Two virtually identical radiocarbon dates—210 ± 50 BP (Beta-90603) and 210 ± 40 (Beta-94312) from different units suggest that this extensive fire-cracked rock represents a single feature. In 2000, we excavated 26 m^2 to a depth of 20 cm to expose the upper part of this feature (Figure 11). A substantial amount of animal bone, including deer, bear, and mountain goat, and fish (likely salmon) was found in 1996 in several units.

What has been challenging about the interpretation of this site is that thousands of years of intermittent occupation have disturbed the original deposition of materials, and this is due primarily to feature construction and use. For example, Middle Period artifacts are found above

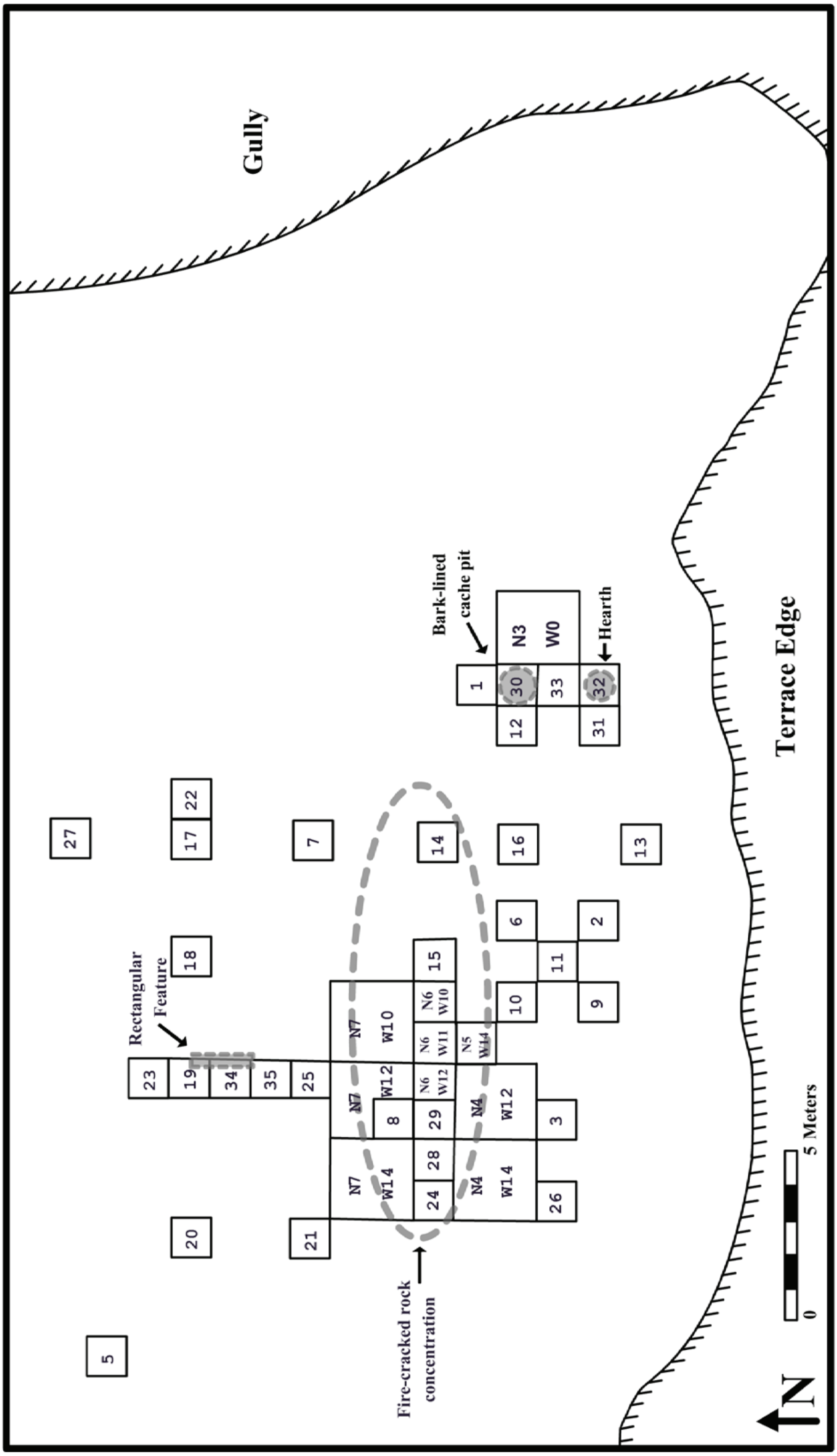


Figure 8. Site map, EeRb 140.

Figure 9. Microblades and microblade core from EeRb 140: the function of these small blades is unknown. Photo by George P. Nicholas.

Figure 10. Excavation of hearth containing unusually large stones and substantial amounts of charcoal, EeRb 140. Photo by George P. Nicholas.

later, Late Period artifacts. Such mixing can occur when a pit is dug into earlier occupation levels, bringing earlier material to the surface.

Figure 11. Part of very large feature (Unit 32) at EeRb 140, consisting of fire-cracked rock, charcoal concentrations, and floral and faunal remains. Photo by George P. Nicholas.

Unit 30 Feature

The single most impressive feature found at this site is a bark-lined cache pit (Figure 12) that was originally located in 1993 when it was exposed in the profile of an excavated unit. At that point the decision was made to leave the feature intact because (a) it appeared to be associated with the Late Period and our research focus at the time was on the earlier archaeology record; and (b) it would be best left until its excavation could be used to address specific research questions. The feature was excavated in 1996 when it became apparent that the site would be threatened by the construction of the Sun Rivers development.

The excavation of this feature[6] revealed that it had a relatively complicated structure, possibly representing several superimposed elements. While exact dimensions are difficult to ascertain, it was approximately 75 cm in diameter (maximum for the lower portion), with a depth of 75 cm below ground surface. There was no surface indication of this feature, which was covered by about 10 cm of surface material. Prior to excavation, the feature appeared to be composed of two parts, distinguished here as the upper and lower feature components. The feature is considered to be relatively recent in age, given that the top of it is so close to the surface, and occurs in a level containing Kamloops Horizon artifacts (1200–200 BP).

The upper portion of the cache pit feature (extending to a depth of about 35 cm) is characteristic of a hearth built within a depression, and contains a layer of fire-cracked rock, animal bone (including deer), numerous birch-bark rolls, several long pieces of wood (up to 50 cm in length), and lithic artifacts and debitage (Figures 13 and 14). Plant remains recovered through flotation and later identified by Michèle Wollstonecroft (see Chapter 4, this volume) included charred seeds representing many of the important berry species used by the Secwépemc in historic times, including chokecherry, saskatoon, red osier dogwood, currant or gooseberry, raspberry or thimbleberry, and pine seeds (*Pinus* spp.). The abundance of the saskatoon berries, along with

Figure 12. Profile of unexcavated bark-lined cache pit, EeRb 140. Photo by George P. Nicholas.

Douglas-fir needles (presumably representing boughs), and sedges and grasses known to be used as tinder and as matting for drying berries (Turner 1998), suggest that one activity conducted at this site was processing berries or the preparation of cakes utilizing one or more species of berries. Also present was charred plant material that Wollstonecroft identified as nodding onion (*Allium cernuum*), which was usually pit-roasted (Turner 1998). Four species of wood were present at the site: cottonwood and Ponderosa Pine as wood charcoal, and Douglas-fir and Ponderosa Pine needles.

The lower portion of the bark-lined cache pit feature was capped by a small amount of fire-cracked rock, birch-bark rolls, sheets of birch bark, thick slabs of Ponderosa Pine bark, and numerous pieces of wood. In addition to the birch bark, some seeds were visible in the lower matrix, including stoneseed (*Lithospermum ruderale*). A single articulated salmon skeleton was found at the bottom of the feature, resting on and between birch-bark sheets and thick Ponderosa Pine bark slabs (Figures 15–17). Part of the side of the basin was lined with sheets of birch bark. Numerous long and thin wood fragments, arranged in a mat-like fashion, were found near one portion of the bottom of the feature and could possibly represent a portion of a berry cake-drying frame (see Teit's description in Table 2). Uncharred plant material in the lower matrix included seeds of pine, chenopod (*Chenopodium* sp.), stoneseed, red-osier dogwood (*Cornus stolonifera* [(Syn. *C. sericea*]), saskatoon, raspberry or thimbleberry, chokecherry, and a number of as yet unidentified weedy species[7] (Wollstonecroft 2000; Chapter 4, this volume). Plant remains, 30 taxa in all, from both the upper and lower features are discussed in more detail below.

Figure 13. *(Left)* Excavation of upper part of the bark-lined feature (Unit 30), 20–25 cm bd, EeRb 140. Photo by George P. Nicholas.

Figure 14. *(Below)* Close-up of birch bark roll, upper part of bark-lined feature (Unit 30), EeRb 140. Photo by George P. Nicholas.

Figure 15. Excavation of lower part of the bark-lined feature Unit 30), 70–80 cm bd, EeRb 140. Photo by George P. Nicholas.

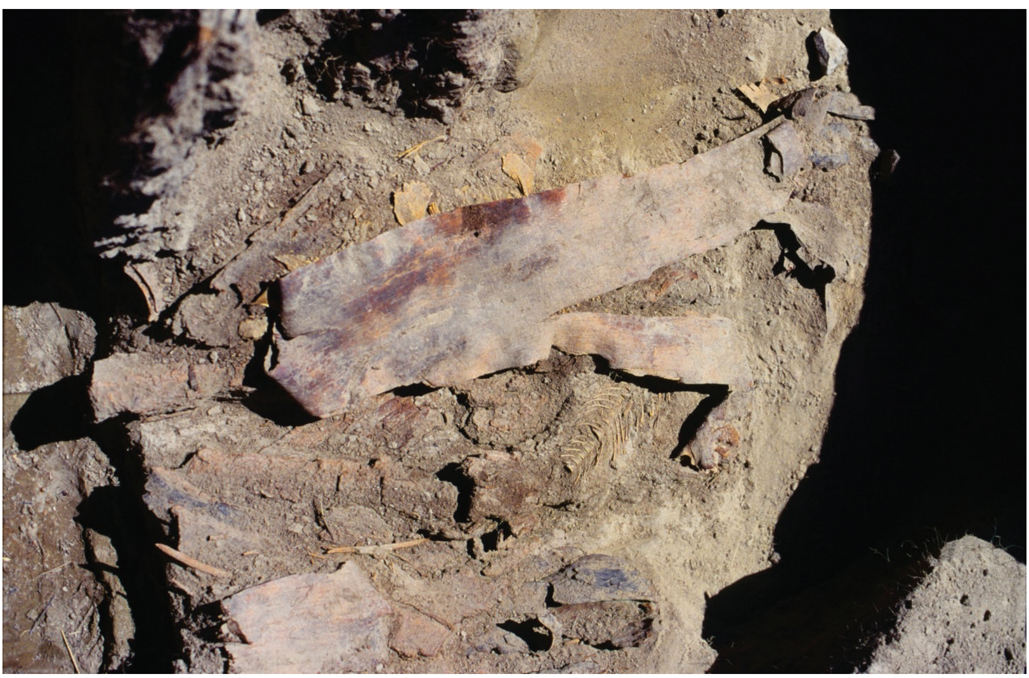


Figure 16. Excavation of lower part of the bark-lined feature (Unit 30), 75 cm bd, EeRb 140. Photo by George P. Nicholas.

Figure 17. Close-up of articulated salmon skeleton at bottom of feature (Unit 30), EeRb 140). Photo by George P. Nicholas.

It appears that the cache pit feature represents two different episodes of use. The first consisted of the construction, use, and later abandonment of the lower feature, which may contain portions of a roof (see Hill-Tout's description above) and/or may have ended up as a garbage pit. The second episode may have been the use of the partially filled depression as a hearth site. The time difference between the two episodes may be very short or may be as long as several hundred years. A radiocarbon date of 140 ± 50 years BP (Beta-94309) was obtained on a piece of bark taken from near the bottom of this feature in 1993. Several Middle Period diagnostic points were recovered from the non-feature portion of Unit 30, suggesting that the pit was dug through earlier occupation levels.

Unit 32 Feature

Another very recent radiocarbon date was obtained on a small, hearth-like feature in Unit 30, 1.5 meters from the Unit 30 cache pit. This hearth was found under an occupation floor containing numerous microblades, an artifact type usually associated with the Early or Middle Periods (i.e., pre-4500 BP). Surprisingly, the single radiocarbon age of the hearth was 160 ± 50 years BP (Beta-103585), which is within the historic period and long after we presume microblades to have been manufactured; at the adjacent EeRb 144 site, microblades have been dated to about 5000 BP. At present, however, we are unaware of any sources of contamination or sampling errors that could be responsible for these recent dates on this feature. Additional dates from EeRb 140 may help resolve this question.

Other Features

Several other features were found on this site. One is a large, unlined rectangular pit that was revealed in the profile of Unit 19 only after it had been excavated in 1996 (Figure 18); the excavation of adjacent units (34 and 35) exposed the size and depth of this feature. Several sheets of birch bark were present within the feature, one of which yielded a date of 860 ± 60 BP (Beta-94200). A substantial quantity of seed-like fruits of stoneseed was also found within the feature matrix during excavation.

Birch bark. Pieces of birch bark (n = 1,609) were found across this site. The majority (81%; n = 1,309) were flat or curled, the remainder rolled (n = 286) or too small to identify as to form (n = 14). Most pieces were only a few centimeters in size but they varied in size and width considerably. The largest pieces were 40 cm in length and 14 cm in width, but most were very small fragments, generally quite brittle and thus subject to breakage. The majority of pieces from the site (n = 983; 61%) exhibited no evidence of charring, which is not surprising given the high state of organic preservation in the terrace silts and sands.

Depth of recovered birchbark pieces in indicated in Figure 19. The largest proportion was between 11 and 25 cm, with strong presence to 65 cm in depth, and then a small percentage to 95 cm. A partially charred piece of birch bark (2.5 by 1.2 cm) was recovered at a depth of 71–75 cm in Unit 5, and another uncharred piece (7.5 by 1.5 cm) between 76 and 80 cm in Unit 9. No evidence of pits or similar features was observed in the field. The birch bark may represent evidence of a relatively early occupation, based on the depth of cultural deposits (i.e., a "Middle

Figure 18. Unlined feature (dark, rectangular stain) in profile, west wall of Units 23, 19, 34, 3, 25, EeRb 140. Photo by George P. Nicholas.

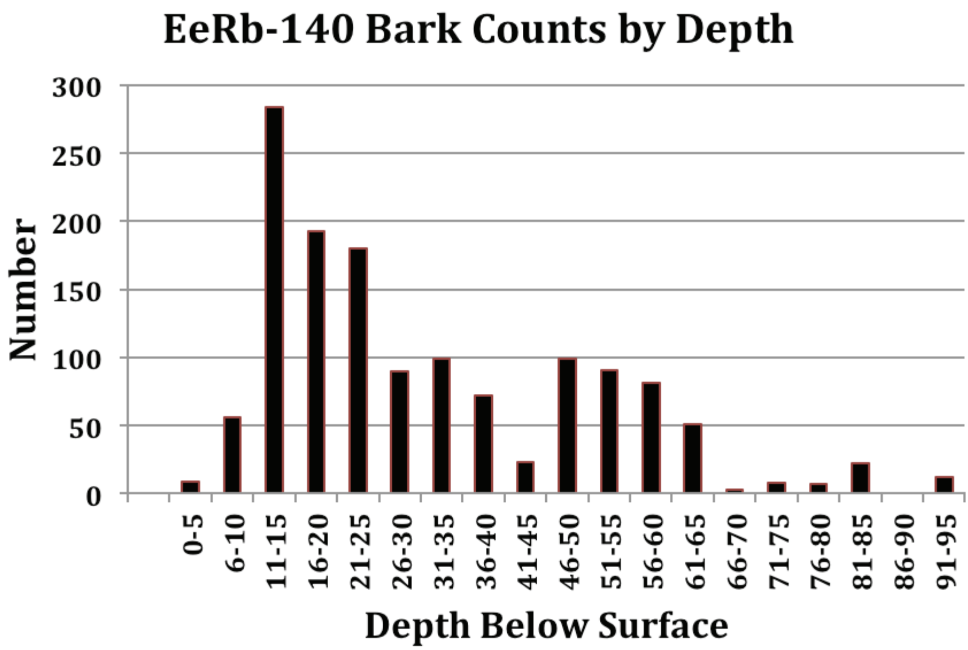


Figure 19. EeRb-140 Birchbark counts by depth.

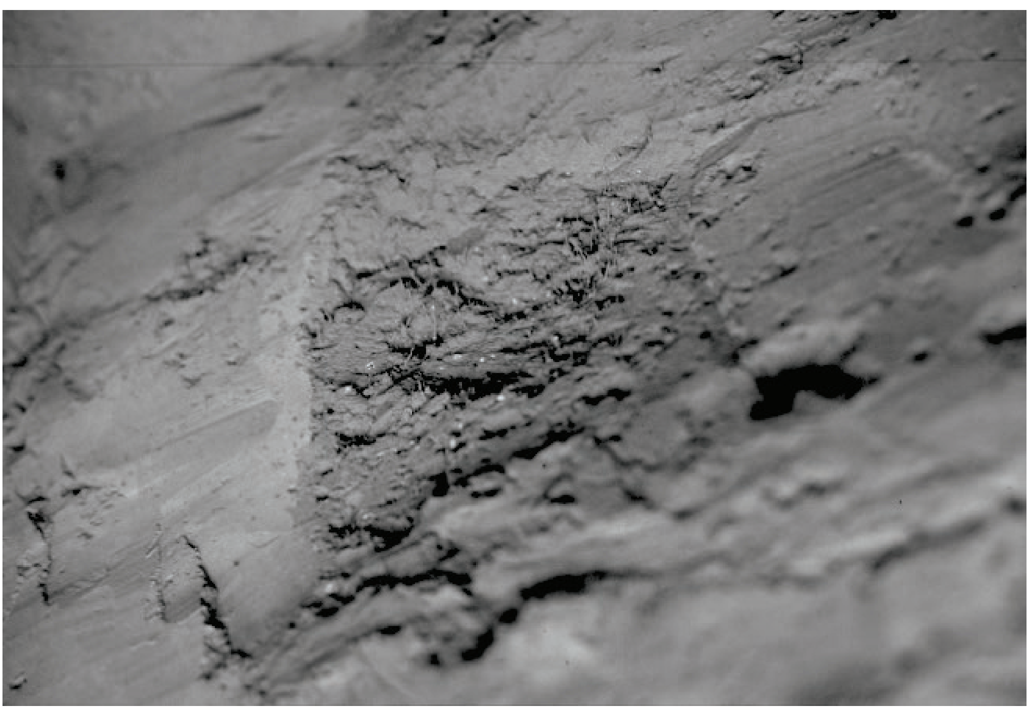
Period-looking" unifacial tool found at a comparable depth *below* the Unit 19 feature). On the other hand, based on what we observed in Units 19, 34, and 35 (Figure 8), unlined pit features may be very difficult to identify in 1 m^2 unit profiles, especially where there is only minimal stratigraphic separation. As a result, we must consider the possibility that these instances of deeply buried bark are associated with intrusive Late Period storage features. Samples submitted for radiocarbon dating were found to be contaminated by micro-rootlets.

Unlined features, such as the one that extended through Units 19, 34, and 35, may have been encountered elsewhere on this site but not recognized as such, given the subtleties of site stratigraphy. In 1993, cultural material was recovered from Unit 6 to a depth of almost 200 cm, yet the depth of cultural deposits across most of the site is typically no more than 50 to 70 cm. A similar feature (Figure 20a, b) was found at another site we tested in 1992, EeRb 178, located 1.5 kilometers to the east of EeRb-140, and one of a cluster of ten sites surrounding a gully that connects the higher elevations with the floodplain. That this was an unlined feature was not apparent until well into its excavation. It did contain a small amount of cultural material, including a projectile point that dates the feature to between 1,200 and 2,400 years ago, and a quantity of durable stoneseed fruits (Figure 19b).

Analysis of the artifacts from this site is contributing toward a fuller understanding of the regional cultural chronology. In addition, the organic materials document dietary patterns, plant use, and environmental conditions in the past, particularly during the Middle Period, a time of pronounced environmental change.

Figure 20a. *(Left)* Profile of unlined storage pit, site EeRb 172 (eastern part of project area). Photo by George P. Nicholas.

Figure 20b. *(Below)* Close-up of contact between pit fill (with Lithospermum) and unexcavated/non-pit matrix, lower right-hand corner of 19A. Photo by George P. Nicholas.



EeRb 144

This is an important multiple-component site known to have been occupied intermittently for at least 6,000 years, and probably considerably longer. The site is located on the last major intermediate terrace before the start of the high terraces (to the east) (Figures 2 and 21), and is situated adjacent to a major gully system. It is one of the largest and most attractive habitation areas within the entire project area. It is 100 meters directly east of EeRb-140, separated by a gully.

In 1991, as part of our search for potentially early sites, three 1 m^2 excavation units were dug, in addition to a series of eight STPs. This limited testing revealed a substantial amount of cultural and archaeobotanical remains (e.g., birchbark). As with most of the multiple-component sites in the area, we identified evidence of Late Period occupations. Material was also identified that could be assigned to the Middle Period, along with one large biface that is virtually identical to artifacts dating to the Early Period (i.e., >8,000 years ago [Stryd and Rousseau 1996:Fig. 6]). In addition to numerous projectile points, knives, scrapers, and tool manufacturing debris, we found an engraved bone point tip, several bone points that may have been part of fishing implements, and bone and shell beads. Over 450 pieces of birch bark were found, in addition to mammal, bird, and fish bones, and freshwater mussel shells.

A major excavation program was initiated in 1997 and continued through 2000 to (a) document the long-term occupancy of the site; (b) identify and define the earlier occupations represented; and (c) open large and contiguous areas of the site to reveal evidence of activity areas relating to technology, gender roles, and domestic economy (including food preparation). Our work concentrated on two areas of the site[8] (Figure 21). In all, over 200 m^2 of the site were excavated, which represents perhaps 20% of the site.

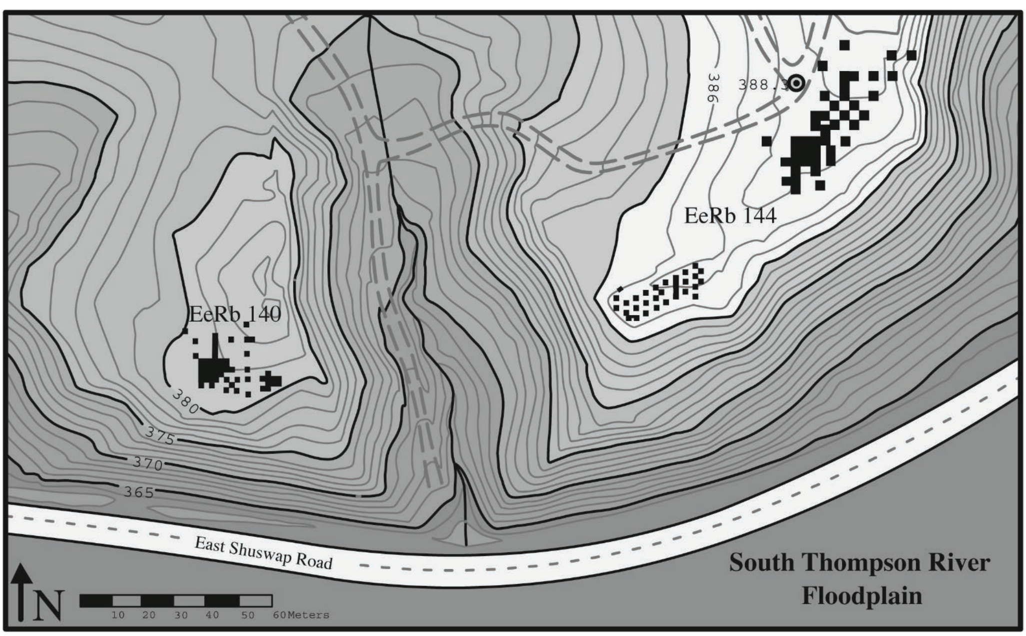


Figure 21. Map of excavation grid, EeRb 144 (includes 1998 units).

The results of our excavation indicate that this is a very important site within the region, given both the time span represented (i.e., virtually all cultural periods/diagnostic artifact types known in the region are present), and the number and variety of artifacts recovered, as well as the activities represented. Formed artifacts include a wide variety of Late and Middle Period diagnostic artifacts. Also found were beads and perforated shells, bone artifacts, and dentalia. From a Middle Period component came three *Olivella* sp. shells, a marine species whose shells have been found at other Middle Period sites in the Interior (Stryd and Rousseau 1996).

Hearth-like features were identified and sampled in both the northeast and southeast quadrants. Associated with the well-defined Plateau Horizon component (2400–1200 BP) is a large hearth feature (Figure 22) situated near a smaller one about a meter away. It appears that they were contemporaneous, although the reason why two were used together is not known. A series of three "single-hook" and one "double-hook" bifaces (Figure 23), unique to the Interior, was associated with these features.

Several different types of macrofossils have been identified at EeRb 144: (a) wood charcoal, usually in association with features; (b) 451 pieces of birch bark (334 flat or curled sheets, 74%; 108 rolled, 24%; and 9 indeterminate, 2%), which are discussed below; and (c) a small number of relatively large seeds. The majority of birch-bark pieces were charred (n = 365, 84%), a much higher percentage than at EeRb 140. Bark was also more restricted to the upper levels of this site, primarily between 6 and 25 cm bd, with very small amounts below that, with the deepest fragments at 46–50 cm (Figure 24).

There was also a very unique item found, a roll or ball of narrow birch bark strips rolled around a stick (now absent). This specimen (Figure 25) measures 40 mm in length and has a diameter of 24 mm in the center, where it is thickest; the diameter of the now-missing stick is 4 mm. The width of the bark strip ranges from 3mm to 6mm, with an average of 5 mm. It was recovered at 10–15 cm below surface, the same level at which Plateau component artifacts have been found (including the hooks described above).

Intensive sampling (each 5 cm level/each unit) of both feature and non-feature matrices was done, although sample size was reduced to 5 liters to keep the total number and volume to a manageable level (albeit still 8,000 liters of soil). Analysis of the light flotation materials recovered from matrix samples has yet to be initiated; when undertaken, it will provide a valuable complement to Wollstonecroft's study of EeRb-140.

EeRb 158

In 1897, Harlan Smith excavated two burials on the southern slope of Government Hill (Smith 1900:436), a large and prominent knoll within our project area (Figure 2). Much of the Government Hill landform is an archaeological site (EeRb 149) characterized by active sand dunes and large "blow-out" (or erosional/deflation) surfaces that were covered with extensive concentrations of fire-crack rock, tool manufacturing debris, burnt bone fragments, and the occasional formed tool. One burial found by Smith here was covered by a "cedar canoe section," the other was surrounded by poles; both were covered with bark and/or matting. Based on the presence of an iron awl, these are probably post-contact burials. In 1995, we relocated this site based on Smith's published photographs, and on our field reconnaissance.

Figure 22. Paired large and small hearth feature in 2 m² excavation block, EeRb 144. Photo by George P. Nicholas.

Figure 23. *(Below)* "Double-" and "single-hook" bifaces with an associated Plateau point, from EeRb 144. Photo by George P. Nicholas.

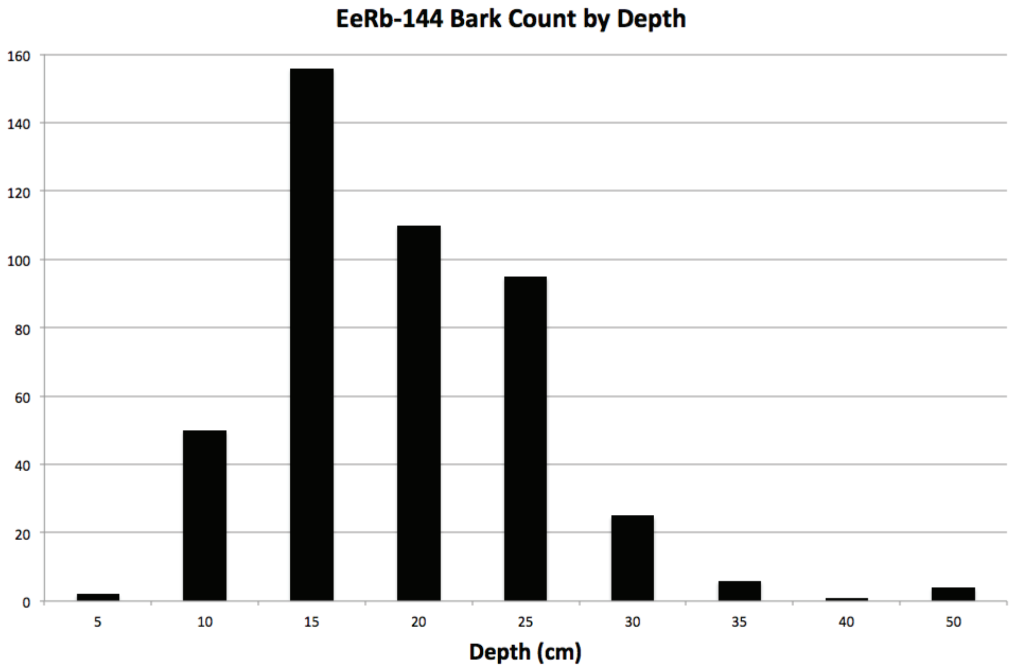


Figure 24. EeRb-144 Birchbark counts by depth.

Figure 25. Bundle of birchbark strips, EeRb 144 in side and end view. Photo by George P. Nicholas.

What is notable about these two burials are the remains of several species of trees and other plants associated with them:

> Grave 1, indicated on the surface by some scattering of dentalium shells, and an oval (three feet long by two feet wide) of brown spots, at intervals of a few inches. These proved to be the ends of decayed fragments of a canoe made of Alaska cedar [yellow cedar] (*Chamaecyparis nootkatensis*) [now *Callitropsis nootkatensis*]) daubed with red ochre.... [The body] was wrapped in a fabric daubed with red ochre, and in pieces of skin. The whole bundle was bound with cords about a quarter of an inch in diameter, made of three strands of vegetable material twisted to the right (Smith 1900:436).

A bag accompanying this burial contained a variety of artifacts (including beaver-tooth dice, bone needles) and what Smith identified as seeds of bearberry (*Arctostaphylos uva-ursi*, also known as kinnikinnick). Both the berries and leaves were utilized by Interior Plateau peoples (Turner 1995:76).

> Grave 2 [was] somewhat similar to Grave 1; but, instead of pieces of a canoe, poles had been placed around the body .... Their tops had been burned off about a foot below the surface or three feet above their lower ends.... A birchbark dish rested over the thighs. The body was wrapped in a fabric of woven vegetable fibre. Outside of this was matting made of cat-tail stalks ... (Smith 1900:437).

Fabrics manufactured of big sagebrush bark (*Artemisia tridentata*) and cattail (*Typha latifolia*) are known ethnographically for the Interior Plateau (e.g., Teit 1900) (of interest, Teit notes (1909:506–507) that generally only the poor wore woven clothing and footwear made of sage or rushes). *Typha* also was used for matting (usually the leaves, not the stalks), and had many other applications among hunting and gathering people in North America (Nicholas 1998), as well as being an important year-round food source. The "cat-tail stalks" mentioned by Smith may well have been tule stems (*Schoenoplectus lacustris*), which were commonly used in mats (Turner 1998).

Smith identified the wood of the canoe in Grave 1 as "Alaskan cedar," an identification that we find surprising, both in terms of its specificity and species identification. *Callitropsis nootkatensis* is not found locally; although it today appears at higher elevations near the lower Fraser River (Lyons and Merilees 1995:76), it was not generally used for canoes. It is likely that Smith may have misidentified the wood, which one could reasonably expect to be cottonwood (Nancy Turner, pers. comm. 1997). Alternatively, the canoe could be of red cedar (*Thuja plicata*) wood transported from an interior source (see Turner 1998) or, less likely, yellow cedar obtained on the coast. Unfortunately, no trace of the canoe remains.

EeRb 77

In addition to the terrace sites, we also conducted extensive excavation at EeRb 77, a site located on the flood plain near the Secwépemc Heritage Park on the Kamloops Indian Reserve, which includes a moderate-sized Late Period pithouse village. Deep testing 500 meters northeast of the village site produced cultural materials to a depth of 3 meters, with charcoal found to 3.5 meters; a radiocarbon date on charcoal of 5590 ± 100 years (Beta-77134) was obtained on charcoal at 250 cm below surface, indicated that the flood plain has considerable potential for providing information on Middle and possibly Early Period culture history and land use. Extensive excavation was undertaken in 2002 and 2004 with the goal of comparing what we could learn from this 6,000-year-old (and older) floodplain site with the similarly aged sites on the terrace sites EeRb 130, 140, and 144 to enable a direct comparison of the sites (within a kilometer of each other) that were probably occupied by the same people, perhaps for different activities and/or at different seasons.

One of the most significant discoveries was a very large shell midden (Figure 26), which consists of hundreds of thousands of freshwater mussel shell (primarily *Margaritifera falcata*) (Lindsay 2004). The shell forms the primary part of a rich organic zone of shell, charcoal, and fire-cracked rock, ranges in thickness from a maximum of 40 cm to 5 cm, and which contained a variety of stone and bone artifacts. An AMS date of 2970 ± 50 BP was obtained on shell from the bottom of the midden. No plant macrofossils were identified, and soil samples have yet to be processed; one relatively large fruit seed, probably rose hip (*Rosa* spp.), was found at a depth of 280–290 cm but because it is not charred it is likely intrusive. Thus, the potential for the recovery of archaeobotanical materials at this floodplain site is unknown at this point. However, backhoe trenching 20 meters to the west revealed a large pit feature (Figure 27) containing a Plateau point (2400–1200 BP) and one complete and one fragmented digging stick handle (Figure 28). These hint strongly at plant processing technology and storage or processing. In addition, at another small site (EeRb 75) west of our excavations, a quarter section of what may have been a large grinding stone (Figure 29) was found that might have been used for plants foods.

EdRa 41

Although outside of the primary project area, this large fish weir site (Figure 30) deserves mention. It is located on the north side of the channel of the South Thompson River, approximately 15 km east of Kamloops. In 2002, Nicholas and Catherine Carlson (then of Thompson Rivers University) undertook to record and map the site, and then remove a sample of wood stakes for examination, speciation, and radiocarbon dating (Nicholas 2002). A total of 1,390 wooden stake remnants were recorded (Figure 31); these extend along the exposed river bottom (at low water) for a distance of 1,100 meters. The feature is thought to have originally extended across the river but the south bank area was not examined due to continuous deep water conditions and limited access.

Nineteen stakes were removed for analysis (Tables 3 and 4). The majority (n = 16) were softwoods (6 lodgepole pine and white pine, 8 Douglas-fir; 2 unknown); the remainder (n = 3 were hardwoods (2 birch; 1 unknown). They ranged in length from 75 to 20 cm, and in diameter from 23 to 11.5 cm. All complete specimens had sharpened tips, with top modification ranging from almost 5 cm to 29 cm. Seven of the stakes appeared to have been burnt.

A series of eight AMS radiocarbon dates was obtained on eight of the stakes collected, and range between 1,560 and 120 years before present. Weirs were being built and maintained in

Figure 26. Profile of extensive shell midden in northern part of EeRb 77.

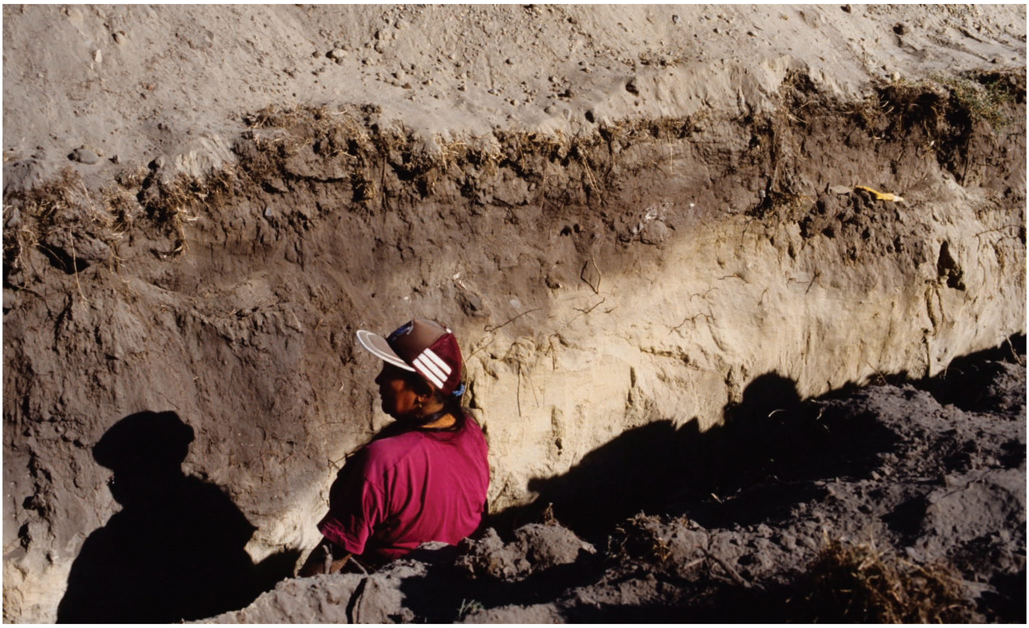


Figure 27. Subsurface feature discovered in monitoring backhoe trenching, EeRb 77. Gladys Baptiste is examining feature. Photo by George P. Nicholas.

Figure 28. (Above) Antler digging stick handle and portion of another found in association with feature in backhoe trench, EeRb 77. Photo by George P. Nicholas.

Figure 29. (Left) Oblique view of section of a possible grinding stone, EeRb 75. Note ground and polished surface. Photo by George P. Nicholas.

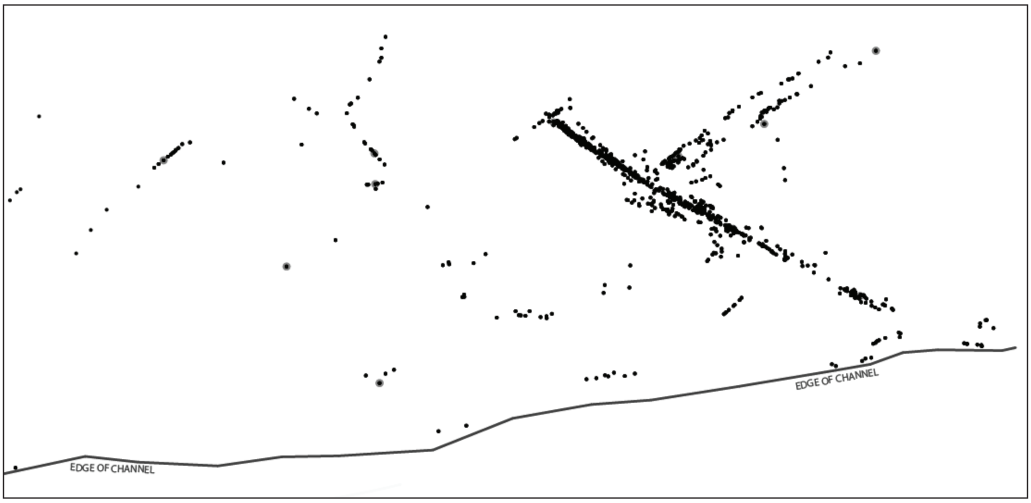


Figure 30. Plan view of EdRa 41, the large fishweir site. Scale is 1 cm = 25 m.

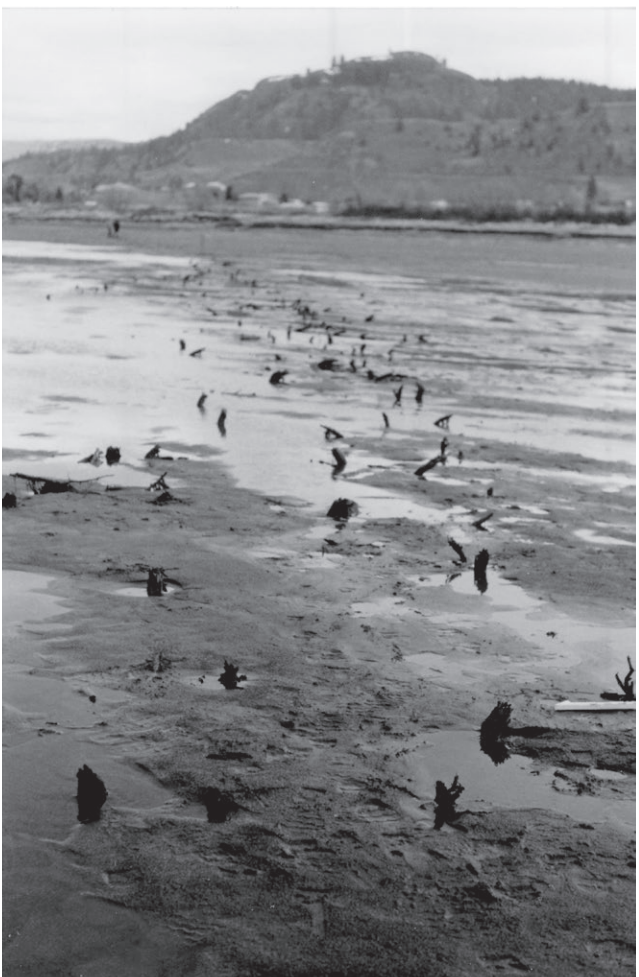


Figure 31. EeRa 41.View of portion of fish weir stake remnants exposed in low water conditions. Photo by George P. Nicholas.

Table 3. Site EdRa–41: Wood identification and dating of fish weir stake samples.

Stake #	Description	Lab #	Radiocarbon Date (BP)
11	Softwood (diagnostic features destroyed by decay)		
200	Douglas-fir		
202	Hardwood (could be maple)		
203	Douglas-fir	TO-9674	630 ± 70
253	Douglas-fir		
289	Douglas-fir; tiny stem with branch stubs		
305	Lodgepole pine; nice cylindrical sample, radius 18 mm, 12 rings in an 11 mm segment	TO-9657	120 ± 60
314	Birch		
328	Hardwood; most likely birch, too fragile for sectioning	T-9676	340 ± 50
339	Softwood; charred outer layer (could be means of preservation?)	TO-9677	410 ± 60
363	Douglas-fir		
393	Lodgepole pine		
920	Douglas-fir	TO-9678	180 ± 50
1035	Lodgepole pine (13 annual rings in 8mm radius = 40 rings/inch)		
1042	Douglas-fir		
1069	Lodgepole pine		
1001	Douglas-fir	TO-9679	1560 ± 50
1105	Lodgepole pine, 27 annual rings from pith-to-bark (35 mm dia.)	TO-9680	260 ± 50
1178	White pine	TO-9681	1520 ± 60
Summary			
Lodgepole pine	5	Softwoods – 16	
White pine	1	Hardwoods – 3	
Douglas fir	8		
Softwood	2		
Birch	1		
Hardwood	2		

(Source: Nicholas 2002)

Table 4. Site EdRa–41: Attributes of recovered wooden stake samples.

Stake	Total Length*	Extent modified*	Max Dia*	Comments
305	28.5	6.9	12.5	
1001	36.3	13.2	17	
202	48.6	10.2	14.2	
253	56.8	17.6	17.2	
289	75.1	4.8	13.2	
314	52.2	10.4	15.2	appears burnt
200	38.7	8.6	11.2	
339	21.8	4.9	13.6	appears burnt
328	16.8	3.7	9.3	tip burnt?
1178	26.2	broken off	23	broken tip
203	20.9	broken tip	14.2	very soft wood
920	39	4.7	15	
1105	32.5	21.3	13.6	tip burned
1035	45.0	18.6	17.7	very blunt tip
363	66.0	18.9	19	burnt?
393	59.8	29.0	19.3	
11	17.8	unclear	13.3	burnt?
1069	33.7	5.1	13.3	
1042	65.4	28.6	15.7	tip burned?

* all measurements in centimeters.
(Source: Nicholas 2002)

this location for at least that length of time, and likely more. There is no clear patterning revealed by this small number of dates: The two earliest dates (1520 ± 60 and 1560 ± 50) are from stakes 300 meters apart, apparently from unrelated structures, and one of those is relatively close (80 meters) to a stake dated 180 years old. In other words, there is no clustering of older or more recent dates within this small sample. The most recent dated stake (120 ± 60) is in between two stakes dated at 340 ± 50 and 410 ± 60 upstream and 630 ± 70 downstream, all some distance apart. The distribution suggests continual use and renewal of weirs in this locale. What is perhaps most intriguing is not the age of the earliest of these, but the evidence that the weir was in use during the 17th or 18th centuries. Generally, it appears that this location was utilized, more or less continually, for as much as 1,500 years, if not considerably longer, with episodes of new weir construction but probably more frequently, refurbishment of the existing structure(s).

The size of the overall weir, and the contemporaneity of sections within it, provides an opportunity to examine aspects of past social organization and population size. For example, if the weir actually consisted of only one or a few sections of stakes active at a time, such a limited operation could easily have been constructed and maintained by a small group, perhaps a family.[9] However, since the evidence suggests that the larger structure was maintained over long periods of time, this would have required a division of labour among members of a larger group and perhaps necessitated a requisite form of social organization that regulated access, labour, and yield. In addition, the number of wooden stakes and branches required for building and maintaining lattices, and the large number of rocks used to anchor the stakes provide a certain indication of the impact of small-scale societies on their landscape (Nicholas 1999).

Initial Results of Archaeobotanical Research

The archaeological investigations summarized here indicate that evidence of past Secwépemc plant use is present in pre-ethnographic contexts but is generally sparse at this point. The majority of archaeological sites have not yielded evidence of plant remains, results of any unprocessed flotation samples aside. There are three notable exceptions. The first of these consists of the array of 1,390 wooden stake remnants in the pre-contact fishweir weir site, EdRa 41, which will not be discussed further here. The second is the large amount of birch bark recovered from two terrace sites, and the third, the archaeobotanical remains, such as seeds and charcoal, recovered by flotation from those two sites.[10]

Speaking to the last point, although the recovery of larger preserved plant material and bone from archaeological contexts reveals certain things about their use, and about past subsistence practices in general, the picture is not complete until preserved seeds and other often-microscopic plant remains are recovered and analyzed through water flotation. For this reason, a large number of soil samples were systematically collected during the excavation of EeRb 140 and 144. These were taken not only from hearths, but also in many instances from each level of each excavation unit. To date, only a portion of the materials recovered through flotation has been examined from EeRb 140, the most complete set being analyzed by Wollstonecroft (2000; also see Chapter 4).

One final consideration of ancient plant use is proxy evidence. A variety of features, including hearths, possible food cooking, roasting, or drying fires, and storage pits, has been found at EeRb-140, 144, and at other sites in the project area. Hearths, represented by discrete concentrations of charcoal and/or fire-cracked rock, are the most common feature. At EeRb 140 these contain both faunal remains, including deer, waterfowl, bear, and mountain goat, fish, and floral remains, described below. Several large concentrations of fire-cracked rock are also present at EeRb 140 and at several other sites (especially the Government Hill site [EeRb 149[11]]), suggesting something other than cooking fires. We suspect that some of the features at EeRb 140 that might otherwise be identified as hearths may, in fact, be the remains of plant processing areas based on the recovery of charred plants. This may also be the case with the extensive fire-cracked rock at EeRb-178 (noted above), which is part of a cluster of sites located along a major gully that would have an obvious travel route between the uplands and floodplain.

The remainder of this chapter focuses on the birchbark samples from EeRb 140 and 144, with some limited discussion on other micro- and macrobotanical remains from EeRb 140 based on analyses completed to date.

Birch Bark in Archaeological Context

Among the peoples of the Plateau, birch bark was intensively harvested (Teit 1909; Turner 1998), and was considered as important to them as the bark of western red cedar was to the coastal groups (Turner 1998; Turner et al. 1981; Turner et al. 1990; Turner et al. forthcoming). For most purposes, the birch bark used by the Interior peoples was of *Betula papyrifera*, commonly known as paper birch or white birch (see Table 5). Across the Plateau, it was utilized in the construction of baskets, cradles, and canoes (Teit 1900, 1909, 1990; Turner 1998, 2008), among other things. The ubiquitous birch-bark container took many shapes and served multiple purposes. It was also used in the preservation of stored foods, as linings for cache pits, and as salmon wrappers. Pieces of birch bark were also used as "matches" and as tinder and fuel.

The earliest recorded evidence of birch bark from an archaeological context is through the work of Harlan Smith (1899, 1900). He noted that pieces and rolls of birch bark, as well as a bark dish in one case, were found associated with human remains (Smith 1899:161; 1900:412, 424, 434, 437, 440). Birchbark rolls, many of which exhibited evidence of burning or charring, were also found in association with hearths (Smith 1899:160), or with charcoal and fire-cracked rock (Smith 1900:434). In more recent times, birch bark has been recovered from a number of sites across the Canadian Plateau, often in association with house pits (Blake 1978:35; Hayden 2000:329–330; I.R. Wilson Consultants 1992:vi, 53; Stryd 1981:228), with hearths (Wilson 1992:102) and features that served as refuse receptacles (Wilson 1992:63–64; Stryd 1981:244, 248). Though most recovered birch bark is highly fragmentary, several examples of stitched basketry remains have been found (Blake 1974; Hayden 2000: 29; Sanger 1968). In the Kamloops vicinity, birch-bark fragments were found associated with cache pits at both the Harper Ranch site (EdRa 9) and the LaFarge site (EdRa 11) (Wilson 1980:31, 37). At the Curr site (EdRa 22), fragments of a possible birch-bark container were found directly beneath an artifact cache (Carlson 1980:94), and fragments were excavated from a cultural depression (Carlson 1978:53; 1980:99). The earliest dateable context in which birch bark has been found is the Plateau Horizon, ca. 2400–1200 BP (Richards and Rousseau 1987:36).

Table 5. Botanical description[1] and technological uses[2] of paper birch (*Betula papyrifera*).

***Betula papyrifera* (Betulaceae)**—common names include white birch, Western white birch, paper birch, canoe birch, and silver birch.
General—*Betula papyrifera* is a deciduous tree that can grow to 40 m in height. It is a fast growing tree with an immature reddish to coppery brown bark that matures to white or cream (Turner [1998] does note that mature bark can also appear coppery brown). The bark has conspicuous dark, horizontally elongated lenticals that readily peel off in sheets.
Ecology and Distribution—In British Columbia, *Betula papyrifera* is most abundant in low to mid-elevations and moist parts of the southern Interior. It prefers moist seepage sites and flood plains. *Betula papyrifera* has a short life cycle (up to 140 years), but has the ability to sprout from cut stumps, and re-sprouts after fire. It provides nutrients and organic matter to soil from falling leaves, browse for wildlife, and seeds for birds. Sapsuckers often drill rows of small holes in birch trees, so that the sap seeps out. Hummingbirds and other birds, as well as the sapsuckers eat the sap and also eat the insects trapped in the sap. Several types of tree fungus, especially the cinder conk fungus (*Inonotus obliques*), grow on birch and these have cultural uses as tinder or as medicine (Nancy Turner, pers. comm. 2001).
Environmental Units—*Betula papyrifera* can be found in the Intermediate Grasslands (IDF-Interior Douglas Fir biogeoclimatic zone) where it tends to concentrate along stream courses and meadow edges. Its range also extends into the Intermediate Grasslands and Intermediate Lakes (IDF). *Betula papyrifera* is scarce, though not absent, in the River Terraces and Valleys; here it is limited to the wetter and more shaded areas (mainly those along valley streams and rivers).
Other—Birch bark pitch contains triterpenoids and steroids, among which *betulinol*, *lupeol*, and *lupenone* are the most characteristic components. Betulinic acid is currently being studied for its anti-carcinogenic (cancer-preventing) properties. Birch resin contains *zylitol*, a disinfectant now commercially as a tooth cleaner. These chemical properties may be why birch bark has been observed to have anti-microbial and/or favorable preservative properties.
Technological Uses—Birch bark was employed in the manufacture of the following: • basketry—different shapes and sizes were used for berry picking, food storage, water containers, cooking/steaming vessels, melting snow, and general storage of provisions and household goods; • canoes (especially among the Secwepemc), linings for canoes; toboggans; • linings for cache pits; food wrappings; • roofing of dwellings and elevated caches; • funnel-shaped rodent protectors at the base of elevated caches; • linings for graves; • splints for broken limbs; • cradles, cradle carriers; urine conduits for infants; • playing cards; • "matches" and fuel for fires; and • ashes to clean teeth with.

[1] Sources: Alexander 1992a; Friends of the Mundy Park Heritage Society 2000; Parish et al. 1996; Reunanen et al. 1993; Turner 1998; Turner et al. 1990.
[2] Sources: Alexander 1997; Kennedy and Bouchard, cited in Hayden 2000; Teit 1900, 1909; Turner 1998; Turner et al. 1990.

Recently, a large birchbark container was discovered in Lillooet and is the subject of a detailed study conducted jointly by the Xaxl'ip Band and Simon Fraser University (Villeneuve 2008). The basket is about 50 cm tall and 30 cm in diameter, and has a folded bottom and a willowbark rim. What is especially interesting is the contents of the basket. Villeneuve reports three layers: upper: "thick mat of pine needles with birch bark rolls;" middle: "tightly packed grasses and small Saskatoon (*Amelanchier alnifolia*) branches, and a few fish vertebrae;" and lower: "very thick mat of grasses which were stained black from organic remains and had a very greasy texture." The study of the basket, its contents, and the site in which it was found provides a rare opportunity to explore the well-preserved plant remains in the context in which they were used and/or stored. Also of interest is the 2010 discovery of about 100 birch-bark and woven baskets on the banks of the South Thompson River just west of the Neskonlith Reserve. Preliminary indications are that they are from the late pre-contact to early contact era (Marianne Ignace, pers. comm. 2011).

Birchbark at EeRb 140 and 144

A significant amount of birch bark was recovered from these adjacent two sites. The study of the birch bark recovered was conducted in two stages. The first was descriptive. A classification scheme was initially developed by Nancy Jules Bonneau for EeRb 140 and then refined by Leisl Westfall for EeRb 144 (see Table 6). As noted above, approximately 1,609 specimens were recovered and examined at EeRb 140, and 451 specimens from EeRb 144. Several observations are notable.

a) *Modification.* No manufactured items of birch bark were found, and much of what has been recovered may simply be production debris. At both sites, the majority of pieces recovered were flat or curled; the relative percentage of these was almost identical (Figure 32). Most of these were relatively small, but some of the largest pieces were flat. The average length and width of pieces was somewhat greater at EeRb 140 than at 144. There was also a tendency for the intermediate-sized pieces to be found as rolls (discussed below). Birch bark has a tendency to curl naturally so these rolls are not seen as evidence of cultural modification beyond being production debris.

Nine specimens from EeRb 144 had cut marks or possible cut marks, and notably these are all from the same general area of the site (N10-E6). Ubiquity analysis was employed by Westfall because much of the collection consisted of small fragments, often damaged in the recovery process or simply deteriorated over time. The items were counted individually to provide empirical data

Table 6. Birch bark archaeological specimen attributes.

Block—2 m^2 excavation block that derives its coordinates from the southwestern corner of the block in the northeast quadrant of the site, and from the northeastern corner of the block in the southeast quadrant of the site.
Unit—individual 1 m^2 unit within excavation block.
Depth—recorded as depth below excavation block datum.
Form—four distinct forms were recorded: 1. Flat—the piece appears relatively "straight," with little or no curl; 2. Curved—the piece exhibits a slight curling, but based on the degree of the curl would not form a roll; 3. Curled—the piece exhibits a marked curl, and may be the remains of a roll; and 4. Roll—a curled piece in which the birch bark has a cylindrical or elliptical form; rolls can be composed of a single or multiple layer(s).
Length—this attribute was measured (in millimeters) from the greatest point between the *ends*, these being the edges of the specimen that run parallel to the grain of birch bark (i.e., a grain that runs horizontally).
Width—this attribute was measured (in millimeters) from the greatest point between the margins, these being the edges of the specimen that run perpendicular to the grain.
Evidence of Burning—this attribute was recorded as either present (P) or absent (A).
Area Burned—for those specimens that evidenced charring or burning, this attribute is listed as either "Portion" or "All." Additional information on location of charring or burning (e.g., along margins; restricted to one end) is included under Comments.

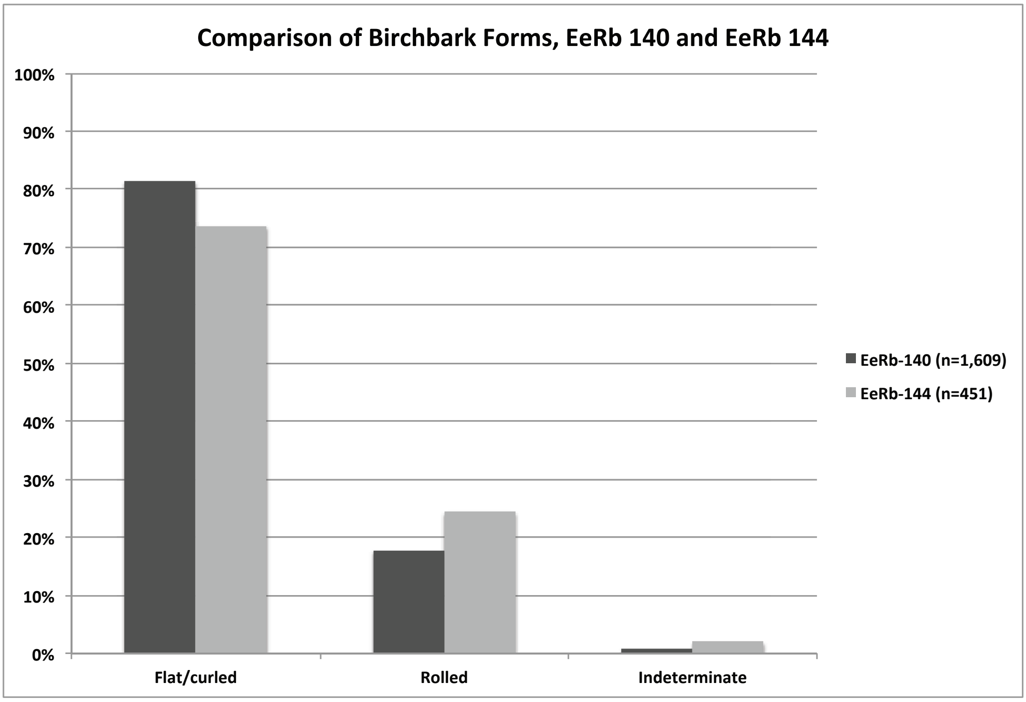


Figure 32. Comparison of uncharred/charred birchbark at EeRb 140 and 144.

on the amount recovered from different levels and site areas, and a catalogue to aid in ongoing and future research was developed. No cut marks were noted on any specimens from EeEb 140.

b) *Distribution.* At both sites, bark distribution could not be clearly correlated to specific areas or features. Features identified at EeRb 140 included the bark-lined feature in Unit 30 and adjacent hearth in Unit 32, the large array of fire-cracked rock center 10 m to the northwest, and the rectangular feature seen in unit profiles 6 m north of that (Figure 8). Here, some of the units with the largest amounts of birch bark were situated near these features, but other units containing large amounts were not associated with such features (which admittedly may have been present but unexcavated nearby). At EeRb 144, the most common and most easily identified features were hearths, which typically were defined by a distinct pattern of fire-cracked rock, soil staining, and/or charcoal, with associated cultural material often including lithic debitage and faunal or floral material. In such features, burned birch bark was always among the recovered material.

c) *Evidence of burning.* The percentages of uncharred and charred birch bark specimens at the two sites differ: uncharred pieces constitute 61% at EeEb 140 but only 14% at EeRb 144. At the latter site, 82% of all bark exhibits exposure to fire, as evidenced by either charring or burning. Forty-eight percent of all burned or charred birchbark was found in these units. In some hearth areas, all birch bark was burned, while in others, a relatively high percentage of birch bark was unburned. In block N3 E9, only unburned bark was recovered. Other blocks contained fire-cracked rock, but absolutely no birch bark. There is also variation in the vertical distribution of birch bark. At both sites, birch bark is present at the initial exposure of fire-cracked rock, while in others it is found in the lower level(s) of the feature. In addition, birch bark is not evenly distributed in hearth areas; for example, at EeRb 144, for the feature that extends through adjacent units N12 E6 and N12 E8, bark is found only in the former (and in relatively high amounts).

There is much yet to be studied about these data. It seems reasonable to correlate the ubiquity of burned birch bark to discrete activity areas, particularly those identified as hearths. However, when we try to account for the presence of unburned birch bark in hearth areas, or the presence of both burned and unburned bark with these features, any explanation becomes more tenuous.

d) *Seasonality.* The presence of birchbark itself cannot be reliably used to date the season of site occupation, as it may have been harvested earlier. While Turner (1998, 2008) notes that it was common to remove birch bark in the late spring or early summer, elsewhere she states that "thick, leathery bark, suitable for baskets, canoes, and baby cradles, was harvested in winter, between January and February. At this time, it was tough and could be peeled off in large sheets" (Turner et al. 1990:190).[12] Furthermore, Turner et al. (1990) suggest that the bark had to be worked rather promptly because it soon became brittle, suggesting that the relative thickness of the birch bark may serve as a seasonal indicator. Most of the birch bark specimens from EeRb 144 are relatively thin, supporting a spring/summer harvest and occupation. Those thicker pieces, one 5 mm thick in its currently desiccated state, may have been harvested at other times, or the thickness may simply be an indicator of tree age.

Why was so much of the material burned? Bouchard and Kennedy (cited in Hayden 2000) note the ethnographic use of birch bark as fuel, torches, or "matches" to start fires[t], and elder Mary Thomas confirmed this use for the Secwépemc (Turner 2008). The latter may be represented at EeRb 144 and at other sites in the project area by the numerous birch-bark "rolls" that show intense burning at one end (Figure 33). It is reasonable to suggest that if there were scraps of birch bark remaining from different activities, much of it would have been used as a convenient source of fuel.

As noted, the bark sheets (Figure 34) vary in size significantly, from small scraps to pieces as large as 45 by 15 cm (from within the bark-lined cache pit in Unit 30). One such sheet at EeRb 140 (from Unit 17) contained several salmon vertebrae and may have functioned as a tray or perhaps the equivalent of a dustpan.

e) *Function:* One last point regarding birchbark is that, in addition to the many utilitarian uses cited above, its association with food storage is significant. The large flat sheets of this strong but flexible material are well suited for baskets and storage pit lining. Birchbark also possesses antimicrobial properties that make it all the more effective in such contexts (Rapp et al. 1999; Reunanen et al. 1993). Perhaps not unexpectedly, these characteristics have been noted and the key components (betulin, a pentacyclic triterpenoid) identified and patented (Glinski and Branly 2001; Krasutsky et al. 2007).

Contextualizing Ancient Plant Use

This chapter documents some of the primary findings of our continuing study of paleoethnobotany and archaeology in the Interior Plateau, guided, in part, by a larger study of long-term land use and ecological relations. While there is still much to be done in completing our own goals in

Figure 33. Example of birchbark rolls, EeRb 144. Photo by George P. Nicholas.

the study of the Interior Plateau, it is clear that the potential of paleoethnobotany to contribute to Interior Plateau archaeology and ethnobotany is substantial in two ways. The first is by allowing us to extend and increase our knowledge of past resource gardening and harvesting, as well as subsistence practices in general (see Chapters 5 and 7, this volume). It is assumed that the so-called ethnographic pattern of plant use will extend back into the Late Period, but also that significant differences will appear with increasing time. The second contribution that archaeobotanical data provide the means to gain insights into the social lives of past Interior Plateau peoples. We discuss this briefly below.

Archaeobotanical remains obviously provide an important source of information on past land use and subsistence patterns that may not be available through other means. They may also contribute evidence of trade networks in the case of resources that originated in other locations. One of the most exciting applications that archaeobotanical remains may have relates to the issue of gender in the archaeological record (e.g., Claassen 1997; Gero and Conkey 1991).

The materials typically preserved at, and excavated from, archaeological sites in the Interior Plateau consist primarily of stone and bone. What has struck us after several years of excavation

Figure 34. Example of birchbark sheets, EeRb 144. Photo by George P. Nicholas.

at EeRb 140 is that if one looks only at these materials, the site would be interpreted by many as a short-term camp primarily associated with hunting, tool manufacture, and related activities. Artifacts such as projectile points, tool manufacturing debris, evidence of hunting and other forms of resource extraction reflect activities that are generally assumed to represent male activities based on the usual reading of the ethnographic record. Are such interpretations of the archaeological record inordinately skewed to particular patterns of human behavior modeled on contemporary Western expectations (see Gero 1991; Peacock 1998)? Do they provide an accurate representation of past gender roles and division of labor in the past? Such models obviously need to be rigorously tested.

This need becomes even more evident when we introduce the archaeobotanical evidence. At EeRb 140 we have identified seeds and other botanical remains that undoubtedly associated with plant collection and preparation, cache pits associated with food storage, and birch bark that is likely production debris from the manufacture of baskets, cradles, and other items. All of these represent what we assume to be typical female activities based on the ethnographic record. Thus, a major implication of our work at EeRb 140 is that we cannot reasonably interpret the function or social dynamics represented at Interior Plateau archaeological sites without an effort to integrate archaeobotanical testing.

The investigation of past social dimensions of the site can be taken a step further. Children are very difficult to identify in the prehistoric record (Ruttle 2010); evidence of their presence on archaeological sites reveals new dimensions of land use. At EeRb 144, the recovery of a deciduous second molar provides definitive evidence that a child, probably 10–12 years old (Brian

Chisholm, pers. comm. 1997), was present long enough to have lost the tooth. Interestingly, the tooth is very worn, suggesting heavy abrasion due either to diet (e.g., grit in vegetable foods) or to activity (e.g., use of teeth as tools to prepare cordage).

The study of plant remains may also provide new insights into the processes of cultural change and resistance. To what degree did traditional Secwépemc plant use continue after European contact? Did the availability of new food types such as flour result in replacement of indigenous root foods, perhaps because they came to be perceived as too labor-intensive to harvest and process? Or were traditional foods retained or amalgamated with new ones as the result of dietary preference or cultural conservatism? The ethnographic and ethnobotanical investigations by Palmer (1975), and by Turner, M. and R. Ignace, Peacock, Loewen (see Chapters 2, 5, 7 this volume) have shed some light on this. The analyses conducted by Wollstonecroft (Chapter 4) clearly demonstrate the importance of paleoethnobotanical investigations in the Interior, and will hopefully encourage others to conduct such studies on a regular basis. These questions may also be addressed at early historic period sites, such as the contact period pithouses that Catherine Carlson (2000, 2006) has excavated at the Thompson River Post in Kamloops, and should in future be seriously considered by archaeologists working at such sites.

Conclusions

Our field investigations on the Kamloops Indian Reserve have accomplished four things. First, First Nations people have been involved in doing their own archaeology and paleoethnobotany at ancestral sites. Second, a systematic study of non-pithouse archaeological sites in British Columbia was undertaken. Third, this work has revealed that the recovery of organic materials from open, dry sites is greater than expected, providing new opportunities to either verify or challenge assumptions about hunter-gatherer land use and resource utilization in the Interior Plateau, and to explore the antiquity of the Secwépemc cultural patterns recorded ethnographically. Finally, the recovery of archaeological and archaeobotanical data contributes to illuminating the past activities of not just men, women, and children, but most likely families.

Collectively, these accomplishments not only expand our knowledge of past Secwépemc lifeways, particularly those relating to plant use, but also support and extend Secwépemc traditional knowledge and oral history and link them to archaeological, ethnobotanical, and other sources of scientific knowledge. Ultimately, however, the work that we are doing is not about plants, but people. In this case, we are using archaeology to trace particular patterns of behavior, including that relating to plant use, into the more distant past. In doing so, our investigations reveal both continuity and change in the Secwépemc way of life.

Notes

1. The participation of First Nations peoples in the process of archaeology, and increasingly in setting its direction, is a crucial element of the decolonization process in British Columbia

(Nicholas 2006), and also an expression of what has become known as indigenous archaeology (see Nicholas 2008; Watkins 2000).

2. The elevation of some of the high terraces is about 425 meters asl; the intermediate terraces about 350–380 meters asl; and floodplain sites above 350 meters asl.
3. This term is commonly used in the Interior to refer to subsurface depressions, which include so-called house pits and cache pits.
4. Government Hill was leveled as part of the Sun Rivers development expansion.
5. A use-wear study of the microblades from EeRb 140 and 144 is currently underway (Dickie 2012).
6. The feature was excavated by Nicholas over a four-week period.
7. Although uncharred, we think these seeds are archaeological because of their density and diversity, and also because in the bark-lined pit, preservation may be improved by the properties of birch bark (discussed above). The surrounding fine silts and sands may also have been dry or dense enough to keep out agents of decomposition such as microorganisms and insects.
8. A total of 29 1-m^2 units and 2 2-m^2 units were excavated in the southwest quadrant, and 43 x 2-m^2 units in the northeast quadrant. The switch to the larger 2-m^2 units allowed us to define more clearly the activity areas present within this portion of the site.
9. For a description of early 20th-century fishing weir technology by Neskonlith elder Ike Willard and an accompanying illustration that appears to match the general design of the structure described here, see Bouchard and Kennedy (1975).
10. There is also a miniscule amount of plant materials from several other sites, such as charred choke cherry and saskatoon berry fruits from EeRb 149.
11. Much of the Government Hill landform consisted of active sand dunes and large or erosional/deflation surfaces covered with extensive concentrations of fire-cracked rock, tool manufacturing debris, burnt bone fragments, and the occasional formed tool. Testing revealed that the upper stratum was aeolian-deposited banded sand. Below that, at a depth of up to 90 cm in places, is a "pavement" of fire-cracked rock and cultural material (similar to that exposed on the surface), underlain by undisturbed cultural deposits. The recovery of three large caliber rifle cartridges 1 m below the surface indicates that they were deposited earlier this century on an exposed deflation surface subsequently reburied by dune migration. Testing in the undisturbed zone produced Late Period projectile points and other artifacts, in addition to lithic debitage, bone and shell beads, bone fragments, fresh-water mussel shell, and an immense amount of fire-cracked rock, and several charred choke cherry and saskatoon berry fruits. Two radiocarbon dates were obtained from just under the "pavement" and are associated with the Late Period occupations: 1630 ± 90 years BP (Beta-90604) and 1950 ± 100 years BP (Beta-90605).
12. In contrast, Marianne Ignace (pers. comm. 2011) notes that "Secwepemc and Ts'ilhqot'in elders who harvest bark, especially large sheets for cradles or formerly for canoes, inevitably do this in late spring to early summer when it pops off." In addition, Secwepemc elders knew where to find—or obtain by trade—large, thick pieces of birch bark from areas that grew particularly large birch trees. One such area is the high elevation Plateau above Quesnel Lake where unusually large birch trees grow.

13. Marianne Ignace also notes that while birchbark "fluff" is used as fire starter, the use of birch bark as torch or match does not involve birchbark *per se,* but birchbark fungus (c.f. Turner et al. forthcoming). Skeetchestn elder Christine Simon remembered her own elders using sheets of birch bark that were gathered up on one end and then scorched to make a "birchbark shovel" or scooper used to move dirt when excavating, snow for melting as drinking water, and probably also ashes from a hearth (M. Ignace, pers. comm. with Christine Simon, November 2, 2015).

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Chapter 4. Linking the Archaeology and Ethnobotany: An Interpretation of Ancient Plant Remains from Stk'emlupsemc Traditional Territory

Michèle Wollstonecroft† and Gladys Baptiste‡

Abstract

This chapter analyses charred plant assemblages from the archaeological site EeRb 140, a Late Period open-air site situated on mid-altitude terraces along the South Thompson River. Over 30 taxa of plants were recovered from two hearth features, many of them edible, including five types of berries, two types of nuts and an edible root, as well as a variety of species that were most likely used as fuel and matting. To interpret the human activities represented at EeRb140, we compared and contrasted the assemblages with the ethnobotanical record as well as with archaeobotanical assemblages from other Late Period archaeological sites in the region, while bearing in mind the distinct characteristics and associated artifacts (e.g., lithic and faunal) of the hearths. The patterns suggest that EeRb 140 was a multi-purpose, seasonally employed work area, probably used by women from a nearby pit-house village in the spring and summer for preparing, and possibly preserving, roots and berries.

Keywords: *Paleoethnobotany, macrobotanical assemblages, plant-processing sites, women's activities, Secwepemc, Plateau archaeology*

Introduction

This chapter discusses plant remains recovered from the archaeological site EeRb 140 (860 ± 60–160 ± 50 BP uncal), an archaeobotanical assemblage that is unique in the prehistory of the Canadian Plateau in terms of its species composition and archaeological contexts. Radiocarbon dates indicate that EeRb 140 was used by repeatedly by hunting-gathering-fishing peoples between approximately 900 and 100 years ago. More than 30 taxa of plants were recovered here, many of them edible and known (ethnographically) to have been important foods of recent Plateau peoples, including five types of berries, two types of nuts, and the charred tissue of nodding onion (*Allium cernuum*). In combination with the associated features, artefacts, and the location of the site itself, the remarkable range and particular species and plant parts recovered here suggest a

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new type of site in Plateau archaeology, one in which women's seasonal activities, including berry and root processing activities, are highly visible (Wollstonecroft 2000, 2002). From the proximity of the site to the contemporaneous pit-house village EeRb 77, in conjunction with the characteristics of the EeRb 140 plant assemblage as well as the fauna and lithic components, it appears that the site served as a seasonal work area and/or camp site that was used throughout the spring and summer by the residents of EeRb 77. It is likely that women from the pit-house village used the site to process and preserve berries and other edible plants before taking them to the winter village to store. Several other types of specialised activities are evident from the artefact and faunal materials including animal food processing, food storage, and the manufacture of lithic and bone fishing tools.

In this chapter, we present an archaeobotanical interpretation of plant assemblages from two hearth features found at EeRb 140. Charred plant macroremains are the subject of our analysis, including seeds, conifer needles, charcoal, and non-wood plant tissue. Our objectives are to interpret the types of plant-related activities that ancient people performed at this site based on: plant taxa, plant parts (e.g., fruit, stem, tuber) and quantities of each recovered, their contextual integrity, and their consistency with other aspects of the archaeological record. We also take into account Plateau ethnobotanies and ethnohistories to explain the plant-related activities that were likely carried out at the site.

We begin with a short introduction to site EeRb 140 that describes its environmental setting and situates it temporally into the archaeological sequence of the region. We then briefly review the archaeobotany on the Canadian (British Columbia) Plateau (also known as the Southern Interior) to establish a general framework for the types of plants that commonly occur at archaeological sites in this region and the archaeological contexts in which they have been found. Subsequently we explain the archaeological methods used to excavate EeRb 140 and describe the archaeological components (features and artefacts). We then explain our archaeobotanical methods of sampling and laboratory analyses. Because our interpretations are highly informed by ethnographic analogy, before presenting the results and interpretation, we diverge to explain our approach to the use of ethnographic analogy; we present two ethnobotany frameworks for interpretation that summarise the plants that were probably available in the region at the time that the site was occupied, and the reported uses of those plants. Then, we compare the archaeobotany of EeRb 140 with these archaeological and ethnographic frameworks to interpret the types of plant-related activities and the seasons and ecological zones represented by the plant assemblage.

EeRb 140: Background Information

The Environmental Setting

EeRb 140 is situated within the Interior Plateau, an inland region of western North America that extends from the 54th parallel, within the Canadian province of British Columbia, down to southern Oregon in the United States and is bordered on the west by the Coast Mountain range and on the east by the Columbia Mountains. The terrain is comprised of remarkably diverse physical geography, climate, ecosystems, and vegetation, with elevations ranging from lowlands at 100 meters (m) above sea level (asl) to alpine regions at over 3,000 m asl. Three major river drainage systems traverse the Plateau: the Fraser, Thompson, and Columbia Rivers. Local climate and precipitation conditions differ from east to west and north-south, but common throughout are extremes in climate, with very hot dry summers and cold winters, with as much as 220 days of frost annually; snow is common in the higher country until April but sparse in the river valleys (Parish et al. 1996; Tisdale 1947).

EeRb 140 (50°41'04"N 120°17'28") is located on the Thompson Plateau, near the present-day town of Kamloops, on lands belonging to the Kamloops Indian Reserve No. 1, the ancestral home of the Stk'emlupsemc, the Kamloops division of the *Secwepemc*, whose traditional territory encompasses the Mid Fraser-Thompson Drainage and surrounding Plateaus and mountain ranges (see Ignace 1998; Ignace and Ignace 2004; Ignace and Ignace this volume). This is a dramatic landscape, characterised by rolling hills that peak at almost 1,100 m asl and descend abruptly to vast river valley floors at 345 m asl. Treeless grass and sagebrush (*Artemisia* spp.) steppe lands and open coniferous forests and grasslands characterise the low and mid-altitudes, while more closely packed coniferous forests characterise the uplands.

The site is on one of the many xeric grassland and sagebrush mid-altitude terraces that demark the north and south boundaries of the South Thompson River floodplain in the vicinity of the present-day city of Kamloops. These terraces are composed of glaciolaucustrine silts and sands that were originally laid down during the Late Pleistocene by the retreating Cordilleran Ice Sheet and re-deposited by wind and erosion during the Holocene (Palmer 1975b; Tisdale 1947). Moist gullies, created by run-off from higher elevations, separate these terraces from each other on their east and west sides. EeRb 140 is located on one of the terraces on the north side of the river. The summit of this terrace, at 425 m asl, overlooks the river flood plain by about 80 m. On its north side, which we refer to as the "back", this and the other terraces merge into a hilly incline, which in turn merges into the steeper hillsides of two mountains, Peter and Paul Peaks.

Throughout the Plateau, elevation significantly affects ecological conditions such that precipitation, temperature, soils, and vegetation vary considerably over the different altitudes. Consequently, from the river basins up through the low, mid and high elevations, diverse populations of plants and animals are found within a few kilometres. Aspect also affects the distribution of habitats, such that adjacent but opposite slopes frequently vary in climate and vegetation. Winds are another factor, especially in the higher, exposed grasslands where they prevent forest growth (Tisdale 1947).

Nine distinct ecosystems are found in *Secwepemc* territory, three of which are present in the South Thompson Valley: the Bunchgrass, Ponderosa Pine, and Interior Douglas-fir zones. EeRb 140 and the surrounding terraces are within the Bunchgrass (BG) zone, an ecosystem that is unique to the hotter and dryer southern regions of BC, where it spans valley bottoms, occasionally to up to elevations as high as 1,000 m asl. This ecosystem is predominantly shrub-steppe, grass meadowlands; numerous types of wetlands are also found in this zone (although none in the area that includes EeRb 140). It is primarily composed of xeric-adapted meadowland plants, of which 60% are bunchgrasses (*Agopyron spicatum*, *Poa sandbergii* and *Stipa comata*) and 15% shrubs, particularly sage (*Artemisia frigida and A. tridentata*) and common rabbit-brush (*Chrysothamnus* *nauseosus*); alkali saltgrass (*Distichlis stricta*) dominates saline meadowlands; trees are rare except for the occasional Ponderosa Pine (*Pinus ponderosa*) or Interior Douglas-fir (*Pseudotsuga menziesii* var *glauca*); mosses and lichens (*Tortula ruralis* and *Cladonia* spp.) are common and ferns are widespread at higher altitudes or in damper areas; wetland species include water birch (*Betula occidentalis*) and cattail (*Typha latifolia*) (Nicholson et al. 1991; Parish et al. 1996).

The BG vegetation that covers the EeRb 140 terrace is dominated by scattered clusters of bluebunch wheat grass (*A. spicatum*) and dense stands of sagebrush. Prickly-pear cactus (*Opuntia fragilis*) occurs here and in the nearby BG meadows where numerous geophytes also grow, such as the desert parsleys (*Lomatium* spp.) and several lilies, including mariposa lily (*Calochortus macrocarpus*), yellowbell (*Fritillaria pudica*), fool's onion (*Brodiaea hyacinthina*), and death camas (*Zigadenus venenosus*). Steep gullies on the east and west sides of the terrace, which separate it from the adjacent terraces, are home to more mesic-adapted herbaceous plants and shrub species.

The Ponderosa Pine (PP) ecosystem is restricted to hotter and dryer latitudes of British Columbia that are south of 51°N. PP zones typically span areas between the BG and Interior Douglas-fir ecosystems. Xerophytic species are also common here. On the hillsides above EeRb 140, the PP zone is characterised by open Ponderosa Pine (*Pinus ponderosa*) woodlands and bluebunch wheatgrass meadows. Berry producing shrubs such as Saskatoon (*Amelanchier alnifolia*) and numerous perennial Asteraceae are frequently found here, including balsamroot (*Balsamorhiza sagittata*) and slender hawksbeard (*Crepis atrabarba*) (Hope et al. 1991a; Parish et al. 1996).

On the uplands, above the PP zone, is the Interior Douglas-fir zone (IDF). The IDF ecosystem is also unique to the south-central regions of the province, occurring in low- to upland elevations at latitudes below 52°N. The uplands of the South Thompson River are classified within a subzone known as the Very Dry Hot IDF ecosystem, composed of open-to-closed Douglas-fir (*Pseudotsuga menziesii*) forests interspersed by pinegrass (*Calamagrostis rubescens*) meadows. Hazelnut (*Corylus cornuta*), which is presently rare within the Kamloops area, and numerous geophytes including balsamroot, spring beauty (*Claytonia lanceolata*), and nodding onion (*Allium cernuum*) are typical of this ecosystem (Hope et al. 1991b).

Significantly, according to Hebda (1995) the climate and vegetation of the South Thompson River valley have been relatively unchanged over the past 3,000 years, so the present day composition of natural vegetation is probably similar to the period when EeRb 140 was occupied. However, there has been a decrease in the distribution and abundance of many species since European contact, especially economically important root foods. Bitterroot (*Lewisia rediviva*), for example, said to be once plentiful in the Kamloops locality in the early 1900s, is no longer found in the South Thompson region (Palmer 1975a; Teit 1909). This depletion of species is largely due to the discontinuation of Native management strategies and the introduction of cattle and foreign plants (Parish et al. 1996; Peacock et al. this volume; Thomas et al. this volume; Tisdale 1947; Turner and Turner 2008). Overgrazing by cattle, for example, has in many areas lead to a loss of moisture and shifts in the floral composition to more xeric plants, typically species that can withstand cattle grazing, e.g., sagebrush (*Artemisia tridentata*). Although many of the plants that were present in the Late Period continue to thrive in this locality, it is therefore unlikely that their present-day distribution is identical to that of the Late Prehistoric period.

The Temporal Setting

Plateau archaeology is characterised as having three major cultural periods, an Early, Middle, and Late (Table 1). Little is known about the Early and Middle periods other than that people followed highly mobile, generalised, and opportunistic hunting and gathering practices based on primarily terrestrial upland resources (Carlson 1995, 1997; Stryd and Rousseau 1996). A shift to the semi-sedentary pit-house settlement systems and logistical (radiating) mobility strategies (Binford 1980), which characterised the Late Prehistoric and Historic periods, occurred between the final Middle period and early Late Period. In this paper we follow the local chronological scheme for the Late Period of the Mid-Fraser-Thompson River drainage area defined by Stryd and Rousseau (1996) that classifies the period into three archaeological horizons known as the Shuswap (3500–2400 BP), Plateau (2400–1200 BP), and Kamloops (1200–200 BP) (Table 1). This chronological scheme roughly corresponds with the general scheme of three broad archaeological Late Prehistoric sequences suggested by Chatters and Pokotylo (1998): Late Prehistoric I (ca. 4500–2500 BP); Late Prehistoric II (ca. 2500–1500 BP); and Late Prehistoric III (ca. 1500–200 BP). Site EeRb 140 dates from the Kamloops Horizon (Late Prehistoric III).

During late Middle Period/early Late Period significant changes in settlement patterns and demographic distributions occurred, with populations aggregating in the valley bottoms where they established pit-house base-camps. These new settlement patterns are attributed to socioeconomic re-organisation and diversification of the subsistence base. New hunting, fishing, and plant exploitation strategies were implemented that permitted people to obtain a greater range of resources within more geographically limited territories. Logistical mobility was one of these strategies; it permitted improved seasonal exploitation of the many different plant and animal habitats between the uplands and the river valleys, necessitated socioeconomic re-organisation. Dividing into specialist-led task groups, probably according to gender, age, and abilities, communities were able to exploit concurrently available resources (although it is not clear when groups began to divide their work among specialist-lead task groups and/or practice a gender division of labour). These new strategies, including the constructing of semi-subterranean permanent houses for winter occupation, intensified harvesting of seasonally-available anadromous salmon from the

Table 1. Archaeological sequence for the Mid-Fraser-Thompson River drainage area (after Stryd and Rousseau 1996:Fig. 2; Palaeoclimate after Hebda 1995).

<table>
<tr><th>^{14}C years BP</th><th>ARCHAEOLOGICAL PERIOD</th><th>ARCHAEOLOGICAL UNITS</th><th>CLIMATE PERIOD</th><th>PALAEOCLIMATE</th></tr>
<tr><td>1200–200</td><td rowspan="3">LATE</td><td>Kamloops Horizon</td><td rowspan="6">Post-hypsithermal</td><td rowspan="4">modern climate</td></tr>
<tr><td>~2400–1200</td><td>Plateau Horizon</td></tr>
<tr><td>~3500–2400</td><td>Shuswap Horizon</td></tr>
<tr><td>~5000–3800~</td><td rowspan="3">MIDDLE</td><td>Lochnore Phase</td></tr>
<tr><td>~6000–4500~</td><td>Lehman Phase</td><td rowspan="2">cooling trend and increase in moisture; warmer than today</td></tr>
<tr><td>~7200–5500~</td><td>Early Nesikep</td></tr>
<tr><td rowspan="2">~11,000–7200</td><td rowspan="2">EARLY</td><td rowspan="2">Mixed early cultural traditions</td><td>Hypsithermal</td><td>hot and dry; warmer and drier than today</td></tr>
<tr><td></td><td>cold and moist</td></tr>
</table>

rivers, increased production of and reliance on stored plant and animal foods, particularly edible geophytes (dryland plant storage organs such as tubers, bulbs, corms, taproots) and became the hallmark of the Late Period Plateau Pit-house tradition (Richards and Rousseau 1987).

Late Period groups followed similar hunter-gatherer-fisher patterns but there were significant regional and local differences in demography and group socioeconomic structure (and probably language). Along the Fraser River and Upper Columbia River watersheds, villages were small, with not more than five pit-houses and probably composed of unstratified extended family groups. But villages located in the Mid-Fraser, Upper Chilcotin, Slocan, and parts of the South Thompson rivers, had as many as 130 pit-houses, some of them large, as well as relatively socially and economically stratified large populations (Morin et al. 2008; Hayden 2000).

Likewise, the diet varied among Plateau groups, with north-south and east-west differences in staple foods, due probably to ecological as well as historic differences. Stable-carbon isotope analyses on human remains from the Late Period show that, from east to west on the Canadian Plateau there were significant differences in the proportion of marine resources in the diet, with groups in the West consuming the greatest amount and groups in the east the least (Chisholm 1986: Richards and Rousseau 1987). Ecological differences undoubtedly influenced mobility patterns and some groups were probably more nomadic than others (see Teit 1909 and Palmer 1975a). Temporal developments also vary on the Plateau, e.g., the intensification of root processing began about 3,100 years ago on the Canadian Plateau, a trend that began somewhat earlier (c. 3,500 years ago) on the Columbia Plateau, although the use of pit-cooking technology in that region dates from much earlier (Peacock 2002; Thoms 1989, 2008, 2009).

The subsistence system observed at European contact is thought to have developed during final phase of the Late Period, the Kamloops Horizon (1200–200 BP) (Alexander 1992b; Rousseau and Richards 1985; Teit 1900, 1909). This period is characterised by population dispersals into smaller socioeconomic units and an apparent disintensification, resulting in a re-organization of the labour force and redirecting of labour. Large villages were permanently abandoned and smaller village communities were established again along the rivers. Economic and social practices continued from the previous period, including the logistical resource procurement strategies. From the feature and artefact evidence, we know that pit-oven processing of roots and meats continued but with some modifications (Alexander 1992b; Frieberg and Stenholm 1991; Pokotylo and Froese 1983; Turner 1997). Pit-oven features, for example, continue to occur but are fewer and smaller, averaging one meter in diameter compared with the large features found in Shuswap and Plateau Horizon sites (Frieberg and Stenholm 1991; Lepofsky and Peacock 2004; Peacock 1998).

Plateau Archaeobotany

Given the ethnobotanical and ethnohistorical evidence that plants were integral to the economies and traditions of Plateau peoples (see the authors in this volume as well as Dawson 1891, 1875–1878; Hill-Tout 1899–1911; Ignace 1998; Palmer 1975a; Teit 1900, 1909; Turner 1992, 1997; Turner et al. 1980; Turner et al. 1990), it is not surprising that whenever Plateau archaeological sites are sampled for plant remains, more often than not, they are found to contain rich and diverse assemblages (Table 2). Yet, up to recently, Canadian Plateau archaeologists typically assumed that plant remains could not be recovered from archaeological sites on the Northern Plateau, and therefore rarely sampled for them (for a discussion, see Lepofsky 2004). In fact, systematic archaeobotanical sampling, first implemented in the late 1980s with Hayden and Lepofsky's work on the Keatley Creek pit-houses (Lepofsky et al. 1996), continues to be rare in this region. Archaeologists more often infer plant gathering and processing from the presence of secondary (proxy) evidence such as digging sticks and pit-oven features.

The earliest proxy evidence of plant collecting and processing is from the Shuswap Horizon. Pecked and ground-stone pestles are found in various sites, and a small pit-oven of 1 m in diameter was found at the Parker Site in the Oregon Jack Creek valley, approximately 100 km west of present-day Kamloops. Dating from 3130 BP, this pit-oven provides rare evidence of earth-oven technology and the use of upland resources in the early Prehistoric period (Lepofsky and Peacock 2004; Peacock 1998; Richards and Rousseau 1987).

Evidence of the intensification of root processing, beginning during the late Shuswap (Late Period 1) and Plateau (Late Period II) Horizons on the Canadian Plateau, has been inferred from increases in the number of pit-oven sites found in the uplands, increases in the number of pit-oven features at each site, the massive size of some of these features (up to seven meters in diameter), and evidence of their frequent re-use (Lepofsky and Peacock 2004; Peacock 1998, 2002; Pokotylo and Froese 1983). These pit-oven sites appear to have been situated adjacent to root-harvesting grounds and to have been used to mass process the edible roots, probably species in the Liliaceae and Asteraceae plant families.

Intensification is suggested by the labour organisation and concentration of labour that was necessary to construct and maintain the ovens and for the mass collecting and processing of the root foods as well as for the collecting of other materials required for pit-cooking, such as fuel, rocks, and vegetation for lining the pit and wrapping the foods (Peacock 1998). Mass collecting and processing of root foods has been inferred from the number of features found at each site, e.g., more than 100 ovens occur within 38 sites in the Oregon Jack Creek Valley, 84 within 44 sites in the Upper Hat Creek Valley (near Oregon Jack Creek) and 102 within 35 sites at the more northerly Potato Mountain. Of particular relevance here is *Ck'emqenétkwe* (*"Komkanetkwa" or* Scheidam Flats), an upland valley on Stk'emlupsemc lands located about 8 km from Kamloops and site EeRb 140. Here, 61 root processing sites, containing a total of 170 earth ovens, were identified in a series of survey carried out between 1969 and 1995 (Peacock 1998, 2002). Peacock (2002) reported that the *Ck'emqenétkwe* pit ovens are typically 1.5 to 4 m or more in diameter and have a depth of 25–80 cm.

The first direct evidence of plant use on the Canadian Plateau was Ketcheson's (1979) archaeobotanical identifications of charred plant materials from the Upper Hat Creek Valley pit-oven sites, which were excavated by Pokotylo and Froese (1983). Ketcheson identified several bulbs as *Allium* species and seeds of Asteraceae and Liliaceae. Other charred botanical materials identified by Ketcheson include the needles and branches of an unidentified conifer, which she interpreted as fuel or pit-oven lining (Table 2).

A recent rise in interest in pit-ovens has resulted in several new archaeobotanical studies of Canadian Plateau pit-oven sites. They include Peacock and colleagues' on-going investigations at the

Table 2. Plant taxa recovered from other BC plateau archaeological sites. Key: ch = charcoal, n = conifer needle, s = seed, v = vegetative tissue.

POTENTIAL PLANT USES[1]	ARCHAEOLOGICAL CONTEXTS				
	BERRY PROCESSING[2]	PIT-OVEN SITES[3]			WINTER VILLAGE[4]
	Big Meadow	**Upper Hat Creek**	**White Rock Springs, Hat Creek**	**Keatley Creek ovens**	**Keatley Creek pit-house floors**
FOOD	*Vaccinium* (s)	*Allium* (v) Asteraceae Liliaceae (v)	*Arctostaphylos uva-ursi* (s) cf. *Berberis aquifolium* (s) cf. *Rosaceae* (s) *Rubus* (s) *Shepherdia canadensis* (s)	*Allium* (v) Ericaceae (s) *Lomatium* (v) unid. parenchyma	*Amelanchier alnifolia* (s) *Ar. uva-ursi* (s) *Cornus stolonifera* (s) Ericaceae (s) *Opuntia* (s) *Prunus* (s) *Pseudotsuga menziesii* (s) *Ribes* (s) *Rosaceae* (s) *Rubus* (s)
MEDICINE			cf. Ranunculaceae (s)		*Phacelia* sp. (s) *Silene* sp. (s)
TECHNOLOGY	Cyperaceae (s)	unid.conifer (n)	Cyperaceae (s) Poaceae (s) *Picea gluaca* (n) *Pinus ponderosa* (n) *P. contorta* (n) *P. menziesii* (n)	unid. conifer (n)	Cyperaceae (s) Poaceae (s) *Pinus* (n) *P. menziesii* (n)
MULTIPLE USES			cf. *Achillea* (s) *Chenopodium* (s)	*Chenopodium* (s) *Smilacina racemosa* (s)	Boraginaceae (s) *Chenopodium* (s) *S. racemosa* (s)
FUEL	*Populus/Salix* (ch) *P. menziesii* (ch)	unid. conifer (ch)	cf. *Alnus* (ch) cf. *Betula* (ch) *Picea glauca* (ch) *Pinus* (ch) *Populus* *P. menziesii* (ch) cf. *Salix* (ch) unid. dicot (ch) unid. conifer (ch)	cf. *A. uva-ursi* (ch) unid. conifer (ch) unid. wood (ch)	*B. papyrifera* (ch) *Pinus* (ch) *Populus/Salix* (ch) *P. menziesii* (ch)

[1] References for plant uses: Palmer 1975a; Parish et al. 1996; Teit 1900, 1909; Turner 1992, 1997, 1998; Turner and Peacock 1995; Turner et al. 1980; Turner et al. 1990; Turner et al. In Press.
[2] Frieberg and Stenholm 1991.
[3] Hayden and Cousins 2004; Nicolaides 2010; Pokotylo and Froese 1983.
[4] Lepofsky et al. 1996.

root processing site known as White Rock Springs (EeRj 226) site in the Upper Hat Creek Valley (Peacock et al. 2007; Peacock et al. 2009; Peacock et al. 2014; Pokotylo et al. 2008) and Nicolaides' (2010) archaeobotanical analysis of three earth ovens there, as well as analyses of eight pit ovens at the Keatley Creek winter village (Hayden and Cousins 2004) and six ovens at *Ck'emqenétkwe* (Peacock 1998, 2002). The results of these archaeobotanical analyses (Table 2) are surprising in that few root foods were recovered: Hayden and Cousins (2004) tentatively identified *Lomatium* spp. and *Allium* spp. tissue from the Keatley Creek pit-ovens. This pattern may be due to the fact that, according to the ethnographic information (Turner et al. 1990; Turner et al. forthcoming), Plateau people typically wrapped food items before they were placed in the pit-ovens, reducing the likelihood of spills. This pattern may also reflect taphonomic and preservation problems. Charred plant tissue is fragile and vulnerable to mechanical damage such as the re-use of the pit-oven during prehistory and/or recently during archaeological recovery (Hather 1993).

Among the other plant remains identified from the pit oven sites, charcoal from the White Rock Springs and *Ck'emqenétkwe* sites was identified as *Populus* spp., Douglas-fir, and pine, which in this part of the Plateau were most common woods used for fuel (Lepofsky et al. 1996; Wollstonecroft 2002). A variety of seeds were also recovered from the White Rock Springs and Keatley Creek pit-ovens (Table 2); only *Chenopodium cf. capitatum* seeds were recovered from *Ck'emqenétkwe* (Peacock 2002).

Another pit-oven site that is of relevance here is Lucky Break on Lake Wenatchee in the Cascades of Washington State, analysed by Frieberg and Stenholm (1991). Dating from 500 to 600 BP, this Late Prehistoric III feature is temporally more contemporaneous with our site than the pit-ovens discussed above. Compared with the size and depth of the massive Plateau Horizon (late Prehistoric II) pit-ovens, the Lucky Break pit-oven was notably shallow, measuring less than a meter in diameter and 7–10 cm deep. Frieberg and Stenholm (1991) interpreted this site as a roasting pit for biscuitroot (*Lomatium* spp.), which they based on the recovery of two possible foods, *Lomatium* root and a lily (*Allium* spp.) seed. From the charcoal they identified Saskatoon, alder and an unknown coniferous wood, which they interpreted as fuel, and coniferous branches and needle fragments as pit-oven lining.

Except for the present study (see below), few other types of Plateau plant-processing sites have been sampled for archaeobotanical remains. The best example is the berry-processing site of Big Meadow Camp in the Cascade uplands of Washington State. Here, Mack and McLure (2002) recovered the seeds and fruit tissue of blueberry or huckleberry (*Vaccinium* spp.), seeds and stems of a sedge (*Scirpus validus*), which they interpreted as matting, and fragments of willow and Douglas-fir charcoal, which they interpreted as fuel. Significantly, Mack and McLure interpreted the plant assemblage as representing a specialised berry-processing site, based on their previous ethnobotanical studies of berry processing by Native groups in the area.

Winter villages would be expected to produce a highly diverse plant assemblage, compared with specialised root- and berry-processing sites, given that a range of routine activities probably took place in and around the pit-houses. Indeed Lepofsky's (Lepofsky et al. 1996) analysis of flotation samples from the roof, rim, and pit-house floors of three of the Keatley Creek winter village pit-houses resulted in the recovery of more than 80 plant taxa from seeds, needles, buds, charcoal, and bark (Table 2). Of the identified plants, most are known ethnographically to have been of economic and cultural significance to Plateau First Peoples, including the *Nlaka'pamux* (Thompson), *Secwepemc and St'at'imc First Peoples* (Turner 1992, 1997; Turner et al. forthcoming), whose traditional territories meet in the Keatley Creek area. The seed assemblages recovered from the pit-houses provided evidence for the gathering edible berries, including Saskatoon (*Amelanchier alnifolia*), cherry (*Prunus* spp.), wild rose (*Rosa* spp.), Solomon's seal (*Maianthemum* spp.; syn *Smilacina* spp.), kinnikinnik (*Arctostaphylos uva-ursi*), red-osier dogwood (*Cornus stolonifera*), gooseberry/ *current (Ribes* spp.) and blackberry/thimbleberry (*Rubus* spp.). The seeds of prickly-pear cactus (*Opuntia fragilis*) were also identified. The pads of prickly-pear cactus are known ethnographically to have been used as foods by Plateau groups, however, Lepofsky interpreted the *Opuntia* seeds, along with non-food seeds of grasses (Poaceae), sedges (Cyperaceae), Chenopodium, *Silene* spp., *Phacelia* spp., and stoneseed (*Lithospermum ruderale*) as having been unintentionally introduced. Douglas-fir and Ponderosa Pine (*Pinus ponderosa*) needles were distributed around the periphery of the pit-house floors, which Lepofsky et al. (1996) interpreted as sleeping areas. Most of the grass and chenopod seeds were also found in those areas. Fuel wood was identified from the charcoal as pine, cottonwood (*Populus* spp.), and Douglas-fir (*Pseudotsuga menziesii*). Each of the examined pit-houses, which differed in size and artefact assemblages, produced significantly different plant (and fauna) assemblages in terms of species richness, which accorded with Hayden's interpretation of the Keatley Creek Village community as a highly socially stratified society (Hayden 1992, 2000; Lepofsky et al. 1996).

Table 2 summarises the plant assemblages from Upper Hat Creek, White Rock Springs, the pit-oven and domestic contexts of Keately Creek and the Big Meadow berry processing sites. We return to this table later (below) and to compare our results from EeRb 140 with the plant assemblages from these five sites.

The Archaeological Components of EeRb 140

Site EeRb 140 is one of 60 archaeological sites identified on the terraces in the 1990s by George Nicholas, which are discussed in detail by Nicholas and Westfall (Chapter 3, this volume). Some of these sites were first reported more than 100 years ago by Harlan I. Smith (1900) who, employed by Franz Boas as part of the Jessup Expedition, travelled through this region in 1897. Smith carried out surface collecting of artefacts at various sites on the terraces and found objects dating from the early and middle parts of the Late Prehistoric Period (c. 3,800–1000 years ago), including a decayed cedar canoe, burials covered in matting, a birch-bark dish, bone tools, stone pipes, and beads.

Radiocarbon dates indicate that EeRb 140 was used repeatedly during the final part of the Kamloops Horizon of the Late Prehistoric, between approximately 900 and 100 years ago. However the presence of diagnostic artefacts from the two earlier Late Prehistoric Period horizons (the Shuswap and Plateau), combined with an apparent mixing of the cultural stratigraphy, suggest that the site was used repeatedly from c. 3,500 years ago up to recent times. Moreover, even earlier Middle Prehistoric Period (7,200–3,800 years ago) occupations have been inferred from the presence of microblades, notched cobbles, and diagnostic points (Nicholas and Tryon 1999).

The site covers an area of about 45 x 50 m. In field seasons from 1991 and 1996, George Nicholas and his teams of field school students excavated thirty-five square meters of the area (Figure 1). They excavated in 1 x 1 m units, which were dug in five centimetre arbitrary levels, with the exception of deeper cultural strata of some features that were excavated in natural layers. The

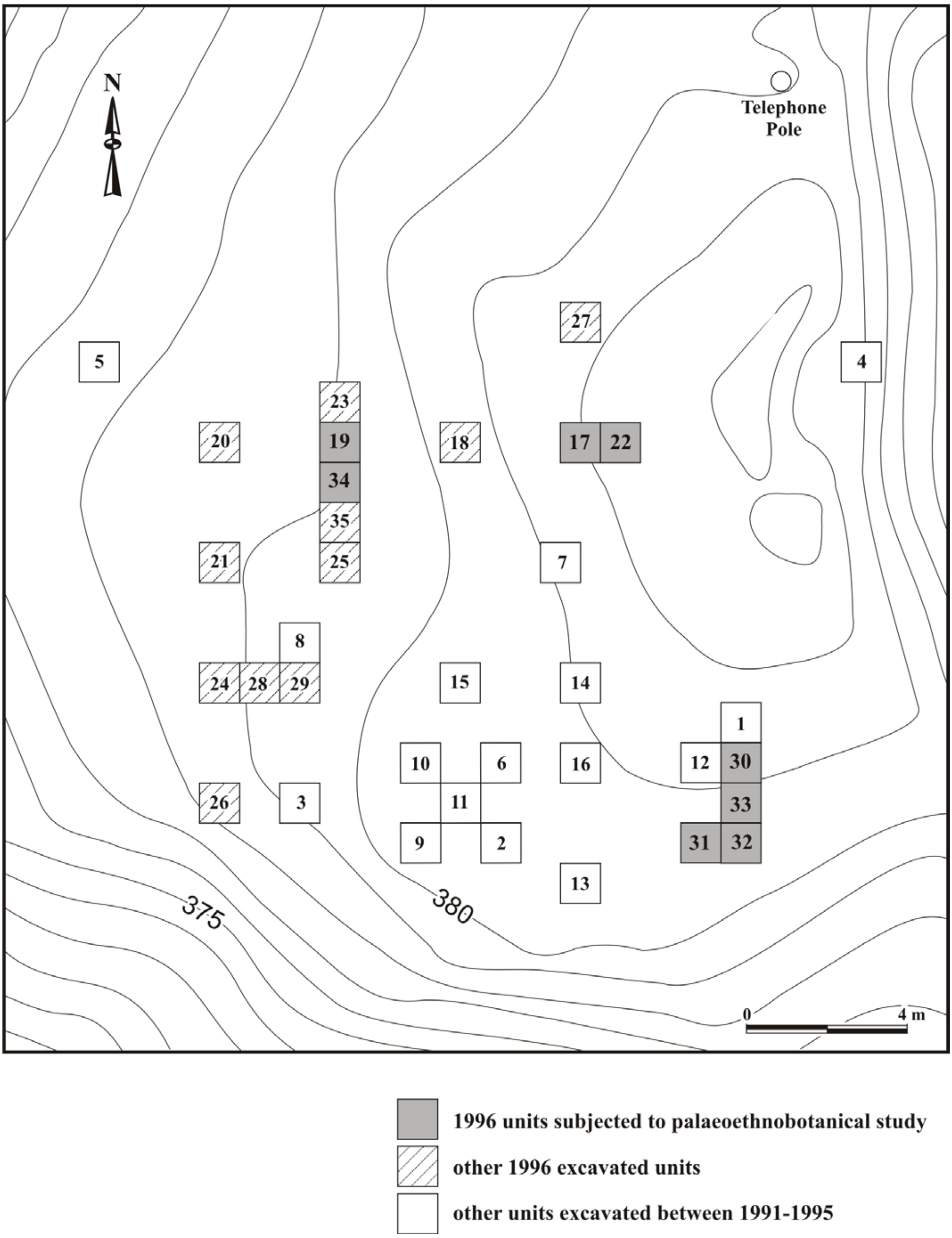

Figure 1. EeRb 140 site map (after Nicholas 1996).

"front" of the terrace, i.e., south part that overlooks the river floodplain, appeared to have been more heavily used because *in-situ* features were found here including the Units 30 and 32 features, which are the subjects of this chapter.

The artefact and faunal assemblages suggest that several types of specialised activities were routinely carried out at EeRb 140 including the manufacturing of lithic and bone tools, animal food processing, and food storage. Among the bone artefacts were needles and a large bone point. Dentalia shell from the coast, birch bark rolls, and shell and bone beads were also found here. Lithic (primarily basalt) artefacts and debitage were found at EeRb 140 in significant numbers, suggesting that both the manufacture and use of stone and bone tools were carried out here (Nicholas and Tryon 1999). The lithic assemblage included hafted and hand-held drills, retouched flakes, and hammerstones, the latter are thought to have been associated with stone tool manufacture. Among the other stone artefacts were unifacial and bifacial tools are thought to have been used for bone working, key-shaped scrapers for making arrow-shafts and endscrapers possibly for hide working and notched cobbles, which were probably used as fishing net-sinkers. Features were found in the south (front) of the site. Two *in-situ* features were identified in the upper levels of the Unit 30 and Unit 32 excavation squares and one in the lower levels of the Unit 30 excavation square.

The Unit 30 excavation square contained two nested features, a hearth in the upper levels (5–35 cm below the surface (bs) and bark-lined pit in the lowest levels (50 to 85 cm bs), which were separated by a narrow "transition zone" (Figure 2), at 35–50 cm bs, that contained some rock and birch bark, although the latter appeared to be an intrusion from the feature below. Horizontally, the Unit 30 hearth (upper feature), which is the subject of the present discussion, covered an area of approximately 80 cm in diameter (Figure 3). Excavation of this feature produced charcoal, partially burned wood, and fire-altered rock as well as a dentalium shell, a basalt core, a roll of birch bark, and numerous fragments of deer bone.

The Unit 30 lower feature, a bark-lined pit, contained the articulated vertebrae of a fish, thin wooden sticks, small birchbark rolls and large sheets of birch and Ponderosa Pine bark, and fire-altered rock at the base. The side walls were lined with birch and Ponderosa Pine bark strips. Significantly, there was no evidence of an *in situ* fire within this feature. Nicholas (1996 and in Nicholas and Tryon 1999) inferred that it had initially been created for storage and later used for rubbish.

The other feature of interest here, the Unit 32 hearth (Figure 4), was located approximately two meters south of the Unit Hearth, closer to the south edge of the terrace (Figure 1). This square was excavated to a depth of 40 cm below surface (bs) and three layers were identified, with the hearth situated in Layer II. Compared with the Unit 30 hearth, the Unit 32 hearth was shallow, with a thickness of only 5 cm extending between 15–20 cm bs. Horizontally it covered a horizontal area of about 40 x 50 cm. It contained a relatively high concentration of charcoal and charcoal-stained soil, as well as partly burnt wood and fire-altered rock. Above the hearth, in Layers I and II, animal bone and an uncharred birchbark roll were recovered. Chert and basalt microblades were found scattered around this hearth.

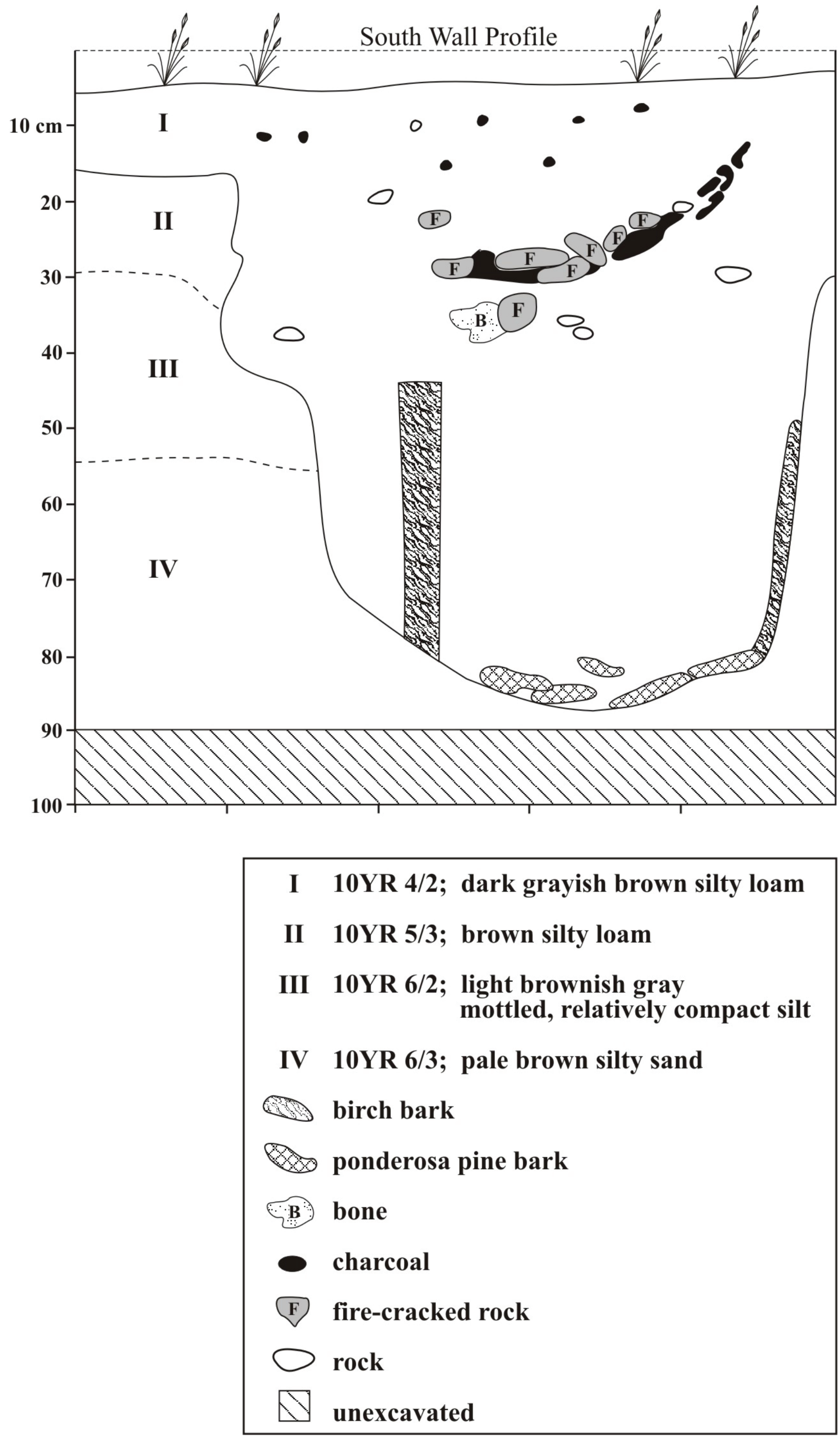

Figure 2. Profile of the Unit 30 features, upper (hearth) and lower (bark-lined pit), as seen from the south wall profile of Unit 1 (after Nicolas 1996).

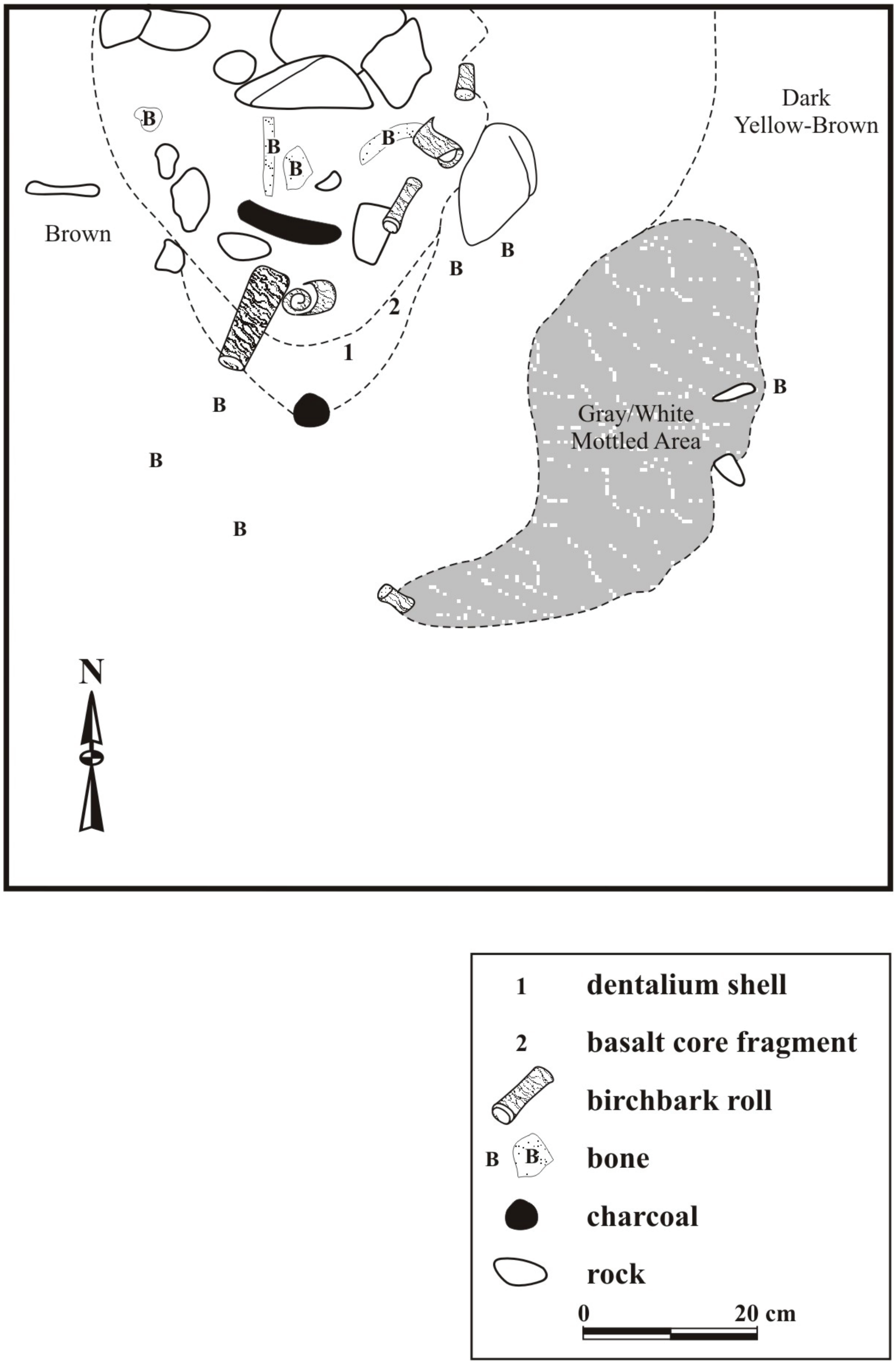

Figure 3. Plan view of the Unit 30 hearth (upper feature) at 15 cm bs (after Nicholas 1996).

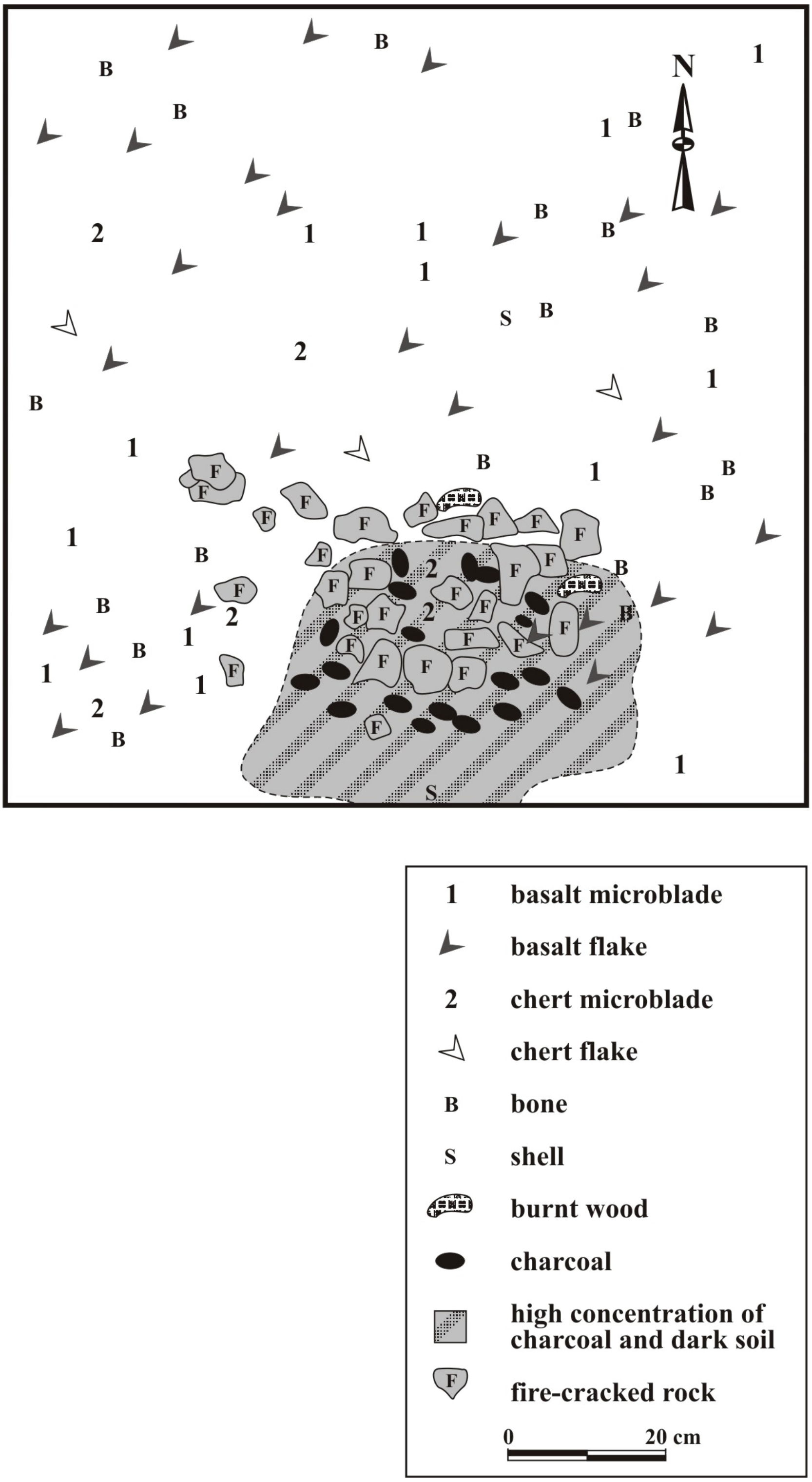

Figure 4. Plan view of the Unit 32 hearth at 10-15 cm bs (after Nicholas 1996).

EeRb 140: Archaeobotanical Field and Laboratory Methods

Archaeobotanical sediment sampling and flotation were carried out in the 1996 field season. We processed and analysed sediment from each of the eight 1 x 1 units that were excavated in that season. The archaeobotany of the six non-feature units are explained by Wollstonecroft (2002, 2002) and is not repeated here. From the Unit 30 and 32 feature contexts, all sediment was collected for flotation. From Unit 30 a total of 20 flotation samples were collected: nine from the upper (hearth) feature, with a total volume of almost 34 litres (L); three from the transition zone, with a total volume of 11 L; and eight from the lower (pit) feature, with a total volume of 30 L. From Unit 32 a total of eight samples, with a total volume of 33 L were collected, four of them from in and immediately around the hearth. Sediment samples were processed with bucket flotation, using a geological sieve with a mesh size of 425 μ.

Laboratory analysis was conducted in the Archaeology Department of Simon Fraser University (Burnaby, Canada) in 1997 using standard palaeoethnobotanical techniques. Meiji EMZ-TR binocular light microscope with a magnification range of 10–60X was used to sort the flotation samples, to identify the seeds, and to distinguish morphological features of the charcoal and non-wood plant tissue. A Zeiss metallurgical microscope with magnifications of 100–500X was used to distinguish the anatomical features of the wood charcoal. A Hitachi S-570 scanning electron microscope (SEM) at the UCL Institute of Archaeology (London, England) was used to study the anatomy of the non-wood plant tissue and to photograph some of the seeds and conifer needles.

Seed identifications were made from the characteristics of the external and/or internal seed morphology; criteria for identification followed guidelines set out by Martin (1946), Martin and Barkley (1961), Montgomery (1977), Berggren (1969, 1981), and Anderberg (1994). Wood charcoal identifications followed standard methods set out by Hoadley (1990), Panshin and de Zeeuw (1980), and Pearsall (1989). The identification of vegetative plant tissue (also called "archaeological parenchyma") followed methods designed by Hather (1993). Seeds, needles, vegetative tissue, and charcoal were also compared with modern specimens from comparative collections housed at the Simon Fraser University Archaeology Department, in Burnaby, BC (Canada) and the UCL Institute of Archaeology, in London (England), as well as specimens collected by the authors in the Kamloops vicinity in 1996.

The results and our interpretations of the plant assemblages from the Units 30 and 32 features are presented in the final sections of this paper. Because our interpretations are highly informed by ethnographic analogy, the next sections of this chapter explain our theoretical approach to the use of analogy in this study and present two ethnobotany-based interpretative frameworks.

The Use of Ethnographic Analogy in Archaeobotanical Explanation

Ethnographic analogy is the comparison of archaeological evidence with observed ethnographic data such that unobserved human behaviour can be inferred from archaeological evidence. Over the past 40+ years the history and problems with uncritical uses of ethnographic analogy for archaeological explanation, beginning with the incompleteness of the ethnographic record itself, have been extensively discussed and debated in a range of well-known articles including those by

Binford (1967), Gould and Watson (1982), Hodder (1982), Trigger (1982), Watson (1999), Wylie (1982, 1985), and Stahl (1993). These will not be repeated here except to say that we (the authors) regard ethnographic analogy as indispensible in archaeobotanical interpretation because it can provide "base lines against which to compare evidence from the past" (Hodder 1982:26).

It has been argued by Plateau archaeologists that ethnographic models are applicable for at least the 3,000 to 4,000 years in this region (Peacock 2002; Pokotylo and Mitchell 1998). We are of the view that there is high relevance for comparison of the plant assemblage from EeRb 140 (c. 900–200 years ago) with Plateau ethnobotanies, and for several reasons. The site dates from the Kamloops horizon (c. 1,200–200 years ago), which is the period in which the social organisation and subsistence systems observed at contact were developed (Alexander 1992b; Rousseau and Richards 1985; Teit 1900, 1909). Furthermore, because together, the pollen record and archaeofauna data indicate that sequential generations of hunting-gathering-fishing people who lived in the South Thompson Valley over the last 3,000 years had access to a similar range of plants, animals and ecosystems as in early historic times. Finally, from the artefact, feature, and fauna records, we also know that over the last 1,000 years people in this region exploited their environments in similar ways and using similar techniques and technologies as were reported in Plateau ethnographic data pertaining to the early 1800s to early 1900s, and by Plateau elders during the twentieth century, i.e., after European contact (Ignace and Ignace this volume; Teit 1900, 1906, 1909, 1930; Turner et al. 1990; Turner et al. forthcoming). These include the exploitation of the vertical zonation of habitats, pit-cooking of root foods, and intensive seasonal harvesting of anadramous salmon.

On the other hand, the ethnographic record is not complete because along with environments, the subsistence practices of Plateau peoples undoubtedly changed over the past 1,000 years. Some plant-exploitation practices may have been discontinued due to changes in species selection preferences or to the demise of certain species. For example, as we noted earlier, bitterroot (*Lewisia rediviva*) and hazelnut (*Corylus cornuta*) disappeared from the Kamloops area by the early 1900s. Likewise, some plant-related activities may not have been observed by ethnographers.

But we believe that, through the careful use of *relational analogies*, we can highlight differences as well as similarities between the archaeobotany and the ethnobotanies. Relational analogies are models that consider the relevance of comparison between the analogy and the archaeology. In this case, "relevance" refers to the significance of the similarities between ecology, economy, and/or technology; Relational analogies are applied in a contrastive manner to identify the cause-and-effect relevance of the similarities between ecology, economy, and/or technology (Hodder 1982; Wylie 1985). The significance of the similarities is assessed by identifying the underlying principles and processes that cause similarities between the ethnographic example and the archaeological record.

The Ethnographic Pattern

According to Plateau ethnographies and ethnohistories, at contact Plateau people consumed diets typically composed of both riverine and land-based resources including fruit, roots, greens, fish, mammals, and birds. Dietary diversity was maintained through radiating mobility, the division of work among task groups, the exploitation of the vertical zonation of habitats, seasonal scheduling, preservation, storage, and exchange. Dietary diversity was supported by resource specialisation, i.e., technological, biological, and ecological knowledge and efficient task groups (Ignace and Ignace 2004; Palmer 1975a; Teit 1909; Turner et al. 1980; Turner et al. 1990; Turner et al. forthcoming.)

Plant foods, particularly berries, nuts, greens, edible roots, are thought to have provided between 30–50% of the total calories (Spier 1938; Turner 1997). Keeley (1980) estimated that on the Columbia Plateau plants comprised as much as 60% plant foods, of which 48% were roots and 12% fruit. Sanger (1969) and Palmer (1975a) argued that at European contact, the eastern *Secwepemc* were more dependent on root foods than western Secwepemc because there were fewer salmon available in the eastern part of the territory.

Plants also provided essential raw materials for fuel, medicine, dyes, gums, and adhesives and the manufacture of tools, utensils, shelter, and clothing and were important in the symbolic and social structure of Plateau societies, having a role in gender relations, oral history, religion, mythology, trade, and linguistics. It is thus not surprising that the Okanagan-Coleville named more than 250 plant species, the Nkla'pamux (Thompson) more than 350 species and the Secwepemc over 200 species (Dawson 1891, 1875–1878; Hill-Tout 1899–1911; Ignace 1998; Ignace and Ignace Chapter 2, this volume; Palmer 1975a; Teit 1900, 1909; Turner 1992, 1994, 1997; Turner et al. 1980; Turner et al. 1990; Turner et al. forthcoming)

The Ethnobotany Frameworks

We constructed two ethnobotany frameworks to facilitate comparisons of the plant assemblage from EeRb 140 with the ethnobotanies of the Plateau. Ethnobotany Framework 1 (Table 3) lists economically and culturally important Plateau plants that were probably available to the residents of site EeRb 140. Based on the likelihood that the biogeoclimatic zones that occur in the South Thompson Valley are similar to those of the Kamloops Horizon, when the site was occupied (and that people exploited their environments in similar ways (see above), Ethnobotany Framework 1 classifies the economically useful species that currently grow in this area according to their Latin and common names, biogeoclimatic ecosystem and habitat preferences, plant parts reported to have been used, type of traditional use by Plateau groups, and reported seasons of harvest. No comprehensive ethnobotanical study has yet been published for the South Thompson River Valley locality surrounding EeRb 140 so this framework draws heavily on studies of the Secwepemc made by Teit (1909), Palmer (1975a), and Turner et al. (forthcoming) as well as Turner et al.'s (1990) ethnobotany of the Nlaka'pamux (Thompson people), Turner's (1992) study of Stl'atl'imx (Lillooet people) plant uses, and Alexander's 1992a/b models of Stl'atl'imx and Secwepemc land-use and ecosystems.

The objective of this framework (Table 3) is to provide a baseline for comparison with the plant assemblage from EeRb 140, to facilitate insights into prehistoric land-use and seasonal scheduling, i.e., where and when people situated themselves at different times of the year. Likewise, comparisons of the list of taxa from the site with Ethnobotany Framework 1 (Table 3) was expected to help us identify economically significant taxa that are absent from the assemblage ("missing plants" as per Hillman 1989:218). Additionally, by comparing and contrasting the list of taxa from EeRb 140 with this ethnobotany framework, we may identify plants that were not locally avail-

Table 3. Ethnobotany framework 1: plants and environments that were likely available in the South Thompson River valley during the period that EeRb 140 was occupied. Table summarises the ecological zones and habitats where the plants are most commonly found and based on Plateau ethnographies, the reported plant parts used, uses and months of harvest.

1	2										3	4	5
	Biogeoclimatic Zones and Plant habitats[2]												
	Bunchgrass (BG)				BG/PP overlap	Ponderosa Pine (PP)	PP/DF overlap		Douglas fir (DF)				
Economically significant Plateau plants occurring in the Kamloops region[1]	meadowland	shrub-steppe	creekside	marsh	swales, depresssions, gulleys, ravines	fir woodland	meadowlands alkaline ponds	gullies, ravines	upland meadow	upland forest	Plant part(s) used[3]	Traditonal Plateau uses[3]	Months harvested by Plateau peoples[3]
LICHENS AND MOSSES													
black tree lichen (*Bryoria fremontii*)										x	ST ("hair")	f	some people June, some year-round
wolf lichen (*Letharia vulpina*)						x					ST	d	not reported
TREES													
Rocky Mountain maple (*Acer glabrum*)			x								C, L, T, W	t	C, May–June; W, year round
green alder (*Alnus crispa*)			x	x							BK, W	fl, m, t	year-round
water birch (*Betula occidentalis*)			x	x							W	f	year-round
paper birch (*B. papyrifera*)										x	BK	fl, t	spring & autumn
Rocky Mountain juniper (*Juniperus scopulorum*)						x		x		x	F, BG	f, fgt, m, t	year-round?
Engelmann spruce (*Picea engelmannii*)										x	BK, R, W	fl, m, t	April–Oct.
lodgepole pine (*Pinus contorta*)										x	BG, C, S, W	f, fl, m, t	C, April–June; W, year-round
ponderosa pine (*P. ponderosa*)					x	x		x			BG, F, N, S, W	f, fl, m, t	S, May–Sept.; W, year-round
cottonwood (*Populus balsamifera*)			x	x		x				x	buds, C, L, W	f, fl, m, t	year-round
trembling aspen (*P. tremuloides*)			x	x	x			x	x	x	buds	fl, m, t	year-round
Douglas fir (*Pseudotsuga menziesii*)					x	x		x	x	x	BG, N, S, sugar, T, W	f, fl, m, t	S, autumn; sugar, summer; W, year-round;
willows (*Salix* spp.)			x	x						x	BK, T	m, t	year-round

[1] References for economically significant plants reported as occurring in the Kamloops region: Angrove 1981; Meidinger and Pojar 1991; Palmer 1975a; Tisdale 1947; Teit 1909; Turner and Peacock 1995; Turner et al. In Press.

[2] References for biogeoclimatic zones and plant habitats: Alexander 1992a; Hebda 1995; Hitchcock et al. 1955, 1959, 1961, 1964, 1969; Meidinger and Pojar 1991; Parish et al 1996; Turner and Peacock 1995.

[3] References for plant parts used, traditional Plateau uses and months harvested: Alexander 1992a; Palmer 1975a; Parish et al. 1996; Teit 1900, 1909; Turner 1992, 1997, 1998; Turner and Peacock 1995; Turner et al. 1980; Turner et al. 1990; Turner et al. in press.

Table 3 continued.

1	2										3	4	5
	Biogeoclimatic Zones and Plant habitats[2]												
	Bunchgrass (BG)				BG/PP overlap	Ponderosa Pine (PP)	PP/DF overlap		Douglas fir (DF)				
Economically significant Plateau plants occurring in the Kamloops region[1]	meadowland	shrub-steppe	creekside	marsh	swales, depresssions, gulleys, ravines	fir woodland	meadowlands alkaline ponds	gullies, ravines	upland meadow	upland forest	**Plant part(s) used[3]**	**Traditonal Plateau uses[3]**	**Months harvested by Plateau peoples[3]**
SHRUBS													
Saskatoon (*Amelanchier alnifolia*)			x		x	x		x	x	x	FT, BG	f, m, t	June–Aug.
kinnikinnick (*Arctostaphylos uva-ursi*)									x	x	FT, L	f, m, tob	Aug.–Nov.
northern wormwood (*Artemisia frigida*)		x									BG, L	fgt	not reported
big sagebrush (*A. tridentata*)		x									BG, BK, L, W	fgt, fl, m, t	year-round
Oregon-grape (*Berberis aquifolium*)			x		x	x		x	x	x	BK, F, L, R, T	d, F, m	Aug.–Sept.
rabbit brush (*Chrysothanmnus nauseosus*)		x									L, ST	m	April–May
white clematis (*Clematis ligusticifolia*)			x	x							BG, BK, L, ST	fgt, m, t	summer?
western clematis (*C. occidentalis*)			x	x							L, S	m	summer?
red-osier dogwood (*Cornus stolonifera*)			x	x	x				x	x	BG, BK, C, FT,T, W	f, m, t, tob	Aug.–Oct
black hawthorn (*Crataegus douglasii*)			x	x							FT, BK	f, m, t	July–Aug.
dwarf juniper (*Juniperus communis*)									x	x	BG, BK	fgt, m	year-round
black twinberry (*Lonicera involucrata*)									x	x	T, L	d, m	July–Sept.
choke cherry (*Prunus virginiana*)			x		x			x			BK, F, T, W	f, m, t	Aug.–Sept.
squaw currant (*Ribes cereum*)		x									FT	f	June–July
wild gooseberry (*R. inerme*)			x	x		x			x	x	FT	f	July–Aug.
swamp gooseberry (*R. lacustre*)						x			x	x	FT	f, m	July–Aug.
prickly wild rose (*Rosa acicularis*)			x	x		x			x	x	FT? BG	f, m, t	Aug.–March
wood's rose (*R. woodsii*)			x		x	x		x			FT? BG	f, m, t	Aug.–March
wild raspberry (*Rubus idaeus*)			x	x		x					FT, L, R, ST	f, t	July–Sept.
red elderberry (*Sambucus racemosa*)				x		x					BK, FT, R, ST	f, m	July–Nov.
soapberry (*Shepherdia canadensis*)					x			x	x	x	FT, L, T	f, m	July–Sept.
flat-topped spirea (*Spirea betulifolia*)					x			x	x	x	L, R (rhizomes)	b,m	not reported
waxberry (*Symphoricarpos occidentalis*)			x	x		x			x	x	L, ST	m, t	Aug.–Sept.
highbush cranberry (*Viburnum opulus*)			x	x							BG, FT, T	f, m, tob	Oct.–Nov.

Table 3 continued.

1	2										3	4	5
	Biogeoclimatic Zones and Plant habitats[2]												
	Bunchgrass (BG)				BG/PP overlap	Ponderosa Pine (PP)	PP/DF overlap		Douglas fir (DF)				
Economically significant Plateau plants occurring in the Kamloops region[1]	**meadowland**	**shrub-steppe**	**creekside**	**marsh**	**swales, depresssions, gulleys, ravines**	**fir woodland**	**meadowlands alkaline ponds**	**gullies, ravines**	**upland meadow**	**upland forest**	**Plant part(s) used[3]**	**Traditonal Plateau uses[3]**	**Months harvested by Plateau peoples[3]**
HERBACEOUS PLANTS													
yarrow (*Achillea millefolium*)		x				x			x	x	L, W	fgt	spring, to Sept
mountain dandelion (*Agoseris glauca*)		x									L, R, S	m	not reported
bluebunch wheat trass (*Agopyron spicatum*)	x	x								x	ST	t	year-round
nodding onion (*Allium cernuum*)		x	x		x	x		x	x	x	R (bulb)	f	April, May, July
arnica (*Arnica cordifolia*)						x				x	L?	m	not reported
tarragon (*Artemisia dracunculus*)		x									L, S?	m	not reported
showy aster (*Aster conspicuus*)			x					x		x	L, R, W	m	Aug.
balsamroot (*Balsamhoriza sagittata*)		x							x	x	L, R (taproot), S	F	Mar, Apr, July–Oct.
pinegrass (*Calamagrostis rubescens*)										x	ST	t	July–Sept.
mariposa lily (*Calochortus macrocarpus*)		x				x				x	R (bulb)	f	April–June
calypso (*Calyposa bulbosa*)						x					R (corm)	f, m	not reported
swamp hay (*Carex* spp.)				x							ST	t	summer & autumn
spring beauty (*Claytonia lanceolata*)					x	x			x	x	R (corm)	f	May–June (some to August)
slender hawksbeard (*Crepis atrabarba*)						x					L, ST	m	not reported
delphinium (*Delphinium nuttallianum*)											FL	d	not reported
alkali saltgrass (*Distichlis stricta*)			x	x	x						ST	t	July–Sept.
giant wild rye grass (*Elymus cinereus*)		x	x		x						ST	t	July–Sept.
fireweed (*Epilobium angustifolium*)			x								ST	f, m, t	May–June
common horsetail (*Equisetum arvense*)			x								ST	m, t	March–Oct
branchless horsetail (*E. hyemale*)			x								ST	m, t	year-round
wild strawberry (*Frageria virginiana*)			x		x	x				x	BG, F?, L	f	May–July
chocolate lily (*Fritillaria lanceolata*)						x			x	x	R (bulb)	f	May–August
yellowbell (*F. pudica*)		x									R (bulb)	f	late spring
bedstraw (*Galium* spp.)		x									R	d	not reported
rattlesnake plantain (*Goodyera oblongifolia*)						x					L?	m	not reported
cow-parsnip (*Heracleum lanatum*)			x								SH, ST	f, m	S, spring; R, year-round
alumroot (*Heuchara cylindrica*)											L, R (rhizome)	m	not reported

Table 3 continued.

1	2										3	4	5
	Biogeoclimatic Zones and Plant habitats[2]												
	Bunchgrass (BG)				BG/PP overlap	Ponderosa Pine (PP)	PP/DF overlap		Douglas fir (DF)				
Economically significant Plateau plants occurring in the Kamloops region[1]	**meadowland**	**shrub-steppe**	**creekside**	**marsh**	**swales, depresssions, gulleys, ravines**	**fir woodland**	**meadowlands alkaline ponds**	**gullies, ravines**	**upland meadow**	**upland forest**	**Plant part(s) used[3]**	**Traditonal Plateau uses[3]**	**Months harvested by Plateau peoples[3]**
HERBACEOUS PLANTS (continued)													
Indian tea (*Ledum* spp.)												b, m	April–August
bitterroot (*Lewisia redivida*)*	x	x									R (taproot)	f, m	May
tiger lily (*Lilium columbianum*)						x			x	x	R (bulb)	f	Nlaka'pamux & Stl'atl'imx spring; Secwepemc, Okanagan, Ktunaxa, late summer, autumn
stoneseed (*Lithospermum ruderale*)		x									R (taproot)	d, f?, m	not reported
chocolate tips (*Lomatium dissectum*)					x	x					R (taproot), SH		R, May; ST March-Apr
desert hog-fennel (*L. macrocarpum*)		x									R (taproot)	f, m	April–June
Canada mint (*Mentha arvensis*)			x	x							L	b, m	May–Nov.
prickly pear cactus (*Opuntia fragilis*)		x									ST	f	Apr.–June, sometimes winter
sweet cicely (*Osmorhiza chilensis*)						x					ST	f	March–April
shrubby penstemon (*Penstemon fruticosus*)								x			L, ST	d, m	spring–summer
wild caraway (*Perideridia gairdneri*)					x						R (tuber)	f	May–June
miscellanous wild grasses (*Poaceae* spp.)	x	x					x		x		ST	t	May–Oct.
silverweed (*Potentilla anserina*)			x				x				R	f	spring, autumn
sagebrush buttercup (*Ranunculus glaberrimus*)		x									whole plant	m, p	spring
tule (*Scirpus acutus*)				x			x				ST	t	August
water-parsnip (*Sium suave*)			x	x							R	f	spring, summer
star-flowered Solomon's-seal (*Smilacina stellata*)								x			FT, R (rhizomes), SH	f	FT, July; R, summer; SH, spring
cattail (*Typha latifolia*)			x	x							FL, L, R (rhizomes), seed fluff, ST	f, t	FL, summer; L, autumn; R, spring; seed fluff, latesummer
stinging nettle (*Urtica dioica*)			x								L, S	f? M, t	April–Sept.
death camas (Zigadenus venenosus)		x									R (bulb)	p	not reported

able, and therefore indicative of trade or long-distance travel. Again, although the immediate Kamloops locality is comprised of three biogeoclimatic zones, nine environmental zones are found in *Secwepemc* territory and were accessible to the Stk'emlupsemc through travel and/or exchange among themselves and with neighbouring groups (e.g., the Thompson and Lillooet). Moreover, the Stk'emlupsemc had access to and routinely used more distant ecosystems, e.g., the Engelmann Spruce-Subalpine Fir (ESSF) at Mount Lolo, Mount Harper, and Mt. Tod, located approximately 1–2 days walk from Kamloops (Turner et al. forthcoming).

Ethnobotany Framework 2 (Table 4) summarises the ethnographically-reported routine fire-related activities of the Plateau. The point of this framework is to provide a baseline for assessing how specific plants may have come into contact with fire and become charred and deposited in Plateau sites. It also provides a means of identifying the range of species that would be expected to be found in association (together) when subjected to specific fire-related activities and conditions, e.g., Plateau groups used particular species for their leaves and boughs, with specific properties, to line pit-ovens and wrap foods, because they helped to retain the heat, protect foods, and/or did not impart an unpleasant smell (Turner 1997, 1998; Turner et al. 1990).

Results

A list of the recovered plants is presented in Table 5 and some of the seeds, needles, and nodding onion plant tissue are illustrated in Figures 5 through 15. More than 30 species were identified from the Unit 30 hearth feature, including 12,820 (n) charred seeds, more than 900 (n) charred conifer needle fragments, 100 g charcoal, and over 6 g vegetative tissue, the latter which included fragments of nodding onion (*Allium cernuum*) and crushed fruit of *Ribes* spp. (currant/ gooseberry) and Saskatoon (*Amelanchier alnifolia*). The edible bulb tissue of nodding onion (Figure 13) was identified by Wollstonecroft using anatomical techniques designed by Hather (1993). From the vertical patterning in Unit 30, it was inferred that plants were charred within the hearth (upper feature) and later became mixed into the transition zone and pit feature below. Several factors may explain this mixing including the re-use of the feature in prehistory or natural causes such as perturbation due to rodent burrowing or winter freezing and thawing (Wollstonecroft 2000).

From the Unit 32 hearth and the sediments immediately around it, 12 plant taxa were identified from 66 (n) charred seeds, 108 g charcoal, and almost 5 g charred vegetative tissue. Pine (*Pinus* spp.), Douglas-fir (*Pseudotsuga menziesii*), and cottonwood/willow (*Populus/Salix* spp.) were identified from the charcoal of both the Unit 30 and 32 hearths, while sagebrush (*Artemisia cf. tridentata*) occurred exclusively in the Unit 30 hearth. Fragments of conifer needles found in the Unit 30 features were identified as pine and Douglas-fir, while only Douglas-fir needle fragments were found in Unit 32 (Figures 14 and 15).

The archaeobotany of the two hearths differed in terms of the dimensions of the deposit, the density of the charred plant remains, the number of species recovered, species abundance, and the density and condition of the charcoal. Given that the two hearths appear to have been subject to the same preservation conditions, we inferred that the differences between the two plant assemblages indicated that they were used primarily for different types of activities. Our interpretations

Table 4. Ethnobotany framework 2: ethnographically-reported[1] Plateau plant uses that may have resulted in plant parts becoming charred and deposited in site.

1	2				3		4	5		6	7		
	ACCIDENTAL INTRODUCTION TO HEARTH							INTENTIONAL INTRODUCTION TO HEARTH					
	During food preparation				Preparation of medicine		During other activities	In food preparation		Fuel	Other		
Economically significant Plateau plants occurring in the Kamloops region	**Pit-cooked**	**Boiled or steamed**	**Roasted or dried over fire**	**Basketry, matting**	**Boiled, inflused as beverage or for bathing**	**Roasted**	**While boiling plant materials to produce dyes**	**Lining of pit oven**	**Condiment or aromatic for smoking fish or meat**	**Tinder or fuel**	**Tobacco**	**Fumigant, vaporisre or insect repellent**	**Rubbish: discarded materials and objects e.g., cooking waste, broken & worn out tools**
LICHENS													
black tree lichen (*Bryoria fremontii*)	ST												
wolf lichen (*Letharia vulpina*)					ST		ST						
TREES													
Rocky Mountain maple (*Acer glabrum*)				C	C, L	L, T		L?					S digging sticks, fishing tools
green alder (*Alnus crispa*)		BK			BK		BK	BG, BK		W		BK	?W structures
water birch (*Betula occidentalis*)													T baby carrying frames
paper birch (*B. papyrifera*)				BK						BK, W			BK containers
Rocky Mountain juniper (*Juniperus scopulorum*)		FL			BG							BG	
Engelmann spruce (*Picea engelmannii*)				BK	C					W			R basketry
lodgepole pine (*Pinus contorta*)			FT		BG, C				BG, W	W			BG bedding
ponderosa pine (*P. ponderosa*)			FT		BG, C		pollen	BG, N		W		BG	BG bedding
cottonwood (*Populus balsamifera*)		buds			buds, C, L	buds			W	T, W			
trembling aspen (P. *tremuloides*)					Buds								W drying racks, tent poles
Douglas fir (*Pseudotsuga menziesii*)		N,T			T			BG/N		BK, W			B bedding
willows (*Salix* spp.)				BK, T	BK, T				L, T				L & T mats for food
SHRUBS													
Saskatoon (*Amelanchier alnifolia*)	FT	FT	FT	T	BG			T					BG tools
kinnikinnick (*Arctostaphylos uva-ursi*)		FT	FT		L				F		L		
northern wormwood (*Artemisia frigida*)					BG, L							BG, L	
big sagebrush (*A. tridentata*)					BG, L					BK, W		BG, T, L	BK clothing, woven mats
Oregon-grape (*Berberis aquifolium*)		F			BK, L, R, T		R						
rabbit brush (*Chrysothanmnus nauseosus*)					L, S								
white clematis (*Clematis ligusticifolia*)					L, S							BG	BK woven mats
western clematis (*C. occidentalis*)					L, S								
red-osier dogwood (*Cornus stolonifera*)			FT	T	BG, BK, C			BG	BG	W	BD		T used as rope
black hawthorn (*Crataegus douglasii*)		FT			BK, FT								W tools

Table 4 continued.

1	2				3		4	5		6	7		
	ACCIDENTAL INTRODUCTION TO HEARTH							**INTENTIONAL INTRODUCTION TO HEARTH**					
	During food preparation				**Preparation of medicine**		**During other activities**	**In food preparation**		**Fuel**	**Other**		
Economically significant Plateau plants occurring in the Kamloops region	**Pit-cooked**	**Boiled or steamed**	**Roasted or dried over fire**	**Basketry, matting**	**Boiled, inflused as beverage or for bathing**	**Roasted**	**While boiling plant materials to produce dyes**	**Lining of pit oven**	**Condiment or aromatic for smoking fish or meat**	**Tinder or fuel**	**Tobacco**	**Fumigant, vaporisre or insect repellent**	**Rubbish: discarded materials and objects e.g., cooking waste, broken & worn out tools**
SHRUBS continued													
dwarf juniper (*Juniperus communis*)		BG			BG, BK							BG	W bows & spears
black twinberry (*Lonicera involucrata*)					BG, L		FT						
choke cherry (*Prunus virginiana*)		FT, T	FT		BK, FT								BK & W implements
squaw currant (*Ribes cereum*)		FT	FT?										
wild gooseberry (*R. inerme*)		FT	FT?										W combs
swamp gooseberry (*R. lacustre*)		FT	FT?										
wild roses (*Rosa* spp.)		F?			BG, FT			BG			BK, L		BK/W arrows
wild raspberry (*Rubus idaeus*)		FT	FT		L, R			L?					
red elderberry (*Sambucus racemosa*)		FT			BK, R				L, T				
soapberry (*Shepherdia canadensis*)		FT	FT		FT, T								BG soapberry whipper
flat-topped spirea (*Spirea betulifolia*)					L, R								
waxberry (*Symphoricarpos occidentalis*)					L, S								BG used as broom
highbush cranberry (*Viburnum opulus*)		FT			BG, T						BG		
HERBACEOUS PLANTS													
yarrow (*Achillea millefolium*)													
mountain dandelion (*Agoseris glauca*)													
nodding onion (*Allium cernuum*)													
arnica (*Arnica cordifolia*)													
tarragon (*Artemisia dracunculus*)													L, S?
showy aster (*Aster conspicuus*)					L, R, W								
balsamroot (*Balsamhoriza sagittata*)	R	S?			L, R								
mariposa lily (*Calochortus macrocarpus*)	R?	R											
calypso (*Calyposa bulbosa*)	R?				R?	R?							R medicine
spring beauty (*Claytonia lanceolata*)	R	R	R										
slender hawksbeard (*Crepis atrabarba*)													
sedges (Cyperaceae)				ST						ST			ST matts

Table 4 continued.

1	2				3		4	5		6	7			
	ACCIDENTAL INTRODUCTION TO HEARTH							INTENTIONAL INTRODUCTION TO HEARTH						
	During food preparation				Preparation of medicine		During other activities	In food preparation		Fuel	Other			
Economically significant Plateau plants occurring in the Kamloops region	**Pit-cooked**	**Boiled or steamed**	**Roasted or dried over fire**	**Basketry, matting**	**Boiled, inflused as beverage or for bathing**	**Roasted**	**While boiling plant materials to produce dyes**	**Lining of pit oven**	**Condiment or aromatic for smoking fish or meat**	**Tinder or fuel**	**Torches**	**Tobacco**	**Fumigant, vaporisre or insect repellent**	**Rubbish: discarded materials and objects e.g., cooking waste, broken & worn out tools**
HERBACEOUS PLANTS (continued)														
delphinium (*Delphinium nuttallianum*)					?		FL							
fireweed (*Epilobium angustifolium*)		ST			ST			L, ST						ST eaten raw, used as string
Horsetail (*Equisetum* spp.)					ST	ST						?		Raw ST used for polishing
wild strawberry (*Frageria virginiana*)			FT?		L, R, S			L, St?						
chocolate lily (*Fritillaria lanceolata*)	R	R												
yellowbell (*F. pudica*)	R	R												
bedstraw (*Galium* spp.)							R							
rattlesnake plantain (*Goodyera oblongifolia*)					L?									Raw L medicine
cow-parsnip (*Heracleum lanatum*)		ST			R								R	L cover for berries
alumroot (*Heuchara cylindrica*)					R	R								
Indian tea (*Ledum* spp.)		L			L									
bitterroot (*Lewisia redivida*)	R													Raw R medicine
Canby's lovage (*Ligusticum canbyi*)											R			Raw R medicine
tiger lily (*Lilium columbianum*)	R				R									
stoneseed (*Lithospermum ruderale*)					R		R							S as decorative beads
chocolate tips (*Lomatium dissectum*)	R	FL, L												
desert hog-fennel (*L. macrocarpum*)	R	R			R									
Canada mint (*Mentha arvensis*)		L			L									
prickly pear cactus (*Opuntia fragilis*)	ST	ST												Spines used as fishooks
sweet cicely (*Osmorhiza chilensis*)	R	R												Raw R used medicinally
shrubby penstemon (*Penstemon fruticosus*)		L, ST			BG		L, S	L, S	L, S					
wild caraway (*Perideridia gairdneri*)	R?	R?												
miscellanous wild grasses (Poaceae spp.)				ST				ST		ST				
silverweed (*Potentilla anserina*)	R													
sagebrush buttercup (*Ranunculus glaberrimus*)					Whole									Plant as poison for arrowtips
water-parsnip (*Sium suave*)		R												
star-flowered Solomon's-seal (*Smilacina stellata*)									SH					
cattail (*Typha latifolia*)	R		R											
stinging nettle (*Urtica dioica*)					L, R									ST used as string
death camas (*Zigadenus venenosus*)					R									R as poison for arrowheads

Table 5. Results from the Unit 30 and 32 Hearths. Seeds, needles and berries are represented by counts (n), charcoal, vegetative tissue, and birch bark by weights (g).

	TAXON	UNIT 30 HEARTH	UNIT 32 HEARTH
	Saskatoon (*Amelanchier alnifolia*)	684	12
	Artemisia	105	
	Asteraceae (Sunflower family)	1	
	Brassicaceae (Mustard family)	179	3
	Chenopodium cf. *capitatum*	10,904	3
	Red-osier dogwood (*Cornus stolonifera*)	6	
	Hazelnut (cf. *Corylus*)	5	
	Sedges (Cyperaceae spp.)	9	
	Heath (Ericaceae)	4	
	cf. *Lappula*	74	8
	Pine (*Pinus*)	1	
	Grasses (Poaceae spp.)	351	30
	Chokecherry (*Prunus virginiana*)	41	6
	Currant/gooseberry (*Ribes*)	19	
	Rose (Rosaceae)	2	
	Raspberry/thimbleberry (*Rubus*)	29	1
	Dock (*Rumex*)	2	
	Blueberry/huckleberry (*Vaccinium* sp.) (s)	3	
	Unknown Seed Type 1	2	
	Unknown Seed Type 2	2	
	Unknown Seed Type 3	17	
	Unknown Seed Type 4	4	
	Unidentified seeds	52	2
	Unidentifiable seeds	107	1
	Unidentifiable seed fragments	622	11
CH (g)	CHARCOAL (g)	100.52	100.67
	Pseudotsuga menziesii (Douglas-fir)	9,708	2
	Pinus ponderosa (ponderosa pine)	63	
	Unidentifiable fragments	2	2
WHOLE BERRY (n)	*A. alnifolia* berry fruit (mashed) (n)	25	
	Ribes berry fruit (mashed) (n)	2	
	Unidentifiable berry	26	4
VEGET. TISSUE (g)	*Allium cernuum* (nodding onion) tissue	0.33	
	Unknown Vegetative Tissue Type 1	1.38	3.45
	Unidentifiable Vegetative Tissue	4.51	1.53
BK (g)	Birch bark	1.62	
	ORIGINAL SEDIMENT VOLUME (litres)	33.950 (L)	21.12 (L)
	ARBITRARY LEVELS:	Levels 2–7	Levels 2–5
	DEPTH IN CENTIMETERS BELOW SURFACE:	5–35	5–25

Figure 5. Charred seed of Saskatoon (*Amelanchier alnifolia*) recovered from the Unit 30 hearth. Photo by Michèle Wollstonecroft.

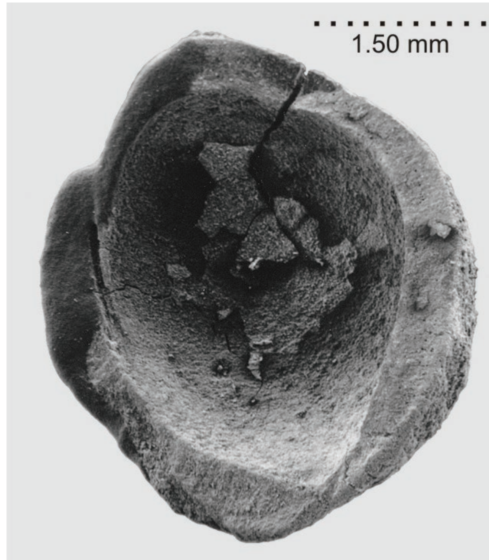

Figure 6. Charred fragment chokecherry (*Prunus virginiana*) stone recovered from the Unit 32 hearth. Photo by Michèle Wollstonecroft.

Figure 7. Charred "seed" (achene) of *Rubus* (raspberry thimbleberry) from the Unit 30 hearth. Photo by Michèle Wollstonecroft.

Figure 8. Charred red-osier dogwood (*Cornus stolonifera*) stone from the Unit 30 hearth. Photo by Michèle Wollstonecroft.

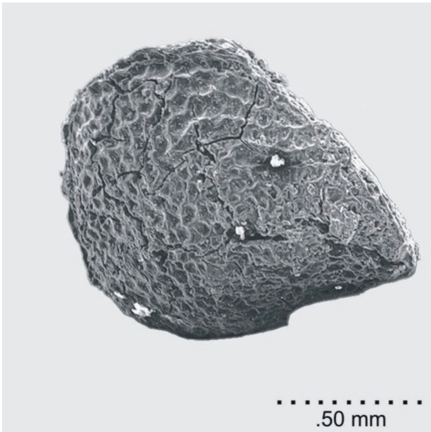

Figure 9. Charred seed of *Vaccinium* (blueberry/huckleberry) from the Unit 30 hearth. Photo by Michèle Wollstonecroft.

Figure 10. Charred seed of *Ribes* (gooseberry/currant) from the Unit 30 hearth. Photo by Michèle Wollstonecroft.

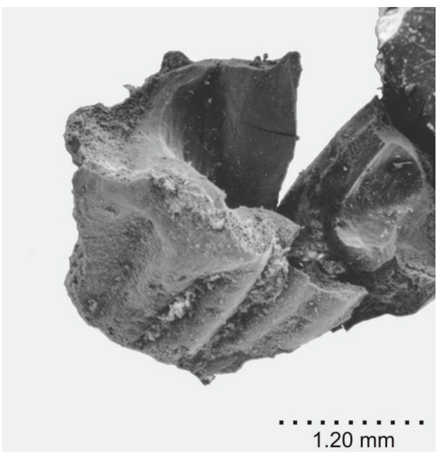

Figure 11. Charred (immature) nutshell of *Corylus cf. cornuta* (hazelnut) from the Unit 30 hearth. Photo by Michèle Wollstonecroft.

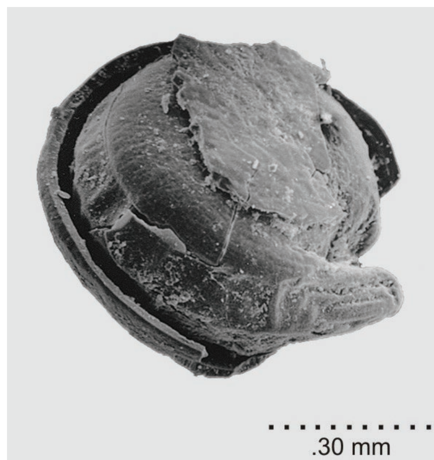

Figure 12. Charred chenopodium (*Chenopodium cf. capitatum*) seed from the Unit 30 hearth. Photo by Michèle Wollstonecroft.

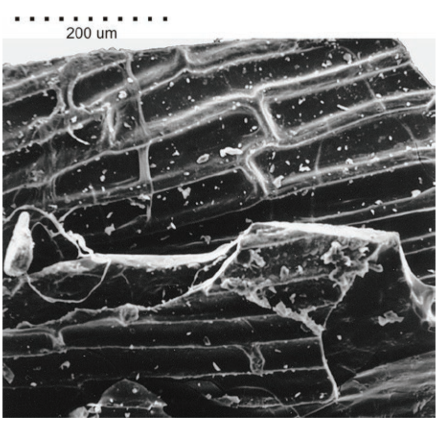

Figure 13. *(Left)* Charred tissue of nodding onion (*Allium cernuum*) from the Unit 30 hearth. Photo by Michèle Wollstonecroft.

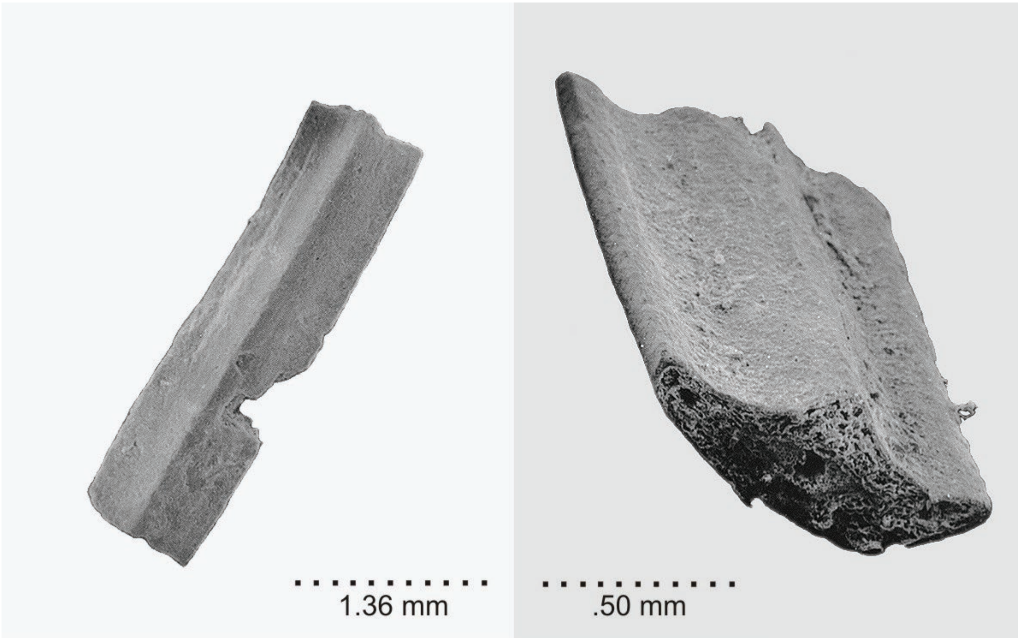

Figure 14. Charred ponderosa pine (*Pinus ponderosa*) needle fragments from the Unit 30 hearth. Image on left shows the view of the lower surface; image on the right shows the cross-section, with the lower surface facing up to illustrate the diagnostic ridge down the centre. Photo by Michèle Wollstonecroft.

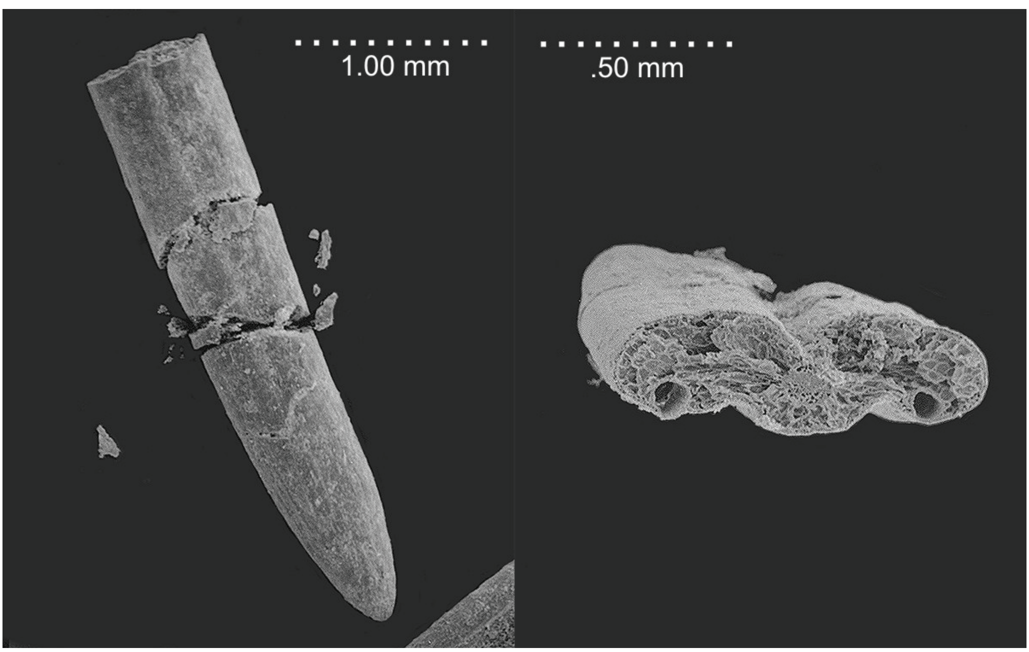

Figure 15. Charred Douglas-fir (*Pseudotsuga manziesii*) needle fragments. Image on left, showing the upper surface, shows the ways that these needles typically fragment; image on right shows the typical cross-section of Douglas-fir needles, with the upper surface facing up. Photo by Michèle Wollstonecroft.

of plant-related activities at each of the hearths are therefore discussed separately, beginning with the Unit 30 hearth.

To identify the patterning in the plant remains, abundance, and ubiquity measures are used in the following sections. Seed abundance was determined by tabulating the total number of seeds recovered from the Unit 30 Hearth and then calculating the percentage of that total represented by each type. In consideration of the large amount of fragmentation of the vegetative tissue, conifer needles, and wood charcoal, presence analysis was used to tabulate and assess the patterning (see Smart and Hoffman 1988). For seeds and needle fragments, ubiquity (presence) was determined by counting the number of sub-samples in which each species occurs within a sample and then converting that count to a percentage. Ubiquity measures for vegetative tissue and charcoal were calculated from weights rather than counts.

Interpreting the Unit 30 Hearth (Upper Feature)

Table 6 classifies the plant assemblage from the Unit 30 Hearth into their known uses according to Ethnobotany Framework 1 (Table 3). The seed abundances (Table 6) show that 46.1% of the seeds found in the Unit 30 Hearth are species ethnographically reported to be Plateau foods, primarily "berry foods" (Saskatoon, *Cornus* spp., chokecherry, gooseberry/currant, raspberry/thimbleberry, and blueberry/huckleberry) and nuts (pine and hazelnut) (illustrated in Figures 5–10). Interestingly, several of the plants classified as food had high ubiquity scores, indicating that they were present in many of the samples from this feature, including Saskatoon and chokecherry (91% and 66%, respectively) and nodding onion (77%).

Another 21.1% of the seed represented plants reported to have been used for their stems as matting and basketry (grasses and sedges); 14.9% represented species reported to have been used medicinally, although (see below) these three species (mustards, stickseed, and dock) may simply have been weeds that were accidentally introduced; the last 6.4% of the seed assemblage is composed of species with multiple uses, including Asteraceae, *Artemisia* spp., *Chenopodium*, heath (Ericaceae), and rose.

Given the range of edible species, which collectively represented almost 50% of the seed assemblage, and the high ubiquity scores of the nodding onion and Saskatoon and chokecherry seeds, we inferred that plant processing had taken place in this feature. To distinguish the methods of plant processing consideration was given to ethnographically-reported Plateau plant preparation methods that involved a hearth, described in Ethnobotany Framework 2 (Table 4). Berry processing was inferred because berries alone, which included six taxa (Saskatoon, *Cornus* spp., chokecherry, gooseberry/currant, raspberry/thimbleberry, and blueberry/huckleberry), made up 45.9% of the seeds from the Unit 30 Hearth; again, Saskatoon and chokecherry had particularly high presence scores of 91% and 66% respectfully (see Table 5). Furthermore, mashed and whole fruit tissue, identified as Saskatoon and currant/gooseberry, were recovered in addition to the seeds. The grass and sedge seeds found in association with the berries accord with to the ethnobotanies (Ethnobotany Framework 2, Table 4) in that grass stems were frequently used as matting during berry processing. No grass stems were identified at EeRb 140 but grass and sedge seeds comprised 21% of the Unit 30 hearth seed abundances, moreover grass seeds had the same high presence score (91%) as Saskatoon seeds, which were the most ubiquitous fleshy fruit in this fea-

Table 6. Potential economic uses of plants identified at EeRb 140, based on Plateau ethnobotanies summarised in Table 3.

POTENTIAL PLANT USE BASED ON THE ETHNOGRAPHIC RECORD

TAXON[1] and likely use	UNIT 30 HEARTH		UNIT 32 HEARTH	
	Seeds only % Abundance[2]	All plant parts % Ubiquity[3]	Seeds only % Abundance[2]	All plant parts % Ubiquity[3]
FOOD				
Saskatoon (*A. alnifolia*)	40.2	91	5.3	50
Red-osier dogwood (*C. stolonifera*)	0.3	14		
Hazelnut (*cf. C. cornuta*)	0.2	14		
Pine (*Pinus* sp.)	< 0.1	3		
Chokecherry (*P. virginiana*)	2.4	66	10.5	75
Currant/gooseberry (*Ribes* sp.)	1.1	31		
Raspberry/thimbleberry (*Rubus* sp.)	1.7	34		
Blueberry/huckleberry (*Vaccinium sp.*)	0.2	9		
Allium cernuum (V)		77		
Total % abundance food plants	**46.1**		**15.8**	
MEDICINE				
Mustards (Brassicaceae spp,)	10.5	54	2.6	25
Stickseed (*cf. Lappula* sp.)	4.3	60		
Dock (*Rumex* sp.)	0.1	6		
Total % abundance medicinal	**14.9**		**2.6**	
TECHNOLOGY				
Pinus cf. Ponderosa (N)		77		33
P. menzeisii (N)		100		
Sedges (Cyperaceae spp,)	0.5	26		
Grasses (Poaceae spp.)	20.6	91	76.3	75
Total % abundance technology	**21.1**		**76.3**	
FUEL				
Pinus cf. ponderosa (CH)		100		100
P. menzeisii (CH)		25		33
Populus/Salix (CH)		100		100
Artemisia cf. tridentate (CH)		37.5		
MULTIPLE USES				
Artemisia sp.	6.1	37		
Sunflower (Asteraceae sp.)	< 0.1	3		
Chenopod (*C. cf. capitatum)*	**	80	2.6	25
Heath (Ericaceae spp.)	0.2	9		
Rose (Rosaceae spp.)	0.1	6		
Total % abundance multiple uses	**6.4**		**2.6**	

[1] Seeds unless indicated as (N) = needles, (CH) = charcoal, (V) = vegetative plant tissue.

[2] %Seed abundances were determined by tabulating the total number of seeds recovered from each hearth and then calculating the percentage of that total represented by each type of plant.

[3] % Presence (ubiquity) was determined by counting the number of sub-samples in which a species occurs within a sample, and then converting that count to a percentage.

** The relative abundance of *Chenopodium* in Unit 30 is omitted because the high percentage obscures the patterning among the other taxa.

ture. These patterns provide persuasive evidence for the fruit having come into contact with fire while being dried on grass/sedge mats.

The interpretation of berry processing in this feature is supported by the ethnobotanies. Teit (1900, 1909), Turner (1997), and Turner et al. (1990) report that Plateau people typically dried these species of berries by laying them out on mats made from grass or sedge stems; or else mashed into cakes, sometimes with several types of berries, and then laid out on the grass/sedge mats to dry. In both cases, the berry foods were typically dried over or near to a hearth. The interpretation of berry processing activities at the Unit 30 Hearth is further supported by Mack and McLure's (2002) archaeobotanical and ethnobotanical results from the Big Meadow site, which linked the *Vaccinium* spp. seeds, sedge (*Scirpus validus*) seeds and stems, and willow and Douglas-fir charcoal with berry processing.

The charred birch bark found in the Unit 30 Hearth also suggests food preparation given that Plateau groups used it for many food preparation activities, including wrapping food for storage and making baskets for berry collecting and storing, as well as boiling foods (Turner 1998). On the other hand, the birch bark possibly originated in the lower feature and become mixed into the upper feature sediments during the prehistoric re-use of this feature.

The abundance of possible medicinal plants (14.9%) including mustards, stickseed, and dock (although, again, we make this analogy with caution as we cannot be sure that these species were brought into the site intentionally) may support the reasoning that this feature was at least used for open-hearth processing: Plateau First Peoples prepared many of their medicinal plants in proximity to a hearth by boiling and/or steeping them directly over a fire or drying them near a fire (Turner et al. 1990; Turner et al. forthcoming).

However, the interpretation of this feature was confounded by the fact that most Plateau food preservation activities evidently involved a hearth, even if solely for the purpose of creating smoke to deter flies and other insects (Turner et al. 1990:29). Moreover, pit-oven technology can also be inferred from this assemblage, given the concentration of Douglas-fir needles in association with nodding onion tissue, pine nut, pine needles, grasses, and sedges. Douglas-fir needle fragments had a ubiquity score of 77% in this feature and Ponderosa Pine needles 100% (Table 6), although Douglas-fir needle fragments (n = 10,122) significantly outnumbered those of pine (n = 66) (Figures 14 and 15).

Conifer boughs and pine needles were used routinely by Plateau groups as lining for pit ovens. While grasses and sedges are reported to have been used in both roasting pit and berry-processing, and sometimes as fuel (Ethnobotany Framework 2, Table 4), conifer boughs are not reported to have been used in open-hearth food processing. These patterns correspond well with Teit's (1909:236) description of pit oven construction in which the upper layers of the pit were lined with a layer of yellow pine needles (Ponderosa Pine) interspersed between two layers of Douglas-fir branches. Significantly, Ponderosa Pine needles were concentrated within the Unit 30 Hearth and absent from samples taken from the surrounding areas.

In her archaeobotanical analysis of pit-ovens at White Rock Springs, Nicolaides (2010:46) observed that the prevalence of grass seeds and conifer needles in the EeRb 140 Unit 30 feature could possibly represent matting materials, and thereby give support to the interpretation of this feature as a pit oven. But she goes on to suggest that the relatively low amount of charcoal and the small size of this feature strongly indicates that it represents a small baking pit used without steam (described by Turner et al. 1990:316) rather than mass processing of root foods. The likelihood that this feature functioned as a pit oven is further supported by two other types of archaeological evidence: the faunal assemblage and the dimensions of the feature itself. Although Plateau groups used pit cooking primarily for processing root foods, such as the nodding onion found here, pit-ovens were occasionally used for cooking meat in this region (Thoms 2008, 2009). Deer bone that was recovered from the Unit 30 Hearth may represent the remains of meat that was pit-cooked. Moreover, the dimensions of the Unit 30 hearth are similar to those of pit-ovens reported ethnographically (Teit 1909:236; Turner and Peacock 1995), which evidently measure approximately 80 cm wide by 40 cm deep. This diameter is also similar to that of the Late Period Lucky Break pit-oven, discussed above, although it is deeper and has a richer plant assemblage.

To further complicate matters, some of the plants recovered from the Unit 30 hearth can be linked to both pit-cooking and open hearth processing. According to the ethnographic literature, Plateau First peoples used grasses and sedges as lining for pit ovens as well as mats for drying berries, e.g., Turner (1997:62) reports that several grasses were specifically harvested for pit-cooking nodding onion. Nodding onion, however, was also sometimes roasted in open hearths. And, while berries alone are not reported as having been processed by pit cooking, berries and berry juice were sometimes added as flavouring to meat (Turner 1997; Turner et al. 1990). The notably high ubiquity (77%) of an identifiable but unknown non-wood tissue that we labelled Unknown Vegetative Tissue Type 1, also complicated the issue.

Again, with reference to our Plateau ethnobotany frameworks (Tables 3 and 4) and patterns in Plateau archaeobotany (Table 2) we concluded that the best explanation for the patterning in the Unit 30 Hearth is that this feature was reused several times and possibly for multiple purposes. It appears to have served as a hearth on some occasions, probably to dry berries for winter use, and maybe to process medicinal plants; at other times, it appears to have served as a pit oven, possibly to prepare food for immediate consumption, such as the nodding onion and deer that were found in this feature.

Interpreting the Unit 32 Hearth

While the Unit 30 Hearth can be confidently linked to food processing activities, the uses of the Unit 32 Hearth (discussed below) are more ambiguous. The Unit 32 Hearth, situated at 10–15 cm below the surface, contained significantly higher concentrations of charcoal and charcoal-stained soil than the Unit 30 Hearth. Some plant remains were recovered from the layer above the hearth but little plant material was recovered from the areas surrounding and below it.

The archaeobotanical composition of this feature is significantly different from that of the Unit 30 Hearth (Table 5). Species classified as food plants (Table 6) represented less than 16% of the Unit 32 Hearth seed assemblage. Grasses (76.3% abundance) dominated the seed assemblage. Birch bark is absent. Significantly, Unknown Vegetative Tissue Type 1 (Table 5) was present in all of the samples (100% ubiquity).

No conclusive evidence for food processing was observed in this feature. Nevertheless, we cannot rule out the possibility that food processing took place here. Charred fruit seeds were present as well as charred grass seeds, (again, which may represent stems used as matting for food processing). Moreover, all the species found in the Unit 32 hearth were also recovered from the Unit 30 Hearth, where food processing has been confidently identified.

Interpreting Wood Charcoal from the Hearths

Ethnographic research shows that Plateau people selected fuel woods according to cultural and technological reasons and not simply the availability, abundance, and ease of collection (Turner 1992; Turner et al. 1990). The choice of species and even the size of the branches depended on the type of fire required, e.g., whether higher or lower temperatures are needed, longer or shorter burning times, more or less smoke, and the presence or absence of a strong scent. For example, species of *Populus* produced a slow burning wood that was preferred by Plateau First Peoples for smoking meat but not for smoking fish because the resinous scent makes the fish bitter tasting (Turner 1998:195).

Similarities are evident between the charcoal assemblages from the Unit 30 and 32 hearths. The branch wood of pine, cottonwood/willow (*Populus/Salix*), and Douglas-fir occurred in both features. These three woods typically dominate charcoal assemblages from Plateau archaeological sites, including Lucky Break, Keatley Creek, and Hat Creek (Freiberg and Stenholm 1991; Lepofsky et al. 1996; Pokotylo and Froese 1983). Evidently, Plateau First Peoples preferred these three species as fuel woods for many purposes, including the preparation of food and medicine as well as the smoking of hides (Turner 1998).

Differences between the two charcoal assemblages include the condition of the specimens and that sagebrush (*Artemisia cf. tridentata*) was present in 37.5% of the Unit 30 Hearth samples but absent from the Unit 32 Hearth. Plateau groups used sagebrush as kindling because of its highly flammable properties (Turner et al. 1990). While most specimens from the Unit 32 Hearth were in an identifiable state, many specimens from the Unit 30 Hearth were too fragmented to be identified beyond conifer and deciduous. This suggests that the Unit 32 Hearth burned differently or else suffered less mechanical damage, possibly indicating that it remained undisturbed after its final use. In comparison, the frequency of unidentifiable specimens in the Unit 30 Hearth suggests that mechanical damage occurred, and supports the above inferences that the Unit 30 Hearth was reused.

Significantly, within the Unit 30 Hearth, pine charcoal had a notably higher ubiquity score than Douglas-fir. This pattern contrasts with those of the conifer needles in Unit 30 (Table 3), where substantially greater concentrations of Douglas-fir needle fragments were recovered than pine. These disparities suggest that pine was the preferred fuel but that for other purposes, the needle-laden boughs of Douglas-fir were selected over those of pine. Again, these patterns accord well with ethnographic reports that Plateau groups used fir boughs to line the upper layers of pit ovens, sprinkled with a small number of pine needles (Teit 1909).

The Question of Chenopods

Most of the plants recovered from the Unit 30 and Unit 32 hearths probably grew within the terrain that surrounded EeRb 140. It is therefore likely that some plants were accidentally brought to the site or arrived by natural means, e.g., the mustards, strawberry blite, dock, stickseed, stoneseed, grasses, sedges, and wild roses. Nevertheless, we inferred that the majority of these plants represent human plant-use activities because all the identified species were of economic value to Plateau First Peoples (Table 3) and because the specific combinations of plants found here accord with specific plant-use activities, i.e., the preparation of food and medicines. Again, it is conceivable that some species had uses for Late Prehistoric people that were lost to later generations or were not reported by ethnographers. For example, herbaceous species such as the mustards, stickseed, and dock could possibly have been used as condiments for flavouring meat or as lining in pit-cooking.

Chenopodium cf. capitatum

Of all the plants recovered at the site, the presence of strawberry blite (*Chenopodium cf. capitatum*) is the most difficult to explain (Figure 12). These seeds clustered in the Unit 30 Hearth but were sparse or absent in the other contexts. In fact, strawberry blite was the most abundant seed in the Unit 30 Hearth, comprising 86% abundance (n =10,904) and having an 80% presence score.

Certainly, the fact that strawberry blite clustered only within the Unit 30 hearth, in large concentrations, and is relatively absent elsewhere, strongly suggests that it was introduced as a result of human selection. Natural causes such as seed rain, the likelihood that *Chenopodium* plants grew near the Unit 30 hearth and/or the large number of seeds typically produced by *Chenopodium*, may explain this concentration. However, natural causes do not explain how large numbers of seeds got into the feature in the first place, or why they were relatively absent from samples taken from the surrounding areas.

Chenopodium seeds are frequently recovered from Plateau archaeological sites. It was recovered from specialised pit-ovens at *Ck̓emqenétkwe* (Peacock 2002) and White Rock Springs (Nicolaides 2010) and from domestic contexts at Keatley Creek. Lepofsky et al. (1996) argue that *Chenopodium* found in domestic contexts of the Keatley Creek pit-house village site, near present day Lillooet, were accidentally introduced into the pit-houses by people who unintentionally harvested them with other resources.

Several *Chenopodium* species have been used as food in other parts of the Americas, but whether or not this plant was used as a food on the British Columbia Plateau is subject to debate. Teit (1909) reported that the Tsilhqot̓in (Chilcotin) ate the fruit of *C. macrocarpum* but according to Hitchcock et al. (1964) this species is not indigenous to the region. Kuhnlein and Turner (1991) propose that instead, it was the fruit of *C. capitatum* that was occasionally eaten by some Tsilhqot'in and Ktunaxa people. Other than these two sources, *Chenopodium* is not reported as a food on the Plateau. In fact, Turner (1997:186) notes that the fruit of strawberry blite was avoided because "… if you eat them you will get very fat, as if you are pregnant, and your friends will laugh at you".

The ethnographies do report the use of strawberry blite as a dye. This raises the possibility that, in addition to food processing, the Unit 30 Hearth served as a place to prepare raw materials for domestic use, such as the dying and smoking of hides (see also Nicholas et al. this volume). Ponderosa Pine wood, also recovered from the Unit 30 hearth, is also reported to have been used for smoking hides (Turner 1998). However, given that the Unit 30 Hearth appears to have been used primarily for food processing, we cannot rule out the possibility that strawberry blite was also used as a food or else as a raw material to facilitate food processing, e.g., as a condiment or part of the lining of the pit oven. This interpretation diverges significantly from reported Plateau uses of this plant.

"Missing" Plants

A number of species reported to have been of economic importance on the Plateau are absent from EeRb 140, many of them species known to have been processed by open-hearth and/or pit-oven methods. Early summer ripening plants (mid-May–mid-June) as well as those harvested in the late fall (October) are poorly represented in the assemblage. Particularly conspicuous by their absence are early summer species that probably grew within the meadowlands and shrub-steppe around the site including: prickly pear cactus (*Opuntia* spp.), yellowbell (*Fritillaria pudica*), chocolate tips (*Lomatium dissectum*), desert hog-fennel (*Lomatium macrocarpum*), and bitter-root (*Lewisia rediviva*). Also missing from the assemblage were plants that typically flourish in the uplands including soapberry (*Shepherdia canadensis*), strawberry (*Fragaria* spp.), kinnikinnick (*Arctostaphylos uva-ursi*), balsamroot (*Balsamorhiza sagittata*), spring beauty (*Claytonia lanceolata*), Solomon's seal (*Maianthemum* spp.; syn *Smilacina* spp.), and black tree lichen (*Bryoria* spp.). Balsamroot, (which also grows in the gullies that border the terraces) and black tree lichen are known to have been processed by drying over or near hearths or in pit ovens (see Peacock 1998; Crawford, Chapter 9, this volume), with technology similar to that used at the site.

We concluded that the low numbers of early summer and autumn ripening plants, combined with the low numbers of upland species (Tables 7 and 8, discussed below), support the interpretation that this assemblage represents mid to late summer activities and that most plants were collected from the low to mid elevations surrounding the site. The relative absence of upland plants at the site can best be explained by the fact that upland species were probably processed near to their harvesting grounds. The relative absence of early summer and autumn ripening taxa suggests that the features examined here were not used for plant processing during these time periods. It is possible that these "missing" plants were processed at other terrace sites within the locality that have not yet been examined for plant remains. On the other hand, they may have been processed at EeRb 140 but, due being well-wrapped during pit-cooking, did not leave traces. Another possible explanation is that the tissue of these species did not survive due to their fragility and other taphonomic factors.

The Evidence for Land Use: Environments and Seasonality

Table 7 classifies EeRb 140 plant assemblages according to the habitats in which they most commonly grow in the Kamloops area, described in Ethnobotany Framework 1 (Table 3). According to Table 7, The EeRb 140 plants were available in the low, mid and upland habitats of the Bunchgrass, Ponderosa Pine, and Douglas-fir vegetation zones. The majority of species represented here are most abundant in the dry sage and grass steppe of the lower altitudes and the open coniferous forests of the mid altitudes. In fact, with the exception of nodding onion, huckleberry/blueberry, hazelnut, and Douglas-fir, most of these plants were probably obtainable within the vegetation zones that immediately surround the site. The proximity of these harvesting grounds to the site supports observations by archaeologists and ethnographers that from the Late Prehistoric

Table 7. Vegetation zones from which the EeRb 140 plants were probably collected based on the ecosystems in which they most commonly occur[1].

ENVIRONMENTS IN WHICH THESE PLANTS ARE THE MOST COMMON

SEEDS & ECOSYSTEMS	UNIT 30 HEARTH		UNIT 32 HEARTH	
	% seed abundance	**% presence**	**% seed abundance**	**% presence**
BUNCHGRASS (BG) ZONE				
Artemisia sp.	6.1	37		
Artemisia cf. tridentata (CH)		37.5		
Stickseed (*cf. Lappula*)	4.3	60		
Total % abundance BG zone	**10.4**			
BG/PP OVERLAP				
Saskatoon (*A. alnifolia*)	40.2	91	5.5	50
Red-osier dogwood (*C. stolonifera*)	0.3	14		
Grasses (Poaceae spp)	20.6	91	76.3	75
Chokecherry (*P. virginiana*)	2.4	66	10.5	75
Total % abundance BG/PP	**63.5**		92.3	
PONDEROSA PINE (PP) ZONE				
Pine (*Pinus sp.*)*	<0.1	3		
Pine (*Pinus cf. ponderosa*) (CH)”		100		100
Total % abundance PP	**<0.1**			
DOUGLAS-FIR (DF) ZONE				
Hazelnut (*cf. C. cornuta*)	0.2	14		
Douglas fir (*P. menziesii*)(CH)		25		33
Blueberry/huckleberry (*Vaccinium)*	0.2	9		
Total % abundance DF zone	0.4			
SPECIES FOUND IN ALL 3 ZONES ZONES				
Nodding onion (Allium cernuum)		77		
Sunflower (Asteraceae sp.)	<0.1	3		
Mustard (Brassicaceae spp,)	10.5	54	2.6	25
Chenopod (*C. cf. capitatum)*	**	80	2.6	25
Sedge (Cyperaceae spp.)	0.5	26		
Heath (Ericaceae spp.)	0.2	9		
Cottonwood/willow (Populus/Salix)(CH)		100		100
Currant/gooseberr (*Ribes* sp.)	1.1	31		
Rose (Rosaceae)	0.1	6		
Rasp/thimbleberry (*Rubus* sp.) himbleb (*Rubus* sp)	1.7	34		
Dock (*Rumex* sp.)	0.1	6		
Total % abundance 3 zones	**14.2**		**5.2**	

[1] References: Alexander 1992a; Hitchcock et al. 1955-1969; Meidinger and Pojar 1991; Parish et al. 1996; Turner 1997; Turner and Peacock 1995; Turner et al. In Prep.

** The relative abundance of chenopodium is omitted for the Unit 30 hearth as the values are extremely high and otherwise obscure the patterning of the other taxa.

Table 8. Months in which EeRb 140 plants were probably harvested, based exclusively on the archaeobotanical seed assemblage, with reference to the ethnobotanies summarised in Table 3 (above).

	TAXA & SEASONS	UNIT 30 HEARTH		UNIT 32 HEARTH	
		% seed Abundance	% Ubiquity	% seed Abundance	% Ubiquity
PROBABLE SEASONS OF HARVEST	**EARLY SUMMER (mid May–mid June)**				
	Nodding onion (*Allium cernuum*)*		77		
	Sunflower (Asteraceae sp.)*	<0.1	3		
	Mustard (Brassicaceae sp.)*	10.5	54	2.4	54
	Stickseed (*cf. Lappula* sp.)*	4.3	60		
	Total % abundance early summer	**14.8**		**2.4**	
	MID -SUMMER (late June through July)				
	Saskatoon *(A. alnifolia)**	40.2	91	9.7	50
	Chenopod (*C. cf. capitatum)*	**	80	2.4	25
	Sedge (Cyperaceae sp.)	0.5	26		
	Heath (Ericaceae spp.)*	0.2	9		
	Pine *(Pinus* sp.)*	<0.1	3		
	Grass (Poaceae spp.)*	20.6	91	70.7	75
	Currant/gooseberry (*Ribes* sp.)	1.1	31		
	Rose (Rosaceae sp.)*	0.1	6		
	Raspb/thimbleberry *(Rubus* sp.)*	1.7	34		
	Dock *(Rumex sp.*)*	0.1	6		
	Blue/huckleberry *(Vaccinium* sp.)*	0.2	9		
	Total % abundance mid-summer	**64.7**		**82.8**	
	LATE SUMMER (August through September)				
	Artemisia sp.	6.1	37		
	Red-osier dogwd (*C. stolonifera*)	0.3	14		
	Chokecherry (*P. virginiana)*	2.4	66	12.2	75
	Total % abundance late summer	**8.8**		**12.2**	
	AUTUMN (October)				
	cf. Hazelnut (*C. cf. cornuta*)	0.2	14		
	Total % abundance fall	**0.2**			

*Indicates that, at the earliest, this plant fruits at this time, but may ripen later, depending on the species and altitude.

** The relative abundance of chenopodium is omitted for Unit 30 as the values are extremely high and otherwise obscure the patterning among the other taxa.

through historic times, that Plateau people typically processed plant foods near to where they were harvested (Pokotylo and Froese 1983; Turner 1992).

Table 8 classifies the EeRb 140 plants identified from seeds into their seasons of ripening. Together the seasons of ripening and habitat characteristics of the different species found at EeRb 140 indicate that the site was used between early and late summer. Most of the edible plants found at EeRb 140 are species that ripen between late June and August or September, depending on the elevation in which the particular plant grew. If the people who used EeRb 140 did process food plants near the harvesting sites, as reported in the ethnographies (Alexander 1992b), then it is more likely that berries such as the Saskatoon, raspberry/thimbleberry were harvested in the lower elevations and brought to EeRb 140 to be processed in June or July (Wollstonecroft 2002). In the latter scenario, people would have returned to the site again in August or September to process the later-ripening red-osier dogwood and chokecherries. The latter interpretation accords more closely with the ethnographic pattern described by Alexander (1992b), who reports:

> People returned to the terraces in June. The ripening of the berries, especially saskatoons (the most common berry on the Interior Plateau), was the event the most commonly used to signify the month. The upper edge of the Terraces, near the treeline, was one of the most important locations for gathering saskatoons and soapberries, and their harvesting and drying continued into July. Gathering wild onions was also an important activity in early July (Alexander 1992b:158).

It is also possible that early-ripening species were partially processed in June/July and processed again in August/September along with the red-osier dogwood and chokecherry.

The Evidence for Exchange and Long-Distance Travel

Most of the charred plants found at EeRb 140 are species that probably grew and were harvested from the environment around the site: the Bunchgrass, Ponderosa Pine, and Interior Douglas-fir ecosystems. Some plants found at EeRb 140 may nevertheless have been obtained by exchange or travel, such as huckleberry/blueberry, and hazelnut (Teit 1909; Turner et al. forthcoming). These species could feasibly have been collected from the nearby Douglas-fir uplands. On the other hand, huckleberry/blueberry are reported to have been particularly abundant in the Neskonlith Creek, to the east of present-day Kamloops (Palmer 1975a) and in recent times hazelnuts were supplied by the Chua Chua band of the North Thompson River.

According to ethnobotanical research with Plateau First Nations, the Secwepemc and their neighbours routinely exchanged plant and animal products among themselves and with neighbouring first nations (Ignace and Ignace, this volume; Turner and Loewen 1998; Turner et al. forthcoming). People were thus able to access resources from up to nine or more different ecosystems. In the case of the Stk'emlupsemc, travel and exchange permitted them to expand the accessible range of resources by almost threefold. Likewise, it is feasible that the occupants of EeRb 140 had similar practices of exchange and travel. The low numbers of taxa from more distant ecosystems is again probably due to the fact that people processed plants near to where they were collected.

Identifying Gender

Berry drying and pit-oven cooking are ethnographically reported to be primarily female tasks, as are the harvesting of food and medicinal plants (Alexander 1992a; Palmer 1975a; Teit 1900, 1909; Turner 1992, 1997; Turner et al. 1980; Turner et al. 1990). Therefore, if the ethnographic pattern does indeed hold for EeRb 140 then the archaeobotany suggests that this site represents the routine activities of a female task group(s). The role of women's production as it relates to the procurement, processing and control of critical resources, is of prime importance in gender research (Jackson 1991). If we can make distinctions between archaeological features and sites according to gender, we may also be able to determine how men and women differentially affected site formation processes (Brumback and Jarvenpa 1997a). Moreover if we can recognise the patterning in men's and women's activities over the landscape, we will also be better able to identify links between gender and the spatial organisation of labour and the distinct roles of men and women as they structured prehistoric Plateau subsistence settlement systems (Bromback and Jarvenpa 1997a, 1997b; Jackson 1991). A recent exploration of Plateau women's work by Nicolaides (2010) shows that further studies of women's space-based practices would be highly useful for interpretations of archaeological sites and archaeobotanical assemblages in this region.

Comparing the Plant Assemblages of EeRb 140

We compared the archaeobotany of EeRb 140 with those of the five other Late Prehistoric Canadian Plateau archaeological sites described in Table 2. Several similarities were evident between the Unit 30 hearth and the pit-oven sites, particularly the common use of *Populus* spp., Douglas-fir, and pine woods as fuel, the presence of conifer needles (White Rock Springs) and the presence of *Allium* (Upper Hat Creek and Keatley Creek). Nevertheless there were more differences than similarities, including the fact that EeRb 140 produced a much wider and different range of plants, is dated to a much later period in time (the Kamloops Horizon), is found in mid-altitude rather than upland area, and is significantly smaller than the Shuswap and Plateau horizon roasting pit sites.

The Unit 30 Hearth and Lucky Break pit oven share several characteristics including being from the same temporal period (Kamloops Horizon/Late Prehistoric III) and similar physical features including diameter and depth. Like the Unit 30 Hearth, the Lucky Break pit-oven was relatively small and shallow and lined at the bottom with charcoal, some of it from coniferous wood, and fire-cracked rock. Similar to the EeRb 140 Hearth, charred seeds of sedge, fragments of *Allium* spp,. and conifer needles were found here. Nevertheless, there are significant differences. *Lomatium* spp. was found at Lucky Break but not EeRb 140. Significantly, EeRb 140 produced a considerably wider range of species indicating it was used for a wider range of activities.

Similarities were also apparent between EeRb 140 and the Big Meadow Camp blueberry/huckleberry processing site. The archaeobotany and archaeological features of both EeRb 140 and the Big Meadow Camp suggest that berries were dried on reed and grass matting in proximity to a hearth. However, while both grass stems and seeds were recovered at the Big Meadow Camp (Mack and McLure 2002), at EeRb 140 only the seeds were recovered.

The greatest number of similarities between the archaeobotanical assemblage from EeRb 140 and the other sites discussed earlier (Table 2), in terms of the range and types of species recovered, are with domestic contexts of the Keatley Creek pit-house village, (Wollstonecroft 2002). This is surprising because one would expect a significantly greater range of plant-related activities in a winter village than in a specialised processing site (Alexander 1992b). Both EeRb 140 and the Keatley Creek pit-houses produced edible berries including Saskatoon, red-osier dogwood, Ericaceae, *Rubus* spp., *Ribes* spp., rose and choke-cherry, and charcoal that was predominantly composed of *Populus/Salix*, *Pinus* spp., and Douglas-fir (Lepofsky et al. 1996).

Some plants appear to have been used in different ways and/or to have been introduced by different means at each of these sites. Douglas-fir and significantly large quantities of Ponderosa Pine needles were distributed around the periphery of the Keatley Creek pit-house floors, which Lepofsky et al. (1996) interpreted as sleeping areas. Grasses and *Chenopodium* seeds were also found in these "sleeping areas." Lepofsky et al. (1996) argue that the grass seeds and conifer needles represent materials used as bedding while the *Chenopodium*, stoneweed, *Silene* spp., *Phacelia* spp. sedges, and prickly pear cactus seeds were brought into the pit-houses accidentally or by natural factors. While charred birch bark was found at EeRb 140, none of the birch bark found at Keatley Creek was charred.

Edible species found at EeRb 140 but not the Keatley Creek pit-houses are the bulb tissue of nodding onion and the seeds of hazelnut, pine, and *Vaccinium* spp. Non-food species that were recovered from only our site were *Artemisia* spp., Asteraceae, mustards, dock, and stickseed. Plants that were unique to the Keatley Creek village include kinnikinnick, prickly pear cactus, *Silene* spp., *Phacelia* spp., and Solomon's seal.

In summary, the archaeobotany of EeRb 140 has similarities with all four Late Prehistoric sites examined above. However, in terms of the range of identified species, the plant assemblage from the EeRb 140 is more similar to the Keatley Creek winter village, than the specialised processing sites. Thus, in addition to the processing and preservation of plant foods, EeRb 140 appears to have served a range of activities of daily life.

Summary and Conclusion

The archaeobotany of EeRb 140 suggests it was a seasonally-used work area, which served multiple purposes including the preservation of berries for winter stores and the pit-cooking of plant (and animal) foods for immediate consumption. It was most likely used by women's task groups between the months of June and August/September. The range of species recovered from the two hearth features suggest that this group followed a radiating mobility pattern to collect, process, preserve, and stockpile seasonally available resources from nearby Bunchgrass, Ponderosa Pine, and Douglas-fir ecosystems.

Given that EeRb 140 and the nearby pit-house village site (EeRb 77) produced contemporaneous archaeological components, it was probably members of this riverside community who created and used the site. As observed by Alexander (1992b:158), during the summer, Plateau groups would have frequented their winter villages to stockpile preserved food and other supplies. Thus EeRb 140 may have provided an intermediary station between the harvesting grounds and the winter village (EeRb 77), serving as a place to process and preserve berries and other edible plants before taking them to the winter village to store. During this period, when there were regular movements of people between the harvesting grounds, EeRb 140 and the winter village, EeRb 140 may also have provided a convenient location for the routine activities of daily life, such as processing of food for immediate consumption and the preparation of medicines, as well as the manufacture of stone and bone tools, which are suggested by the lithic assemblage. Therefore, we believe that the interpretation of EeRb 140 as a multipurpose plant-processing site best explains the condition, wide range, and relatively high densities of plant remains that were found here.

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Chapter 5. *Re Secwépemc Re Syecwmenúl̓ecwems:* Secwepemc Stewardship of Land and Resources

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Abstract

This chapter examines the principles and practices of Secwepemc resource stewardship, with a focus on the activities used to sustain and enhance culturally significant plants and plant gathering habitats. These activities are grouped into three types based on the spatial scale at which they are applied: the management of plant populations, the management of plant habitats, and the social dimensions of plant management at the landscape level. Numerous examples are provided to illustrate practices at each level. The chapter also discusses the relationships of specific strategies to the creation and maintenance of diverse ecosystems and identifies issues relating to contemporary Secwepemc resource use, including recent environmental deterioration and the loss of biodiversity. It concludes with recommendations to renew traditional stewardship practices and approaches as a means of restoring both habitats and cultural values.

Keywords: *Secwepemc traditional resource stewardship, plant knowledge, sustainable harvesting, habitat conservation and restoration, biodiversity*

Introduction

> You could pick roots and everything down there [at ***Ck̓emqenétkwe***, Scheidam Flats near Kamloops]; you could find anything. ***Skwenkwínem*** (*Claytonia lanceolata*), carrots (*Lomatium macrocarpum*) and onions (*Allium cernuum*), and celery (*Lomatium nudicale*) …. We had everything, all of our vegetables right there; and especially back there; my grandmother used to get us to pick all these wild stuff …. I remember the things we used to get for bathing ourselves and wash our hair in it, make it glisten; it was … wild rhubarb [*Heracleum maximum*]; my mother used to make bread—bannock—put it in there and stick it

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> under the ground, in a pit…. (Annie Parker, interview with Sandra Peacock, April 10, 1992).

The Secwepemc, like other First Peoples of British Columbia, recognized and appreciated the abundance provided to them by the Creator, through their rich and diverse territory. In the past, at least, the lands and waters of their home places yielded everything they needed, as well as the surpluses that allowed them to survive in times of shortage, and to trade with neighbouring peoples for products not available within their own territory. This situation has changed since the coming of Europeans and imposition of colonial laws, the reserve system and western lifeways, as described in Chapter 2 by Ignace and Ignace, and in the chapter co-authored by Mary Thomas (Chapter 10 with Turner and Garibaldi; see also Turner and Turner 2008). It is important to remember, however, that it was the Secwepemc people's knowledge of how to harvest, process, use, protect, and perpetuate their resources that allowed them to rely on their environments for sustenance year after year. Secwepemc traditional ecological knowledge and wisdom, discussed elsewhere in this volume (Chapter 2, Chapter 12), is the fundamental cultural knowledge that has enabled peoples' survival. Encompassed within this knowledge system is a complex and multi-faceted system of traditional land and resource management practices and strategies that are in turn connected to the Secwepemcs' existence in a *known* landscape and environment for thousands of years (see Ignace 2008, and Chapter 2, this volume). By holistically connecting resource management practices to a land ethic, it represents a system of resource stewardship.

Traditional resource stewardship can be defined as the cultural accumulation and development of knowledge, practices, institutions, and philosophies that sustain and enhance productivity of resources and the integrity of ecosystems occupied and used by humans. Traditional resource management is directly linked to Traditional Ecological Knowledge systems (Turner et al. 2000, see also Chapter 12 this volume), and thus is embedded within language, technologies, social systems, and beliefs. As such, it both shapes and is shaped by the places where people live and harvest their resources.

Each Secwepemc community, for hundreds—even thousands—of years, maintained their harvesting, hunting, and fishing grounds, caring for them, and teaching their children to care for them, season after season, year after year. The ways in which these places were looked after are complex, and are effective at different scales of time and space (see Peacock and Turner 2000). In the course of our research with Secwepemc knowledge holders, we have visited many sites within Secwepemc territory, from ***Ck̓emqenétkwe*** (Scheidam Flats in Paul Creek Valley), to Trophy Mountain, to Neskonlith Meadows, to ***Pellmelálmen*** (Hat Creek Valley) (Figure 1), which are well known harvesting grounds for traditional plant foods, especially wild root vegetables. These places show a tremendous abundance of plant resources, even though people have been harvesting roots and other plants there, usually in immense quantities, over many generations. One might think that if these food plants were intensively exploited, their populations would decline over time compared to places where they were not gathered, yet, this is not the case. In fact, the elders emphasize that the very best places for harvesting their roots and other plant resources are exactly in those locations where harvesting took place over countless generations (Anderson 1993a, 1993b, 1993c, 2005; Deur and Turner 2005; Peacock and Turner 2000).

Figure 1. ***Pellmelálmen*** (Hat Creek Valley)—an upland valley situated between the Fraser and the Thompson River systems—was an important hunting and harvesting locale for generations of Secwepemc peoples. Archaeological evidence indicates people first used the valley at least 8,000 years ago, with intensive harvesting and processing of edible wild roots beginning 2,000 years ago and continuing well into the historic period. Photo by Sandra Peacock.

In the late nineteenth century, George M. Dawson commented on the abundance and productivity of tiger lily (*Lilium columbianum*) in places where the bulbs were annually harvested (although Elders born in the early twentieth century did not consider them as much of a staple root vegetable compared with *Claytonia lanceolata*, *Erythronium grandiflorum* and *Balsamorhiza sagittata*):

> The native root chiefly sought for and most largely employed is that of the lily, named ***tah-tshin'*** (***textsin̓*** both Secwepemctsin and Nlkaka'pamuxcin,] … This often weighs several ounces, *and the places in which it abounds are well known and regularly visited in the early summer or autumn*. These localities are generally situated at some height above the principal valleys, on the plateaux or mountains, where camps are formed during the season of harvest …. This root, like most of the others, is cooked by baking in the ground (Dawson 1891:19–20; emphasis added).

In the 1990s, numerous Elders of the Secwepemc and other First Nations observed deterioration in the quantity and productivity of roots and other resources (see Thomas et al., Chapter 10, this volume). There are many explanations for such a decline, but one of the key reasons, according to Mary Thomas and others, is that people are no longer harvesting and caring for the plants as they did in the past. They talk about practices such as landscape burning, pruning, tilling, and even digging and replanting methods that enhance the resources, making them more bountiful, and improving their quality and size. In fact, there is a growing body of ethnobotanical evidence suggesting that Indigenous peoples in British Columbia and elsewhere in of North America—people commonly described as “foragers” or “hunter-gatherers”—actively managed their environmental resources to ensure a predictable, abundant source of the plants and animals they relied on, whether for food, materials or medicines (Anderson 2005; Boyd 1999; Deur and Turner 2005; Ignace and Ignace, Chapter 2, this volume; Johnson 1999, 2000; Johnson and Gottesfeld 1994a, 1994b; Peacock and Turner 2000; Turner 1998, 1999, 2006; Turner and Peacock 2005; Turner et al. 1980, 1990, 2003, 2005). Furthermore, as noted previously, tending practices to sustain plant and animal populations are not based solely on economic rationales, but are embedded in social organization and other social contexts, and reflected in peoples’ worldviews, spiritual beliefs, oral traditions, and teachings (Turner 2005; Turner and Berkes 2006).

In this chapter, we discuss resource management strategies of the Secwepemc and neighbouring peoples, with particular reference to plant resources, and to the scales at which people have applied these management practices. Although we may use the past tense in referring to practices and concepts that do not exist at present or are no longer prevalent, we acknowledge and recognize that these practices can be reinstated, and that restoration and renewal of activities that bring back and sustain traditional resources and their associated knowledge systems are not only possible, but are already occurring at some level (Anderson 2005; Senos et al. 2007). The proposed Secwepemc environmental and cultural education centre envisioned and initiated by the late Elder Dr. Mary Thomas and her family at Salmon Arm is a good example of the type of initiative that can help make this happen. Other examples include the Indigenous Food Sovereignty movement led by another Secwepemc, Dawn Morrison, and the many occasions and instances where traditional food gathering, pit-cooking, and feasting have been re-intregrated into youth summer camps, First Nations community science camps, and language immersion courses in Secwepemc communities—many of them indeed connected to community based Secwepemc ethnobotany courses offered since the mid-1990s in various Secwepemc communities by Marianne Ignace with elders through Simon Fraser University.

Using some key culturally important plant resources and plant gathering habitats of the Secwepemc, we examine some practices used to sustain and enhance resources at different scales. We also discuss the relationships of specific management strategies to the creation and maintenance of biodiversity and identify the issues relating to resource use, including recent environmental deterioration and loss of biodiversity. Finally, we provide recommendations to renew traditional management practices and approaches as a means to restoring both habitats and cultural values.

Secwepemc Territory: The Interior Plateau

Secwepemc territory, its core situated in the vast region known as the Interior Plateau, is described in detail in Chapter 1 of this volume, and from a Secwepemc perspective in Chapter 2.

Its tremendous elevational range and topographic diversity yields an immense variety of habitats, and, in turn, a great diversity of flora and fauna throughout the region. Each of the nine biogeoclimatic zones represented in Secwepemc territory, and each habitat within them, is in turn characterized by typical plant and animal species, many of which provided particular resources to the Secwepemc economy.

The diverse environment that has been the home of the Secwepemc and other Interior Plateau peoples for thousands of years (see Chapters 1 and 2 this volume)—and, as we shall see, peoples' management practices—created "patches" of resources distributed over both time and space. The people moved from the rivers and lakes to upland and mountain harvest sites at various times throughout the year to take advantage of the range of resources these places provided. Families visited specific resource harvesting places year after year, in a patterned and predictable seasonal round. Although Palmer (1975:213) noted, "the zoned pattern of resources in the [Canadian] Plateau allowed a typical riverine community to exploit almost any type of habitat occurring in the Plateau within the distance of a few miles," ethnographic and ethnohistoric evidence indicates that in practice, the annual seasonal round of members of most Secwepemc communities comprised much larger tracts of land; narratives of seasonal mobility by elders born in the late 1800s and early 1900s (see Chapter 2) document that families, and even more so task groups of men, often traveled a radius of 50–100 km to resource producing locations, with further occasional travel to even more distant areas.

Plant Resource Stewardship Strategies

Plants have been essential to all aspects of Secwepemc life. In fact, the roots, shoots, leaves, berries and/or wood of over 150 different species were named and utilized as foods, materials, and medicines (see Appendix 1). As indicated in the Appendix, various management strategies were utilized to maintain and enhance these plant resources, ranging from developing and perpetuating particular habitats using fire, to more focused practices for individual trees or plant populations. Beyond these, Secwepemc indigenous laws, protocols, and procedures regarding access to, use of, and maintenance or management of resources are of importance. In sum, these management activities may be categorized into three general types on the basis of scale of application:

1. Plant Population Management: Activities and practices designed to enhance the reliability and productivity of any culturally significant species at the individual or population level;
2. Plant Habitat Management: Strategies which create and maintain diversity in selected and specific habitats or locales, often successional, where populations or groups of culturally significant plant and animal resources occur; and
3. Social and Political Concomitants of Plant Management at the Landscape Level: The social dimensions of plant management regimes, including the system of decision making and social sanctions which, at the level of the community and Nation, support

and perpetuate the management and harvesting of plant resources in various habitats throughout Secwepemc territory.

We recognize that these levels of management are not mutually exclusive, but interact with one another in promoting total biological diversity and productivity, both intentionally and incidentally. In some cases, it is difficult or impossible to determine intention in conservation, since the practices that result in conserving a species or habitat may be deeply embedded in long-time traditions whose origins may now be obscured but which are nonetheless effective (Turner and Berkes 2006). Management activities at the population level will impact on the overall composition and structure of a plant community or habitat, which in turn, is reflected on the landscape as a whole. Similarly, social and political decisions concerning the overall timing of management and harvesting of diverse resources in a traditional territory will have repercussions at the habitat and population levels.

Plant Population Management

A fundamental unit of plant management is the species, and even within a species, a particular strain, variety, population, or individual. Secwepemc and other peoples recognize that there is often variation in quality, growth, and productivity of root vegetables, berry bushes, birch trees (*Betula papyrifera*), or Indian-hemp (*Apocynum cannabinum*), for example, and that this variation may depend upon where the plants are growing, seasonal changes in growth (phenology), their relative age and stage of development, or specific desirable traits of an individual plant or group of plants in comparison with others (Peacock and Turner 2000). An example of this might be a saskatoon berry bush (*Amelanchier alnifolia*) that produces particularly sweet, juicy berries (Figure 2), or fruits of a slightly different colour or shape, or a patch of Indian-hemp with notably tall, thick stalks.

People had the knowledge and ability to select, maintain, and promote individuals and populations of such plants through a number of strategies associated with traditional harvesting practices that were based on both biological and cultural considerations and employed to ensure the continued productivity of the desired species, varieties, or individuals. These strategies include: 1) sustainable harvesting or extraction methods; 2) maintenance and propagation techniques; 3) practices around protection; and 4) systems of scheduling and regulating timing and frequency of harvest that maintained a species' or individual plant's ability to regenerate. Each of these is discussed, with examples, below.

Sustainable Harvesting Methods

The specific tools and techniques used to harvest root vegetables and other plant resources in a sustainable manner varied according to the species and the intended use of the plant or its products. The net result of harvesting was to create a disturbance regime within a given plant population.

In root harvesting, the root digging implement, the ***pétse*** (Figure 3), made of a hard wood like saskatoon or black hawthorn (*Crataegus douglasii*), or sometimes from a mule-deer antler, facilitates sustainable harvesting by allowing selective removal of some roots while allowing others to

Figure 2. Saskatoon berries (*Amelanchier alnifolia*) were highly prized and berry pickers recognized that individual bushes in certain areas produced sweeter, juicier berries than those in other locales. Such bushes were managed through a variety of strategies to maintain productivity. Photo by Nancy Turner.

Figure 3. Edible and medicinal roots were harvested traditionally with the aid of a ***pétse*** or digging stick similar to this one owned by Elder Mary Thomas and made of black hawthorn (*Crataegus douglasii*). Photo by Nancy Turner.

continue growing. It was used to pry roots out of the ground, an extremely effective technique for extracting large tap-rooted species such as balsamroot, or spring sunflower (*Balsamorhiza sagittata*) or those with deep-growing roots such as desert parsley (*Lomatium macrocarpum*) or yellow glacier lily, also known as yellow avalanche lily (*Erythronium grandiflorum*). The same idea was used by coastal peoples in harvesting camas (*Camassia* spp.) and other coastal root vegetables, and clams, abalone and many types of fish, where the smaller ones were left to grow for subsequent years (Beckwith 2004; Deur and Turner 2005; Turner and Peacock 2005). George M. Dawson (1891:19) described the digging stick as "a pointed stick about four feet in length, with a crutch-shaped handle," and also provided us with further descriptions of late nineteenth practices of Secwepemc root digging:

> Early in July the wild onion [*Allium cernuum*], nearly ready to flower, is in condition to be gathered … 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. 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 are nearly black, and are said to be sweet-tasted …. The root of the Balsamorhiza [balsamroot] is also eaten, being previously roasted or baked in the ground for a period of two or three days. Signs of the old roasting-places are common on hillsides where the plant abounds … (Dawson 1891:20).

Harvesting plant resources was, and is selective, being neither random nor all-encompassing. The criteria used to select plants for harvest varied considerably between species and depending 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 (e.g., Turner 1992b). However, in general, the most important criteria were the yearly growth cycle, reproductive status (e.g., flowering versus non-flowering), and maturity and size. Habitat preference also played a role.

Sometimes, as with balsamroot (Figure 4a), the very largest roots were also left alone. Aimee August of Neskonlith at Chase called such roots the "mother" root, and stated that it was important to leave the "mother," and to harvest only the "daughter" roots, so that the mother would continue to flower and produce seed. Mary Thomas and others explained that the best size of balsamroot to harvest were those that were carrot-sized (Figure 4b), generally those producing 5–15 leaves and perhaps 3–5 flower heads (Peacock 1998). The "mother" plants, on the other hand, might have up to 50–60 leaves and 30 or more flower heads. Their giant taproots could extend a metre or more into the ground, and would be far too tough to eat even after prolonged cooking. Harvesting the carrot-sized roots and leaving the smallest and the largest roots was an excellent strategy for sustaining balsamroot populations. In succeeding years, the smaller roots would grow to an appropriate size for harvest, and the plants with the biggest roots would produce seed that

Figure 4a. The large taproots and fresh shoots of balsamroot (*Balsamorhiza sagittata*) were a significant food and medicine for the Secwepemc. Photo by Sandra Peacock.

Figure 4b. Elder Mary Thomas holding a "carrot-sized" taproot of balsamroot—the correct size to harvest. Photo by Sandra Peacock.

would fall into the dug soil, germinate, and eventually grow into new plants for harvest (Chambers 2001; Peacock 1998).

Other plants were also selectively harvested based on optimal size. According to Mary Thomas, multi-flowered (and therefore large-bulbed) individuals of yellow glacier lily were preferred. She also recalled digging chocolate lily (*Fritillaria affinis*) bulbs and spring beauty corms (*Claytonia lanceolata*) with her grandmother, who taught her always to leave the smallest bulbs and corms in the ground.

Often, plants growing in a specific location or habitat type were preferred to their counterparts in other places. Medicinal plants were considered purer and more potent when collected from higher elevations in the mountains. Berries from certain locales were said to taste sweeter than others. Indian-hemp, an important fibre plant called ***spéts'en*** (W), or ***spets'a*** or ***spets'i*** (E), was said to be tallest and thickest in flat damp areas like floodplains, while the plants growing on steep banks were bushier and not as desirable. Further, if a habitat was particularly productive for one root, it was generally productive for other species as well, a factor that tended to concentrate harvesting activities on the landscape in certain choice locations.

Maintenance and Propagation Techniques

As noted above, Mary Thomas recalled her grandmother "Makrit" (Marguerite) routinely sorting through the children's baskets of harvested chocolate lily, spring beauty (Figure 5a), and glacier lily "roots" at the end of the day, picking out the smallest roots and bulblets they had gathered up, and replanting them (pers. comm. to NT, 1993). Her mother and grandmother also purposely broke off the small cormlets (called the "whiskers" by Mary) attached to the base of the beartooth-like glacier lily bulbs and placing them back into the ground at the digging site. Even when the women were cleaning their baskets of dug bulbs back at their camp, they would set aside the little "whiskers," then carry them back up to the harvest site and replant them the next day. Sarah Deneault (Figure 5b), also from Neskonlith, recalled the same cormlet gathering and replanting activities for glacier lily bulbs (pers. comm. to MI, 1997).

Pruning (***ctálem***) or coppicing was another form of harvesting practiced on the shoots and stems of herbaceous and woody perennials used as food and materials. Cow-parsnip was picked in its edible shoot stage in the spring, then left to mature and flower, die back, and shoot up again the following year. This is very similar in its management approach to a well-known domesticated perennial vegetable, asparagus (*Asparagus officinalis*).

Stems of shrubs such as red-osier dogwood (*Cornus sericea*), used for sweatlodge frames, saskatoon used for arrows and other implements, and green willow (*Salix* spp.), used for rope and for weaving mats, were also cut from living plants. Mary Thomas recalls her mother observing large, bushy overgrown saskatoon bushes and saying, "It's time to cut them back." She then cut the older stems to the ground, and the next year the shoots that grew up were just right for basket rim hoops. A few years later, berry production on these bushes was excellent in terms of both quantity and quality of the fruit. Tule (*Schoenoplectus lacustris*), cat-tail (*Typha latifolia*), and Indian-hemp, all 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.

Figure 5a. Spring beauty (*Claytonia lanceolata*) corms come in all shapes and sizes. Secwepemc elders recall their mothers and grandmothers instructing them to replant the smallest corms from their collections back into the earth to ensure the following year's harvest. Photo by Nancy Turner.

Figure 5b. Elder Sarah Denault harvesting ***skwenkwinem*** (Spring beauty, *Claytonia lanceolata*), whose delicate white blossoms blanket the hillsides of Secwepemc territory in spring. Photo by Marianne Ignace.

Similar practices are also known to have been used by coastal peoples, for species like cat-tail and tule, as well as basket sedge (*Carex obnupta*), and oceanspray (*Holodiscus discolor*) (Turner and Peacock 2005) and were also applied to a range of species by California Native Americans (Anderson 2005),

Certain species of berries, such as soapberry (*Shepherdia canadensis*) and huckleberries (*Vaccinium* spp.), were, and still are, often harvested by breaking off the berry-laden branches (Figure 6). This, too, was a form of pruning. During the pruning and the harvesting of berry-laden branches, ripe berries also become accidentally strewn, which in turn enhanced their propagation. More than that, Dolores Bebbington from Soda Creek (pers. comm. to NT, 2008) recalled that whenever her family picked blueberries, her father, Norman Michel, used to throw handfuls of blueberries into places where no bushes were growing, and "cleaned up all the weeds around our patch."

It should be added here that besides serving the purpose of plant propagation, the practice of moving berry-laden branches to a location where elders and children could pick off the berries or beat them off the branches (***spem***) served a social function. Alongside their elders, children learned to do these tasks with persistence, and elders who could no longer climb the mountainsides were able to participate in berry-picking expeditions.

Near their dwellings and permanent camps, the Secwepemc often burned individual berry bushes or shrubs that had important cultural uses in order to improve their productivity and in

Figure 6. Soapberries (*Shepherdia canadensis*) were often harvested by breaking off the berry-laden branches from the shrub and then knocking the berries off onto a mat by hitting the branch sharply. This was a form of pruning that helped stimulate the production of new shoots and berries. Here, Ron Ignace and Kelly Bannister demonstrate the technique. Photo by Nancy Turner.

order to facilitate access. Like the Nlaka'pamux (Turner 1999; Turner et al. 1990), the Secwepemc also likely burned hazelnut (*Corylus cornuta*) bushes to encourage vigorous new growth in the subsequent years.

The bark and wood of a wide range of trees were also important to the Secwepemc and involved management practices. Bark sheets of birch (*Betula papyrifera*), white pine (*Pinus monticola*), and pin cherry (*Prunus pensylvanica*) were harvested for use in canoes, basketry (Figure 7a), and other purposes, but only the outer bark was taken (Figure 7b); the inner bark was left to protect the tree, and to allow it to continue to grow (Turner 1998, 2005). Bark that people removed totally, either to access inner bark and cambium for food (e.g., lodgepole pine, *Pinus contorta*), or for use as medicine (e.g., cascara, *Frangula purshiana*; syn. *Rhamnus purshiana*), was generally taken in small patches, so that the tree was not girdled and would be able to heal after awhile. Living trees with characteristic scars of bark removal are seen throughout the Plateau (e.g., Dilbone 2011). Of course, trees needed for the wood of their trunks, or those whose bark could not be removed in part, were cut or girdled, but this was evidently done selectively, and, according to Mary Thomas (pers. comm. to NT, 1996), wherever possible it was preferable to use windfalls and dead or dying trees to avoid killing living ones.

Elders also recalled how patches of ***spéts'en***, Indian-hemp, were tended and selectively harvested year after year in order to produce tall, straight, and branchless hemp plants that produced easy to strip and process hemp fibre used to make a strong twine (Figure 8a). Such hemp patches still exist in a few locations where they continue to be harvested, although many of them have been uprooted and lost as a result of urban or industrial development along riverbanks (Christine Simon and Beverley Bob, pers. comm. to MI, 2007). For example, the site of the Kamloops Indian Band Industrial Park featured a large wetland marsh adjacent to two sizable pithouse villages (Carlson and Wilson 1980). The remains of prolific, straight, and densely growing stands of ***spéts'en*** were still visible in 2013 in undeveloped patches that formerly were at the edge of the wetland marshes at the edge of a racehorse track (Figure 8b).

Practices Around Protection

Protecting individual trees or specific patches of plants from harm is an important management activity. A good example is Mary Thomas' recollections (pers. comm. to NT, 1996) of her father and the other Neskonlith men riding around their lands and setting fire to tent caterpillar colonies that were infesting wild cherry trees—either ***tkwlóse7***, chokecherry (*Prunus virginiana*), or ***peklléñ̓llp***, pin cherry (*Prunus pensylvanica*), or both. The health of these trees was important, since the cherries were harvested in large quantities and dried for winter use. Weeding out competing grass and other vegetation from the root digging grounds is another example. The technique of prying up patches of turf using a traditional root digging stick (***pétse***) helped the women, like Mary's mother and grandmother, to pull up and discard the weeds as they overturned the turf and selected the bulbs and corms of the appropriate size, leaving the smaller ones to grow. In more recent years, as introduced species like couch grass (*Agropyron repens*) have invaded the root grounds, the harvesters would be more likely to discard the entire layer of turf above the growing edible roots, making it easier for these indigenous root plants to grow and flourish. Although weeding and clearing competing vegetation may be an outcome of more recent agricul-

Figure 7a. A collection of birch bark baskets made by Elder Mary Palmantier. Photo by Nancy Turner.

Figure 7b. Birch bark (*Betula papyrifera*) was essential to the manufacture of numerous items used on a daily basis by the Secwepemc and for this reason, it was important that it was harvested sustainably. In this photo, Greg Ignace demonstrates how to harvest birch bark without killing the living tree (note, though: the lower part of the piece we peeled was not suitable for basket making, since it contained too many branch holes that punctured the bark). Photo by Marianne Ignace.

Figure 8a. Indian-hemp (*Apocynum cannabinum*) was an important source of fibre for making twine. People cut the long stems off at their full maturity at the end of the summer or in early fall. In this way, the plant's underground parts remained intact and produced new shoots the following year. This form of coppicing created long, straight shoots ideal for fibre. Here, Elders Mary Palmantier and Lilly Harry harvest Indian-hemp near Dog Creek. Photo by Nancy Turner.

Figure 8b. Beverley Bob is harvesting ***spétsen*** (Indian hemp) at what remains of a once extensive hemp patch near the race-track on Kamloops Indian Reserve No. 1. This area once featured an extensive wetland and was the site of a large Plateau phase village. Hemp patches like this were managed to produce tall, straight plants best suited for making hemp fibre. Photo by Marianne Ignace.

tural practices, as part of growing potatoes, peas and other crops in the European tradition (see Turner and Brown 2004), there is evidence from the terms for “weeds” in Secwepemctsin and surrounding Interior Salish languages that this term pre-dated the origin of introduced noxious weeds, but designated native plants that densely grew “hair or fur-like” close to the ground. Thus, the Secwepemc term for “weed” is ***c.wepul̓ecwem***, analyzable as consisting of the prefix ***c*** = inside + root ***wep*** = hairy, furry + lexical suffix ***–ul̓ecw*** = land + em = intransitive verb). In the days before noxious weeds invaded the interior, such plants would have commonly been grasses, which would have been cleared off by root diggers in the process of harvesting.

Systems of Scheduling and Regulating Harvests

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. Often, the reproductive status of a plant is an important aspect of seasonal harvesting (see Loewen et al., Chapter 7, this volume). The green shoots of cow parsnip, for example, were harvested in early to mid-spring, depending on elevation, before the plant flowered (Figure 9). After this, the stalks became unpalatable and undesirable. Likewise, desert parsley needs to be harvested in early spring, because later in the spring, the root turns bitter and leaves a tingling sensation on the tongue.

By contrast, a number of other important root vegetables were harvested primarily *after* the plant was at the fruiting stage or had gone to seed, most notably among them glacier lily, discussed in detail in Chapter 7. The timing of the harvest of plants like glacier lily coincided with maximum seed production. Many medicinal roots, too, were collected after flowering, at which point the roots were considered more potent.

There were also prohibitions against harvesting certain plants at certain reproductive stages. For example, women were taught to avoid collecting the “male” (flowering or fruiting) individuals of desert parsley [***qweq̓wíle*** (W); ***qwaq̓wila*** (E)] in favour of

Figure 9. The yearly growth cycles of plants were a prime consideration in the seasonal movements of people from place to place throughout Secwepemc territory. For example, the fresh, green stalks of cow-parsnip (*Heracleum maximum*) pictured here, were edible only at their young stage, before the flower buds had expanded, usually in early spring, meaning people had only a short window of opportunity to harvest many of these staple resources. Photo by Sandra Peacock.

the "female" vegetative ones. Similarly, the leaves of non-fruiting cat-tail plants, used in the manufacture of mats, were selected for harvest over the fruiting ones, which are too short and brittle. In the case of cow-parsnip, however, the budding "male" plant stalks were selected for harvest over the "female" stalks, which are harder to peel and said to be not as tasty (Sarah Deneault, pers. comm. to MI, 1997). In Secwepemctsin, the "male" and "female" plants are terminologically distinguished as ***sqelemcwúpye7*** and ***nexwenxwúpye7***, respectively.

Within multi-year subsistence cycles, variations in growth often meant a particular plant was left to mature for one or more years prior to harvesting. As is shown in Chapter 2, a system of resource monitoring and taking inventory existed, where on their way to plateau fishing grounds, or in the process of traveling to hunting areas, the members of a community continually monitored the health of root producing areas, berry patches, and medicinal plant patches throughout the seasonal round, with certain individuals functioning as ***yecwmin̓men*** (W) or ***yucwmín̓ma*** (E), resource caretakers (cf. Chapter 2). Based on their skills and experiences on the land, the latter were regarded as tacitly appointed by communities as experts who would assess the quality and quantity of a particular resource at known locations accessed by community members. ***Yecwmin̓men*** took stock of the health and proclivity of salmon and game populations and communicated their findings to members of the community. In addition, it appears that they played the most active roles in the resource management strategies discussed above, particularly burning. Besides the stewardship practices for harvesting sites, an often neglected aspect of indigenous resource management regimes is the maintenance of travel routes that facilitate resource users' access to, and travel between resource producing locations. According to Secwepemc elders, each community had its designated individual(s) whose recognized role it was to keep the extensive network of horseback and foot trails clear of deadfall and brush, and to repair washouts (Ignace 2008:207). Thus, Ron Ignace remembers one of the Skeetchestn adult males, Walter Humphrey, having the tacitly assigned task to keep riding and foot trails clear to allow easy passage to and from resource locations (Ignace 2008).

As Ron Ignace (2008:206) further reported, "the roles performed by the ***yecwimín̓men*** were based on a person's experience and knowledge, and involved an assigned and recognized role within the community." From the late nineteenth century, Dawson (1891:21) corroborated the concept of the ***yecwmin̓men*** or resource caretakers described by contemporary elders, noting that among the Secwepemc,

> … 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) noted that women of one village could pick in the berry patches of another as long as they did so at the proper season.

Based on the work of the ***yecwmin̓men*** as practical resource stewards, community chiefs functioned as decision makers who signaled the commencement of resource producing activity and directed people not only from their own but also from more distant communities to particular berry patches (Figure 10). Teit's description (1909:573) illustrates how community chiefs, ***yecwmin̓men***, and berry pickers interacted:

> 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 [Saskatoonberry] patches near Big Bar. The chief there watched the ripening of the berries, and deputed young men [i.e., ***yecwmin̓men***] 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 out word 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 finished them all.

People closely linked their decisions concerning how much and how often to harvest with fluctuations in the annual productivity of resources. The cyclical nature of the yield of many key plant resources was well known to the Secwepemc and neighbouring peoples. Fruits are notable for having multi-year cycles of heavy and light bearing years, and Indigenous peoples' use of saskatoons, huckleberries, soapberries, and other species reflected these cycles. The cycles of pro-

Figure 10. Productive berry patches were held in common, but access was controlled by community chiefs, who worked closely with the ***yucwmin'men*** to monitor the ripening of the berries. Women began harvesting at designated patches only after permission was received from the chief. This system of resource stewardship ensured access to all while avoiding the risk of overharvesting. This photo shows elder Cecilia DeRose of Esk̓ét harvesting highbush cranberry on Sugarcane Reserve. Photo by Marianne Ignace.

ductivity were also known for plant 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, ensured the continued productivity of a specific population.

Various constraints helped to regulate and schedule plant harvesting. 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 nutritional and cultural preferences for species at certain growth stages, and, last but not least, with ease of access. Prolific plant areas whose locale also fit into the seasonal harvesting of other resources, including other plants, fish and game, were obviously the preferred locations, although certain sought-after food and medicinal plants required specific expeditions to more remote places, unless they could be obtained in trade (Turner and Loewen 1998). Theresa Jules (see Ignace 2008:150) commented on the practice of Secwepemc extended family groups going after multiple resources within a seasonal round by saying, "Whoever was smart enough to find food, they invited one another along. So then off they'd go [to pick berries]. Their husbands were there, they also went hunting. They never stayed in one place."

Often, people took advantage of plants ripening throughout the early spring to early fall season at progressively higher elevations (Figure 11). Mary Thomas recalled, for example, that in the Neskonlith area, Secwepemc women first dug desert parsley roots in the valley bottoms, then the lower elevation spring beauty corms and glacier lily bulbs, then balsamroot, all at lower elevations. By this time the saskatoon berries, soapberries (***sxusem***), and some of the other berries were ready to be picked in the valleys. Then, in mid-summer, people would move up to the mountains and dig more spring beauty and glacier lily "roots," and also harvest more ***sxúsem*** at higher elevations. After this, the huckleberries and blueberries were ready to be picked, and some of the other later ripening fruits such as highbush cranberries (*Viburnum opulus*) and hazelnuts (*Corylus cornuta*). Ron Ignace remembered,

> [My great-grandmother] Julienne could be found picking saskatoons, or choke-cherries in the valley or riding up into the mountains, in the spring, [she harvested] lodgepole cambium or ***st7íq̓wel̓q***, or to pick strawberries, to gather rotten fir, ***yúq̓wi*** for tanning hides; she and Edward could be found down on the river catching fish .... Another elder of our community, Alice Celesta, was into her seventies and still riding her horse into the distant mountains for days on end to pick or dig the berries or bulbs that were in season. She would travel up to Clearwater or Blue River to pick berries and, upon return, would come home laden with berries and stories of her exploits. Upon being asked if she was scared of grizzly bears she would say that she would talk to them and tell them she had to eat and feed her family, and they should go somewhere else to feed and would leave her alone (Ignace 2008:143).

Figure 11. The Secwepemc seasonal subsistence cycle began in early spring in the valley bottoms where people collected the first edible greens and roots, and then gradually progressed up slope as different plants "ripened" at higher elevations. Bitterroot (*Lewisia rediviva*), pictured here, an important root food found only at lower elevations, was harvested in the pre-flowering stage in the springtime. Photo by Nancy Turner.

Similar rounds of progressive resource access are noted for other Plateau peoples (Ignace 2008; Turner 1992a; Turner et al. 1980, 1990), and are also detailed in the description of the Secwepemc Calendar and seasonal subsistence round in Chapter 2 as well as for peoples to the south on the Columbia Plateau (Hunn et al. 1990; Marshall 1977).

Plant Habitat Management

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

Controlled burning was the most common form of plant habitat level management practiced by Interior Plateau peoples. The extensive use of fire to create and maintain ecologically heterogeneous mosaics is discussed in detail elsewhere (Turner 1999) and readers are referred to this reference for a more detailed treatment of the subject. For the St'at'imc, Baptiste Ritchie (in Turner 1999) gave eloquent evidence for community-level management, and other elders confirm similar uses of fire in various parts of the Plateau, including the Secwepemc Nation. It was widely recognized that fire, through clearing brush and providing a quick source of nutrients, can stimulate the growth of certain complexes of plants, as can pruning and thinning. 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).

Mary Thomas (pers. comm. to NT, 1996) recalled, from the Neskonlith area:

> A lot of people couldn't believe that our people deliberately burned a mountainside when it got so thick, nothing else would grow in it. They deliberately burned it, at a certain time of the year when they knew there was rains coming… and 2 years, 3 years after the burn there'd be huckleberries galore, and different plants would come up that were edible (Mary Thomas, pers. comm. to NT, 1995).

Mary Thomas noted that, not only did fire stimulate the growth of the berries, roots, and even mushrooms like edible morels, but also, her mother told her, fire killed harmful plant-eating insects that accumulated in a given area, such as the tent caterpillars on the chokecherries, mentioned earlier. At Skeetchestn, Ron Ignace and his uncle Greg Ignace recalled their grandfather, Edward Eneas, riding up into the mountains in spring and setting fire to forested areas that included berry patches. Secwepemctsin, indeed, has a specific term, ***tsp̓eg***, for a "burnt-out area on the side of a mountain" either caused by natural burning or landscape burning. Competing annual species, too, might be suppressed by burning.

In all, for British Columbia, more than 20 species of plants, including at least a dozen fruiting shrubs, one herbaceous fruit (strawberry, *Fragaria* spp.), and seven herbaceous "edible root" species, have been identified by various sources as having their production enhanced by periodic burning (Turner 1999).

In addition to burning forested mountainsides, the Secwepemc and other Interior peoples also carried out fire management in the bunchgrass and sagebrush valley bottom areas and on sidehills and slopes at lower elevations, in order to improve forage for ungulates and, in the past 150 years, for horses and cattle. Such burning practices, also done in intervals of five to ten years, prevented the spread of sagebrush (*Artemisia tridentata*) and other shrubs while helping the growth of bluebunch wheatgrass and various plant species used as food, such as saskatoonberry, balsamroot, and desert parsley. According to Ron Ignace, a detailed knowledge of moisture and wind patterns at the exact time in early spring, after the snow has melted, is crucial to this. Grassland burning was carried out during a short window in time in early spring when mild winds change direction mid-day, which contained the spread of the fire and allowed fire managers to carry out burning in designated areas. The "well-kept park-like" appearance of the rolling hills around ***Tk̓emlúps*** (Kamloops) noted by Reverend Grant who accompanied railway surveyor Sandford Flemming on an expedition to the Interior in 1872 (Grant 1967:297), was due to the long standing practice of fire management.

As the examples cited above show, the timing of fires was carefully controlled by ***yecwmin̓men***—specialists within the community (Figure 12). 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. Fire management required close monitoring of wind conditions and detailed knowledge of the terrain to prevent fires from burning out of control, and to contain burned areas. 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 (quoted in Turner 1999):

> 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 ***sk'amec*** [*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. They [berries] do [grow] after logging, but its not the right kind….

Figure 12. Controlled burning was undertaken in early spring or late fall to maintain productive plant habitats and to clear transportation corridors. Community specialists—known as ***yecwmin̓men***—controlled the timing and intensity of the burns, balancing moisture levels and wind conditions with knowledge of the local terrain. Here Ron Ignace starts a burn on a hillside by Deadman's Creek in the community of Skeetchestn. Photo by Marianne Ignace.

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. As mentioned earlier, this period of "fallow" was accompanied by the rotation of harvesting locales in the seasonal round. Grassy areas were burned every few years.

Social and Political Concomitants of Plant Management: Access to and Use of Resources

As previously discussed, both plant population and plant habitat management activities influenced the overall composition of the landscape. However, Indigenous peoples of the Plateau also employed a number of resources management strategies on a broad scale, such as within an entire 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 (e.g., Turner and Berkes 2006; Turner et al. Chapter 12, this volume).

The seasonal movements of people across the landscape were, and still are, 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 are 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 have been central to peoples' knowledge and lifestyles. Elders widely recognized that certain plants grow in association with each other, and that often, life cycles of various plants and animals coincide. Nlaka'pamux elder Annie York, for example, noted, "all plants have relatives, all of them …" in reference to companion plants always found growing together, such as bitterroot (*Lewisia rediviva*), an important root vegetable, and miner's lettuce (*Claytonia perfoliata*) (Turner et al. 1990). Plant growth and productivity are dependent on local weather conditions, as well as aspect, moisture, climate and genetic variation. People also recognized the cyclical nature of plant resources, like that of salmon runs and population profiles of game.

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, comparable to the swidden agriculture practices of many tropical forest peoples (see Posey 1990).

As noted above, the monitoring of resources, their health and growth by resource users, including appointed and respected caretaker specialists titled ***yecwminm̓en***, was a significant aspect of Secwepemc resource management protocols. Obviously, the caretaker and regulatory role of Secwepemc community chiefs with respect to important, managed, and thus high yield berry patches speaks to the overall significance that good berry harvests had for the well-being of a community. It is important to point out that, while berry-picking areas in general were considered community property, according to Secwepemc custom, where individuals and families had modified the landscape by burning or clearing brush to enhance the habitat of berry bushes, these people had first priority of use of the berries produced here (see Chapter 2). The same holds for human-modified fishing grounds or deer fences, that were said to be "owned" by certain people: it is not the resource per se which is/was subject to private property regulations, but instead, the human labour behind resource intensification and/or harvesting was acknowledged and respected. Thus, of such managed berry patches, Dolores Bebbington from Xats'ull (Soda Creek) reported (pers. comm. to NT, 2008) that her father used to "… clean up all the weeds around the patch that was ours," and that "Each family had their own patches to pick and no one would touch them unless they would come to the house and ask my father for permission."

Important root digging grounds that were managed by the techniques described previously—and where staple root crops like balsamroot, mountain potato, yellow glacier lily, nodding onion, or tiger lily could thus be harvested in great quantities and qualities—were likewise considered to be under the stewardship of the local community or communities, but accessible to all Secwepemc. In the Secwepemc Nation, these important root-gathering areas often yielded a variety of species and were frequented by multiple local communities, regional communities, and visitors. Some of these central root-gathering locations included Neskonlith Meadows, Pinantan (***Pencentén***) east of Kamloops (Figure 13), Trophy Mountain, Mount Revelstoke, Blackdome Mountain, Mount Tod, and Mount Lolo, Upper Hat Creek, ***Cḱemqenétkwe***. These places would have had enormous numbers of resource harvesters working in cooperation to secure their harvests, not different from what James Teit (1900:294) reported about Botanie Valley in Nlaka'pamux territory:

Figure 13. Important root digging grounds, such as ***Pencentén*** (Pinantan), just east of Kamloops, still boast an abundance of edible root species, a legacy of generations of resource stewardship. Photo by Marianne Ignace.

> Botani [Botanie] Valley, situated in the mountains… has been from time immemorial a gathering place for the upper divisions of the tribe [Nlaka'pamux or Thompson], 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.

The resource management and stewardship system among the Secwepemc that involves ***yecwminm̓en*** and community chiefs—also reported among other Nations of the Plateau—parallels the ***h̲ah̲uulhi*** system of the Nuu-Chah-Nulth peoples of Vancouver Island, whereby a hereditary chief "owned" resources and resource-rich areas, but also had responsibilities to maintain them and share them with his people (Scientific Panel for Sustainable Forest Practices in Clayoquot Sound 1995; Turner and Peacock 2005; Turner et al. 2005). However, the Secwepemc system functioned in the context of the overall principles of Plateau social and political organization, which differ from the autonomous corporate group organization of the Coast. Among the Secwepemc, ***yecwminm̓en*** functioned as practical resource caretakers, whereas community chiefs, on the advice of local ***yecwminm̓en***, had the role of announcing and politically regulating access and use of critically important resources. Further, as villages and indigenous communities, and ultimately, the entire nation, were composed of a network of interrelated bilateral families connected by descent and marriage, the Plateau system of kinship and descent played a key role in allocating access to, and management of resources (see Ackerman 1994; Anastasio 1972; Ignace 1998; Ignace 2008; Ignace and Ignace 2004).

Finally, Secwepemc principles and protocols ensured appropriate resource management. 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, enforced by everyday individual ritual behaviour and supported by oral traditions. All of these guided people in their day to day interactions with the natural environment, a point made very eloquently in Eugene Anderson's (1996) *Ecologies of the Heart* and well-documented in cultures around the world (Berkes 2012; cf. also Turner 2005 for other B.C. examples).

Amongst the Interior Salish peoples, First Foods Ceremonies were one of the more prominent social mechanisms used to control harvesting. For the Nlaka'pamux, immediate neighbours of the Secwepemc, Hill-Tout (1978), based on people's memories in the late 1900s, summarized 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.
>
> These feasts were conducted as follows: When the salmon, for instance, begin to run, the word is brought to the divisional chiefs that the fish are coming up river. Messengers are then sent to the neighbouring villages, calling a meeting

> of the people on a certain day, at which all must attend at the appointed place. When the day has arrived and the people have assembled, the head chief, attended by the other lesser ones and the elders, opens the ceremony at daybreak by a long prayer. When the prayer is being said everybody must stand with eyes reverently closed ….
>
> Exactly to whom these prayers were addressed my informant could not tell me. All I could gather was that the "old Indians" believed in some great and beneficent power who dwelt behind the clouds, and who gave them the salmon, fruits, roots, etc., who, if they showed themselves ungrateful or unthankful, could, and might, withdraw his gifts from them.

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 embodied in the persona of Old-One, the creator, and his teachings: Within the Secwepemc belief system, it was Old One, ***tsk̓éwelc***, who was the "chief of the ancient world" (Teit 1909:596).

As Ron Ignace noted,

> Often equated with ***tqelt kúkwpi7***, the chief above or "Creator," Old-One, who was "all powerful", put the sun, moon, weather, and seasons in place, introduced many of the animals into our land, and taught the people how to harvest and preserve them. He introduced the ***sq̓ilye*** or sweat bathing as a custom that set us apart from animals. Behind the Salish people's movements into different parts of the Interior was Old One's guiding hand or power. After he did his initial work, Old One sent ***sk̓elép*** (Coyote) to "travel over the world and put it to rights" during that period when the earth "was much troubled with great winds, fires, and floods." Old One was the one who reminded us to be respectful of all living things. This notion of respect is at the core of our beliefs about our interaction with the land and all things in it: ***Xyemstém/me7 xyemstéc*** ("be respectful") entails the management and careful harvesting of all plant and animal resources, lest they disappear on us in disgust, and we become pitiful (***qwenqwént***) (Ignace 2008:215–216; see also Chapter 2, this volume).

As explained in more detail in Chapter 2 from a Secwepemc perspective, central to the relationship between an animal and the fisher or hunter who "bags" the animal is the concept that an animal gives itself to the fisher or hunter, expressed as ***kecmentsút*** in Secwepemctsin (Ignace 2008:216). In the same manner, plants, also living things, give themselves to the resource harvester. The resource harvester, in turn, must show respect to the species, in order to ensure that it will continue to give itself to humans, and thus to take pity on them (ibid.). Such respect, in turn, is shown by responsibly harvesting plants and all resources, not wasting them, and not "playing with them" by carelessly destroying them or preventing them from reproducing. An integral part of the harvesting of all things in nature, including plants, is a prayer (in Secwepemctsin, literally, "expressing one's pitiful state") that thanks the creator, ***tqeltk kúkwpi7***, for providing the animals or plants that feed people, and that expresses one's thanks to the resources for giving themselves to people. Secwepemc people to this day give prayers of thanks by communicating with the spiritual world through tobacco that is scattered on the ground as a gift, to both the animal and plant, and to the creator and to the land containing all forms of life (***tmicw***). Besides tobacco, Secwepemc people nowadays leave behind coins, or other tokens, like a few grains for the squirrel, which gave humans some hazelnuts or pine nuts from its cache.

The sanctions for disrespectful behaviour in resource harvesting extend into the social realm, which supports a strong ethic of sharing or ***knucwentwécw***, "helping one another" in harvesting and sharing the benefits of animal and plant resources. Thus, when a hunter or fisherman is "skunked," the reason is often (tacitly) seen in his or her "stinginess" or unwillingness to share. At the same time, Secwepemc cultural norms support a strong ethic of being self-sufficient (***yecwenstsút***) and not "freeloading," ***q̓en7élt***. The Secwepemc term ***yéwyut***, "to be a nuisance" best exemplifies the results of individuals' lack of self-sufficiency and self-reliance, and countless stories tell of the ostracism and demise of those who are considered ***yéwyut*** because they are lazy, ignorant, or disinterested in being self-sufficient.

In Secwepemc culture, an important training ground in the spiritual and practical underpinnings of resource harvesting is the institution of étsxem or spirit guardian questing (Ignace 1999; Ignace 2008; Teit 1909). During their spirit guardian quests, while alone in the mountains, young people, through prayer and practices, had to learn how to harvest resources alone in order to survive. Besides finding spiritual helpers that will guide them through life, they had to practice the tasks that would make them successful hunters and plant harvesters. According to elders' memories, young girls trained to be efficient and fast root diggers by practicing the digging of root harvesting "trenches," systematic trench-digging being the preferred way to harvest roots like glacier lily and Indian potatoes. Incisions of root digging "trenches" on Plateau digging sticks that often accompany prehistoric grave sites further speak to root trench digging as symbolizing female spiritual training and power in their connection to practical skills, as do tattoo and pictograph symbols (Sanger 1968; Teit 1900, 1909, 1930).

Summary of Plant Resource Stewardship Strategies

In summary, the traditional plant harvesting activities practiced by the Secwepemc and other aboriginal peoples of the Interior Plateau, developed over the course of several thousand years of living in their homelands, ensured a reliable, predictable, and productive supply of culturally important plant species. They occurred within a known landscape, supported by a range of management activities in conjunction with a political and social system of caretakership and access, and a set of spiritual norms and sanctions. Without doubt, throughout the past several thousand years, the Secwepemc and other Plateau peoples experienced food shortages caused by climate change, unseasonable weather, and natural disasters (see Hayden 1992); however, practical resource management regimes in connection with social protocols of access to resources

(Anastasio 1972), and spiritual protocols that provided sanctions against careless and wasteful use of resources mitigated the effects of local shortages (Turner et al. 2000).

At the plant population level, plant management was practiced through harvesting strategies dictated by both cultural and biological factors. Harvesting 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 people thinned the populations, decreasing intra-species competition. Weeding also decreased competition between desired and undesired species, giving the culturally important plants a competitive advantage. Pruning and coppicing of herbaceous plants and shrubs encouraged the growth of new shoots, leaving the root systems intact, as did the burning of selected individuals such as hazelnut bushes. The intentional replanting of "roots" and their propagules was also an important factor in maintaining population productivity.

Incidental, but perhaps even calculated, impacts of harvesting practices included localized soil disturbances from digging and tilling. In addition, the inevitable detachment of portions of taproots, tubers, corms, and bulbs would enable vegetative reproduction of the species. In our experience, it is difficult to extract the entire root, and often a small portion is left behind to regenerate vegetatively. 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.

Through the range of resource management regimes they practiced, we not only have convincing evidence that the Secwepemc and other Plateau peoples enhanced the growth and abundance of particular species through time; they may have, in some instances, extended the range of particular species through purposeful or accidental transport and re-planting. In recent years, some people, notably Mary Thomas, have transplanted spring beauty, wild onions, bitterroot, and glacier lily into their gardens, and the Secwepemc Museum in Kamloops has successfully transplanted various higher elevation species, including kinnikinnick into an ethnobotanical garden on the ***Tk'emlúps*** (Kamloops) First Nations Reserve. In the past, root vegetables were commonly stored by burying them fresh in underground caches (Dawson 1891; Nicholas, Chapter 3, this volume; Teit 1900, 1906, 1909; Turner et al. 1980, 1990), and caches which were not emptied in one season might well produce growing plants in the succeeding years.

The use of controlled fires to manage plant communities is well documented for Indigenous peoples throughout the world (e.g., Anderson 1993b; Boyd 1999; Johnson Gottesfeld 1994a, 1994b; Lewis 1973, 1977, 1982; Lewis and Ferguson 1988). It is not surprising, then, that this was one of the most important management tools of the Secwepemc and other Plateau peoples, who burned upland habitats at specified times of the year and at regular intervals to enhance the productivity of roots and berries. In addition, they also burned grassland valleys and slopes to enhance the productivity of lower elevation use plants and animal forage. The continued productivity of these habitats was ensured through alternating harvest locales.

Finally, while these plant management techniques had economic motives, they were embedded in a larger decision-making system structured by social, religious, and moral ideologies. These principles guided people's interactions with the natural environment and ensured careful, considered, and considerate use of plant resources from generation to generation.

On a comparative and theoretical level, this discussion of Secwepemc plant resource management, in connection with previous descriptions of plant management regimes throughout Western North America, further contributes to narrowing the gap between hunters and gatherers on the one hand, and horticulturalists on the other (Anderson 2005; Deur and Turner 2005; Ford 1985; Peacock 1998). As we have learned from ethnoarchaeological investigations and the growing ethnographic and oral historical testimony about indigenous "wild" (non-cultigen) plant management regimes throughout many parts of North America, notably the Interior Plateau, plant gathering as it intensified approximately 2,000 years ago (Lepofsky and Peacock 2004; Peacock 1998), indeed came to entail detailed plant management, intensification, and stewardship regimes as described in this article.

During the nineteenth century, as European visitors and then settlers arrived in their territory, the Secwepemc were exposed to European horticulture and agriculture and its products, while continuing to harvest and manage their own plant foods. However, within a decade, by the 1830s, they began to adapt to the European horticultural methods by planting potatoes, which were, in part at least sold to the Hudson's Bay Company fur traders at Thompson's River post at what is now Kamloops. As settlers poured into Secwepemc territory following the 1858 Gold Rush, the latter introduced further crops and methods of European agriculture. The land ordinances soon began to favour settler society's practice of agriculture over Secwepemc people's attempts to adapt to the same methods by rewarding Europeans with land pre-emptions based on agricultural "improvements" while excluding the indigenous landholders from the very same methods, in spite of their protests and resistance. By the late nineteenth century, the Department of Indian Affairs promoted and implemented the parsimonious policy of "one acre and a cow" (1990), purporting to advance Western Canada's Aboriginal peoples through "evolutionary stages" that started them out at the "peasant" stage of agriculture with small holdings of land on reserves divided into what the Federal government hoped would become individual land holdings as Aboriginal people "advanced" themselves to the appropriate stage of "civilization," helped on by the Department of Indian Affairs.

As elders' accounts from the first part of the twentieth century show, however (Ignace 2008; Ignace and Ignace 2004), Secwepemc people continued to maintain a collective sense of land tenure, supplementing agriculture and horticulture with continuing indigenous plant use and resource management regimes as illustrated by contemporary and recent elders' testimony in this chapter. For Secwepemc people of the late nineteenth and early twentieth century who had been raised with the teachings of countless generations of resource management techniques involving "wild" plant management and intensification *in situ*, the move to on-reserve horticulture was not a revolutionary leap. After all, the term the Secwepemc coined for gardening or agriculture was one that derived from pre-existing terms in Secwepemctsin, and presumably, categories of thought: they referred to gardening and agriculture as ***k̓wén̓llqem***—"to try out plants"— something the Secwepemc and their ancestors had been doing for thousands of years already.

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Appendix: Summary of Culturally Important Plants of the Secwepemc and other British Columbia Interior Plateau Peoples with Associated Management Practices (adapted from Peacock and Turner 2000)

Category	Use and Approx. No. of Species	Examples Species (Common Name)	Management Notes
FOOD	Berries (Total ~50)	*Amelanchier alnifolia* (saskatoon, serviceberry); *Fragaria* spp. (wild strawberries); *Prunus virginiana* (choke cherry); *Ribes inerme, R. irriguum* (wild gooseberry); *Rubus idaeus* (wild raspberry); *Rubus leucodermis* (blackcap); *Shepherdia canadensis* (soapberry); *Vaccinium membranaceum* (black huckleberry); *Vaccinium oxycoccos* (bog cranberry)	all except wild strawberries are woody perennials; fruit picking generally non-impacting on plants; diversification and use of alternative species in poor crop years was practiced; seasonal rounds; most said to be enhanced by periodic landscape burning; some (e.g., soapberry, huckleberries) were pruned periodically;
FOOD	Seeds and Nuts (Total ~ 6-8)	*Balsamorhiza sagittata* (balsamroot); *Corylus cornuta* (hazelnut); *Pinus albicaulis* (whitebark pine)	hazelnut bushes were burned individually; hazelnuts and pine seeds gathered (sparingly) from rodent caches;
FOOD	Root Vegetables (Total ~ 35)	*Allium cernuum* (nodding onion); *Balsamorhiza sagittata* (balsamroot); *Calochortus macrocarpus* (mariposa lily); *Cirsium undulatum* (wild thistle); *Claytonia lanceolata* (spring beauty); *Erythronium grandiflorum* (glacier lily); *Fritillaria lanceolata* (chocolate lily); *Fritillaria pudica* (yellowbell); *Lewisia rediviva* (bitterroot); *Lilium columbianum* (tiger lily); *Lomatium macrocarpum* (desert parsley); *Potentilla anserina* (silverweed); *Sagittaria latifolia* (wapato); *Sium suave* (water-parsnip)	all are herbaceous perennials with bulbs, corms, rhizomes, tubers or taproots; all selectively harvested by season, age, size, life-cycle stage; part of seasonal round harvesting cycles; most said to be enhanced by periodic landscape burning; propagules often incidentally or intentionally replanted; some weeded during harvest; specific sites harvested in several-year cycles;

Category	Use and Approx. No. of Species	Examples Species (Common Name)	Management Notes
FOOD	Green Vegetables (Total ~18)	*Balsamorhiza sagittata* (balsamroot); *Epilobium angustifolium* (fireweed); *Heracleum maximum* (cow-parsnip); *Lomatium nudicaule* ("Indian-celery"); *Opuntia* spp. (prickly-pear cactus); *Rubus* spp. (raspberry, blackcap, thimbleberry); *Typha latifolia* (cat-tail)	all are herbaceous perennials or woody perennials (*Rubus* spp.); all selectively harvested as shoots or leaves by season, age, size, life-cycle stage; part of seasonal round harvesting cycles; some said to be enhanced by picking; cactus propagules incidentally replanted;
FOOD	Tree Inner Bark (Total ~7)	*Pinus contorta* (lodgepole pine); *Pinus ponderosa* (ponderosa pine); *Populus balsamifera* (cottonwood)	all tree species; harvested by partial bark and cambium removal, but not girdling; selectively harvested by season; part of seasonal round harvesting cycles
FOOD	Lichen (1 species)	*Bryoria fremontii* (black tree lichen)	selectively harvested by abundance, taste, season, tree species, location; pulled from coniferous tree branches, allowing regeneration from remaining thallus;
FOOD	Mushrooms (Total ~ 8)	*Pleurotus ostreatus* (oyster mushroom); *Tricholoma magnivelare* (pine mushroom); *Tricholoma populinum* (cottonwood mushroom)	seasonally available; selectively harvested by size, age; cut and ground litter re-covered for multiple harvests (for ground mushrooms);
FOOD	Casual Foods, Flavourings and Sweeteners, Emergency Foods, Beverage Plants (Total ~50)	*Arctostaphylos uva-ursi* (kinnikinnick: leaves thirst quencher); *Rhododendron neoglandulosum* (trapper's tea: beverage); *Larix occidentalis* (western larch: chewing gum); *Pseudotsuga menziesii* (Douglas-fir: sugar)	variously herbaceous or woody perennials; leaves, gum, shoots or other parts selectively harvested by season or at times of need; seldom harvested intensively in any locality;
SMOKING	Tobaccos and Tobacco flavourings (Total ~10)	*Arctostaphylos uva-ursi* (kinnikinnick: leaves smoked); *Cornus sericea* (red-osier dogwood: inner bark smoked); *Nicotiana attenuata* (tobacco; leaves smoked); *Rhus glabra* (sumac, leaves smoked); *Ligusticum canbyi* (Canby's lovage: roots smoked); *Lomatium nudicaule* (seeds as tobacco flavouring)	*Nicotiana* formerly cultivated, annual; others are perennials, materials harvested selectively from living plants; *Ligusticum* roots highly valued; tops stuck back in ground by some people after harvesting root; dug after flowering'
MATERIALS	Pit-cooking matting (Total ~12)	*Pseudoroegneria spicata* (bluebunch wheatgrass); *Cornus sericea* (red-osier dogwood: branches); *Penstemon fruticosus* (shrubby penstemon: leafy shoots); *Pseudotsuga menziesii* (Douglas-fir; boughs); *Pinus ponderosa* (ponderosa pine: needles); *Rosa* spp. (wild rose: branches)	all herbaceous woody perennials; materials harvested selectively from living plants as plucking or "pruning" or (for ponderosa pine) as fallen needles;

Category	Use and Approx. No. of Species	Examples Species (Common Name)	Management Notes
MATERIALS	Woods for construction and manufacture (Total ~25)	*Acer glabrum* (Rocky Mountain maple); *Amelanchier alnifolia* (saskatoon or serviceberry); *Cornus sericea* (red-osier dogwood); *Crataegus douglasii* (black hawthorn); *Juniperus scopulorum* (Rocky Mountain juniper); *Pinus ponderosa* (ponderosa pine); *Populus balsamifera* (cottonwood); *Pseudotsuga menziesii* (Douglas-fir); *Taxus brevifolia* (Pacific yew)	all trees or shrubs; many harvested or coppiced as branches or stems from living plants; some dead trunks selected (as opposed to cutting live trees); trees selectively cut (e.g., cottonwood for dugout canoe)
MATERIALS	Woods and others for fuel, tinder (Total ~25)	*Artemisia tridentata* (big sagebrush); *Betula papyrifera* (Paper birch); *Juniperus scopulorum* (Rocky Mountain juniper); *Pinus* spp. (pines); *Populus balsamifera* (cottonwood); *Pseudotsuga menziesii* (Douglas-fir); *Salix lasiandra* (Pacific willow)	most are trees or woody perennials; materials often harvested from downed/dead trees, or selectively as branches from living trees;
MATERIALS	Bark sheets for manufacture, or lining caches (Total ~10)	*Abies lasiocarpa* (subalpine fir); *Betula papyrifera* (Paper birch); *Pinus monticola* (white pine); *Populus balsamifera* (cottonwood); *Prunus emarginata* (bitter cherry)	all trees; birch and cherry outer bark only removed, without killing tree; others removed in large sheets, which would kill trees if living; possibly dying or dead trees selected for cottonwood bark; barks harvested selectively by size, season, tree characteristics;
MATERIALS	Stem, leaf, root fibres/ fibrous tissues (Total ~25)	*Acer glabrum* (Rocky Mountain maple: inner bark); *Apocynum cannabinum* (Indian-hemp: stem fibre); *Elaeagnus commutata* (silverberry: inner bark); *Picea engelmannii* (Engelmann spruce: roots); *Salix exigua* (sandbar willow: stems); *Schoenoplectus tabernaemontani* (tule: stems); *Thuja plicata* (western red-cedar: roots); *Typha latifolia* (cat-tail: leaves);	all are woody or herbaceous perennials; materials cut (stems, leaves) or pulled in strips (barks) from living plants by pruning; herbaceous materials harvested selectively by size, season, plant growth form, habitat;
MATERIALS	Dyes, stains (Total ~25)	*Alnus* spp. (alders: bark); *Echinodontium tinctorium* (Indian paint fungus); *Letharia vulpina* (wolf lichen); *Mahonia aquifolium* (Oregon-grape: inner bark)	various types of materials; harvested selectively and sporadically as required;

Category	Use and Approx. No. of Species	Examples Species (Common Name)	Management Notes
MATERIALS	Adhesives, caulking, waterproofing agents (Total ~10)	*Abies lasiocarpa* (subalpine fir: liquid pitch); *Pinus contorta* (lodgepole pine: pitch); *Populus balsamifera* (cottonwood bud resin); *Pseudotsuga menziesii* (Douglas-fir: pitch)	harvested selectively from living trees;
MATERIALS	Scents, Cleansing agents, Miscellaneous (Total ~125)	*Abies lasiocarpa* (subalpine fir: boughs as scent); *Anaphalis margaritacea* (pearly everlasting: flowering tops, leaves as menstrual padding); *Artemisia tridentata* (big sagebrush: leaves as scent); *Equisetum hiemale* (scouring rush: abrasive); *Juniperus scopulorum* (Rocky Mountain juniper: boughs as scent); *Lomatium dissectum* (chocolate-tips: roots as fish poison); *Mentha arvensis* (Canada mint: tops as scent); *Typha latifolia* (cat-tail: seed fluff as diapering); *Urtica dioica* (stinging nettle: tops as cleansing agent); (see Turner et al. 1990:38–40 for more examples)	various herbaceous or woody perennials; most materials selectively harvested from living plants; usually harvested by season, life cycle stage;
MEDICINES	Whole plants or leafy branches (Total: ~250-300 plant preparations)[1]	*Artemisia dracunculus* (wild tarragon: wash for sores); *Ceanothus velutinus* (snowbrush: tonic, general illness); *Clematis ligusticifolia* (white clematis: wash for sores, scalp); *Gaillardia artistata* (brown-eyed Susan: influenza, tonic)	various herbaceous or woody perennials; most materials selectively harvested from living plants; usually harvested by season, life cycle stage;
MEDICINES	Bark tissues (Total ~50-60)	*Abies lasiocarpa* (subalpine fir: coughs, tuberculosis, many ailments); *Cornus sericea* (red-osier dogwood: poultice; coughs); *Oplopanax horridus* (devil's-club: diabetes, stomach problems); *Populus balsamifera* (cottonwood: tonic); *Rhamnus purshiana* (cascara: laxative)	barks usually removed from whole twigs or as portions from trunk; trees not girdled; harvested selectively from a number of individual plants;
MEDICINES	Pitch, resin, latex (Total 35)	*Abies lasiocarpa* (subalpine fir: sores); *Pinus contorta* (lodgepole pine: salve; colds); *Pseudotsuga menziesii* (Douglas-fir: salve; colds)	pitch removed from injured or insect-damaged trees, or from bark blisters;

Category	Use and Approx. No. of Species	Examples Species (Common Name)	Management Notes
MEDICINES	"Roots" (Total: ~100-125)	*Balsamorhiza sagittata* (balsamroot: sores); *Heuchera cylindrica* (alumroot: sores); *Ligusticum canbyi* (Canby's lovage: colds, sores); *Valeriana sitchensis* (mountain valerian: colds); *Veratrum viride* (false hellebore: arthritis: TOXIC)	virtually all are herbaceous perennials; roots selectively harvested by size, life-cycle stage; fragments left behind often capable of regeneration; *Ligusticum* said to be enhanced by burning, and tops replanted;
MEDICINES	Leaves and/or shoots (Total ~75)	*Chimaphila umbellata* (pipsissewa: childbirth); *Equisetum hiemale* (scouring rush: childbirth; eye medicine); *Urtica dioica* (stinging nettle: leafy shoots for arthritis)	herbaceous or woody perennials; leaves/shoots harvested selectively from living plants, which can then regenerate;
MEDICINES	Flowers, fruits (Total ~35-40)	*Achillea millefolium* (yarrow flowers: kidney, toothache; leaves, roots also used); *Shepherdia canadensis* (soapberries: indigestion, ulcers); *Symphoricarpos albus* (waxberry: eye medicine)	herbaceous or woody perennials; flowers/fruits harvested from living plants, by season, life cycle stage;
MEDICINES	Miscellaneous, or unspecified, incl. fungi (Total ~30-35)	*Lycoperdon perlatum* (puffball: spores as poultice for burns, sores)	gathered sporadically or incidentally

[1] Note that these numbers are only approximations, based on the summaries calculated for Nlaka'pamux (Thompson) herbal medicines, and the number and types of attested Secwepemc preparations (Turner et al. forthcoming). They are based not on species per se, but on the numbers of particular medicinal preparations used in treating specific illnesses or conditions (see Turner et al. 1990:43–54). The examples provided are generally of species and medicines widely used by all Plateau peoples.

Chapter 6. Nutrients in Selected Secwepemc Traditional Food Species

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Abstract

This chapter focuses on the nutritional contributions of Secwepemc food plants as a significant part of the food system that has maintained the health of Secwepemc people for countless generations. Secwepemc food plants include indigenous root vegetables, greens, fruits, nuts and seeds, inner bark and other parts of trees, mushrooms and various species used as sources of flavouring, chewing gum, and teas. Sixteen culturally important plant foods were analysed for nutrients, including three—prickly pear cactus (Opuntia fragilis), highbush cranberry (Viburnum opulus), and beaked hazelnut (Corylus cornuta)—previously lacking comprehensive nutrient data. Standard collection and analysis methods were used to determine proximate composition, energy values and nutritional minerals, as described in the paper. Energy values were highest for hazelnut, followed by dried root vegetables (nodding onion, balsamroot, glacier lily bulbs). Black tree lichen (Bryoria fremontii) was high in energy and dietary fibre. Hazelnuts were also highest in protein and fat. Several food species contained significant amounts of dietary minerals. Plant food resources remain as valuable components of the Secwepemc food system, and will help support health and food security into the future.

Keywords: *Secwepemc, ethnobotany, Indigenous diet, nutrients, nutrient analysis*

Introduction

This research was initiated as a subproject within the Secwepemc Ethnobotany Project, which was conducted as an interdisciplinary collaborative project funded by the Social Sciences and Humanities Research Council of Canada. The overall research had the goal of documenting the wealth of botanical knowledge of the Secwepemc (Shuswap) Interior Salish peoples of British Columbia. Thus, it became relevant to understand the nutrient contributions of the food plants of the culture; this knowledge in turn can stimulate interest in the contributions of traditional plants for the health of people using them.

It is generally recognized that traditional diets of Indigenous Peoples derived from the local, natural environment, and that have maintained a population for a long period of time, can be considered as sufficiently complete in nutritional aspects for growth, development and reproduction. These diets are also recognized for the many cultural contributions they make to community life. Documenting traditional food has been recognized as an important aspect of cultural recognition, promoting both health and community pride (Kuhnlein 1992, 2001; Kuhnlein and Receveur 1996; Kuhnlein et al. 2009; Nuxalk Food and Nutrition Program 1984; Wirsing 1985; Wong 2003).

For the Secwepemc, a wide variety of traditional plant food types are known, including underground plant parts (roots, rhizomes, bulbs, corms), green vegetables (leaves, stalks, and shoots), fruits (including several kinds of berries), nuts and seeds, tree parts (cambium, sap, cones, buds), fungi, lichen, tea items (gum, bark, leaves, berries, etc.), flavourings and sweeteners (berries, leaves, etc.), and substances for chewing (tree gum and pitch). Animal food items include fish (salmon, suckers, etc.), hoofed mammals (deer, moose, mountain sheep, elk, caribou), other mammals (beaver, porcupines, hare, marmot, bear), birds (various ducks and grouse, Canada goose, coot, and ptarmigan), some birds' eggs, and some invertebrates, such as freshwater mussel. Details of the use of these species have been presented in a number of sources (e.g., Hunn et al. 1998; Kuhnlein and Turner 1991; Laforet et al. 1993; Palmer 1975; Teit 1909; Turner 1991, 1997; Turner and Chambers 2006).

Nutrient composition analysis of the many food species used by the Secwepemc has not been systematically completed. References for several of the plant foods harvested from various regions are presented in Kuhnlein and Turner (1991); nutrient data on fish and animal wildlife food species are available in national North American food composition tables (Health Canada 2010; USDA 1987; USDA 1989) and in analyses for the same species used by the Secwepemc, but harvested from other regions (e.g., Kuhnlein et al. 1994).

In this research, sixteen traditional plant food species (bulbs, taproots, berries, lichen, fruit, and leaves) known to be important components of the Secwepemc diet were collected and analyzed. The selection of plants to be analyzed was determined from knowledge of those known to be important as energy resources in the period before European contact [most notably the root foods: nodding onion (*Allium cernuum*), balsamroot (*Balsamorhiza sagittata*), spring beauty (*Claytonia lanceolata*), tiger lily (*Lilium columbianum*), desert parsley (*Lomatium macrocarpum*), and yellow glacier lily (*Erythronium grandiflorum*)]. We also concentrated on foods, including most of these root vegetables but also black tree lichen (*Bryoria fremontii*), known to have been harvested and dried in significant quantities. We also included those species for which there were no previous comprehensive nutrient data [e.g., prickly pear cactus (*Opuntia fragilis*), highbush cranberry (*Viburnum opulus*), and beaked hazelnut (*Corylus cornuta*)]. All of the species selected are culturally important for the Secwepemc people.

Components determined were protein, crude fat, moisture, ash, and total dietary fibre to determine digestible carbohydrate and estimated energy. In addition, four mineral nutrients determined were calcium, copper, iron, and zinc.

Methods

Traditional plant food harvesting areas were identified through interviews with Elders and literature records, and samples were taken during the usual season of harvest. When possible, food items that were traditionally preserved and prepared by drying and/or pit-cooking were also prepared as such, so that in all, 31 samples of 16 species were selected for analysis. Latin and common names, mode of preparation (if any), part sampled, and number of independent composite samples are given in Tables 1 and 2.

Approximately 500 g of each sample were collected, processed, and frozen within a short period of time, and data sheets were completed for each, stating harvest location, date, stage of plant growth, part sampled, preparation method (if any), and number of the identification photograph. For all the food items reported here, this quantity represented the edible portion of dozens of individual plant parts from several separate plants; thus each 500 g sample can be recognized as a large composite sample from the harvested region. Harvesting implements were either of plastic or stainless steel. Soil was completely removed from the samples by using local, unchlorinated water or distilled water. The samples were completely dried to remove washing water, then stored in clean plastic containers with identification labels. The samples were frozen at −20 degrees C, and shipped to the laboratory on dry ice, where they were subsequently stored frozen until analysis.

For the dried balsamroot (*Balsamorhiza sagittata*) and nodding onion (*Allium cernuum*) samples, the cleaned taproots and bulbs/leaves respectively were hung to dry for approximately two months before analysis. The cleaned glacier lily (*Erythronium grandiflorum*) bulbs were dried for approximately two weeks, soaked in distilled water for 5.5 hours, and then pit-cooked for 20 hours in the traditional manner (for details, see Loewen et al., Chapter 7, this volume). The raw prickly pear cactus (*Opuntia fragilis*) pads were singed to remove the spines before being pit-cooked along with the glacier lily bulbs. The bulbs and pads were placed on ice for a few hours before being placed in a cooler with dry ice and shipped to the laboratory.

Protein, crude fat, moisture, ash, and four nutritional minerals (calcium, copper, iron, and zinc) were determined with AOAC standardized techniques (AOAC 1984) according to the flow diagram sequence of analysis in Figure 1. Minerals were determined with atomic absorption spectrophotometry. Carbohydrate was determined by difference [weight of sample − (% protein + % fat + % moisture + % ash)]. Total dietary fibre (nondigestible carbohydrate) was determined with the sequence of techniques shown in Figure 2 and subtracted from the carbohydrate value to determine digestible carbohydrate. Following this, energy was determined using Atwater factors from values for protein, fat, and digestible carbohydrate (Watt and Merrill 1963). Kcal were converted to kj using the conversion factor x 4.168.

Results and Discussion

The results for proximate composition (protein, fat, carbohydrate, moisture, ash) and calculated energy values (kilocalories and kilojoules) per 100 g original weight of sample are given in Table 1; and for nutritional minerals in Table 2. Of the food samples analyzed, energy values were highest for beaked hazelnut (*Corylus cornuta*) at 331 kcal/100 g, followed by the root samples, with the dried samples having expected higher values than the fresh samples. Dried nodding onions (*Allium cernuum*) contained 131 kcal/100 g in contrast to the fresh sample at 61 kcal/100 g, and dried balsamroot (*Balsamorhiza sagittata*) contained 273 kcal/100 g in contrast to the fresh sample at

Table 1. Proximate composition and energy values per 100 g Secwepemc plant food[a].

Latin name/ (Preparation, if any)	Common name	Part	N	Moisture (g)	Protein (g)	Ash (g)	Crude Fat (g)	CHO[b] (g)	TDF[c] (g)	Calculated Energy kcal	Calculated Energy kj
Allium cernuum	Nodding onion	bulbs	3	70 (2.6)	2 (0.9)	0.6 (0.20)	1.2 (0.16)	26 (3.6)	9 (3.0)	86	359
A. cernuum	Nodding onion	bulbs/leaves	4	77 (4.9)	2 (0.8)	0.8 (0.03)	1.1 (0.13)	19 (5.7)	8 (2.5)	61	255
A. cernuum (dried)	Nodding onion	bulbs/leaves	1	53	5.6	1.5	2.9	37	16	131	548
Amelanchier alnifolia	Saskatoon	berries	4	75 (3.5)	1 (0.2)	0.8 (.08)	1 (0.5)	22 (3.7)	6 (1.3)	78	326
Balsamorhiza sagittata	Balsamroot	taproots	3	66 (1.8)	1.2 (0.60)	1.5 (0.28)	1.6 (0.36)	30 (2.4)	13 (2.4)	88	368
B. sagittata (dried)	Balsamroot	taproots	1	8.4	3.5	3.2	5.2	80.0	27	273	1141
Bryoria fremontii (naturally dry)	Black tree lichen	entire lichen	1	9.0	4.2	0.8	7.4	79	61	154	644
Claytonia lanceolata	Spring beauty	corms	2	82 (3.7)	1 (0.3)	0.7 (0.1)	1 (0.2)	15 (3.1)	4 (0.8)	57	238
Cornus stolonifera	Red osier dogwood	fruit	1	74	1.3	0.9	9.9	14	13	95	397
Corylus cornuta	Beaked hazelnut	nuts	1	51	11	1.6	28	8.7	-	331	1384
Erythronium grandiflorum (dried, pit-cooked)	Yellow glacier lily	bulbs	1	46	1.7	0.6	1.6	50	3.8	207	865
Lilium columbianum	Tiger lily	bulbs	1	74	0.7	0.7	1.0	24	4.2	91	380
Lomatium macrocarpum	Desert parsley	leaves	1	75	5.7	2.8	3.0	14	9.2	68	284
L. macrocarpum	Desert parsley	taproots	1	71	0.9	1.3	2.9	24	11	84	351
Opuntia fragilis (pit-cooked)	Prickly pear cactus	cactus pads	1	82	1.2	1.9	0.8	14	8.5	35	146
Prunus pensylvanica	Pin cherry	berries	1	81	0.4	0.7	0.3	18	6.0	51	213
Prunus virginiana	Chokecherry	berries	1	71	0.4	0.7	4.5	23	1.5	129	539
Shepherdia canadensis	Soapberry	berries	1	79	1.2	0.4	1.5	18	2.4	82	343
Vaccinium membranaceum	Huckleberry	berries	1	86	0.5	0.2	1.2	12	1.5	55	230
Viburnum opulus	Highbush cranberry	fruit	1	86	0.6	0.4	5.6	7.8	6	60	251

[a] Standard deviation reported in parentheses when > 1 sample analyzed.
[b] Total carbohydrate by difference [weight of sample – (% moisture + % protein + % ash + % crude fat)].
[c] Total Dietary Fibre.

Table 2. Mineral nutrients in Secwepemc plant foods.

				mg/100 g wet weight*			
***Latin name*/(Preparation, if any)**	**Common name**	**Part**	**N**	**Calcium**	**Copper**	**Iron**	**Zinc**
Allium cernuum	Nodding onion	bulbs	3	70 (24.4)	0.1 (0.01)	0.5 (0.20)	0.6 (0.16)
A. cernuum	Nodding onion	bulbs/leaves	4	80 (14.9)	0.1 (0.01)	0.5 (0.14)	0.5 (0.27)
A. cernuum (dried)	Nodding onion	bulbs/leaves	1	101	0.19	0.7	1.0
Amelanchier alnifolia	Saskatoon	berries	4	70 (7.9)	0.2 (0.03)	2 (3.1)	0.4 (0.05)
Balsamorhiza sagittata	Balsamroot	taproots	3	160 (63.8)	0.12 (0.01)	1 (0.6)	0.1 (0.09)
B. sagittata (dried)	Balsamroot	taproots	1	290	0.49	2.0	0.8
Bryoria fremontii (naturally dry)	Black tree lichen	entire lichen	1	122	0.26	10	2.1
Claytonia lanceolata	Spring beauty	corms	2	16 (4.1)	0.1 (0.03)	2 (0.2)	0.9 (0.08)
Cornus stolonifera	Red osier dogwood	fruit	1	140	0.20	0.7	0.03
Corylus cornuta	Beaked hazelnut	nuts	1	142	0.54	1.7	1.7
Erythronium grandiflorum (dried, pit-cooked)	Yellow glacier lily	bulbs	1	23	0.13	0.8	0.9
Lilium columbianum	Tiger lily	bulbs	1	6.5	0.11	0.3	0.5
Lomatium macrocarpum	Desert parsley	leaves	1	205	0.21	11.1	1.1
L. macrocarpum	Desert parsley	taproots	1	226	0.19	4.6	0.8
Opuntia fragilis (pit-cooked)	Prickly pear cactus	cactus pads	1	465	0.07	2.3	0.3
Prunus pensylvanica	Pin cherry	berries	1	27	0.08	0.8	0.05
Prunus virginiana	Chokecherry	berries	1	25	0.12	0.5	nd
Shepherdia canadensis	Soapberry	berries	1	18	0.1	0.6	0.05
Vaccinium membranaceum	Huckleberry	berries	1	14	0.09	0.5	0.04
Viburnum opulus	Highbush cranberry	fruit	1	44	0.08	0.4	nd

nd = not detectable.
* Standard deviation reported in parentheses when > 1 sample analyzed.

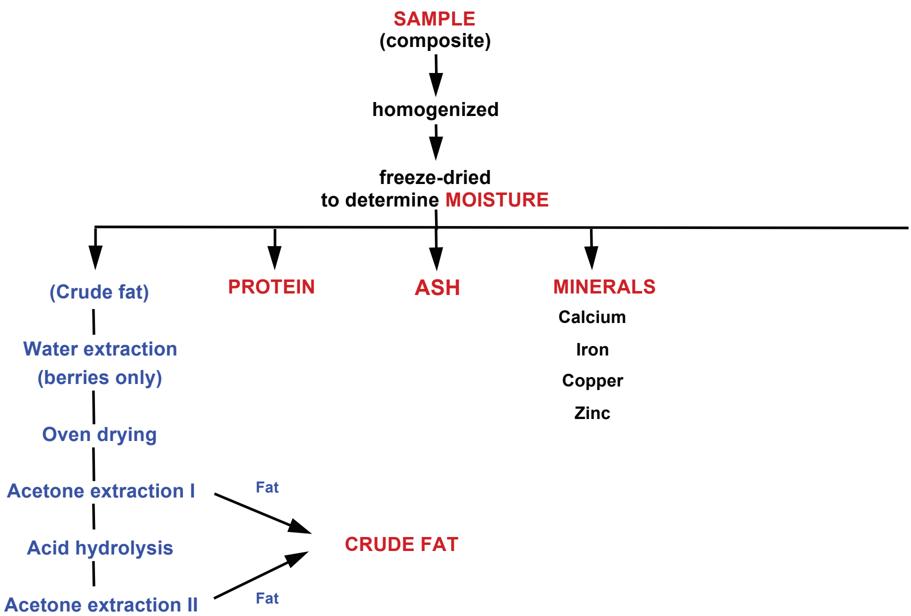

Figure 1. Flow diagram illustrating the sequence of analyses for nutrient and mineral composition.

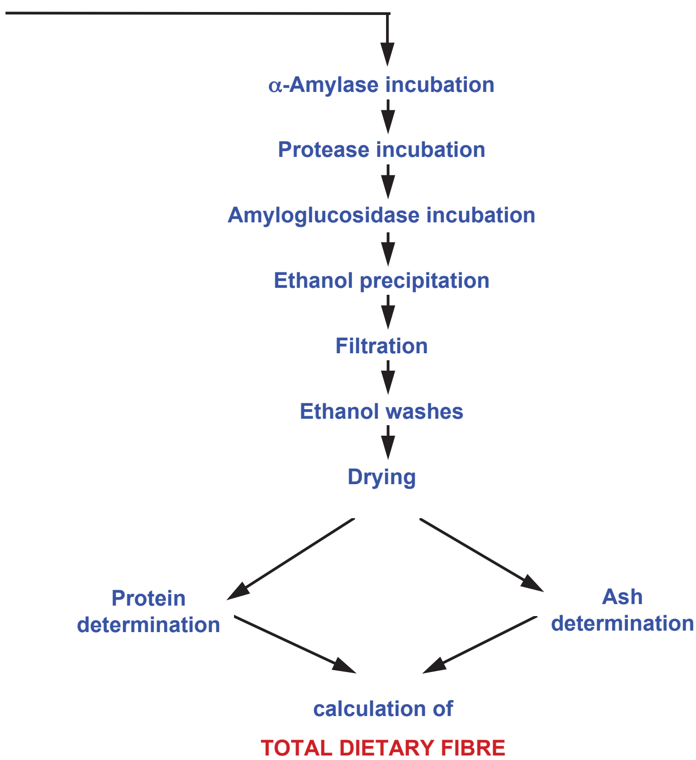

Figure 2. Sequence of events in the determination of total dietary fibre.

88 kcal/100 g. Dried, pit-cooked yellow glacier lily bulbs (*Erythronium grandiflorum*) also had energy values exceeding 200 kcal/100 g. The other two species of food reasonably high in energy were chokecherries (*Prunus virginiana*) (129 kcal/100 g) (Figure 3) and black tree lichen (*Bryoria fremontii*) (154 kcal/100 g). [Note: The usual, assumed species of edible black tree lichen is *Bryoria fremontii* (see Crawford, Chapter 8, this volume). Our sample on which the analyses were based, selected as "the edible type" by several knowledgeable Secwepemc people, was identified by lichenologist Sylvia Sharnoff as *B. tortuosa*, but further analysis by Crawford suggests it can be classed with *B. fremontii*.] For comparison, one can consider that baked potato contains approximately 70 kcal/100 g; commercially packaged blueberries approximately 65 kcal/100 g; and peanuts approximately 216 kcal/100 g (Health Canada 2010).

It can be seen that total dietary fibre (TDF) was highest in the lichen (61 g/100 g), taproots (11–27 g/100 g) and dried nodding onion (16 g/100 g). For comparison, 100 g of uncooked whole grain oats contains 13.3 g of dietary fibre (Health Canada 2010). Protein, fat, and digestible carbohydrate can all contribute variably to energy values. Of these samples, the highest protein values (exceeding 5%) were seen in the hazelnuts, dried nodding onion, and desert parsley leaves; highest fat values were found, as expected, in the hazelnuts (28%). In the traditional food system it is expected that animal and fish food would have contributed the majority of the protein and fat to the daily diet. However, these root samples and berries would have been major contributors to digestible carbohydrate and dietary fibre.

As an emergency food, dried black tree lichen has a reasonable amount of protein, fat, and digestible carbohydrate (but see Crawford, Chapter 8, this volume). Contents of minerals were

Figure 3. Chokecherries (*Prunus virginiana*) (black colour form). Photo by Nancy J. Turner.

also important, with calcium at 122 mg/100 g, iron at 10 mg/100 g, copper at 0.26 mg/100 g, and zinc at 2.1 mg/100 g. However, the TDF is high, and the lichen would have contained too much dietary bulk to be a good food source for young children, in the absence of more nutrient dense foods (Otten et al. 2006), or as a sustained primary source of nutrients for adults. To our knowledge, this is the first report of the nutrient content of this important emergency food source used by Indigenous Peoples in Western North America.

Several of these food species would have contributed important amounts of daily dietary minerals if consumed in quantities of 100 g or more. Good sources of dietary calcium (exceeding 200 mg/100 g) were balsamroot taproots, desert parsley taproots and leaves, and prickly pear cactus pads. Good sources of dietary copper (exceeding 0.3 mg/100 g) were balsamroot taproots and hazelnuts; of iron (exceeding 1.0 mg/100 g) were saskatoon berries, balsamroot taproots, black tree lichen, spring beauty corms, and desert parsley leaves and taproots; for zinc (exceeding 1.0 mg/100 g) were nodding onion, black tree lichen, hazelnuts, and desert parsley leaves. Several of these values in the Secwepemc food species are reported here for the first time.

It must be considered that while these food items may be rich in one or more mineral elements, the bioavailability of the minerals in human nutrition is not known, and would not be easily determined. Many plant compounds (e.g., phytates, lignins, tannins) can interfere with the digestion and absorption of minerals. Nevertheless, it is standard practice to consider the determined quantity of minerals in plants as the important nutritional factors. Animal food such as fish and game would have been more important sources of iron, zinc, and copper. It is more difficult to define the major sources of calcium in the precontact diet, although food derived from mammal or fish bone and fish skin are expected to be the best sources, followed by green plants (Health Canada 2010). Composite samples were made from the fruits, roots, or other parts of many plants to compile a ≥ 500 g. sample. With multiple composite sample analyses (≥ 1) for the same nutrient of the same food, standard deviation from the mean were derived, as is current practice in food composition studies (Greenfield 2011; Kuhnlein 1989). The difficulties in finding and harvesting multiple 500 g composite samples, and the costs of laboratory analysis, made additional sampling problematic.

While it is desirable to determine nutrients in food samples of portions cooked or otherwise prepared for consumption to obtain values useful for analysis of probable dietary intakes of individuals or groups, values in raw samples are also useful. Raw food values are used when the food is consumed raw, and also for comparison to the same food that is cooked, when such samples become available for analysis. Black tree lichen is a unique food that is dry in its natural state, and which is normally soaked and pounded to remove bitter compounds, then pit-cooked (Crawford, Chapter 8, this volume; Kuhnlein and Turner 1991). Tiger lily bulbs have also been normally consumed cooked in various ways (Kuhnlein and Turner 1991); balsamroot was generally pit-cooked (Peacock 1998).

Two of our samples were pit-cooked using traditional methods based on instructions from Secwepemc Elders, particularly Mary Thomas. It is usually the case that food preparation decreases nutrient content from that found in the raw state of a food sample, unless the food is fortified with nutrients in some way, or if the preparation technique involves the removal of moisture which results in a concentration of the nutrients (i.e., as in dehydration). However, cooking, as well as drying (see Loewen et al., Chapter 7, this volume) may also change the food in positive ways, such as breaking down less digestible, complex carbohydrates into simpler, more digestible and palatable compounds, as well as perhaps eliminating or reducing some toxic compounds (Johns 1990). Such increases in digestibility and/or palatability have been shown to occur when drying and/or pit-cooking both yellow glacier lily and balsamroot (Loewen et al., Chapter 7, this volume; Mullin et al. 1997; Peacock 1998), as well as numerous other species (Wandsnider 1997).

Conclusions

Several plant food species known to be important to the traditional diet of the Secwepemc (Shuswap) people were harvested and prepared for analysis of proximate composition and energy, and four nutritional minerals. A number of values for nutrients in these plant species are reported for the first time, and demonstrate that traditional plant food resources of the Secwepemc are valuable for human nutrition.

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Chapter 7. Yellow Glacier Lily (*Erythronium grandiflorum*): An Important Root Vegetable for the Secwepemc and Neighbouring Peoples of the Northwest Interior Plateau

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Abstract

Yellow glacier lily, or **scwicw** *(Erythronium grandiflorum Pursh; Liliaceae), produces elongated, "bear tooth" like edible bulbs that have been an important root vegetable for Secwepemc and other Interior Plateau peoples for countless generations. This chapter presents botanical, ecological and ethnobotanical research on this species. Highly adaptable,* **scwicw** *is found at relatively low elevations but most common in upper-elevation meadows throughout much of the territory. It was formerly harvested in large quantities, usually by women, using digging sticks. The plants were actively managed. Harvesters removed the small appendages on the bulbs and replanted them, a practice experimentally demonstrated to successfully produce new plants. Landscape burning also enhances growth, and the plants respond well to moderate disturbance such as digging and tilling. The usual harvesting time is after flowering, when the leaves are starting to die back. Only the largest bulbs were harvested and were generally processed by drying and later pit-cooking. Analyses show that pit-cooked yellow glacier lily bulbs are nutritionally comparable to peeled baked potato and baked sweet potato, containing mostly starch, but with the carbohydrate profile changing dramatically over the growing season and with preparation. The plants are vulnerable to impacts such as introduced species and overgrazing, and seldom grow to the size they did in the past, but scwicw has good potential for restoration through following traditional management practices.*

Keywords: *Secwepemc, Interior Plateau, yellow glacier lily, nutrition, ethnoecology*

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§ Dr. Mary Thomas, formerly of Neskonlith First Nation, Salmon Arm, BC, passed away in the summer of 2007. She was a major consultant in Dawn Loewen's thesis research on which this chapter is largely based. She is co-author of this paper and two others in this special issue, in recognition of her major contribution.

Introduction

Yellow glacier lily (*Erythronium grandiflorum* Pursh; ***scwicw***), also known as yellow avalanche lily, snow lily, dogtooth violet, kamara root, yellow Easter lily, bear's tooth and Indian potato, is an herbaceous perennial in the lily family (Liliaceae). The elongated bulb of this plant was for some thousands of years, and still is in some areas, an important "root" vegetable among Indigenous Peoples of the Fraser and Columbia Plateau region of northwestern North America. Formerly, the bulbs were harvested in large quantities, up to 90 kg or more per family group per year in the Secwepemc region. As well, the plant was actively tended and managed by the people who used it.

Although this species is widespread and common in upland areas of the Northern Plateau, its ecology has been little studied until recently (Loewen 1998; Loewen et al. 2001). The ecology and ethnobotany of a species are topics that can be pursued fruitfully on their own, but they are also interrelated. Ecological—and, in this case, nutritional—characteristics determine whether a species will become highly significant culturally, but human use and management of a species can in turn influence its ecology. The more common and useful a species is for a group of people, the more significant the ethnobotanical/ethnoecological interactions become.

This paper, originally part of Dawn Loewen's M.Sc. thesis (Loewen 1998), is based on a multidisciplinary research project. It combines experimental ethnobotany with traditional resource ecology, braiding together a diverse assemblage of perspectives on nutrition and the food-medicine continuum as they apply meaningfully to people-plant relationships. We first review aspects of the biology and ecology of this widespread and culturally significant species (Part 1), and then describe its ethnobotany (Part 2), nutritional characteristics (Part 3), and ethnoecology (Part 4). New information based on field research, interviews with Aboriginal elders and carbohydrate analyses is integrated to provide a more complete understanding of this wild geophyte's production system.

Part 1: Botany and Ecology

Distribution and Habitat Requirements

The genus *Erythronium* includes some 24–30 species distributed in the northern temperate regions of North America, Europe, and Asia (Mathew 1992). Most of these species (about 18) are found in North America west of the Rocky Mountains.

Yellow glacier lily *(E. grandiflorum)* inhabits by far the largest range and most diverse habitats of any North American member of the genus (Figure 1). The species is common in the southern half of British Columbia and in southwestern Alberta, and it is the only *Erythronium* species east of the Coast Ranges in BC. Its range follows the Coast/Cascade Mountains and the Rocky Mountains south as far as northern California and New Mexico, but it is apparently absent from the Sierra Nevada and the Great Basin. Yellow glacier lily grows at elevations from 300 m in the Columbia Gorge (Dr. Geraldine Allen, pers. comm. to DL 1998) to 3,700 m in the Rocky Mountains (Fritz-Sheridan 1988). The plant grows in grasslands, deciduous and some coniferous forests,

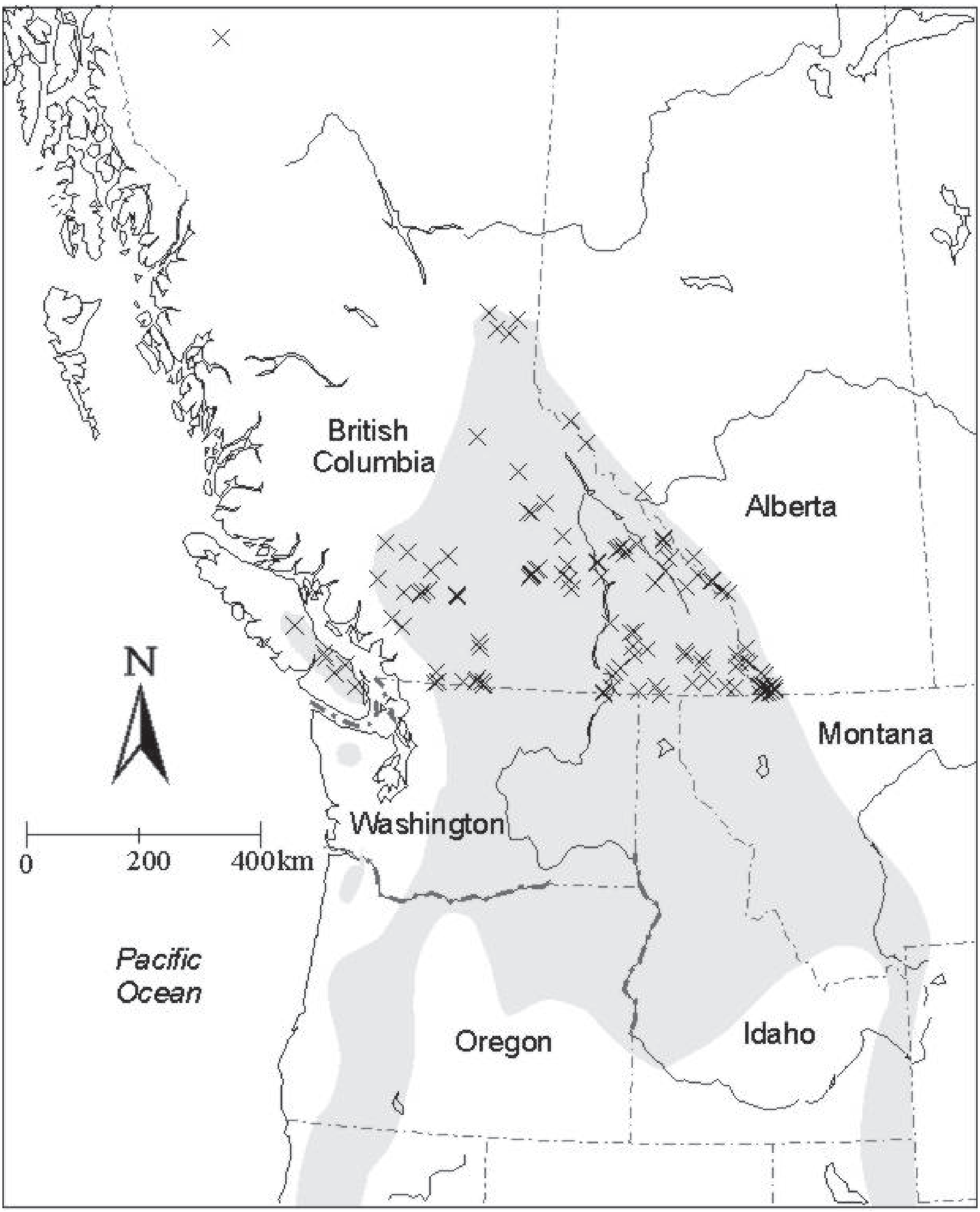

Figure 1. Distribution of yellow glacier lily (*Erythronium grandiflorum*) in northwestern North America. Sites marked in Canadian range indicate herbarium specimens; the site shown in the far northwest corner of British Columbia may be erroneous. United States range is adapted from Fritz-Sheridan (1988).

serpentine barrens, and subalpine meadows (Fritz-Sheridan 1988; Kuijt 1982; Rigney 1995; Williams 1990; herbarium records from CAN, V, UBC, and UVIC).

Loewen's (1998) research included an investigation of the habitat requirements of yellow glacier lily (see also Loewen et al. 2001). *E. grandiflorum* was surveyed in a variety of sites in BC and Alberta, including open meadows or pastures around 500 m elevation; subalpine meadows over 2,000 m; and, at intermediate elevations, avalanche chutes and forested or semi-forested sites dominated by Douglas-fir *(Pseudotsuga menziesii),* Engelmann spruce *(Picea engelmannii),* lodgepole pine *(Pinus contorta),* or trembling aspen *(Populus tremuloides)*. All growth stages of yellow glacier lily were more abundant in open areas or areas with deciduous tree cover than in areas with coniferous tree cover. In the meadow habitats, flowering plants were more abundant and robust at low elevations, but seedlings and juveniles were disproportionately represented at high elevations.

Although low-elevation meadows may represent the most favourable growing conditions for mature yellow glacier lilies, the relatively high cover of shrubs, grasses (many now introduced), and litter may inhibit their seed germination and juvenile survival, at least in comparison with upper-elevation meadows. Subalpine meadows represent the most common habitat for yellow glacier lily in western Canada, apparently because the particular combination of abundant early-season light and moisture required by the species is relatively rare at low and medium elevations, given current climates and plant associations.

A successful transplant experiment carried out by Loewen (1998) suggested that individual yellow glacier lily plants can readily adapt to very different ecological conditions. Bulbs moved from a subalpine meadow to a garden setting 1,500 m lower in elevation were immediately able to adjust their time of emergence to two months earlier the following spring. These plants were still growing and flowering five years later. This adaptability has implications for possible human dispersal of the plant (see Part 4).

In spite of the wide range and diverse habitats of the species, *E. grandiflorum* has only two currently recognized varieties: var. *grandiflorum*, which spans the range of the species (and which is the taxon referred to throughout this paper), and var. *nudipetalum*, endemic to a small area of Idaho. Variation in the colour of the anthers, from lemon yellow to a striking deep crimson, is now believed to be of minor, if any, importance in distinguishing subspecies or varieties (Cronquist et al. 1977; Hitchcock et al. 1969; Shevock et al. 1990).

Plant Description

A typical mature yellow glacier lily is shown in Figure 2. Adult plants are 15 to 30 cm in height and normally bear a pair of basal leaves (rarely a reduced third leaf). The leaves are bright green, unmottled, hairless, and broadly lance-shaped. Above ground level, the stem is leafless and bears one to six or even up to 14 (most commonly one or two) nodding, yellow, nectar-bearing flowers.

After pollination, mainly by bumblebees (Fritz-Sheridan 1988; Pojar 1974; Thomson and Stratton 1985), the stem becomes erect and the flowers give way to cylindrical club-shaped capsules 3 to 6 cm long. When a capsule matures, it turns brown and dry and splits into three parts to release 20 to 60 greenish to reddish-brown seeds (Fritz-Sheridan 1988; Weiblen and Thomson 1995). Interestingly, for such a wide-ranging species, the seeds have no obvious dispersal mechanisms; more than 95% of seeds fall within 0.9 m of the parent plant (Weiblen and Thomson 1995). Fritz-Sheridan (1988) notes that animals and/or people may have influenced dispersal of the plant.

Figure 2. A mature yellow glacier lily (*Erythronium grandiflorum*). The white-flowered plant at left is spring beauty (*Claytonia lanceolata*), a common co-occurring species in yellow glacier lily habitats. Photo by Dawn C. Loewen.

Yellow glacier lily is a spring ephemeral. It emerges soon after or even during snowmelt, with flowers forming as early as late March in the Columbia Gorge. Blooms may, however, appear as late as September at very high elevations or beside late-lying snow patches. In warm weather, flowers may wither within a week of opening (Fritz-Sheridan 1988), and leaves usually wither within about two months after emergence, after which the fruits mature and begin to release the ripe seeds (Fritz-Sheridan 1988; Rigney 1995; pers. observation by DL 1996 and 1997).

No data are available on the time from seed germination to reproductive maturity in yellow glacier lily, but in related species it may take 3 to 10 years (Kawano et al. 1982; Watson and Woodward 1974). Between the distinctive linear seed leaf of the first year and the double-leaved flowering plants are an unknown and probably variable number of single- or double-leaved juvenile stages. After some critical bulb mass is attained, a flowering individual can develop. However, plants may not flower every year upon reaching the critical size. A mature plant may revert to a non-flowering, single- or double-leaved plant as a result of a draining previous season with high seed production (cf. Kawano et al. 1982), or as a result of poor growing conditions in the previous or current year.

Yellow glacier lily is a geophytic plant with an underground storage organ in the form of an elongated, "dogtooth"-shaped bulb, sometimes referred to as a "bear tooth" (Figure 3). The bulb usually grows 10 to 20 cm under the soil surface, but it can grow in almost no substrate in rocky habitats. Often mistakenly termed a corm, the unusual bulb has only a few fleshy, nearly fused scales, so that the typical layered bulb structure is not obvious. Remnants of previous years' bulbs commonly persist, forming a chain of small "bulb-appendages," as they have been termed for *E. japonicum* (Kawano et al. 1982; Ogura 1952). Secwepemc elder Mary Thomas called these structures "whiskers," and noted that her mother and grandmother would routinely remove and re-plant them when they were digging ***scwicw***.

Loewen (1998) carried out an experiment to determine whether the bulb-appendages can indeed act as vegetative propagules in *E. grandiflorum*. Appendages separated by hand from the

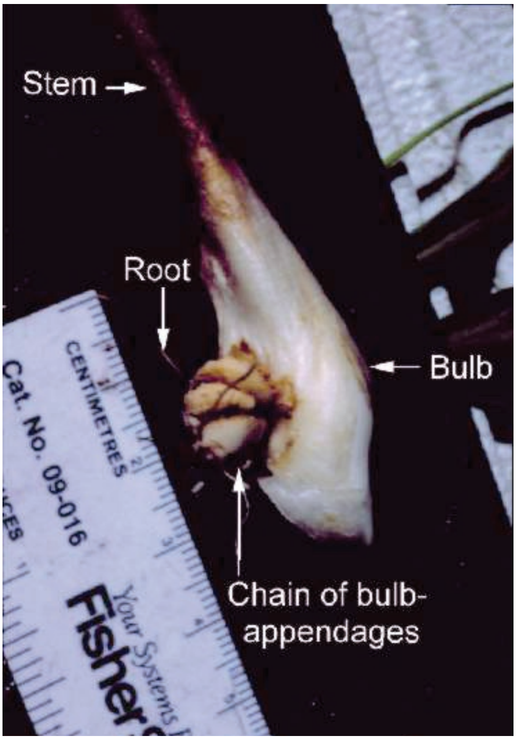

Figure 3. Bulb of yellow glacier lily, showing bulb-appendages. Photo by Dawn C. Loewen.

Figure 4. One- and two-leaved yellow glacier lily plants growing from bulb-appendages, one year after the appendages were removed from bulbs and replanted. Photo by Dawn C. Loewen.

bulbs and from each other were replanted both within the same subalpine meadow and in a garden 1,500 m lower in elevation. About one-third of the sets of appendages sprouted new juvenile plants the following year (see Figure 4), and this number jumped to about 80 percent two years later in the garden site (the only one revisited that year). These garden plants continued to thrive, many flowering five years later. Therefore, the appendages can act as propagules if mechanically separated from the main bulb. The extent of this process without such intervention remains unknown.

Ecological Interactions

In addition to pollinators, many animal species use various parts of yellow glacier lily plants. Seed predators include sawfly larvae (Loewen 1998). Herbivores that eat the leaves and immature seedpods include deer (Clark 1973; Keay 1977), Vancouver Island marmots (Dr. Andrew Bryant, pers. comm. to DL 1996), and possibly hoary marmots and porcupines (Loewen 1998). Domestic livestock such as sheep and cattle also graze the foliage (Williams 1990) and probably young seedpods.

A variety of small mammals consume the bulbs of yellow glacier lily, including marmots, voles, ground squirrels, and pocket gophers (Aldous 1951; Ludwig 1984; Martin et al. 1951). Thomson et al. (1996) suggested that pocket gopher predation exerts a significant impact on the spatial structure of yellow glacier lily populations in subalpine meadows of Colorado.

In many areas, the bulbs are an important and preferred food for grizzly bears (Almack 1985; Hamer et al. 1991; Mace 1987; Martinka and Kendall 1985; Zager 1980). In fact, yellow glacier lily is considered an indicator of prime grizzly habitat in the mountain parks of Canada (Loewen 1998). It is sometimes asserted that black bears eat the bulbs as well (e.g., Clark 1973; Scotter and Flygare 1986); however, according to Herrero (1985), black bears rarely dig for their food. Grizzly bear interactions with yellow glacier lilies have ethnoecological implications that will be discussed further in Part 4.

Human uses and resource management are described in detail in the next part of this paper.

Part 2: Ethnobotany

Research Sources

Ethnobotanical information in this paper is drawn from historical records (cf. Boas 1890; Dawson 1891; Teit 1898, 1900, 1906, 1909, 1912a,b) and from more recent published (Alexander et al. 1985; Palmer 1975b; Turner 1992, 1997a; Turner et al. 1980, 1990) and unpublished (Turner et al. 1987) interviews with Indigenous elders of the Interior Plateau and neighbouring areas (see Acknowledgments). Interviews with Secwepemc elders during the Secwepemc Ethnobotany Project are cited as "SEP (1993–1997)."

Every attempt has been made to include ethnobotanical information for all groups known to have used yellow glacier lily, but most of the information is from Secwepemc and Nlaka'pamux sources. Although it is likely that these groups did indeed use the species most intensively, it is also true that ethnobotanical research with these groups has been relatively extensive. Therefore, the possibility of more widespread, but unrecorded, use cannot be ignored.

The Northern Plateau Peoples and Food Systems

Territories of the Northern Plateau peoples using *Erythronium grandiflorum* are shown in Figure 5. They represent three language families, but the majority are Interior Salish. Predecessors of these peoples inhabited south-central BC as early as 10,000 years ago (Rousseau 1993; Stryd and Rousseau 1996), with a basic subsistence–settlement pattern established for the Interior Salish at least 3,000 years ago (Pokotylo and Froese 1983). Cultural information about the Secwepemc and neighbouring groups, including their food systems and seasonal rounds for resource harvesting, is provided in Chapters 1 and 2 and elsewhere in this volume.

European contact brought fundamental changes to the Secwepemc food system (Thomas et al., Chapter 10, this volume; Turner 1992), including the use of yellow glacier lily. Many indigenous plant foods, particularly root vegetables, were abandoned in favour of domesticated potatoes (*Solanum tuberosum*), grains and flour-based foods. Traditional processing techniques such as pit-cooking were also largely abandoned, while new ones such as freezing, canning and jamming were acquired (Turner 1992). The dietary changes have contributed to a dramatic rise in Type 2 diabetes and other diseases in Aboriginal populations (Young 1993).

Yet, in spite of the changes wrought by enforced acculturation and the devastation of diseases past and present, much has also endured. Many people still value their indigenous foods and their cultural associations highly, and relish these foods when they can be obtained.

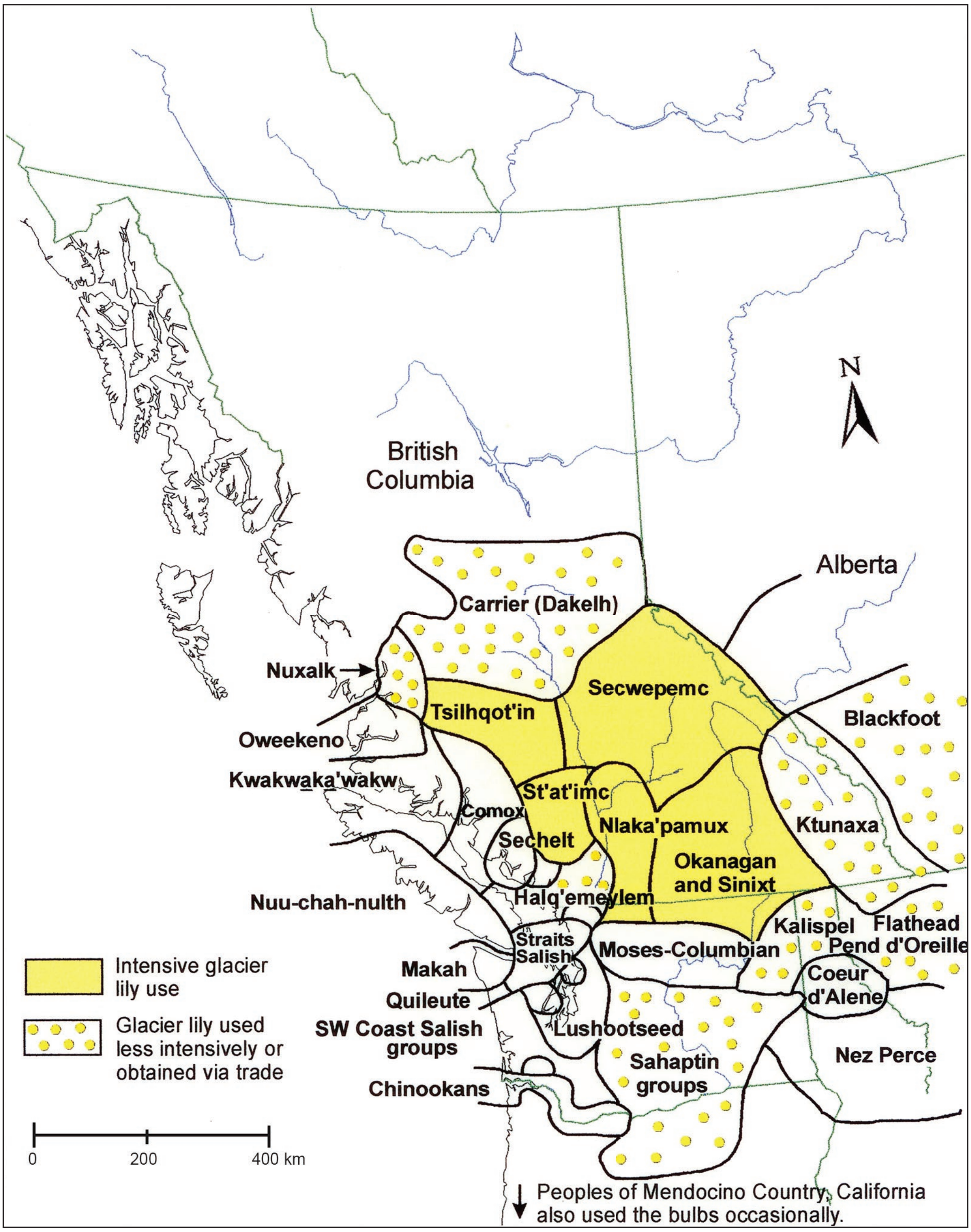

Figure 5. First Nations users of yellow glacier lily, with neighbouring groups. Boundaries are approximate and drawn without prejudice to any First Nations land claims in the area.

History and Extent of Food Use of Yellow Glacier Lily

No direct archaeological evidence currently exists for use of yellow glacier lily per se. Interior Salish cooking pits with charred remains of liliaceous species have been dated to more than 2000 years BP, and the oldest known cooking pits in south-central BC have been dated to 2500 BP (Peacock 1998; Pokotylo and Froese 1983). Use of the species may predate the oldest cooking pits, however, because people may have consumed the bulbs prepared in other ways (see section on processing). Pokotylo and Froese (1983) found that the oldest pits they surveyed were the largest, leading them to suggest that people once relied even more heavily on root vegetables than they did in more recent historical times. Therefore, it seems more than likely that intensive use of yellow glacier lily bulbs, at least among the Interior Salish, predates the ethnohistoric period (see also Peacock and Turner 2000). Further supporting this idea is the array of names for the species in Interior Salish and neighbouring languages.

Glacier lily bulbs were a staple root vegetable for the Interior Salish peoples (Secwepemc, Nlaka'pamux, St'at'imc, and Okanagan/Syilx) and were most intensively used by the Secwepemc and Nlaka'pamux (Turner 1997a). According to Secwepemc elder Aimee August (SEP 1993–1997), yellow glacier lily bulbs were the "most important root," followed by desert parsley (*Lomatium macrocarpum*), and then Indian potato (referring here to spring beauty, *Claytonia lanceolata*). Similarly, as paraphrased by Surtees (1974), Secwepemc elder Mary Thomas, her older sister Teresa Purdaby and their mother Christine Allen noted that "years ago, the Yellow Lily root was as much a part of our daily diet as potatoes are today. They were one of the very important winter foods." Nlaka'pamux elder Annie York declared yellow glacier lily the "boss of all the [edible] roots," because it was so valuable (Turner et al. 1990:122).

In contrast, although the Tsilhqot'in did apparently use glacier lily bulbs regularly, spring beauty corms were more abundant in their territory and were accordingly used more (Alexander et al. 1985; Mellott 2010; Mellott and Turner 2007). Teit (1909:780) notes that, among the Tsilhqot'in, "roots are dug and cooked in the same manner as among the Shuswap. They do not form as large a part of the food-supply as among the Thompson [Nlaka'pamux] Indians, for instance; nor are edible roots found in such variety as in the country of the latter tribe …."

Yellow glacier lily was apparently used only sporadically elsewhere across its range. Kay (1995) reports a low index of cultural significance for yellow glacier lily among the Ulkatcho Dakelh (Carrier) and notes that the species was "used occasionally or in trading." The Blackfoot apparently ate the bulbs "occasionally" (Johnston 1987:25), or "fresh or with soup" (Hellson and Gadd 1974:103). According to Hart (1976:24), yellow glacier lily bulbs served "only as an occasional food source to the Indian tribes of our region," most likely the Montana Salish groups (Kalispel, Flathead, Pend d'Oreille), and the Ktunaxa ("Kootenai" in the U.S.). Contemporary Montana Salish elder Mike Durglo said it was "candy once a year" (Sarah G. Thomason, pers. comm. to DL, 1998). Peoples of Mendocino County, California, also ate the bulbs, "but not in large quantity" (Chestnut 1974:326).

It is not known why the plant was apparently little used in its U.S. range, even though it is abundant in many areas of the western states. Perhaps bulb quality varies, or perhaps the plant was less accessible there than camas (*Camassia quamash*) and a variety of *Lomatium* species, which are abundant at relatively low elevations across the northwest states and California. It is also possible that glacier lily was once used more intensively in these areas. Hunn and Selam (1990:172), for example, include the plant in a list of root-vegetable species that the most knowledgeable Sahaptin elders recall as “rarely used species that were once valued more highly.”

Linguistic evidence can also shed light on past patterns of use of a species. All known names for yellow glacier lily (the plant and the bulbs—usually the same word) in Indigenous languages are listed in Table 1. The Interior Salish names are from three distinct etymons and appear unanalyzable in any of the five languages, indicating a probable long-term cultural association with the species (Turner et al. 2000). It is notable that the Nlaka’pamux and St’at’imc words for this root ***(sk’emets, sk’amts)*** appear to be unrelated to the neighbouring Secwepemc and Okanagan/Syilx terms, both ***scwicw.*** It is not clear whether the Flathead name was borrowed from the Ktunaxa (Kootenai) or vice versa. The Ulkatcho name, ***swih***, indicates that it was borrowed from Secwepemc ***scwicw***, probably as a result of a trade relationship. Similarly, the Stó:lo name was probably borrowed from Nlaka’pamux through trade of the bulbs. The lack of a known name among other groups within the species’ range supports the idea that yellow glacier lily has been little used outside the northern Interior Plateau. However, Hulqumi’num elder Dr. Arvid Charlie of Cowichan was told that his people had a name for the bulb and used to eat the plants from Mount Provost north of Duncan on Vancouver Island, but he did not remember the actual name (pers. comm. to NT 2006).

Table 1. Names for yellow glacier lily among Aboriginal groups of northwestern North America (names refer to both bulbs and plant unless otherwise noted).

Group (language family)	**Indigenous name(s)[1]**	**Reference(s)**
Secwepemc (Interior Salish)	**scwicw** above-ground parts: **scwecwúpya7**	Palmer (1975b), Kuipers (1983), SEP (1993–1997)
Nlaka’pamux (Interior Salish)	**s/k'ém'ets** “small ends of corms” (may refer to bulb-appendages): **k'cm'"/k'cm'"/k'em'ets-=ú["c]pe§**	Turner et al. (1990)
St’at’imc (Interior Salish)	**(s-)k'ám'ts**	Turner et al. (1987)
Okanagan (Interior Salish)	**scwicw**	Turner et al. (1980)
Tsilhqot’in (Athapaskan)	**?esghunsh**	Linda and Helena Myers, pers. comm. to Nancy Turner (1988, 2014); R. Tyhurst (unpub. field notes 1975–1976)
Ulkatcho Carrier (Athapaskan)	**swih**	Kay (1995)
Stó:lo, or Upriver Halq’emeylem (Coast Salish)	**sk'ámeth**	Stó:lo Nation (1982)
Flathead, Pend d’Oreille, Kalispel (Interior Salish)	**/máx̲eʔe/**	Hart (1974), Montana Salish elders (as reported by Sarah G. Thomason, pers. comm. 1998)
Kootenai (Montana K’tunaxa; linguistic isolate)	**/máx̲a/**	Hart (1974), Kootenai Culture Committee (via Dorothy A. Berney, pers. comm. 1998)
Sahaptin (Sahaptian)	**hʷík'ʷk**	Hunn et al. (1990)

[1] Orthography has been modified in some cases for consistency.

Trade

Historical evidence confirms the linguistic suggestion of trade. Strings of threaded, dried glacier lily bulbs, of measured length from hand to elbow, were widely traded within and among Interior Salish groups (Teit 1900, 1906, 1909; Turner et al. 1990). Teit (1906:231–232) notes that the Upper Lillooet (St'at'imc) traded "*Erythronium grandiflorum* var. *minor* and other kinds of roots" along with Indian-hemp fibre *(Apocynum cannabinum)*, dried saskatoon berries (*Amelanchier alnifolia*), soapberries (*Shepherdia canadensis*), dried meat and fat, and other products to the Lower Lillooet (Lil'wet'ul). In return, they received red-cedar bark (*Thuja plicata*), yew wood (*Taxus brevifolia*), black-tail deer skins, hazel nuts (*Corylus cornuta*), dried huckleberries (*Vaccinium* spp.), fish oil and even slaves. According to Secwepemc elders Isaac and Adeline Willard (Palmer 1975b), a big string of yellow glacier lily bulbs about 3 ft. (1 m) in diameter was worth five dollars in the late nineteenth century.

The bulbs were also traded farther coastward and northward. The Stó:lo (Upriver Halq'emeylem) acquired them from the Nlaka'pamux (Stó:lo Nation 1982), and the Carrier obtained them from the Tsilhqot'in (Harlan Smith, unpublished notes on Carrier plant use ca. 1920–1922). The Nuxalk may also have obtained them through trade. Although there is no known Nuxalk name for yellow glacier lily, Nuxalk elders Felicity Walkus and Andy Schooner (cited by Turner 1973:211) recalled a type of "Indian potato" that was long and tapered and came from the interior; they said the plant did not grow in the area and the "potatoes" were probably acquired through trade. Similarly, there is a term in the Stuart/Trembleur Lake Dakelh lexicon for "long shallot," ***usghooh*** (Poser 2008) which is probably this species, obtained through trade.

Much exchange of plant goods, including yellow glacier lily bulbs, was also informal (Turner and Loewen 1998). Mary Thomas described reciprocal "sharing" of ***scwicw*** and other plentiful items that were valued by friends and relatives living in other areas. This type of exchange has persisted to the present day (see section on current use), and for elders who remember when ***scwicw*** bulbs were a common and favourite food, a gift of the bulbs, fresh or dried, would be greatly treasured, representing far more than a simple source of carbohydrates in the diet.

Wide-ranging, frequent trade of the bulbs has a number of implications. First, it underscores the size of the harvests; people regularly gathered so much that they could afford to use some as surplus to obtain other desired items. Second, it means that the effective range of use of the species was greatly increased. Third, the very fact that the bulbs were in demand as a trade item emphasizes the extent to which they were favoured as a food resource. Finally, trade might have helped disperse the plant to other areas (see Part 4).

Harvesting

The detailed gathering information for this intensively used resource can be made more manageable by considering five aspects separately: where the bulbs were harvested, when harvesting took place, who did the work, how harvesting was carried out, and how much of the resource was gathered.

Where?

Examples of harvesting sites used by northern Interior Plateau peoples are shown in Figure 6, with details about the sites given in Table 2. One important root-harvesting area is Botanie Valley, located in Nlaka'pamux territory. A flat area in Botanie Valley is called ***k'em'k'em'ats-útsiyem'cw*** after yellow glacier lily, which grows there abundantly (Turner et al. 2000). Botanie Valley as a gathering place for root-digging and other activities is described in a number of ethnographic

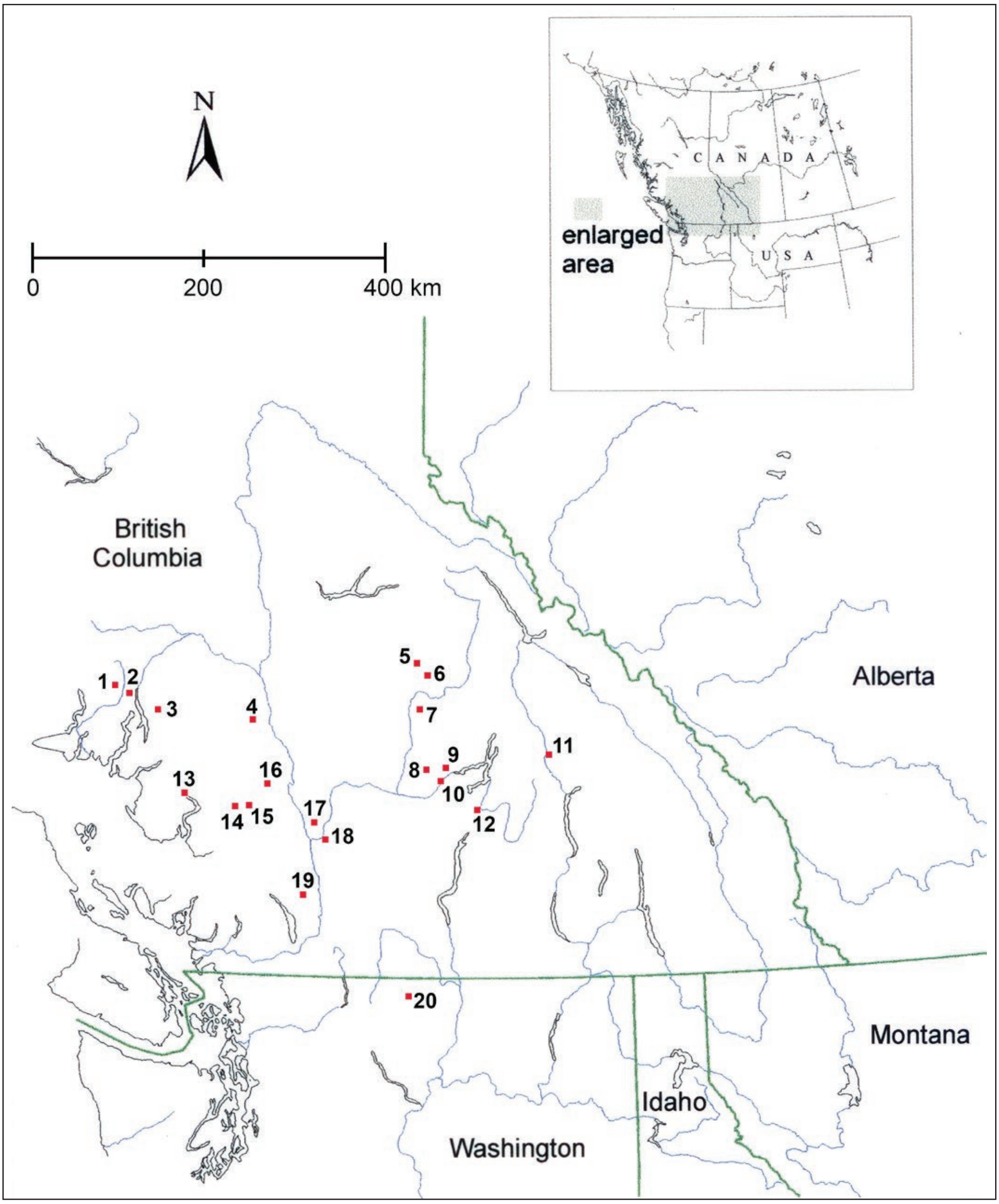

Figure 6. Some areas traditionally used by Northern Plateau peoples for harvesting bulbs of yellow glacier lily. See Table 2 for information corresponding to these numbered sites.

Table 2. Details regarding yellow glacier lily harvesting sites shown in Figure 6. Note that these sites are given as examples only; many additional areas for gathering the bulbs were and are known.

Site no.	Site description	Group/s using site	Reference
1	West side of Tatlayoko Lake	Tsilhqot'in	Alexander et al. (1985)
2	Cheshi Pass (in Potato Range)	Tsilhqot'in	Alexander et al. (1985)
3	Mt. Tatlow	Tsilhqot'in	Alexander et al. (1985); Glavin et al. (1992)
4	Black Dome Mountain	Secwepemc	SEP (1993–1997)
5	Green Mountain	Secwepemc	SEP (1993–1997)
6	Trophy Mountain	Secwepemc	SEP (1993–1997)
7	Baldy Mountain	Secwepemc	SEP (1993–1997)
8	Mt. Tod	Secwepemc	SEP (1993–1997)
9	Sidehills east of Adams Lake	Secwepemc	Palmer (1975b); Arcas Consulting (1990)
10	Neskonlith Meadows	Secwepemc	SEP (1993–1997)
11	Mt. Revelstoke and area	Secwepemc	SEP (1993–1997)
12	Enderby/Mabel Lake area	Secwepemc	SEP (1993–1997)
13	56 km up Lillooet River from Pemberton	St'at'imc	Mack (1977)
14	West of Birkenhead Lake	St'at'imc	Mack (1977)
15	South side of the reserve at D'Arcy	St'at'imc	Mack (1977)
16	Mission Ridge	St'at'imc	Turner (1992)
17	Botanie Valley (north of Lytton)	Nlaka'pamux and others	Teit (1900); Turner et al. (1990); Hanna and Henry (1996)
18	Mountains behind Thompson Siding	Nlaka'pamux	Turner et al. (1990)
19	Headwaters of Spuzzum Cr.	Nlaka'pamux	Turner et al. (1990)
20	Methow Valley	Okanagan	Spier (1938)

sources (e.g., Dawson 1891; Teit 1900; Turner et al. 1990). Even in modern times, elders still vividly recall gatherings in Botanie Valley, as illustrated in the story "Trips to Petani," told by Mary Williams, and translated by Mamie Henry (Hanna and Henry 1996:149):

> In the month of August, the people gathered up in Petáni [Botanie Valley]. People gathered from all over—Spences Bridge, Nicola, and 30 Mile [30 miles north of Lytton on the Fraser River]… Then the people dug roots such as *sk'ə́m'ats* [yellow glacier lily], *tatúwen'* [spring beauty], water leaf [*Hydrophyllum capitatum*], and tiger lily [*Lilium columbianum*], and gathered all the other kinds of food found there. They shot deer and roasted them over open fires… My, we used to have nice times in those days!

Nlaka'pamux elder Louie Phillips (Turner et al. 1990) recalled that some women would dig ***sk'ə́m'ets*** by the sackful on the valley sides at Botanie and bet their day's harvest on the horse races. Clearly, harvesting of root foods like glacier lily bulbs was not solely a subsistence activity, but rather was embedded in a cultural context of other economic and social relations.

When?

The seasonality of harvesting root foods has three interrelated aspects: phenology (cycles of growth and reproduction) of the species, season and geography of harvesting locations. Root harvesting could take place throughout the growing season, partly because of the different times when species became available at a given elevation, and partly because some individual species, including glacier lily, occur at a wide range of latitudes, elevations and aspects. Glacier lily bulbs could be harvested at any time from early April and May to August and fall, depending on the elevation (Teit 1900:238; Turner 1992; Turner et al.1980:46).

In some cases, people dug the bulbs when the plants were flowering. According to some contemporary Montana Salish elders, the bulbs are best in spring, "just when it starts to bloom"; the bulbs get woody if one waits too long (Sarah G. Thomason, pers. comm. to DL 1998). The Tsilhqot'in also harvested yellow glacier lily bulbs and spring beauty corms during the blooming season, "the only time of year when these plants are visible" according to Alexander et al. (1985:46), although unlike spring beauty, yellow glacier lily has upright fruiting stalks that remain readily visible for at least two months after flowering.

Spring beauty commonly occurs and flowers together with glacier lily and the two "roots" were frequently harvested together. Mary Thomas referred to them with the Secwepemc word for "sisters." The fact that they could be harvested simultaneously enhanced the importance of each, in that a given harvesting effort would result in essentially double the return. In some cases, the convenience of harvesting both species together may have led people to dig glacier lily at its full flowering stage along with spring beauty.

Indications are, however, that the *preferred* stage for harvesting yellow glacier lily bulbs was after flowering, when the leaves were fading and fruits were starting to form. Isaac and Adeline Willard (Palmer 1975b:54) said that the bulbs were dug on the low-elevation sidehills in the vicinity of Adams Lake in May and June, "when the leaves are all withered." Annie York (Turner et al. 1990:123) said that [early] fall was the usual time for them to be dug, "… when they're picking those huckleberries up on the mountain" (a time when the lilies would have been in fruit). Again, yellow glacier lily harvesting was not done in isolation; the availability of other foods in the same area probably often played a role in determining at what stage the bulbs were harvested.

Mary Thomas (SEP 1993–1997) emphasized that when the leaves begin to dry up and wilt, the "sugar content in the ***scwicw*** [yellow glacier lily bulbs]" is highest. Earlier, when the plants are flowering, she said, the sugar content is lower. On the other hand, as Mary's mother had told her and shown her, the bulbs are also inferior if harvested too late in the season, when the fruits are fully mature and the leaves have completely disappeared. At that point, she said, the bulb is preparing to grow for the next year, and the part of the bulb around the flower stem starts to get clear and mushy. The bulb then develops a funny taste and does not have a good crisp texture.

Who?

Peoples of the Interior Plateau practised a clear gender-based division of labour. It was largely women's work to gather and process root vegetables such as yellow glacier lily bulbs (Alexander et al. 1985; Dawson 1891; Teit 1900, 1906, 1909, 1912a), although children would often help (Mary Thomas, SEP 1993–1997). Harvesting roots was difficult and tedious work, but also pleasurable, according to the recollections of Mary Thomas, Annie York, Edith O'Donaghey, and other Interior Salish elders. Pairs or groups of women of various ages—sisters, mothers and daughters, cousins, grandmothers and granddaughters—would go out to the digging grounds from their base camp and work from dawn to dusk. For the Okanagan, entire families sometimes participated in large harvests (Turner et al.1980).

How?

The root-digging tool common to all peoples of northwestern North America was the digging stick, or root-digger. Handles of digging sticks 2,400 years old have been found near Kamloops and Chase in BC (Turner et al. 2000). Interior Plateau digging sticks were usually made of some hard wood such as black hawthorn (*Crataegus douglasii*) or saskatoon, with a cross-piece of wood, bone or antler fitted across the top to form the handle, sometimes decorated with carved designs. The shaft was sometimes slightly curved, and the tip was pointed and often fire-hardened. Another style was crafted from an antler, with the spike becoming the digging end, and the axis cut off to form a handle (Teit 1909). After European contact, the shaft of the root-digger was sometimes made from a piece of iron, such as the tine of a hay rake. More recently, people have used crowbars or other metal tools as diggers. Different sizes of digging sticks were used for different types of roots (Teit 1900, 1909). For the Secwepemc, the sticks could be as long as four feet (122 cm), although the Willards noted that digging sticks for yellow glacier lily bulbs were just over two feet (64 cm) long and those for spring beauty corms were shorter (Palmer 1975b).

People located bulbs by means of the plants' flowers or their fading leaves and developing fruit, depending on the growth stage when gathered (Turner et al. 1990). They would pry out the bulbs with digging sticks, or loosen a whole chunk of turf and break off the bulbs from the soil underneath (SEP 1993–1997; Turner et al. 1990). Some people deliberately "weeded out" grasses and other unwanted vegetation during the harvesting process (SEP 1993–1997). According to Secwepemc elders (including Les Williams and Sarah Deneault, pers. comm. to Marianne Ignace), in prolific areas digging ***scwicw*** involved trench-digging, often carried out cooperatively by large family groupings. The common theme of [root digging] "trenches" on digging sticks and women's spirit questing sites also attests to the importance of this technique (see Sanger 1968; Teit 1900).

The bulbs were dug selectively; only the largest bulbs were harvested, and these tended to come from plants with multiple flowers or fruits (Mary Thomas, SEP 1993–1997; Turner et al. 1990). Significantly, smaller bulbs were purposely left behind to regenerate. Mary Thomas recalled that her grandmother would remove small bulbs from the children's harvesting baskets at the end of the day and replant them. She also replanted the "little whiskers" or ***supuptsítsii*** (bulb-appendages with roots attached) on plants like ***scwicw***, and the tiny bulblets of riceroot (*Fritillaria affinis*). Other Secwepemc elders Sarah Denault and Les Williams confirmed the practice of replanting bulb-appendages of ***scwicw*** (SEP 1993–1997). Similarly, Nlaka'pamux elders Mabel Joe and Annie York (Turner et al. 1990:28) said that it was considered important to "leave some for next year." The existence of a Nlaka'pamux name for "small ends of corms" (Table 1) suggests that the appendages had some importance to that group of people as well. Mary Thomas and Les Williams

(SEP 1993–1997) remembered that the harvests were rotated; a given gathering area would be left for four or five years before being used again. When people returned to that area, according to Les Williams, the yellow glacier lilies would be "just thick."

How Much?

The quantities of bulbs harvested may have changed significantly over the hundreds or thousands of years yellow glacier lily has been used, and they have certainly decreased dramatically in the past century or so. However, estimates provided by elders within the past 30 years give an idea of the likely minimum magnitude of the harvest.

Mary Thomas (SEP 1993–1997) remembered going on horseback with her family to montane gathering grounds, and riding back on "gunny sacks full" of the bulbs. Independent reports from Nlaka'pamux (Louie Phillip in Turner et al. 1990) and Secwepemc (Willards in Palmer 1975b) sources indicate that four 50-pound potato sacks (90 kg total) was an average harvest by a single family group for their winter supply. This much could be harvested in perhaps 10 to 14 days. These recollections would have been from the early 1900s, in the childhood days of these men, who were elders in the 1970s. Most of the harvest does appear to have been for winter use, but people consumed additional, unknown amounts during the growing season as well (Turner et al. 1990).

Such minimum quantities would apply to people with ready access to prolific root grounds. In other areas, where the resource was less abundant, acquired mainly by trade, or overshadowed by a more dominant root food, lesser quantities would have been harvested. Any of these scenarios may have applied to the St'at'imc, for whom it has been estimated that 5 to 20 kg of the bulbs was collected per family in historical times (Turner 1992).

Processing, Storage, and Preparation

Because most of the harvest was for winter use, yellow glacier lily bulbs had to be preserved in some way. They could be simply dried after harvesting, or they could be dried before *or* after slow steam-cooking in an earth oven (pit-cooking; see Figure 7). The bulbs took a long time to pit-cook—usually 24–48 hours, at least twice as long as spring beauty corms. Isaac Willard described Secwepemc pit-cooking of ***scwicw*** (Palmer (1975b:38):

> Dog-tooth violet [*E. grandiflorum*] together with bisquit root [*Lomatium macrocarpum*] was steamed for a night and half a day… A hole was dug about 1½ ft. in diameter and into this hole one put about half a dozen hot rocks specially chosen (so that they would not break). A special type of hay was put on top of the rocks and the… [***scwicw***], which had been soaked overnight, were laid upon this without touching the walls. Then more hay was put down and the bisquit root was placed on top and covered with woven bulrushes and a board and buried so that no air could escape.

According to Teit (1909:516), nearly all roots were threaded on strings before cooking in earth ovens. Elders (SEP 1993–1997; Turner et al. 1987, 1990) have indicated that bulbs were left to

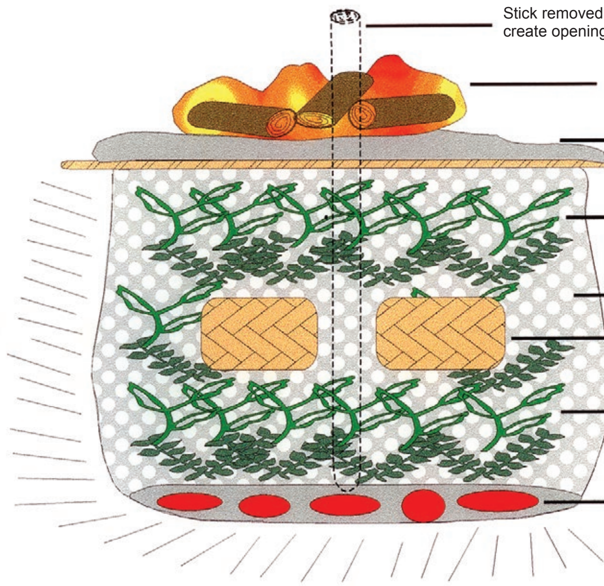

Figure 7. Schematic diagram of the type of roasting pit used by Northern Plateau peoples, based on descriptions by Mary Thomas and Aimee August (SEP 1993–1997) and other elders (Alexander et al. 1985, Turner et al. 1990).

wilt for a day at the harvesting grounds to soften them, so that they could be threaded, without breaking, on strings of bark or Indian-hemp or on long, thin sticks. After bulbs were threaded, they were often pit-cooked *before* further drying. Archaeological evidence (Alexander et al. 1985; Pokotylo and Froese 1983) suggests that, at least 2,000 years ago, root vegetables were processed by roasting in earth ovens close to the montane harvesting grounds (Dawson 1891), and after baking, the roots, including yellow glacier lily bulbs, were taken out and eaten immediately or dried for future use. Bulbs that were wilted, strung, pit-cooked and dried would have been light weight and convenient for transport back to the winter dwellings for storage. Pit-cooking thus acted not only as a preparation method but also as part of the preservation process (Laforet et al. 1993; Wandsnider 1997). Tsilhqot'in sources cited by Alexander et al. (1985) maintained that, in fact, pre-cooking was *necessary* for most root vegetables, including yellow glacier lily bulbs, before drying; only for spring beauty corms was this evidently not the case. Similarly, Nlaka'pamux elders Annie York and Mary Anderson (Turner et al. 1990) indicated that their families pit-cooked the bulbs immediately, then dried them for storage.

But other preservation and processing strategies have also been reported (see Figure 8 for a summary of the myriad possible pathways bulbs could follow from harvesting to storage and consumption). According to Okanagan and Secwepemc elders (SEP 1993–1997; Turner et al.1980), the bulbs could be boiled or pot-steamed and then either eaten or dried for future use. Also, people often partially dried the bulbs, without pit-cooking them, at the harvesting grounds. The bulbs would be strung and hung up until the root gathering was completed, then transported back to the winter sites. There the strings of bulbs would be hung again to finish drying, often with smoke, to cure them and deter insects.

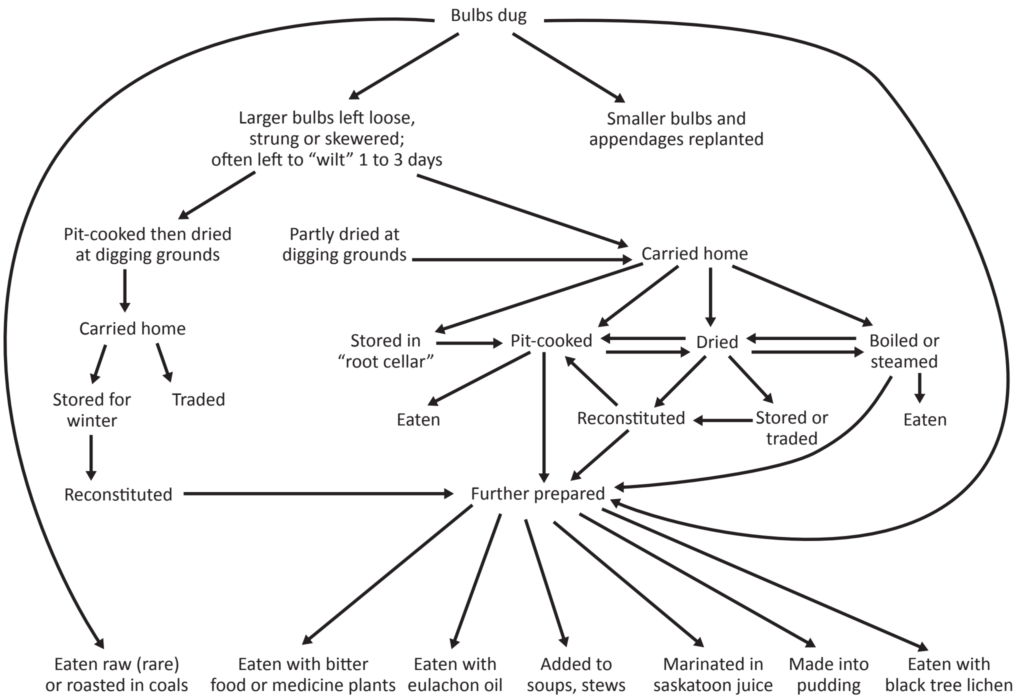

Figure 8. Procedures and options for processing yellow glacier lily bulbs as a traditional food.

Drying took up to two weeks (Spier 1938; pers. observation by DL 1996). The bulbs could then be stored by simply hanging the long threaded strings. Unstrung bulbs could be stored in sacks made of silverberry fibre or tule stalks (*Schoenoplectus acutus*). Annie York described another storage method, in which a number of cooked and dried foods, including salmon and yellow glacier lily bulbs, were placed between layers of birch bark *(Betula papyrifera)* and stored on scaffolding (Turner et al. 1990). Later the bulbs would be pit-cooked or prepared by other means (see below).

Yellow glacier lily bulbs could also be stored fresh. Mary Thomas (SEP 1993–1997) described a type of "root cellar" used to store fresh roots:

> But some of the, most of the ***scwicw***—if they're going to spend a week up there, the first ones they dug, yeah, they would have to dry them, and then the last day or two, when they were planning to come back, then they'd bring back the fresh ones. And if you don't break the ***scwicw,*** if it's not broken, you leave it with, you know, the dirt on it, and if you put it away like that, they keep for a long time—you can keep them in pits. When they bring it back—I remember my grandma used to have a pit down by the river. If you dig a hole in the ground and you get … ***k'éme*** [dry pine needles]. My grandma used to gather all that and bring it back and put that on the bottom, and then put a little bit of dirt, and then put the ***scwicw*** and ***skwakwina*** [spring beauty corms] in a pit and then bury it—put some more ***k'éme***, dry leaves, she'd put another bunch on top, and

> bury it—say about a good foot deep. As long as it's buried it will keep for a long time. I guess when you talk about the winter houses, the depression of a winter home, it was found that there were a lot of small ones [depressions] around the outside of the main winter home—those were used as their cache pits. I asked my mom about that one time. I said, "What were they used for?" And she said, "Well, you got cellars today—they had cellars then, too." So that's the way they were put away.

Similarly, Hill Tout (1978b:109) noted that the St'at'imc stored roots in shallow cellars dug beneath the sleeping platforms of winter pit-houses. The use of these types of cellars or cache pits is certainly ancient, because, as Mary Thomas indicated, they have been uncovered archaeologically (see Nicholas et al., Chapter 3, this volume). It is not clear, however, to what extent they were used for fresh, as opposed to processed, roots. It is possible that transporting and storing fresh roots became more common once horses were introduced, because the weight of the roots would not have been as great a concern. For example, Nlaka'pamux elder Christine Bobb mentioned that when they went up in the mountains to collect different foods, they packed everything out with horses (Hanna and Henry 1996:148). Then, at home, they prepared and dried the food, and "when it was almost wintertime" they pit-cooked things like ***sk'ə́m'ets***.

A variety of methods were used to prepare the bulbs for eating. Dried bulbs were often partially reconstituted with water before pit-cooking (Palmer 1975b; Turner et al. 1990), although Mary Thomas feels that the steam from the pit is sufficient to do this as long as the rocks are very hot. In addition, dried bulbs, or pit-cooked-then-dried bulbs, were commonly boiled or steamed, or added to soups and stews. Reconstituted bulbs could be eaten as a side dish with meat or fish, "like potatoes," according to Mary Anderson (Turner et al. 1990). Annie York said that a family of four might eat a string of bulbs about 20 cm long as part of a meal (Turner et al. 1990); this probably would have been about 10–12 bulbs.

During the harvesting season, fresh bulbs were prepared in the same ways or could be roasted in hot coals (Surtees 1974). Eating raw bulbs was uncommon. Mary Thomas remembered casually nibbling on raw glacier lily bulbs as a child, but she said they tasted very different from the cooked ones. Hellson and Gadd's (1974:103) indication that the Blackfoot ate the bulbs "fresh" may mean they ate them raw, or it may mean they cooked the bulbs fresh without drying them first. The Ktunaxa (Kootenai) apparently ate the bulbs raw, but it was not an important food source for them (Kootenai Culture Committee, via Dorothy A. Berney, pers. comm. to DL 1998). Annie York (Turner et al. 1990) felt that the bulbs were poisonous if eaten raw. However, she viewed white fawn lily *(Erythronium oregonum)* as being the same as yellow glacier lily, only with white flowers, and there has been some suggestion that white fawn lily is toxic (Kingsbury 1964). Hart (1976) suggests, without supporting evidence, that the raw bulbs and leaves may be emetic; we have not noticed such effects in our own experiences eating small raw quantities.

Cooked bulbs were highly appreciated as a tasty food, and both drying and pit-cooking were perceived to be important in developing a sweet taste. Mary Thomas (SEP 1993–1997) said, referring to yellow glacier lily bulbs, "… if you dry the natural foods and then steam it afterwards it has its own sugar content—you don't need to put any sweetener." Louie Phillips (Turner et al. 1990) said that bulbs cooked and eaten immediately after harvesting were not as sweet and good as those that had been stored first. The sweetness of the dried bulbs is also indicated by Nlaka'pamux elder Bernadette Antoine:

> When they're dried, they're like candy… when I was a kid I used to get some from my uncle and eat it… it takes a while to soak it in your mouth when it's dry… then they taste sweet… We used to call it candies when we were kids. (Turner et al. 1990:122)

Pit-cooking had a distinct effect on the bulbs, making them dark coloured and sweet, "like chocolates," according to Louie Phillips (Turner et al. 1990:29). Boiled bulbs, on the other hand, did not change colour and were not as sweet (Mary Thomas in SEP 1993–1997). (See Part 3 for further discussion of the nutritional and chemical aspects.)

Some particular dishes mentioned by Nlaka'pamux elders include glacier lily bulbs marinated in saskatoon berry juice (Laforet et al. 1993), and a special type of pudding called ***nkéxw*** (Turner et al. 1990), which is made by boiling some combination of the following ingredients: marrow of deer, bear, or mountain goat; deer fat; cured salmon eggs; processed black tree lichen *(Bryoria fremontii)*; dried saskatoon berries; yellow glacier lily bulbs; spring beauty corms; tiger lily bulbs; riceroot bulbs; and bitterroot roots (*Lewisia rediviva*). The Secwepemc make the same dish, and call it ***scpet̓ám***. Yellow glacier lily bulbs were also cooked and eaten together with only black tree lichen. The Carrier people ate them, as they ate many other root vegetables, with eulachon fish oil (imported from the coast), salmon oil, or bear grease (Harlan Smith, unpublished notes on Carrier plant use ca. 1920–1922).

The bulbs were even used as the proverbial spoonful of sugar to help the medicine go down. According to the Willards (Palmer 1975b) and Aimee August (SEP 1993–1997; pers. comm. to NT, B. Compton, and D. Gardiner 1992), desert parsley (*Lomatium macrocarpum*) and chocolate-tips (*L. dissectum*) were eaten occasionally for their tonic properties. A taste could be developed for the bitter leaves and roots, but yellow glacier lily bulbs were often eaten along with them to make them more palatable. Aimee August explained that people would "chew it together, eat it like that"; she held her index and middle fingers straight out together, indicating one bulb of yellow glacier lily to be eaten with one leaf or root of the *Lomatium* at the same time.

Annie York neatly summed up the general perspective on the prepared bulbs:

> The man eats first. He eat a little piece of meat, and ***tetuwn*** (spring beauty corms), and then when he's got through eating that, then they eat the ***sk'ém'ets***. And that's their dessert, the ***sk'ém'ets*** is their dessert…. (pers. comm. to NT 1980)

Traditional Resource Management and Other Traditional Ecological Knowledge

Indigenous peoples, who occupy a given area for countless generations, acquire a great deal of ecological knowledge. Northern Plateau peoples' knowledge of yellow glacier lily ecology serves as a good example: much traditional ecological knowledge (commonly referred to as TEK—see

Chapters 2 and 12, this volume) is apparent from the above discussion. People had to have an intimate knowledge of the species in order to know when, where and how to harvest it so that it yielded maximal food value and remained prolific in future years. As well, people had knowledge of the plant's interactions with other species. For example, St'at'imc elder Alec Peters remembered seeing grizzly bears dig the bulbs and then leave them to wilt before coming back to eat them:

> In a certain time of the years they pick it… The oldtimers used to pick it and dry it for winter use. I know the grizzly bears they dig it out too. They use their big claws like that [raking motion], and they just leave it like that in the sun, you know. I guess they must taste good when they're dry. They don't eat it right away. I've watched them. A long time, I've watched the grizzly bear, digging it out. I've seen them ***k'ám'ts*** [yellow glacier lily bulbs] laying like that…. (Turner 1997b:34)

Isaac Willard also knew that grizzly bears ate yellow glacier lily bulbs. He remembered seeing the grizzlies in May and June on the sidehills around Adams Lake, where there are only cattle now (Palmer 1975b). Kootenai elder Basil White recalled being told as a child, "Don't you go near," because these plants were grizzly food (Kootenai Culture Committee, via Dorothy A. Berney, pers. comm. to DL 1998). Close observation of animals such as grizzly bears may have led people to try the bulbs as a food resource in the first place (Turner 1997b).

An even broader level of knowledge is indicated by the management strategies Indigenous peoples have applied to the habitats of resource species. Before governmental fire suppression, landscape burning was widely practised by peoples of the Interior Plateau to maintain open habitats for berry and root crops, and to facilitate travel and hunting (Turner 1999; see also Chapter 5 this volume). Successful burning requires detailed knowledge of plant and ecosystem ecology, including concepts of ecological succession, geographic and climatic characteristics of the area to be burned, and responses of individual plant and animal species to fire. Elders recalled that the edible portions of root plants were notably larger after burning (Turner 1999). Burned areas were rotated—any given site burned about every four to five years—and maximum productivity of certain root and berry species was said to occur after about three years. Mary Thomas (SEP 1993–1997, pers. comm. to DL and NT 1998) believed that the ashes from fire add "food value" to resource plants like huckleberries and ***scwicw***, and also that fire helps reduce populations of insect herbivores. Other elders also explicitly recognized yellow glacier lily as a resource species enhanced by landscape burning. Annie York noted, "… and the ***sk'ém'ets***, that's when it grows, when you burn" (Turner 1991:63). Baptiste Ritchie, a St'at'imc elder, confirmed that *Erythronium* was one of the species enhanced by burning:

> When it gets too bushy, then the ripe berries disappear and the roots like ***sk'ém'ets***, ***swenkwina*** [spring beauty], ***skimuta*** [tiger lily] disappear…. Then they burned. It was marked out, and there one did his own burning (Turner 1991:62).

Early ethnographic sources confirm this practice (cf. Teit 1900). Teit (1898:72–74) recorded a story involving four brothers who "burned a piece of the mountain side so that the ***s'ka'mitc*** root should yield a better crop, and it was here that the little sister went to dig roots." Four grizzly bear sisters later "came to the spot which had been burned, and found the ***s'ka'mitc*** root very plentiful."

In modern times, traditional ecological knowledge also includes observations on habitat degradation and its impacts on traditional food species such as yellow glacier lily (see Thomas et al., Chapter 10, this volume). Such degradation, elders believe, has occurred in part because traditional management practices are no longer being carried out (Turner 1991:62; Turner et al. 1990).

Elders recognize modern disturbances, particularly cattle overgrazing and introduced weeds, as serious negative influences on resource species (see Thomas et al., Chapter 10, this volume). Mary Thomas (SEP 1993–1997) was concerned that yellow glacier lilies were not producing nearly as much seed as formerly and that invasive weeds and trampling by cattle were reducing the size of the bulbs and ability to harvest them. On a field excursion in 1996, we dug a bulb that seemed exceptionally large: 9.5 cm long by 2 cm wide at its widest point. Mary commented that the bulb was merely of the average size collected formerly, and that smaller ones (i.e., those currently of average size) would have been replanted or left to regenerate.

Other elders have also noted a general decrease in the size of glacier lily bulbs since routine harvesting and traditional management methods stopped and foreign disturbances began. According to an Okanagan source, the bulbs were formerly the size of one's fist (reference cited by Turner et al.1980). Although it will never be possible to know exactly how large the bulbs once were, the concordant opinions from many different First Nations sources suggest that there has been some notable, and preventable, decrease in bulb size.

The information presented in this section supports suggestions (Anderson 1993a; 1993b; Anderson 1996) that "hunter-gatherer" peoples were much more than passively adapted to their environment. Rather, these peoples actively managed the landscape, and the "pristine wilderness" the first Europeans perceived appears to have been a gross misinterpretation.

Rituals, Mythology and Other Cultural Aspects

The high significance of root vegetables, including yellow glacier lily, for Interior Plateau peoples is reflected in many rituals, stories, traditions and other aspects of culture. "First Fruits" ceremonies are more widely known than "First Roots" ceremonies (Palmer 1975b), though both have been and sometimes still are practised (Hunn et al. 1998). Even when the ceremony was known as "First Fruits," the sentiments expressed often extended to other types of foods, including root vegetables. As Hill-Tout (1978a:46) noted for the Nlaka'pamux:

> …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…. Exactly to whom these prayers were addressed my informant could not tell me. All I could gather was that the 'old Indians' believed in some great and beneficent power who dwelt behind the clouds, and who gave them the salmon, fruits, roots, etc., who, if they showed themselves ungrateful or unthankful, could, and might, withdraw his gifts from them.

Hill-Tout sometimes referred to the ritual as the "Feast of Berries and Roots" (p. 47), indicating its generality (a similar report appears for the Okanagan on p. 134). Teit (1906:282) noted that, on the day when the St'at'imc held their First Fruits ceremony, they could not gather more berries than could be eaten the same night: "If they gathered more than this, they would afterwards be unlucky in procuring roots or berries."

One Secwepemc elder recalled a ceremony just for yellow glacier lily (Arcas Consulting 1990). Mary Arnouse said that when she was about 10 years old, she went with her grandmother to a place called ***skwnu7tús*** near the headwaters of Nikwikwaia Creek, east of Adams Lake. Here she saw a first-root ceremony carried out for ***scwicw***, but this was the only time she observed such a ceremony.

The importance of yellow glacier lily is also reflected in language. According to Teit (1900), the Lower Nlaka'pamux commonly named their children after plants, and one such name translated as "Yellow-lily." Mary Thomas (SEP 1993–1997) called the month of May ***scwicwu*** (***scwicwem*** in Western Shuswap—[month for] "***scwicw***-ing [***scwicw*** gathering]"), and the Willards (Palmer 1975b:54) called the "third month" (approximately April) ***pellscwicwem***, "when the Kamara roots [glacier lily bulbs] are showing growth."

Many stories mention yellow glacier lily as part of the tale, showing the everyday importance of the plant. In "Coyote and the Two Sisters" (Hanna and Henry 1996), Nlaka'pamux elder Mandy Brown tells of two sisters who were harassed by Coyote on a trip to Botanie Valley to gather ***sk'ém'ets***. In the St'at'imc story "Origin of the Skîmqai'n People" (Teit 1912b), the hero's wives "dug roots in great abundance;" these roots were spring beauty corms and yellow glacier lily bulbs. The hero made the roots assume the size and weight of two small bundles, and later at home transformed them to their original proportions, "and they filled many scaffolds." The bulbs were also recognized as a favourite food of grizzly bears, and this relationship appears in a number of stories (e.g., Teit 1898:72–74; see previous section).

In some stories, yellow glacier lily plays a more prominent role. For example, the St'at'imc "Myth of the Deserted Boy," reported by Hill Tout (1978b:150), lists ***skemts*** along with dried saskatoon berries and cured salmon as the three foods for which the gluttonous boy begged. Teit (1912b:334) recorded the St'at'imc story "The Loon and the Woman," in which a woman gathered ***sk'emts***-root every day near two small lakes on the Upper Lillooet River, above Pemberton Meadows. "She was fascinated by them, and began to have amorous desires." She became Loon's lover, and as a result of this distraction kept returning home with only a small harvest of bulbs, arousing her husband's suspicion and ultimately leading to her demise.

The association of women with plant foods like yellow glacier lily is also strongly reflected in tradition. The Sinixt traditionally celebrated the "fruitful season" with a ceremony in which women danced all day while the men cooked and served food. All the food had to be eaten or burned, in order to ensure that the herbs, roots, and berries would be fruitful in the coming season (Turner et al. 1980). Nlaka'pamux and St'at'imc girls, as part of their ritual isolation during puberty, dug trenches as preparation for root digging (Teit 1900, 1906). "Each day at dusk and at daybreak [a pubescent girl] prayed, 'O Day Dawn! (or 'O Dusk!' as the case might be) may I be able to dig roots fast and easily, and may I always find plenty!' " (Teit 1906:265). During their menses, Secwepemc women were required to live "principally on roots" and were forbidden to eat fresh meat (Boas 1890:90). Conversely, pubescent Nlaka'pamux and St'at'imc boys did not eat berries or roots, as these were believed to make them heavy and slow-footed (Teit 1900, 1906).

Medicinal Use

Only a few accounts describe medicinal uses of *E. grandiflorum*. The Wailaki, an Athapaskan group of northwest California, used the crushed bulb as a poultice for boils (Chestnut 1974). Futhermore, they had "a peculiar superstition that if they wash themselves with a decoction of it they can stop a rattlesnake from having dreams, which, they say, make them more irritable and dangerous" (Chestnut 1974:326).

The Chestnut reference (originally published in 1902) was cited by Blankinship (1905) in his "Native Economic Plants of Montana" as support for his statement that the bulbs were crushed and used as poultices for boils. Other reviews have since cited Blankinship for this use in Montana (e.g., Johnston 1987; Moerman 1986). It is not clear why Blankinship assumed that the Californian use applied to Montana peoples; however, contemporary Montana Salish elders have also indicated that the bulbs were used medicinally by mashing and applying to swellings (Sarah G. Thomason, pers. comm. to DL 1998).

Okanagan elder Selina Timoyakin said simply that the bulbs were good medicine for a bad cold (Turner et al.1980). Of the Secwepemc sources, Bill Arnouse remarked that the plant was good for a cold (part of the plant not specified), and Aimee August indicated that the plant was "a good medicine" (SEP 1993–1997), apparently referring to its value in maintaining good health. As Hilda Austin, a Nlaka'pmx elder, put it, "Our food is all medicine. If you eat it often, that's a medicine" (Turner et al. 1990:43). Similarly, Aimee August has said that root vegetables such as desert parsley, balsamroot *(Balsamorhiza sagittata),* tiger lily and yellow glacier lily "are all healing medicine, but food." Modern science is beginning to catch on to this "functional food" perspective (see also Bannister and Thomas, Chapter 9, this volume; Etkin 2006). This is also some indication of significant antibacterial activity of yellow glacier lily aerial parts and bulbs as well as some antifungal activity (Bannister 2000, pers. comm. to DL 1998).

Diamond et al. (1985) found that yellow glacier lily (part of plant unspecified) contains alpha-methylene butyrolactone, a naturally occurring plant compound shown to have slight antimutagenic activity. A previous study isolated this same lactone from all parts of a related species, yellow trout lily *(E. americanum)*, and reported that it exhibited antibacterial activity (Cavallito and Haskell 1946). Other studies have found fungitoxic and allergenic activity associated with the compound (see Slob 1973). Stermitz et al. (1981) found that above-ground parts of yellow glacier lily contained relatively high amounts of undetermined alkaloids, and that an extract had cytotoxic activity but was not lethal to mice by injection at the maximum dose of 400 mg/kg. Bannister (2000 and pers. comm.) stresses that, except in the treatment of fungal or bacterial skin infections, mentioned previously, it is not clear to what extent such in vitro results imply any "real-life" therapeutic effectiveness; it can only be said that the potential for such effectiveness exists.

Current Use

Yellow glacier lily bulbs, like many other Indigenous foods (cf. Turner and Turner 2008) are little used today as food compared with their former staple status. Even in the late 19th century, when

Dawson travelled in Secwepemc territory, European flour and potatoes were rapidly replacing native root vegetables (Dawson 1891). Yellow glacier lily bulbs are now used even less for medicinal purposes, although some alternative medicine practitioners recognize their potential therapeutic effects (Willard 1992).

As noted, habitat degradation has made the bulbs much more difficult and time-consuming to gather. Also, of course, societal changes have led to declining use of this and other traditional foods: decreased time for traditional activities because of participation in the modern economy; interrupted transfer of knowledge to younger generations, often because of enforced attendance at residential schools; destruction of or decreased access to traditional harvesting areas; changing acceptability of and tastes for traditional foods; and ready availability of modern foods (Hopkinson et al. 1995; Kuhnlein 1989; Turner and Turner 2008).

In spite of all these influences, yellow glacier lily bulbs are still highly valued on the Northern Plateau, particularly by the oldest generations of First Nations. Tsilhqot'in people still dig yellow glacier lilies occasionally in the same places their ancestors harvested them (Linda Smith, pers. comm. to NT 2001). Among Interior Salish groups, the bulbs are harvested for traditional feasts, or even by some for more regular use. They are also exchanged for other highly valued foods (e.g., bitterroot) from elders in other areas, and may be given as gifts. When she was living in Enderby, Mary Thomas transplanted yellow glacier lily to her garden, and she also had buried fresh bulbs collected elsewhere in her garden (her "root cellar").

Freezing is probably now the most common means to preserve the bulbs, although some people still dry them. In the early 1980s, Annie York was still using her traditional storage methods, but used layers of heavy brown paper instead of birch bark (Turner et al. 1990). Even canning in jars has apparently been used.

Pit-cooking is now rare as a method of preparing the bulbs—it is largely performed for ceremonies or for cultural education. Instead, the bulbs are generally boiled or steamed, or sometimes deep-fried (Turner et al. 1990). The traditional pudding described earlier was still being prepared by Hilda Austin and Annie York in the early 1980s, with sugar added and flour often substituted for the gelatinous black tree lichen (Turner et al. 1990). The use of ***scwicw*** and other traditional root vegetables may increase in the future, with growing cultural renewal and revitalization.

Part 3: Nutritional Aspects

Background

Of greatest nutritional interest for yellow glacier lily is the carbohydrate content of the bulbs, both because carbohydrates are a major component of root vegetables, and because carbohydrates tend to be low in Indigenous Peoples' food systems in non-agricultural societies (Speth and Spielmann 1983). As well, it has not been clear which particular carbohydrates yellow glacier lily bulbs contain.

Although anthropologists recognize that the nutritional qualities of animal foods (e.g., lipid levels) vary significantly over the course of the year (Wandsnider 1997), they have not generally recognized that the same principle applies to plant foods. For certain types of foods, such as spring greens or ripe fruits, there is an obvious stage of growth that yields an optimal nutritional benefit. For root vegetables, however, the optimal harvest time may be less obvious. It is important to consider this variable in nutritional analyses of such foods, given the clear evidence of carbohydrate cycles from botanists (e.g., Miller 1992; Mooney and Billings 1960) and food scientists (e.g., Limami and Fiala 1993).

As well, elders' observations about the effects of drying and pit-cooking on the sweetness of the bulbs invite a detailed analysis of changes in relative proportions of carbohydrates after different treatments. Increasingly, researchers are recognizing that processing has diverse and important effects on nutritional qualities of plant foods (Johns 1990; Wandsnider 1997). One such effect is to increase digestibility and palatability of a food. For example, camas bulbs, an important root food for peoples of the Pacific Northwest (Beckwith 2004; Kuhnlein and Turner 1991; see also Crawford, Chapter 8, this volume), were prepared by pit-cooking, after which they were described as being exceptionally sweet, with a characteristic dark colour (Malouf 1979).

Analysis of raw camas bulbs revealed that they contained almost no starch, but rather a fructose-dominated polysaccharide, or fructan, called inulin (Yanovsky and Kingsbury 1931). ("Inulin" now specifically refers to fructans with mainly (2–>1) fructosyl-fructose linkages [Waterhouse and Chatterton 1993], but for the purposes of this discussion, inulin and fructan can be used interchangeably.) Fructans are not digestible in the human small intestine, but rather are fermented in the colon. However, under prolonged moist-heating conditions, inulin hydrolyzes to its constituent fructose units and becomes both sweet and digestible. Konlande and Robson (1972) showed experimentally that pit-cooking breaks down the inulin in camas bulbs almost completely. It is likely that the same process occurs in pit-cooked bulbs of onions and other *Allium* species, which also contain fructan as a major storage carbohydrate (Van Loo et al. 1995), as well as *Balsamorhiza* and other inulin containing roots.

On the basis of circumstantial evidence, some have suggested that yellow glacier lily bulbs also contain inulin (e.g., Kuhnlein and Turner 1991; Parish et al. 1996; Turner et al. 1990). As described in Part 2, these bulbs were often pit-cooked traditionally and became sweet and brown following that treatment. The similarities to camas and onion bulbs are undeniable, and all these species are in the same plant family (Liliaceae).

Contrary evidence comes from Yanovsky and Kingsbury (1938), who found mostly starch in the yellow glacier lily bulbs they analyzed. However, they used an outdated and crude analytical method, and according to Incoll and Bonnett (1993), any analytical work on fructans that predates chromatography must be confirmed and refined with modern methods. Also, starch and fructans are not mutually exclusive as storage carbohydrates, and Yanovsky and Kingsbury may not have detected short-chain fructans.

The rest of this section presents the results of nutritional and carbohydrate analyses of yellow glacier lily bulbs, including changes in bulb carbohydrates over the course of the growing season and with different treatment methods. It also assesses the practical nutritional contributions and health implications of these bulbs as part of the traditional food system.

Field Methods

Most bulbs for carbohydrate analysis were collected in 1996 at Neskonlith Meadows, near Chase in south-central BC (see Figure 6 and Table 2). This low-elevation (500 m) area has great traditional significance to the Secwepemc for root gathering. For the seasonal comparison, bulbs were collected at Neskonlith Meadows from plants at four growth stages (Figures 9–12): *pre-flowering, flowering, early fruit,* and *mature fruit*.

For the treatment comparison, bulbs came from two places. The first set, from Neskonlith Meadows, was divided into samples for all five treatments: *raw, wilted, boiled, dried* and *pit-cooked* (see the diagram of this protocol in Figure 13 and the photos in Figures 14–17). These Neskonlith bulbs were collected when the yellow glacier lilies were just entering the mature-fruit stage. Although this was phenologically slightly later than the preferred time described by Mary Thomas (Part 2), she was present during the digging and confirmed that the bulbs had not yet turned "watery" and were therefore still suitable for consumption.

The second set of bulbs was collected later in 1996 in a subalpine meadow east of Enderby, BC (1,870 m elevation), from plants at the preferred early-fruit stage. Owing to logistical constraints, these bulbs were used to replicate only the drying and pit-cooking treatments. Some of the pit-cooked subalpine bulbs were used for a general nutrient analysis (i.e., proximate composition and some minerals) in addition to carbohydrate analysis (see Kuhnlein et al., Chapter 6, this volume).

Figure 9. *(Far left) Pre-flowering:* leaves expanding, flower buds unopened. Photo by Dawn C. Loewen.

Figure 10. *(Left) Flowering:* leaves fully expanded, flowers fully opened. Photo by Dawn C. Loewen.

Figure 11. *(Far left) Early fruit:* leaves beginning to wither and turn yellow, tepals faded or shed and green fruits formed. Photo by Dawn C. Loewen.

Figure 12. *(Left) Mature fruit:* leaves completely withered and brown, fruits straw-coloured and opened. Photo by Dawn C. Loewen.

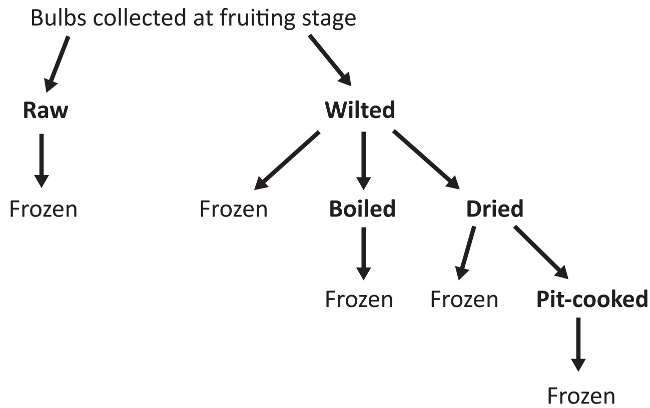

Figure 13. Diagrammatic scheme of bulb processing procedures for treatment comparison. Bold type highlights the five compared treatments.

Figure 14. *Wilted:* bulbs cleaned and left to dry at ambient temperature for about 24 hours. Photo by Dawn C. Loewen.

Figure 15. *Boiled:* wilted bulbs cooked by boiling until tender, about five minutes. Photo by Dawn C. Loewen.

Figure 16. *Dried:* two sets of wilted bulbs strung on cotton thread and hung to dry in well-ventilated location indoors, the first set for 21 days and the second for 14 days. Photo by Dawn C. Loewen.

Figure 17. *Pit-cooked:* two sets of dried bulbs steam-cooked in earth oven, the first set for 21 hours and the second for 20 hours. Photo by Dawn C. Loewen.

For both the seasonal and treatment testing, bulbs were cleaned with tap water, frozen immediately or right after treatment and freeze-dried as soon as possible. Bulbs for the general nutrient analysis were cleaned meticulously with distilled water after harvesting to avoid confounding the mineral readings.

As shown in Figure 13, the treatments are cumulative; later treatments build upon certain preceding ones. The "wilting" treatment was important because enzymes can rapidly change the carbohydrate profile once an underground structure is detached from the rest of the plant (Geigenberger et al. 1994; Oparka et al. 1990). Because the bulbs could not be boiled immediately after digging—and generally would not be by anyone on a digging expedition—a "wilted" (one-day dried) control was needed to separate the effects of temporary drying from those of boiling. Similarly, we wished to compare changes induced by wilting to those caused by complete drying; and we wished to compare changes caused by drying alone to those caused by drying and pit-cooking.

Our two pit-cooking trials incorporated the essential elements of the Interior Salish method, as depicted in Figure 7. In the first trial, which was part of a cultural education course in July 1996, we dug a pit approximately 1 m in diameter and 1 m deep, and heated grapefruit-sized "lava rocks" (vesicular basalt) in a fire alongside the pit for approximately two hours. The pit was "glazed," as Mary Thomas recommended, by using small, dry sticks as fuel to create a very hot fire in the pit, thereby blackening and hardening its sides. Debris from this fire was removed, and about 20 red-hot rocks were placed on the bottom of the pit in a single layer. A thin layer of moistened dirt was spread on the rocks, and then water-soaked Douglas-fir, rose (*Rosa* sp.), and thimbleberry (*Rubus parviflorus*) branches were layered on top. Next came the food: dried (not reconstituted) yellow glacier lily bulbs from Neskonlith Meadows, wrapped in cotton cheesecloth, along with balsamroot roots, wild nodding onion bulbs, whole salmon, moose meat, garden potatoes, carrots and onions. On top of the food, more thimbleberry, rose and Douglas-fir branches were layered. Finally, about four litres of clean stream water was poured into the centre of the pit, and temperature probes were placed near the top and bottom of the pit. Finally, a large canvas was used to cover the pit, and dirt was shovelled on top until no steam could be seen escaping.

The temperature of the pit was recorded periodically throughout the 21 hours of cooking time (see Peacock 1998). An average of the top and bottom values should give a reasonable indication of the cooking temperature in the centre of the pit, where the food was located. The average temperature reached a maximum of 78°C within the first hour, and declined gradually to 36°C after 21 hours, when the pit was opened. In this first pit-cook trial, the bulbs did not appear to have been penetrated fully by the steam, as they were still somewhat dry in the centre, but they were still deemed suitable for analysis.

The second pit-cook, in August 1996, used the same pit. It had been filled in and was now re-excavated to only 50 cm deep and 80 cm wide, because less food was being cooked in this trial. In general, the same procedure was followed, with the following exceptions. First, in this trial the dried yellow glacier lily bulbs were rehydrated by soaking them for 5.5 hours in distilled water before cooking. Second, fist-sized river cobbles (granite) were used instead of the "lava" rocks, because it was felt that they would perhaps retain heat better. Third, the fire used to heat the rocks was located in the pit instead of next to it (unburned wood was removed once the rocks were hot). Fourth, we added to the pit only the subalpine yellow glacier lily bulbs, balsamroot roots, prickly pear cactus (*Opuntia fragilis*) pads, and about three litres of stream water. Finally, the pit was opened one hour sooner. Temperatures of this pit were higher, quickly reaching a maximum of 98°C and decreasing to 58°C after 20 hours. The lily bulbs were cooked through, and looked much darker than after the first attempt.

Laboratory Methods

The dried/pit-cooked sample for general nutritional analysis was placed on ice upon removal from the pit, then placed in a cooler with dry ice and shipped by air to the Centre for Indigenous Peoples' Nutrition and Environment (CINE), McGill University, Montreal, for freeze-drying and analysis. See Kuhnlein et al. (Chapter 6, this volume) for methods used to determine moisture, protein, ash, crude fat, three nutritional minerals (calcium, iron and zinc), dietary fibre, digestible carbohydrate and energy.

The rest of the samples, all for detailed carbohydrate analysis, were freeze-dried to constant weight, then shipped in sealed plastic bags to Agriculture Canada in Ottawa (now Agriculture and Agri-Food Canada, Harrow, Ontario). See Mullin et al. (1997) for methods used to determine starch, water-extractable sugars (glucose, fructose, sucrose, fructans), and soluble and insoluble fibre.

It later became possible for additional analyses to be performed in Ottawa (protein, ash, and fat), which resulted in a partial duplication of, and useful comparison with, the general analyses performed in Montreal (Chapter 6, this volume). In these additional analyses, ash and fat were determined using AOAC (1984) methods. Protein was determined from the nitrogen generated by the Kjeldahl digestion method, using a conversion factor of 6.25 (IDF 1993). Duplicate subsamples were analyzed for moisture, protein, ash, and dietary fibre; subsampling for the other analyses varied and is indicated in the results accordingly.

Results

Proximate Analysis, Energy, and Minerals

The analyses performed in Montreal and Ottawa on the dried/pit-cooked bulbs from early-fruit, subalpine plants produced comparable results (Kuhnlein et al., Chapter 6, this volume; Loewen 1998). Therefore, the average values from the two analyses are presented in Table 3. The bulbs consist of just over 94% carbohydrate on a dry basis, with about 7% of this in the form of dietary fibre and thus not considered digestible. The other approximately 6% is divided as follows: 3.1% protein, 1.6% fat (one analysis found 3%, the other a trace), and 1.1% ash. Of the four nutritional minerals assayed individually, calcium had the highest values. However, the bioavailability of these minerals (i.e., the ease with which they can be absorbed by the human digestive tract) is not known.

Table 3 also shows that the composition of pit-cooked yellow glacier lily bulbs is comparable to that of baked potato (*Solanum tuberosum*) and baked sweet potato (*Ipomoea batatas*) (both peeled). In fact, the lower moisture value of the dried/pit-cooked lily bulbs makes them a more nutrient-dense food source; i.e., for a given amount of cooked product, more food energy is derived from lily bulbs than from baked potato or sweet potato. On a dry basis, lily bulbs are lower

Table 3. Proximate composition and mineral nutrients for yellow glacier lily bulbs, potato tubers, and sweet potato roots, per 100 g fresh and dry mass. The second line for each sample represents values calculated on a dry basis.

Food	Moisture (g)	Fat (g)	Protein (g)	Total fibre (g)	Digestible CHO by diff. (g)	Energy kcal	Energy kJ	Calcium (mg)	Copper (mg)	Iron (mg)	Zinc (mg)
Yellow glacier lily bulbs from early-fruit plants, dried and pit-cooked[1]	51.0	0.8	1.5	3.3	42.9	186	776	23.0	0.13	0.8	0.9
	—	1.6	3.1	6.7	87.6	380	1,584	42.6	0.24	1.5	1.7
Potato tubers, baked and peeled[2]	75.0	trace	1.9	1.0	20.4	93	389	5.0	0.18	0.4	0.3
	—	trace	7.6	4.0	81.6	372	1,556	20.0	0.62	1.6	1.0
Sweet potato roots, baked and peeled[3]	73	trace	1.8	2.4	22.2	103	431	28.1	0.15	0.4	no
	—	trace	6.7	8.9	82.2	381	1,596	104.1	0.53	1.5	data

[1] Average of values from analyses at two laboratories, except for minerals (analyzed by one laboratory).
[2] Health and Welfare Canada (1988), except zinc and copper data from Paul and Southgate (1978).
[3] Health and Welfare Canada (1988), except copper data from Paul and Southgate (1978) for boiled sweet potato (zinc not available).

in protein but higher in fat than the other two sources. The bulbs are also higher in calcium and zinc than baked potato, with about the same amount of iron as both potato and sweet potato. If the full spectrum of vitamins and minerals were analyzed, a more complete comparison could be made. It is clear, however, that this root vegetable acted as a potato-like, carbohydrate-rich food source in the traditional diet, and in at least some respects it was more nutritious.

Seasonal Changes in Carbohydrates

General nutrient data for yellow glacier lily bulbs at the four seasonal stages are given in Table 4. Moisture levels are high during the early, most active period of plant growth, declining to a low in the early-fruit stage. Fibre and protein increase to a peak in the early-fruit stage, but still represent a relatively small amount of the total mass. Carbohydrates make up a higher proportion (almost 30%) of the fresh mass at the early-fruit stage than at any other stage measured, and therefore the bulbs are the most nutrient dense at early fruit.

The digestible carbohydrate fraction is presented in more detail in Table 5, with the results distilled graphically in Figure 18. Two important results are evident:

1) *Starch, not sugars or fructan, is the dominant storage carbohydrate in yellow glacier lily bulbs over most of the growing season.* Kestose (a three-unit fructo-oligosaccharide) and traces of nystose (a four-unit fructo-oligosaccharide) were the only fructans present in sufficient quantities to be detected and measured individually. These quantities were very low compared with the amount of starch present, at all stages.They are also very low when compared with fructans in known inulin-storing species, such as balsamroot (Mullin et al. 1997) or camas (Konlande and Robson 1972).

Another result supports the assertion that fructans play a relatively minor role as a storage carbohydrate in yellow glacier lily bulbs. The fructose/glucose ratio was determined for all yellow glacier lily samples using hydrolysis by 1% oxalic acid. This treatment hydrolyzes fructans, including sucrose, but does not affect starch, cellulose, hemicellulose and pectins. The resulting fructose/glucose ratio gives an indication of the mean fructan chain length. Ratios for all yellow

Table 4. Proximate composition and energy values for raw yellow glacier lily bulbs at different seasonal stages, per 100 g fresh and dry mass. The second line for each sample represents values calculated on a dry basis.

Stage	Moisture (g)	Fat (g)	Protein (g)	Ash[1] (g)	Soluble fibre (g)	Insoluble fibre (g)	Total fibre (g)	Digestible CHO by diff. (g)	Energy kcal	Energy kJ
Pre-flowering	90.7	trace	0.4	0.5	0.2	0.3	0.5	7.9	33	139
	—	trace	4.2	5.1	2.6	3.2	5.8	84.9	356	1,491
Flowering	87.3	trace	0.5	0.5	0.3	0.4	0.7	11.0	46	192
	—	trace	4.2	3.6	2.7	3.2	5.9	86.3	362	1,515
Early fruit	66.9	trace	1.4	0.4	0.9	1.0	1.9	29.4	123	515
	—	trace	4.1	1.2	2.6	3.1	5.7	89.0	372	1,558
Mature fruit	69.9	trace	1.2	0.8	0.8	0.9	1.7	26.4	110	462
	—	trace	4.1	2.6	2.6	3.1	5.7	87.6	367	1535

[1] Variation in ash may be due to traces of soil clinging to the bulbs; these samples were not cleaned meticulously because they were not being assayed for individual nutritional minerals.

Table 5. Carbohydrate composition per 100 g dry mass of raw yellow glacier lily bulbs collected at Neskonlith Meadows at different seasonal stages.

Stage	Glucose[1] (g)	Fructose[1] (g)	Sucrose[1] (g)	Kestose[1] (g)	Starch[2] (g)	Total CHO[3] (g)
Pre-flowering	11.2 (1.59)	12.9 (1.45)	16.3 (2.20)	4.4 (0.59)	19.4 (0.51)	64.1
Flowering	5.1 (0.79)	4.0 (0.64)	2.4 (0.16)	1.5 (0.58)	53.8 (0.44)	66.8
Early fruit	1.1 (0.10)	0.3 (0.06)	3.6 (0.34)	2.9 (0.36)	77.5 (0.30)	85.3
Mature fruit	1.2 (0.20)	0.5 (0.09)	4.7 (0.42)	3.5 (0.49)	74.0 (0.25)	83.8

[1] Standard deviation of mean given in parentheses; 6 subsamples.
[2] Standard deviation of mean given in parentheses; 3 subsamples.
[3] Sum of the carbohydrate values listed here. Not included are traces of nystose (tetrasaccharide fructan consisting of three fructose units and one terminal glucose), which were also found in all samples. These values differ from the carbohydrate values as calculated by difference in Table 4. This type of discrepancy is a topic of current interest in food science now that detailed carbohydrate analysis is becoming more common, and is not an aberration unique to this study (see further discussion in Loewen 1998).

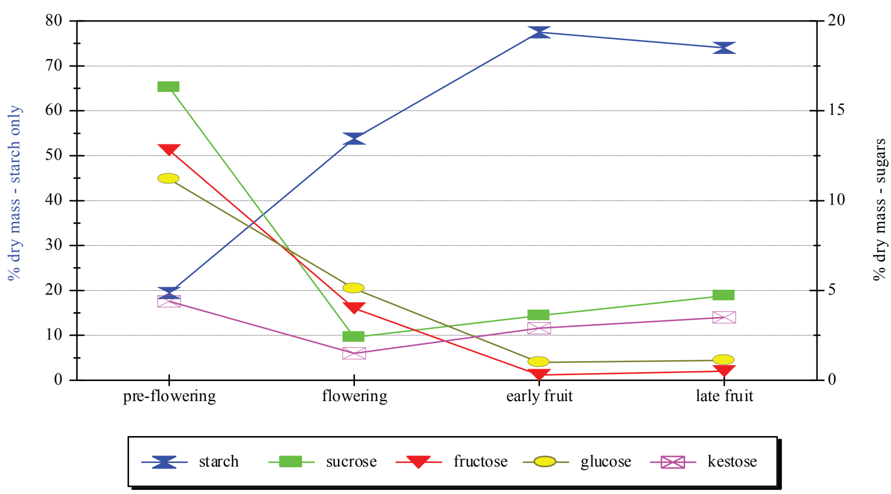

Figure 18. Changes in carbohydrates of yellow glacier lily bulbs over the growing season. Note that for ease of viewing, the axis for sugars is exaggerated relative to the axis for starch.

glacier lily samples ranged from 0.77 to 1.01, with no obvious relationship to stage of growth or treatment. In contrast, values for balsamroot ranged from 5.91 to 8.20, with smaller values associated with pit-cooked samples.

2) *The carbohydrate profile of the bulbs changes dramatically over the course of the season*. At the beginning of the growing season, yellow glacier lily uses soluble sugars translocated from the bulb to support its early rapid growth (cf. Miller 1992). These sugars (glucose, fructose, kestose and particularly sucrose) are together present in an amount more than double that of starch. However, this spring ephemeral begins to store energy in the bulb, in this case as starch, almost as soon as the leaves unfold. The increase in starch and decrease in sugars from the pre-flowering to flowering stages is remarkable because these stages may be separated by a matter of only days.

Starch reaches a peak and sugars a minimum at the early (green) fruit stage of growth. Later in the season, as the fruits mature and leaves shrivel, starch begins to decline, while sugars increase. At this point, the active period of photosynthetic accumulation is coming to an end, and the plant will have to rely on stored carbohydrates for the remainder of the fruiting period.

Effects of Processing Treatments

General nutrient analysis of lily bulbs subjected to five different treatments revealed insignificant differences among treatments (Loewen 1998); the values on a dry basis were all very similar to those presented for dried/pit-cooked bulbs in Table 3. Moisture levels showed the only real change, and it was predictable; raw bulbs contained 68% moisture, declining to 62% for wilted bulbs and 20% for dried bulbs. Boiling rehydrated the wilted bulbs completely (to 69% moisture), while pit-cooking rehydrated the dried bulbs partially (to 51%). Of greater interest are the results from the detailed carbohydrate analysis, presented in Table 6 and Figure 19. Kestose is omitted in the figure because it generally occurs in trace quantities in these samples, and does not vary in any systematic way.

Table 6. Carbohydrate composition per 100 g dry mass of yellow glacier lily bulbs collected at two sites and subjected to different treatments.

Treatment	**Glucose[1] (g)**	**Fructose[1] (g)**	**Sucrose[1] (g)**	**Kestose[1,3] (g)**	**Starch[2] (g)**
Raw (Neskonlith)	1.0 (0.24)	0.5 (0.01)	3.9 (0.26)	3.2 (0.25)	76.9 (0.52)
Wilted (Neskonlith)	2.8 (0.38)	2.2 (0.20)	4.7 (0.58)	trace	71.7 (0.07)
Wilted, Boiled (Neskonlith)	1.7 (0.33)	1.2 (0.22)	4.6 (0.49)	trace	72.4 (0.50)
Dried I (Neskonlith)	9.2 (1.97)	7.8 (1.50)	12.4 (2.39)	4.0 (0.63)	47.3 (0.45)
Dried/Pit-cooked I (Neskonlith)	7.8 (0.48)	7.5 (1.42)	2.9 (0.15)	trace	62.0 (0.28)
Dried II (subalpine)	5.0 (0.46)	4.0 (0.22)	8.5 (0.52)	trace	64.6 (0.35)
Dried/Pit-cooked II (subalpine)	3.8 (0.32)	3.6 (0.40)	5.9 (0.30)	trace	69.4 (0.21)

[1] Standard deviation of mean given in parentheses; 8 subsamples.
[2] Standard deviation of mean given in parentheses; 3 subsamples.
[3] Traces of nystose were also found in all samples.

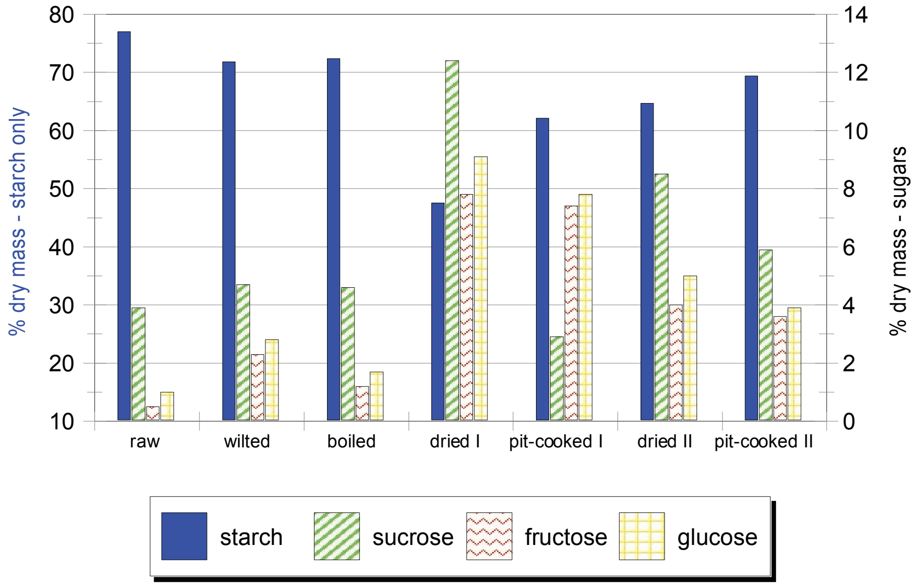

Figure 19. Carbohydrates in raw and treated yellow glacier lily bulbs (all from fruiting plants). Note that for ease of viewing, the axis for sugars is exaggerated relative to the axis for starch.

Common to all samples is the high proportion of starch, which is not surprising given that all samples were collected when the plants were in fruit. The wilting process did affect the sweetness of the bulbs to some degree, with an increase in all simple sugars and a corresponding decrease in starch. This increase in sugars at the expense of starch occurs much more noticeably after drying for three weeks. Therefore, it appears that enzymatic activity in the bulbs continues well into the drying period. Boiling of the wilted bulbs had little impact on the carbohydrate profile, with the slight decrease in monosaccharides probably due to leaching. Finally, pit-cooking appears to actually *decrease* the level of sugars slightly from the level in the dried bulbs. Sucrose is readily thermally degraded (Wursch 1989) and was likely hydrolyzed to its constituent monosaccharides by the hot steam in the pit. In turn, the decrease in monosaccharides may have been due to Maillard reactions (nonenzymatic browning), in which reducing sugars (e.g., fructose, glucose) react with free amino groups of amino acids. These reactions, which are encouraged by long exposure to heat (Wursch 1989), yield compounds that could account for the distinctive flavours and colour of pit-cooked bulbs.

The absolute amounts of the various carbohydrates differ between the first and second dried samples, and between the first and second dried/pit-cooked samples. This difference is most likely because the subalpine bulbs were from plants in early fruit, while the Neskonlith bulbs were from plants just entering mature fruit (see Table 5; early-fruit bulbs have higher starch and lower sugar levels). However, the pattern of change—a decrease in sugars, though higher than in raw bulbs—remained the same when the second group of bulbs was pit-cooked.

Discussion

Carbohydrate Composition and Seasonal Changes

This study is by far the most detailed to date of the carbohydrate composition of yellow glacier lily bulbs. However, a limited comparison can be made with the results of three other studies on the same species.

Yanovsky and Kingsbury (1938) analyzed many traditional food plants. For yellow glacier lily bulbs, they found the following carbohydrate breakdown, on a dry basis (stage of growth was not specified: 44.8% starch, 12.2% "reducing sugar," which they interpreted as glucose, and 9.2% "non-reducing sugar," which on the basis of optical rotation they determined was sucrose. As noted above, their methods would have been unable to separately detect short-chain fructans. Our results support the idea that starch makes up most of the bulb carbohydrates of yellow glacier lily. The importance of a seasonal comparison is apparent, however, because our data show that the bulbs do contain a significant proportion of water-soluble carbohydrates (sugars and short-chain fructans) early in the growing season.

Two more recent studies have also contributed some information on the carbohydrates in glacier lily bulbs. Wittenberg (1998) found combined starch and glucose values for the bulbs ranging from 77.6% (dry weight) at full flower, rising to a maximum of 85.0% when the foliage started to brown, and falling again to 75.4% when the plant was completely desiccated. These values are quite similar to those reported here. On the other hand, Tardiff and Stanford (1998) found "water-soluble carbohydrates" in the bulbs at a level of approximately 55% dry weight in full flower, and about 65% very late in fruit. These results are very different, but the analysis method was also completely different. Tardiff and Stanford followed a method normally applied to forest litter, using a hot-water extraction to assay the water-soluble carbohydrates. According to Southgate (1991), such an extraction will also extract part of the starch fraction. Therefore, it is not clear to what extent Tardiff and Stanford's water-soluble carbohydrates represent sugars, fructans, or starch.

The seasonal changes in carbohydrates we found in yellow glacier lily bulbs are very similar to those described by Risser and Cottam (1968) for two eastern species, white trout lily *(Erythronium albidum)* and yellow trout lily *(E. americanum)*. In these two species, which have almost identical patterns, starch content is low at the beginning of the growing season, and then increases rapidly (to 64% from 13% over 21 days in *E. albidum*). Following this burst of accumulation, starch decreases slowly over the summer and then drops off more rapidly in fall. Conversely, moisture and soluble sugars (especially sucrose) are in high amounts at the beginning of the growing season, steadily decline until the end of the growing season, and then increase again in fall.

This type of change in the storage carbohydrate, from sugars during the early, cold part of the season, to starch during the active part of the growing season, has also been noted in certain alpine species such as American bistort *(Polygonum bistortoides)* (Mooney and Billings 1960). It has been suggested that soluble carbohydrates, including fructans, play a role in frost hardiness, but the evidence is equivocal (Pollock 1986).

Such changes in relative amounts of carbohydrates do not necessarily correlate with changes in total bulb mass. Young (1998), however, recently determined that bulb biomass of yellow glacier lily increases over the growing season to a maximum at the last stage studied, which was when the leaves were beginning to die back (early fruit). No further stages were measured, so it is not clear whether this stage represented peak biomass, but an indication that this is in fact true come from Muller (1978). His research included a detailed study of biomass accumulation in *E. americanum*. During the "lag phase" immediately following snowmelt, bulb weight drops as material is translocated to the shoot. Then, in the "active phase," plant (and bulb) weight increases in a rapid, almost linear fashion, on the order of 190% in 18 days. The end of this phase, during which most of the bulb mass is added, occurs shortly after the leaves begin to die back. A period of relative stasis and finally a decrease in plant and bulb weight follows and continues through the fall and winter, except for a slight increase in bulb weight when the shoot dies back completely and, presumably, materials are resorbed into the bulb.

On the basis of these studies and the results reported here, it seems reasonable to conclude that the cycles of starch and biomass accumulation coincide in the bulbs of yellow glacier lily. Further evidence of this type of correlation in starchy geophytes comes from Theron and Jacobs (1996), who found that in a nerine (*Nerine bowdenii*), changes in starch content closely followed dry weight changes in the bulb.

Given, then, that for yellow glacier lily bulbs, a) bulb mass appears to be at a maximum when starch is at a maximum, and b) starch (and total carbohydrate, relative to moisture) reaches a maximum in the early-fruit stage, it appears that harvesting bulbs at the early-fruit stage would result in obtaining more mass per bulb, and more energy per unit mass, than at any other stage of growth. Therefore, as has been suggested by some Indigenous elders, this stage would be optimal in terms of maximum food value return on the harvesting effort. The bulbs would also be a good food source during much of the flowering period and well into the fruiting period.

Effect of Processing Methods on Bulb Carbohydrates

In inulin-containing root vegetables, pit-cooking—a long exposure to heat, moisture, and acidity—is necessary to make the food digestible and sweet (Konlande and Robson 1972). In the starch-containing yellow glacier lily bulbs, digestibility is not an issue to the same degree. Any cooking process involving moisture along with temperatures above about 65°C (Kearsley and Sicard 1989) will gelatinize the starch and make it available to digestive enzymes. In terms of sweetness, it appears that for these bulbs it is *drying* that increases levels of sugars relative to starch. Certainly, some elders have noted the distinct sweetness of dried bulbs and the importance of drying bulbs before pit-cooking. As Mary Thomas (SEP 1993–1997) put it, "They'd leave [the bulbs] to dry, or wilt, and then string [them] up on maple inner bark … to dry, and that was pit-cooked in winter or any other time … you bring out the sugar content after it was dried and then pit-cooked."

The enzymatic process underlying the conversion of starch to sugars in the bulbs is unknown. In potatoes, it is common knowledge that low storage temperatures (below 10°C) induce an increase in hexose content, and the physiology of this process has been well studied (Geigenberger et al. 1994; Oparka et al. 1990; Richardson et al. 1990). In certain other starchy root vegetables, however, storage at *warm* temperatures results in conversion of starch to sugars; e.g., when tubers of oca *(Oxalis tuberosa)*, an Andean root crop, are placed in the sun for a few days, the amount of glucose can nearly double (Flores and Flores 1997). As the latter authors point out, much work remains in understanding the biology and biochemistry of many underground storage organs.

Pit-cooking after drying reduces the sugars somewhat from their levels in dried glacier lily bulbs, but these levels are still much higher than those in the raw, wilted or boiled bulbs. Levels of simple sugars, in particular, are higher, and fructose is known to be 74% sweeter than sucrose by weight.

Unlike fructan-containing plants such as balsamroot or camas, yellow glacier lily bulbs were processed in other ways in addition to pit-cooking (see Part 2). This fact supports the suggestion that pit-cooking was not necessary to derive maximal nutritional benefit from the bulbs.

Still, pit-cooking was undoubtedly significant in the ethnobotany of this species. Pit-cooking represents an efficient means of processing the large quantities of bulbs that were gathered, and they were often cooked together with other foods. Indeed, cooking such large quantities appears to be a general characteristic of pit-processing (Wandsnider 1997). Also, pit-cooking would have imparted distinctive flavours to the bulbs. Other foods and vegetation used to line the pit (e.g., rose branches) must have added flavours that were appreciated traditionally. Maillard reaction products produced in the bulbs may have been significant; some of these compounds do in fact have sweet, caramel aroma notes (Rizzi 1994). Maillard products are also known to reduce oxidative degradation in foods (Pischetsrieder and Severin 1994), a fact that may have been significant in winter storage of lily bulbs.

Nutritional Significance of Yellow Glacier Lily Bulbs

As is the case for most root vegetables (FAO 1990), yellow glacier lily bulbs are rich in carbohydrates and food energy, and relatively low in protein, fat and minerals. Ascertaining the nutritional characteristics of a food source, however, is only one step in assessing its overall importance in the diet. It is also necessary to consider the total amounts of the food consumed, and how these compare to amounts of other plant and animal foods in the traditional diet.

As noted in Part 2, a northern Interior Salish family group might gather approximately 90 kg of yellow glacier lily bulbs as a winter supply. Assuming a family group is five people, then for eight months (September to March), the average daily intake per person would be about 75 g. Additional bulbs would have been available fresh at either low or high elevations for most of the remaining months. However, there may have been a few months when intakes were low, either because of the stores running out, or because people were concentrating on gathering other foods. If it is conservatively assumed that the 90 kg represented the *entire year's* consumption by five people, the result is an average daily intake per person of just under 50 g.

It may be that the estimate of 75 g/day is reasonable for people living close to abundant supplies of the lily (e.g., around Neskonlith), while 50 g/day is more realistic for groups with less convenient supplies, or who acquired their supply through trade. Note that both estimates are still likely to be conservative for two reasons: first, the 90 kg estimate is derived from post-contact interviews, and the actual consumption before European influence was likely to be considerably higher; and second, we assume a family group is five people, rather than four, as in other similar calculations (Hunn and Selam 1990).

To put the estimate of 50–75 g/person/day in perspective, it can be compared with the modern consumption of potato, the root vegetable that has largely supplanted traditional root foods in Interior Salish diets. Per capita consumption of fresh potatoes in Canada in 2000 was about 33 kg (Statistics Canada 2001; Vandenberg and Burafuta 2001), or 91 g/person/day. This value is an overestimate, because it represents the amount available to consumers, rather than the amount actually eaten (losses from spoilage and waste are not considered). The lily estimate, on the other hand, is conservative. The two values, then, are of a similar magnitude, suggesting that yellow glacier lily bulbs can indeed be considered a starchy staple in the traditional diet.

For most northern Interior Salish peoples, yellow glacier lily bulbs and spring beauty corms were the most significant root vegetables in terms of quantities eaten, based on comments by elders on the relative importance of different plant foods. Other root vegetables (e.g., spring beauty, balsamroot, desert parsley, chocolate-tips, riceroot, tiger lily, bitterroot, nodding onion) and greens (e.g., cow parsnip, *Heracleum lanatum*) provided energy, fibre, vitamins and minerals. Fruits, such as saskatoon berries, chokecherries (*Prunus virginiana*), and huckleberries (*Vaccinium membranaceum* and other spp.), may have been as significant as root vegetables in providing energy, as well as other nutrients.

In terms of animal foods, the traditional view of Interior Plateau hunter-gatherer diets has been that they were dominated by fish and game (see Part 2). Recent ethnobotanical research on the Plateau has suggested that plant foods were more important than previously thought. Hunn et al. (1998) estimate that many Plateau groups, at least in the protohistoric period, derived more than 50% of their food energy from starchy root vegetables. Also, as Pokotylo and Froese (1983) point out, it is likely that prehistoric groups relied more heavily on native root foods than is apparent from ethnographic records, because new forms of carbohydrates (potatoes, flour, sugar) quickly displaced the traditional sources after contact (Dawson 1891).

Even if animal foods did dominate the Plateau diet, the consumption of even small amounts of carbohydrate could have inordinately significant consequences for peoples' nutritional well-being. Carbohydrates supply much of the metabolic energy that enables the body to perform its different functions (Kearsley and Sicard 1989). The role of carbohydrates may have been especially critical for societies with pronounced seasonal fluctuations in food abundance, in which lean meat was often the only resource available in late winter and early spring (Speth and Spielmann 1983). Carbohydrates have a greater protein-sparing action than fat; i.e., carbohydrates, more than fat, allow protein to be used for its normal structural functions instead of for energy. Therefore, even if protein and fat sources are readily available, a hunter-gatherer society would benefit from expending significant effort on gathering energy-rich, easily stored sources of carbohydrate (Speth and Spielmann 1983).

From all accounts, it appears that yellow glacier lily bulbs were indeed collected and stored in large quantities, and were highly regarded as a tasty food and valuable trade item. They truly appear to have been a staple root vegetable on the Northern Plateau, analogous to modern potatoes in both composition and consumption.

Health Implications of Consuming Yellow Glacier Lily Bulbs

The potential health effects of consuming yellow glacier lily bulbs and other root vegetables extend beyond the nutritional contributions discussed above. Such considerations are particularly relevant given that diabetes and related disorders are severe problems in native North American populations today (Young 1993).

In particular, the starch component of the bulbs requires a closer examination. Although we have compared the bulbs to potatoes, these foods may have had very different properties in terms of the glycemic response. Increasingly, nutrition researchers are recognizing that not only the quantity but the quality of starch may have major health implications, in the same way that not all dietary fat is considered equal (Wolever 1991). Differences in starch digestibility, in fact, may have long-term implications with respect to risk factors for chronic diseases such as diabetes (Wolever 1991).

As much as 10–20% of the starch we consume reaches the colon as resistant (i.e., undigestible) starch (Stephen 1991). This newly recognized component of dietary fibre may be partly responsible for the positive health benefits previously attributed to various non-starch polysaccharides (Southgate 1989). These potential benefits include attenuated glucose and insulin responses, favourable influences on blood lipids and cholesterol, and improved colonic health (Muir et al. 1993).

Thorburn et al. (1987) and Brand et al. (1990) demonstrated that traditional starchy Australian Aboriginal and Pima Indian foods were digested more slowly and had lower blood glucose and insulin responses than modern starchy staples such as potato, bread, and rice. The authors impute an antidiabetic role to the slow digestion and absorption of starch in traditional foods.

It will require further research to determine the precise nature of the starch in raw and cooked yellow glacier lily bulbs. However, it is almost certain that the bulbs do contain a measure of resistant starch under a typical traditional processing regime. Starch that is cooked (gelatinized) and then cooled regains some of its crystalline structure, in a process called retrogradation. Retrograded starch is highly resistant to digestion (Muir et al. 1993). Reheating reverses the effect, but only partially, and successive cycles of heating and cooling result in increasing amounts of resistant starch (Englyst and Cummings 1987). Traditionally, yellow glacier lily bulbs were often cooked, cooled, cold-stored for winter, and reheated, processes that would result in some accumulation of resistant starch. Wandsnider (1997) suggests that traditional foods with slowly digested starches were often pit-cooked (though with lower temperatures and less cooking time than fructan-containing roots), while foods with rapidly digested starches were not. Yellow glacier lily bulbs may fall in the former category, while spring beauty corms, which were not pit-cooked, may fall in the latter.

Fructans, and particularly short-chain fructo-oligosaccharides (FOS), represent another category of newly recognized dietary fibre whose health benefits are only now being appreciated. FOS are present in relatively low amounts in glacier lily bulbs, but they cannot be ignored given the large quantities of the bulbs traditionally consumed. Also, Incoll and Bonnett (1993:319) note that the "greatest interest in occurrence of fructan in food plants has been in species containing high concentrations like Jerusalem artichoke (*Helianthus tuberosus*) and chicory (*Cichorium intybus*). This is unfortunate in our opinion because beneficial effects of fructan in human diets may be apparent at much lower concentrations."

Many of the health benefits of FOS stem from the fact that they selectively encourage the growth of "good" bacteria (bifidobacteria) in the colon (Modler 1994), at the expense of such toxin-producing bacteria as *Clostridium* species. It is possible that once a bifidobacterial flora has developed in the colon through exposure to fructan, then small amounts of fructan are enough to "keep the flora going" (Dr. L. D. Incoll, University of Leeds, pers. comm. to DL 1998). In addition to a healthier colon, other possible benefits include lowered triglycerides and cholesterol, mediated by the absorbed fermentation products (Roberfroid 1993). In Japan and Europe, recognition of these benefits has advanced to the point where FOS are widely used as food additives (Modler 1994; Tomomatsu 1994); the trend is now taking off in North America.

Traditional forms of food processing would have culturally evolved to maximize the energy benefit from carbohydrate-rich foods, and to minimize indigestible fructans and digestion-resistant raw starch (Wandsnider 1997). Yet, such efforts probably were not totally successful, in the sense that nutritionally significant quantities of indigestible, or slowly digested, carbohydrates remained after processing. However, this "failure" appears to have its own positive health consequences, lending new meaning to the blurring of the food and medicine concepts in the Indigenous worldview (see Part 2). The modern concepts of "nutriceuticals" and "functional foods" show that science is increasingly recognizing the validity of this holistic viewpoint. Foods such as garlic (*Allium sativum*), for example, have taken on a new role as dietary supplements with scientifically recognized health benefits.

Also likely to be significant are the positive cultural ramifications of consuming traditional foods such as yellow glacier lily bulbs as part of a modern diet (cf. Kuhnlein et al. 2006). Next to language, food may be the most fundamental defining element of any cultural group. A number of programs that have encouraged integrating traditional foods into the modern diet have been successful both in improving health and increasing cultural awareness and pride; e.g., the Nuxalk Food and Nutrition Program (Kuhnlein and Burgess 1997) and the Wai'anae Diet Program in Hawai'i (Shintani et al. 1991).

Yellow glacier lily bulbs can certainly be recommended as a traditional food for such a program. They are nutritious, tasty and culturally significant. The plant is common in the wild, and it can also be grown in a garden setting, as Mary Thomas did. Harvesting the bulbs would have additional benefits in terms of exercise, particularly given the very tough turf layer that has developed in many traditional gathering areas. The potential for overharvesting is always a concern when recommending use of a wild food, but in this case, if harvesting is done prudently—in keeping with traditional principles—it could actually help maintain vigorous lily populations, as discussed in Part 4.

Part 4: Ethnoecology

Many plant ecologists' research concerns plant dynamics in "natural" or "pristine" environments, with human influence considered an unnatural disturbance factor. This view of human impacts may be appropriate in terms of modern effects such as urban sprawl, industrial logging or pesticide spraying. But many plant communities in western North America and elsewhere have been influenced for millennia by First Nations peoples (Anderson 2005; Blackburn and Anderson 1993; Boyd 1999; Deur and Turner 2005; Minnis and Elisens 2000), and therefore past human impacts legitimately may be considered a natural part of such ecosystems. An ecological examination of any plant species—particularly one known to have been used and managed intensively—is incomplete without considering potential cultural influences. Conversely, ecological information can lend insight into a species' cultural significance.

The commonness and abundance of yellow glacier lily must have been key factors in allowing this species to become an important food resource for Northern Plateau peoples. Yet, the breadth of the species' range, and the fact that large populations of the plants still exist in traditional gathering areas, lead to such questions as the following:

i. Could Indigenous peoples have influenced the range of the species?
ii. How could the bulb resource have been harvested sustainably in large quantities over long periods of time?
iii. Is yellow glacier lily adapted to a disturbance regime such as that associated with First Nations' use and management?

These questions relate to distribution and abundance, the two major aspects of ecology according to Krebs (1978). Of the two, distribution is more difficult to address. Many factors, including chance, can influence why a species occurs in some areas and not others, and conditions may have been very different for dispersal of yellow glacier lily in the distant past than today (Loewen et al. 2001).

For yellow glacier lily, there is little evidence that Northern Plateau peoples deliberately started new populations with seeds, although they may well have actively participated in seed dispersal during harvesting activities. In terms of transplanting the bulbs, opinions differ among contemporary Secwepemc elders. Although Mary Thomas transplanted the bulbs into her garden, she felt that in the past people had no need to do this: "They just cultivated them where they were growing" (SEP 1993–1997). By contrast, George Keener said of transplanting ***scwicw*** or other roots that "our people were known to do that" (SEP 1993–1997). Based on ethnobotanical documentation, it seems unlikely that the practice of transplanting was common, at least in the ethnohistoric period. Still, it may have been more common long in the past, or it may have taken place accidentally (Turner and Peacock 2005). Certainly it is possible for the bulbs to be transplanted successfully, even to a very different elevation and climate zone, as both Mary Thomas and Loewen (1998) have shown. The practice of storing bulbs fresh in cache pits may have led to this kind of accidental dispersal, if a pit were abandoned for some reason (Peacock and Turner 2000).

Likely effects of First Nations on plant abundance are easier to assess, and were probably more significant. At least three aspects of traditional use not only might have prevented overharvesting of yellow glacier lily populations, but might have positively affected them.

1) Tilling

Most gardeners are aware that tilling the soil can be beneficial for plant growth, and in fact "gardening" may be an apt description of the type of relationship Plateau peoples had with many plant resources. The action of the digging stick aerated the soil, aiding the growth of microorganisms and thus nutrient cycling (Bidwell and Hole 1965), as well as root growth. In addition, churning the soil and selectively harvesting the bulbs effectively thinned the growth, reducing competition from other vegetation and from older yellow glacier lily plants (see Anderson 1993b; Gott 1982; Gottesfeld 1994). Hughes (1992) showed experimentally that disturbance resulting in removal of co-occurring vegetation dramatically increases the local distribution and abundance of yellow trout lily in New Hampshire. That *Erythronium* species normally spreads by rhizomes, but sexual reproduction and seed dispersal also increase as a result of decreased competition.

The disturbed substrate resulting from digging probably also enhanced seed germination. Loewen's (1998) study (see Part 1) suggested that litter cover and depth inhibit seedling germination and juvenile survival in yellow glacier lily. Digging would remove litter from small areas and promote direct contact of seeds with the soil. This idea is supported by Caldwell's (1969) observation that seedlings of yellow glacier lily established readily on exposed mineral soils disturbed by burrowing animals.

Furthermore, the fact that people often harvested glacier lilies during the fruiting stage may have been significant in helping to scatter the seeds, which would prevent the seeds from being eaten by seed predators in the capsules. Also, the act of digging would have promoted at least partial burial of the seeds. Thomson et al. (1996) observed that, in garden plots, broadcast seeds of yellow glacier lily germinate much more prolifically if lightly buried by raking.

Indigenous peoples and grizzly bears once created such microdisturbances at lower elevations as well as in subalpine habitats. Today, grizzly digging and small mammal activity probably help maintain these effects at high elevations. Many vole populations exhibit periodic irruptions (Smolen and Keller 1987), and in such peak years their digging activity may produce a substrate remarkably like cultivated soil.

Bob Miller, a former park warden who spent most of his life in the Wells Gray Provincial Park area of BC, related (pers. comm. to DL 1996) that about 20 years ago a population irruption of voles occurred at Table Mountain. The yellow glacier lilies appeared at first to be decimated, but the ones that were left behind were larger than normal and had more flowers. Another such irruption occurred in 1996 on 52 Ridge (ca. 1,900 m) in Wells Gray Provincial Park, and there was indeed a "rototiller"-like effect (pers. observation by DL 1996). Over an area of at least a square kilometre, vigorous subalpine plants were growing in a churned soil with absolutely no turf layer and little litter.

Significant small mammal disturbances occur at some low elevation sites as well; for example, fresh winter soil casts left by pocket gophers are apparent in some sites in southwestern Alberta (pers. observation by DL 1996). In other low-elevation areas, such as Neskonlith Meadows in BC, the apparent current lack of human, grizzly bear and small mammal digging is a possible problem now compounded by increased litter from introduced grasses, the absence of landscape burning (see below), and the presence of cattle. These factors could have reduced the size of yellow glacier lily bulbs, as observed by Aboriginal elders (Part 2), and may hinder seedling establishment relative to subalpine habitats (Loewen 1998; Loewen et al. 2001).

Although experimental work investigating the impacts of Indigenous digging and harvesting is still in its infancy (Anderson 1993b, 2005), interesting comparisons can be made to studies of animal digging and burrowing. In particular, studies of pocket gopher and grizzly bear activity are relevant, because these mammals are known to influence many areas where yellow glacier lilies grow. Pocket gophers are fossorial rodents that create extensive tunnel systems. They have broad vegetarian diets but consume below-ground storage organs preferentially (Huntly and Inouye 1988). Pocket gophers alter species composition in their habitats, change soil structure and soil nutrients, and increase primary productivity (Huntly and Inouye 1988). One study cited by Huntly and Inouye (1988) found that the area around pocket gopher mounds exhibited significantly increased production that more than offset the local bare area of the mounds, a phenomenon they attribute to soil nutrients. Of particular interest is the fact that plants preferred as food by the gophers actually appear to *increase* in abundance as a direct result of gopher disturbance. As Huntly and Inouye (1988:791) remark, "These facts raise the interesting possibility that the overall effects of gophers, under at least some conditions, may result in gophers effectively farming their preferred resources."

Recent studies on grizzly bear digging are even more relevant here, for two reasons. First, grizzly bear digging is more similar to Indigenous human digging than is pocket gopher tunnelling (see Tardiff and Stanford 1998:2220). Young (1998:3) even notes that bears "have been observed redigging old digs, as if they were 'farming' the glacier lilies." Second, these studies have examined effects of digging in direct relation to yellow glacier lily growth, reproduction and physiology. Tardiff and Stanford (1998) and Young (1998) studied grizzly digs in a subalpine meadow in Glacier National Park, Montana, comparing soil and lilies in dug areas with those in adjacent undisturbed meadow. Tardiff and Stanford (1998) obtained the following statistically significant results: higher levels of ammonium and nitrate in dug soil—even true for soil from a 10-year-old dig; higher tissue nitrogen and water-soluble carbohydrates in bulbs from digs; and twice as many seeds produced by lilies in digs. They also created experimental digs and confirmed that digging results in higher ammonium and nitrate levels, ruling out the possibility that the bears are choosing sites already high in nitrogen. Young (1998) found that lilies in digs had higher photosynthetic rates than plants in undisturbed areas, a finding she attributed to the increased soil nitrogen in digs. The release from competition due to the digging disturbance may also help explain the results of both studies. Young did not find significant differences in seed number, seed weight, bulb biomass, or bulb nitrogen and carbohydrates, though the trends were for higher values in digs; the issue of statistical power was not addressed.

In both studies, the authors considered the broader ecosystem-level implications of the results. Bears may increase the rate of cycling and amount of nitrogen, a limiting nutrient, which would allow yellow glacier lilies and other plants with a low C:N ratio to be maintained over time; such plants, in turn, are more favourable for herbivores and microbial decomposers.

2) Vegetative Propagation

In the act of using their digging sticks and removing yellow glacier lily bulbs from the ground, Indigenous women probably separated the bulb-appendages from the bulbs and thereby promoted vegetative reproduction. This effect could be considered part of the incidental benefits of tillage discussed in the above section. However, this process was not always accidental. As discussed previously, at least some women purposely separated and replanted these appendages, thereby making the process much more effective.

It is clear that Indigenous hunter-gatherers had an understanding of the importance of selective harvesting and vegetative regeneration for root vegetables. At least 35 species were managed this way on the BC Plateau (Gottesfeld 1994; Peacock and Turner 2000). For the Dena'ina of Alaska, "if a person digs the roots or other underground parts of a plant, he may bury a small piece to insure the growth of a new plant" (Kari 1991:19). Anderson's (1997) review cites many examples for various groups in the present-day U.S. One example is the Cahuilla of southern California, who gathered the mature corms of blue dicks (*Dichelostemma capitatum*) in great quantity but carefully replanted the cormlets. A number of early European explorers and researchers observed these practices, and it is unlikely that all of these cases could have resulted from Indigenous peoples' learning horticulture from the Europeans.

The importance of replanting small segments has been demonstrated scientifically by Anderson (1993b) in her seminal traditional-harvesting research using blue dicks. Her experimental design consisted of factorial combinations of two-level variables including harvest intensity (50% or 100%) and replanting of cormlets (yes or no). At the end of the four-year experiment, medium-intensity harvests with replacement of cormlets resulted in the greatest number and weight of corms and cormlets. That these values were higher than those in the control plots shows the importance of thinning for this species. Surprisingly, however, harvesting 100% of the corms produced no significant differences from the 50% rate *when cormlets were replanted*. Therefore, the study showed that, even with very intensive harvesting, intentional vegetative propagation could maintain a productive and sustainable supply of a root-vegetable species.

3) Landscape Burning

As discussed in Part 2, landscape burning was widely practised by Plateau First Nations for a variety of purposes, including maintaining habitat for root-vegetable species (Turner 1991, 1999). The ethnographic literature and contemporary elders specify that yellow glacier lily was one root resource managed this way.

Yellow glacier lilies are well equipped to survive fires; the plants are safely ensconced underground well before conditions are warm and dry enough for an area to burn. Fire is a common influence in the glacier lily habitats surveyed by Loewen (1998): charcoal was found in 30 of 38 soil samples from widely separated sites in western Canada. Even more direct proof that these plants survive fire is given by Christensen et al. (1989): a photo shows yellow glacier lilies coming up through blackened ground the year after the intense 1988 Yellowstone fires.

Yellow glacier lily not only may be able to withstand fires, it may actually respond positively to them. Fire may be important in opening up and maintaining suitable habitat in otherwise unfavourable forested environments (Loewen et al. 2001). Even in meadows where the woody cover consists of shrubs, fire may play a positive role. Although yellow glacier lilies are often found growing under and around deciduous shrubs such as hawthorn, snowberry (*Symphoricarpos* spp.), and saskatoon, this co-occurrence is likely due to microtopography that influences moisture availability. Shrubs are a major source of litter, which is negatively correlated with reproductive success (Loewen 1998). If these areas were burned, lilies would very likely be more vigorous than they are now, in terms of increased juvenile survival and vegetative growth. Certainly many elders believe that when areas get too "bushy," they have to be burned to maintain optimal growth of root-food species (Turner 1991, 1999). Although many shrubs resprout (the basis of First Nations' burning to enhance berry crops), burning would still remove litter and reduce geophytes' competition from fire-intolerant species.

In addition to opening habitats, removing litter, and reducing competition, fire has other effects that would probably benefit yellow glacier lily growth. In general, soil pH increases after a fire, and this increase in pH, along with released nutrients, enhances growth of free-living, nitrogen-fixing bacteria (Barbour et al. 1987). The positive effects of nitrogen inputs on yellow glacier lily were discussed above; therefore, it seems that both digging and fire may be significant in promoting vigorous growth of this species. Scientific support also exists for Mary Thomas' idea that controlled burning removes pathogenic organisms (Bidwell and Hole 1965), though research has not been done on yellow glacier lily habitats specifically.

Although no studies have specifically examined the effects of fire on any *Erythronium* species, effects on other bulb-forming perennials have been documented. Californian species including death-camas (*Zigadenus fremontii*), soap plant *(Chlorogalum pomeridianum)*, blue dicks, and several species of mariposa lily (*Calochortus*) all exhibit enhanced flowering following a fire (Muller et al. 1968, cited by Barbour et al. 1987). In addition, a recent prescribed burn experiment in the San Juan Islands revealed that great camas (*Camassia leichtlinii*) increased dramatically after the burn, with cover values three to four times what they had been before (Dunwiddie 1997). Similarly, nodding onion and a species of mariposa lily (*Calochortus macrocarpus*) exhibited extremely vigorous growth in a burned area north of Lillooet, BC; the nodding onion plants were 65 cm tall (pers. observation by NT 1998). All of these species except death-camas were intensively used root foods in the Pacific Northwest (Anderson 1997; Turner 1995, 1997a), and it is likely that yellow glacier lily, another geophytic, managed food resource, would exhibit a similar pattern.

It is unlikely that seeds of yellow glacier lily in the capsules or on the soil surface could survive a fire. If, however, post-flowering harvesting helped bury seeds in the ground, such harvesting would aid survival because even just a few centimetres' depth may be enough to escape lethal temperatures (Barbour et al. 1987). Yet, even if the current year's seed crop were destroyed by a burn, the approximately five-year rotation of burning (see Part 2) would have allowed ample time for seed reproduction between burns. Also, according to seed biologist and *Erythronium* researcher Carol Baskin (pers. comm. to DL 1998), yellow glacier lily plants emerging the following year would probably be exceptionally vigorous and produce many seeds, so that the destruction of seeds in one year would be followed by a year of high seed production.

Implications of the Research for Related Disciplines

In the preceding discussion, we have used previous research to make specific inferences about likely effects of First Nations' activities on yellow glacier lily growth. In turn, the results of this study relate to and can help inform research in at least three fields of study: anthropology, ecology, and ethnoecology.

1) Anthropology

Alston Thoms' (1989) dissertation was an important advance in examining the potential past significance of root vegetables to hunter-gatherer diets in the Pacific Northwest. Using camas as the main basis for his argument, he delineated the following five criteria for determining whether a root resource is "intensifiable" (i.e., a resource for which intensive and sustained exploitation is expected):

- carbohydrate-rich underground parts;
- reproductive systems well adapted to regularly churned soils;
- extensive abundance in accessible settings;
- readily available (relative ease of digging); and
- resilience to environmental fluctuations.

Yellow glacier lily clearly meets the first three criteria. The fourth is more questionable today, with the tough turf layer in many areas, but elders indicate that at one time the bulbs were much easier to dig. Finally, it seems clear that the fifth criterion also applies to yellow glacier lily. The species' environmental amplitude is demonstrated in a basic way by the variety of habitats that it occupies. However, even if this amplitude is due to ecotypic differentiation, the transplanting experiment discussed in Part 1 (see also Loewen 1998; Loewen et al. 2001) suggests that yellow glacier lilies from a given site can adjust successfully to an entirely different environment, at least over a five-year period. The fact that two different types of mycorrhizae have been identified with roots of yellow glacier lily (Currah and Van Dyke 1986) also suggests a wide environmental amplitude.

That most or all of these criteria are met lends support to the idea that yellow glacier lily was intensively exploited in the past by Plateau Indigenous peoples. It would be interesting to examine whether these criteria are met in the U.S. part of the species' range, where the plant was little used for food. If they are met, which seems likely, it would suggest that Thoms' criteria may be necessary but not sufficient for intensive exploitation of a given root resource, and that other factors must be considered (e.g., the relative abundance of other, alternative root foods) in developing a more complete model.

Another aspect of the anthropological literature worth considering is the "hunter-gatherer" (or "forager") versus "agriculturalist" dichotomy. The traditional view is that hunter-gatherers in no way actively managed the food resource:

> Previous to the advent of the Christian Missionaries, the Indians of British Columbia did no cultivation, as such. They depended for their vegetable food on certain kinds of roots, shoots, leaves, and berries which grew in their immediate neighbourhood, or which they might come across in their wanderings. (Wilson 1916:17; see also Deur and Turner 2005)

This perspective remains common even today, but it is beginning to be challenged. Ford (1985) was among the first to suggest that plant food production be viewed not as a dichotomy but as a continuum, from *foraging* through *cultivation*—characterizing "incipient agriculture" and gardening—to *domestication,* in which major genetic changes are produced through selection and hybridization. Cultivation strategies include, for example, tending, tilling, and transplanting. Deur (1997:1) has similarly defined cultivation as "a continuum of practices in which the repeated manipulation of both plants *and* their environments serves as a means toward the anticipated ends of quantitatively and qualitatively enhanced plants" (see also Deur and Turner 2005; Peacock and Turner 2000). The traditional harvesting and management strategies here described for yellow glacier lily support these new perspectives, and suggest that the "hunter-gatherers" of the Northern Plateau be viewed not as foragers but as incipient agriculturalists or cultivators.

2) Ecology

Increasingly, ecologists are recognizing that interactions among organisms in a community are not limited to the classic, often obvious predation, parasitism, competition and mutualism. Rather, the various actions and interactions of many species also have broader, more subtle, ecosystem-level implications. As noted by Huntly (1995:76):

> I also suggest that herbivores frequently are a cause of spatial and temporal structure in environmental conditions. Both trophic and nontrophic activities contribute to production of structure, which provides opportunities for different sorts of primary producers to persist in communities, often changing species composition, tending to increase diversity, and probably affecting spatial and temporal stability of ecosystem productivity and nutrient dynamics.

Lawton and Jones (1995) coined the term "ecosystem engineering" to refer to this role of organisms in creating, modifying, and maintaining habitats. These authors do not recognize Indigenous peoples as having been significant in this regard; their only mention of humans is in terms of modern engineering "analogues" such as dams, skyscrapers, and sea walls. However, using their own definitions, hunter-gatherer peoples should certainly be considered natural "ecosystem engineers," with very similar effects to those of animals in terms of, for example, digging.

Of course, the intentional and sophisticated traditional management strategies used by First Nations are also fundamentally different from the incidental effects of animals. Indigenous strategies include weeding of the harvesting grounds, selective harvesting of the largest bulbs, deliberate removal and replanting of bulb-appendages, landscape burning, and broader societal controls on harvesting (e.g., rotating harvests, prohibitions against waste and overuse). As well, many of these strategies no longer operate in many ecosystems, so many ecologists may consider them irrelevant. Yet, these differences in no way negate the fact that Indigenous peoples in northwestern North America have had ecologically and probably evolutionarily significant interactions with plants and their habitats (Anderson 2005; Boyd 1999; Deur and Turner 2005). These interactions deserve consideration and experimental research—and at the very least, acknowledgement of their past importance. Unfortunately, many ecological papers and books illustrate the limitations attendant with academic specialization and lack of communication among disciplines. Almost invariably, if human impacts are mentioned, it is in the modern, industrial sense only.

3) Ethnoecology

The above discussion suggests that both anthropologists and ecologists are—or should be—rethinking two long-established, artificial dichotomies: that of foragers vs. agriculturalists, and that of "natural" ecosystems vs. those with Indigenous human impact. Clearly, these dichotomies are related. Both are addressed in the expanding field of ethnoecology, which examines the interrelationships of Indigenous peoples with ecological patterns and processes.

Our work is relevant to and supports work by Anderson (1997, 2005), which deals with Indigenous cultivation of geophytes and other plant resources in California. The following points of correspondence between Anderson's and our conclusions are worth emphasizing. They suggest that aspects of geophyte use may be general among hunter-gatherers and their root resources.

Underground parts of many geophytes were traditionally harvested in great abundance, but in a sustainable manner.

- Methods of tillage, selective harvesting, vegetative propagation, and general ethics of respect and conservation are common to peoples who used geophytes.
- Disturbances of various types, such as digging by large and small mammals and fires caused by lightning, are natural aspects of ecosystems in which many geophytes thrive. These disturbances appear to have been mimicked and intensified by Indigenous practices, to the benefit of the resource species used.

To summarize, and to address the third question put forth at the beginning of Part 4, it does appear that yellow glacier lily is adapted to a periodic, moderate disturbance regime such as that associated with First Nations' use and management. Bulb "predation"—whether by small mammals, grizzly bears, or people—occurs in a patchy fashion across the landscape, and would allow populations in individual sites time to recover before being "farmed" again. Yet the relationship is better described as mutualistic than as predatory. Human use may have had far-reaching effects in terms of increasing vegetative and sexual reproduction, and in terms of enhancing the nutritional characteristics of the resource. In addition, on a landscape level, First Nations' burning increased fire frequencies and kept open areas that would otherwise have been forested, maintaining favourable habitat characteristics over time (Turner 1999). Indigenous use and management strategies, then, may have led to a co-evolutionary situation in which disturbance led to positive feedback in both the quantity and quality of yellow glacier bulbs (see also Peacock et al., Chapter 5, this volume).

Finally, it is important to note that, in spite of its apparent adaptation to the digging disturbance, yellow glacier lily is almost certainly not immune to overharvesting. As Gottesfeld (1994) notes, even with low population densities, any level of human technology is likely to eliminate culturally significant species with unrestricted or unmanaged exploitation—undoubtedly a reason why a conservation ethic is so prevalent in traditional Indigenous worldviews. Yellow glacier lilies are probably adapted to *moderate* levels of disturbance (periodic digging and fires), and at some level of harvesting intensity the balance may be tipped toward degrading the population.

Future research will have to determine the nature of this balance for yellow glacier lily—the particular degree of disturbance and removal that encourages vegetative regeneration and sexual reproduction, but does not overwhelm the population. Results of this research could ultimately inform management policies in protected areas, as well as restoration efforts elsewhere. As noted by Anderson (1996:155), "restoration involves not only reintroducing plants and animals known to exist in the area historically, but also reproducing the forces that shaped the model community." Research into such forces may confirm that the Secwepemc and other Interior Salish peoples long ago empirically determined a sustainable level of disturbance for their stable root vegetable, yellow glacier lily.

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Chapter 8. The Ethnolichenology of *Wila* (*Bryoria fremontii*): An Important Edible Lichen of Secwepemc Country and Neighboring Territories

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Abstract

Wila (Bryoria fremontii) is a dark brown hair lichen common in mountainous areas of western North America. It is an important traditional food for Secwepemc and many other cultures throughout the range of this lichen. Wila can form two different morphotypes—one which is edible, and another which contains toxic levels of vulpinic acid. Eating wila therefore requires choosing the correct morphotype, and thoroughly washing it. The edible and toxic morphotypes can be indistinguishable to the naked eye. However, traditional selection techniques can successfully use species associations to identify populations of wila where the toxic morphotype is less common. The main storage carbohydrate of wila is lichenin, a β-glucan that is indigestible to humans. Wila is traditionally pit cooked before it is eaten, a process which is known to break down indigestible carbohydrates in some other vegetables and render them digestible. However, a series of pit cooking experiments failed to break down the lichenin in wila using conditions possible in a traditional pitcook. It therefore seems unlikely that wila can provide significant direct caloric benefits, even after pit cooking. These experiments did show that wila can provide indirect caloric benefits by capturing simple sugars that would otherwise be lost from other vegetables that are cooked with it.

Keywords: *Plateau ethnobotany, Secwepemc, lichenlogy, Bryoria fremontii, nutrition*

Introduction

Wila is a lichen that resembles coarse, dark-brown hair and grows hanging from the branches of trees (mostly conifers) in montane ecosystems in western North America. This lichen is currently classified as *Bryoria fremontii* (Tuck.) Brodo and Hawksworth (1977) and placed in the family Parmeliaceae, although in earlier literature it was usually referred to as *Alectoria jubata* (which included most other species of *Bryoria*). Several different English names have been applied to this lichen, including black moss, tree hair, black tree lichen (Turner 1977), and edible horsehair lichen (Brodo et al. 2001; Goward 1999), but none of these names have gained widespread use

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because this lichen is not culturally significant to most English speakers. Fortunately, there are plenty of opportunities to borrow a more elegant name from a culture for whom the lichen has more significance. In North America, there are names for this lichen in at least 20 of the indigenous languages (see Table 1). In Secwepemctsin it is called ***wíle*** (western dialect) or ***wíla*** (eastern dialect). In this chapter, I use the name ***wila*** throughout and I propose it as an appropriate English common name for *Bryoria fremontii*, as it is simple for English speakers to pronounce, and minor variations of this name have widespread use among several of the Interior Salish nations.

Wila grows abundantly in the inland portions of its range. In the past, large quantities of wila were eaten by people of several Interior Salish and Sahaptin nations, including the Secwepemc. Some people still eat wila as a special treat (see Figure 1).

This chapter is a summary of part of my M.Sc. thesis (Crawford 2007). Part 1 is a brief description of the biology, ecology, and nutritionally relevant chemistry of wila. Part 2 provides a review of the ethnolichenology of wila, based on a literature review as well as interviews with Dr. Mary Thomas, a well-known Secwepemc elder (see Chapters 7, 9, 10). Part 3 examines the traditional methods of utilizing wila, and includes summaries of an ecological study that investigates how traditional lichen identification methods work, as well as a series of pitcooking experiments that evaluate the nutritional contributions of wila. The ecological study suggested that traditional lichen identification corresponds to the ecology of wila and its relatives. The pitcooking experiment indicated that wila is not rendered digestible by traditional cooking, but it still might provide a significant nutritional benefit by preventing loss of nutrients from foods with which it is cooked.

Part 1: The Biology, Ecology, and Chemistry of Wila

Ecology and Distribution

Wila is common in the mountainous areas of western North America, being found throughout most of the interior of British Columbia (less common or absent in the northern third of the province), extending east into the Albertan Rockies, and south into Montana, Idaho, Wyoming, Washington, Oregon, and California (Brodo and Hawksworth 1977; Goward 2009a, pers. comm.; see Figure 3). Wila also grows in northern Europe and Russia (Velmala et al. 2009).

In North America, wila is usually found at elevations between 1,200 and 2,300 m, and rarely as low as 700 m (Brodo and Hawksworth 1977). It prefers to grow on trees with acidic bark, such as conifers and birch, but it can be found growing on just about any tree species within its range.

In general, most species of *Bryoria* prefer more open, well-ventilated forests than do other genera of arboreal hair lichens in North America (Benson and Coxson 2002; Edwards et al. 1960; Szczawinski 1953). Judging from its distribution, wila is one of the most drought tolerant species of *Bryoria*, although in dry regions it is most abundant in habitats exposed to frequent occult precipitation, such as fog, cloud, or nighttime dew (Goward 2009a, pers. comm.). Like other members of its genus, wila disperses almost exclusively through fragmentation (Goward 2003). Its tendency to break off in fragments larger than those produced by most other species of *Bryoria* is a major limiting factor in its ability to recolonize after disturbances such as fire and clearcut logging. For this reason wila is most abundant in mature forests, where it is particularly abundant

Table 1. Use of Bryoria species by First Peoples in North America.

People	**Uses for *Bryoria* species**	**References**
Sugpiaq	All *Bryoria* spp. called ***nakuraartum nuyii*** or ***napam ungagua'i***. Medicine: steam baths, bandages.	Wennekens 1985
Inland Dena'ina	Called ***dehtsighu*** ("branch hair") or ***ch'vala andaz'i*** ("spruce hair"). Includes other alectorioid lichens. Famine food: boiled, then mixed with berries, fish, or grease.	Kari 1987
Sekani	Called ***da'txis'ghoo***. Probably includes all *Bryoria* spp. Food: unconfirmed. Fibre: camouflage traps, cushions.	Davis and Tsay Tay 2008; Turner 1977
Dakelh	Called ***teh-ra***, ***dohgha*** (Central), or ***dahgha*** (Ulkatcho) ("raised hair") – may include other alectorioid lichens. *B. fremontii* called ***dechun degha***, or ***chun degha*** (Ulkatcho). Food: pitcooked, or baked with flour, or cooked with grease.	Antoine et al. 1974; Dawson 1891:120; Hebda et al. 1996; Kane 1846–1848; Kay 1995; Morice 1894:129; Y.D.L.I. and C.L.C. 1997
Wet'suwet'en	Called ***dikhghe***. Food: unconfirmed. Fibre: used as tinder.	Dawson 1891:20; Johnson 1994; Morice 1894:129; Turner 1977
Tsilhqot'in	Called ***taxa***, ***texa*** Food: unconfirmed. Medicine: burned and rubbed in hair to keep it black.	Dawson 1891:20; Kuhnlein & Turner 1991; Turner 1977, 2004; Tyhurst 1975
Haisla	Alectorioid lichens called ***c̓ac̓qx̌ƛ̓awài*** ("goat's wool in tree") or ***c̓ax̄c̄ax̄d̄hlawa*** ("grows on branches"); *Bryoria* spp. called ***cü̓ɻdu hs_p̓àp̓alms*** or ***c̓ax̓c̓ax̓dlawái*** Paint: *Bryoria* spp. burned to powder, made into black paste.	Bach et al. 2008; Compton 1993
Kwakwaka'wakwa	Called ***p̓elems***, includes other alectorioid lichens. Fibre: for household activities.	Turner and Bell 1973
Tsimshian	Not called ***whyelkine*** (misinterpretation of Mayne 1862). Food use is actually moss being used to line a pitcook (Boas 1916).	Boas and Tate 1916; Kuhnlein and Turner 1991; Turner 1977; Turner and Clifton 2002
Gitksan	Called ***ligimtxhl gan*** ("tree fur") or ***gesgan*** ("tree hair"). Food: Unconfirmed.	Johnson 1997; Turner 1977
Secwepemc	Called ***wila*** or ***wile*** ("has fringes"). Major food: pitcooked, sometimes with berries, roots, or wild celery. Fibre: moccasin lining, diapers, casts, bandages. Featured in traditional stories.	Dawson 1891; Ignace 2008:139, 145; Ignace 2011; Kennedy and Bouchard 1996; Kuipers 1974:274; Palmer 1975; Teit 1909; Turner et al. 2009;

Table 1 continued.

People	Uses for *Bryoria* species	References
Stl'atl'imx	Called ***a.wi'.a***, ***skwl'íp*** (singular), or ***skwekwl'íp*** (large quantity). Major food: pitcooked. Fibre: made into clothing. Featured in traditional stories.	Bouchard and Kennedy 1977; Teit 1906; urner 1977, 1978, 1998; Turner and Bouchard 1974; Turner and Davis 1993; TTurner et al. 1987
Nlaka'pmx	Called ***wí7e***. Major food: pitcooked with roots; or boiled with roots, berries, meat, or grease. Lichen cake is ***Itxwa***. Medicine: poultice. Fibre: to make clothing.	Newcombe 1901–1913; Teit and Boas 1900; Turner 1977, 1978, 1998; Turner et al. 1990
Nxaʔamxcín and Wenatchi	Called ***sxk̓ə́kst***. Food	Kinkade 1981; Turner 1977
Schitsu'umsh	Called ***sä'tc'Etct***, ***sech'echt***, or ***séč'-ečt*** ("hand-branch"). Major food: pitcooked with camas & onions.	Palmer et al. 2003; Teit and Boas 1928
Kalispel and Spokan	Called ***šáw'tmqn*** (Kalispel), ***sqʷl'ápqn*** (Spokan) ("dark-"). Food: pitcooked.	Carlson & Flett 1989; Douglas 1914:171; Thoms 2008; Turner et al. 1980;
Okanagan (including Northern, Sinkaietk, Sanpoil-Nespelem, Lakes, and Coville)	Called ***skwelíp***, ***sqʷel'íp***. Major food: pitcooked with camas, onions, or berries; or roasted over coals then boiled. Medicine: for babies. Featured in traditional stories.	*Northern*: Gabriel & White 1954; Turner et al. 1980. *Sinkaietk*: Spier et al. 1938. *Sanpoil-Nespelem*: Ray 1932; Turner et al. 1980. *Lakes*: Elmendorf 1935–1936; Thompson 1784–1812b:388–392. *Coville*: Franchére 1820:279; Turner et al. 1980. *Unspecified*: Dumbeck 1945; Lerman 1952; Teit and Boas 1928; Wilkes 1845:462.
Flathead	Called ***caúmtemkan***, ***st'telu***, ***skola'pkEn***, ***sqatlo***, ***šáwtəmqən*** (when alive), or ***sqʷúƛ̓a*** (cooked). Major food: pitcooked with roots. Medicine: tonic if cooked alone.	Hart 1974, 1976; Stubbs 1966; Teit and Boas 1928; Turney-High 1937
Ktunaxa	Called ***ä'ttla***, ***á-hła***, ***7ałła*** (only after cooked?), ***7aaquka*** (only when alive?) Famine food: pitcooked; or boiled with grouse stomach contents or droppings; or pounded with stone maul into cake and baked.	Chamberlain 1892:573; Curtis 1911a:174; de Smet 1847:118; Hart 1976; Hart et al. 1978; Keddie 1988; Thompson 1784–1812a:85–89, 1784–1812b:388–392
Niitsitapii	Famine food: in Montana.	Johnston 1970, 1982
Unknown interior peoples of BC	Called ***whyelkine***. Major food.	Mayne 1862:301

Table 1 continued.

People	Uses for *Bryoria* species	References
Unknown coastal peoples of BC	Food: baked between hot rocks, wrapped in vegetation. Questionable account.	Mayne 1862:256
Coast Salish (V. I.)	Food: unconfirmed.	Turner 1977
Lummi	Dye: dark green	Stern 1934:89
Halkomelem	Called ***sqwelíp*** ("hair in the dirt"). Food: boiled & dried into cakes; or pitcooked into lichen loaf.	Duff 1952; Galloway 1982
Twana	Food: pitcooked. Dye: dark green	Subiyay 2003, pers. comm.
Ila'xluit (Wishram)	Called ***ik!u'nuc***, ***a-ḳú-nǐksh̄***. Major food: pitcooked.	Curtis 1911b:201; Spier and Sapir 1930
Tenino	Called ***wa-kamwa***. Food: unspecified use	Murphey 1959:17
Umatilla, Cayuse, Yakima, and other Sahaptin	Called ***kw"u'nch***, ***qụnsh̄***. Food: pitcooked.	Curtis 1911a:174; Hunn 1997; Hunn 2005, pers. comm.
Nimi'ipuu	Called ***ho.póp***. Food: regular and famine food. Boiled, or pitcooked with roots. Medicine: upset stomach, diarrhea.	Hart 1976; Lewis and Clark 1804–1806:Vol.5:4; Marshall 1977; Spinden 1907–1915; Turner 1977
Klamath	Called ***k̇al***. Famine food	Coville 1897; Curtis 1924:238, 273
Modoc	Called ***qa'l***. Food: unspecified use	Ray 1963
Shasta	Food: unconfirmed.	Turner 1977
Atsugewi	Medicine: poultice.	Garth 1953
Wailaki	Famine food	Chesnut 1902

Figure 1. Delicious loaves of cooked ***wila*** (*Bryoria fremontii*). Photo by Stuart Crawford.

on dead and dying trees; on older, defoliated branches of living trees; and higher up on trees (Goward 1998). There can be little doubt that a century of intensive logging through the range of this species has caused a considerable reduction in its habitat, in many areas limiting it to small islands of old forest that are surrounded by a sea of young, regenerating stands (Goward 2009a, pers. comm.).

Wila can be very abundant in some ecosystems. Researchers have documented up to 3,291 kg of arboreal hair lichens (of which wila was a major constituent) per hectare in some parts of Secwepemc territory in the interior of British Columbia (Edwards et al. 1960). Many lichens are quite slow growing, but wila can actually grow relatively rapidly. In Sweden, wila has been measured to increase in biomass by 0.6% to 10.8% (average 6.3%) each year (Renhorn and Esseen 1995).

Species Description

There are 24 species of *Bryoria* that have been identified in North America, 13 of which can be found in Secwepemc territory. Almost all of these species are dark-brown hair lichens that grow on trees, and differentiating them can be difficult. The simplest characteristic that distinguishes wila from the other species of *Bryoria* is that wila has main branches that grow to be quite thick (greater than 0.4 mm wide) and usually become somewhat flattened, wrinkled, and twisted with age. Other species of *Bryoria* usually have narrower, rounder main branches. Wila is also the largest species of *Bryoria* in North America, and is the only one that regularly grows longer than 20 cm (occasionally reaching 90 cm in length). Wila is usually slightly darker in colour than most other species of *Bryoria*, although this can vary significantly. It is rare for wila to produce either soredia (asexual reproductive structures) or apothecia (spore-producing structures), but these are very distinctive when present, as they are both yellow (no other *Bryoria* species produces yellow structures).

Most lichens contain secondary lichen substances. Over 800 of these substances have been isolated so far, and most of them are unique to lichens (Huneck and Yoshimura 1996). Many of these chemicals are also biologically active in humans (Müller 2001), and could potentially have a significant impact on the health of someone who ate them.

Wila (*Bryoria fremontii*) normally does not contain any secondary lichen substances (Brodo and Hawksworth 1977), except for the occasional specimen that can be quite high in vulpinic acid (a bright yellow toxin). The vulpinic acid-containing specimens have until recently been classified as the separate species *Bryoria tortuosa*, but recent research using DNA analysis has shown that *B. fremontii* and *B. tortuosa* both contain the same species of fungus (Velmala et al. 2009). As a result, lichenologists now consider these two lichens to be two different morphotypes of the single species *B. fremontii*.

However, Goward (2009b) has astutely pointed out that although *Bryoria fremontii* sensu stricto and "*Bryoria tortuosa*" can be formed by the same species of fungus, they are not necessarily the same species of lichen. The actual lichen that we see and eat is an emergent property of a symbiosis between a fungus and an alga, and probably a variety of bacteria as well. *Bryoria fremontii* s.s. and "*B. tortuosa*" are visually and chemically different, a fact that has probably been known by traditional wila experts for millennia, and by lichenologists for the last 100 years.

Vulpinic acid is both toxic and bright yellow. *Bryoria fremontii* sensu stricto does not contain any vulpinic acid, so it is always edible and is reddish-brown to dark-brown in colour. "*Bryoria tortuosa*" does contain vulpinic acid, causing it to be toxic and vary in colour from dark brown to bright yellow. Although all yellowish *Bryoria* specimens are "*B. tortuosa*", not all specimens of "*B. tortuosa*" are distinctly yellow. Often the vulpinic acid is concentrated in the medulla (inner tissue) of the lichen, and is not apparent from the colour of the outer cortex (surface). A more reliable characteristic to distinguish the toxic "*B. tortuosa*" from the edible *B. fremontii* s.s. is that "*B. tortuosa*" usually has abundant, long, yellow pseudocyphellae (holes in the outer cortex of the lichen) that twist around the main branches (these require a hand lens to see), as is shown in Figure 2.

"*Bryoria tortuosa*" may have slightly different habitat preferences than *B. fremontii* sensu stricto. Goward and Ahti (1992) contend that "*B. tortuosa*" tends to prefer drier and more exposed habitats. Furthermore, recent analysis of "*B. tortuosa*" collected in Secwepemc territory has shown that they can also contain two other secondary lichen substances—norstictic acid and/or barbatolic acid (Velmala et al. 2009).

Potential Toxicity

Vulpinic acid is generally lethal to mammals in doses of 75 mg vulpinic acid per kg body weight, as has been shown in mice (Brodersen and Kjaer 1946), rats (Foden et al. 1975), and cats (Santesson 1939). Even doses as low as 60 mg/kg can be fatal in mice, with serious toxic (but non-lethal) effects at only 40 mg/kg (Appa Rao and Prabhakar 1988). As little as 5 mg/kg can have some biological effects on rats (Appa Rao and Prabhakar 1988; Foden et al. 1975). For a 70 kg human,

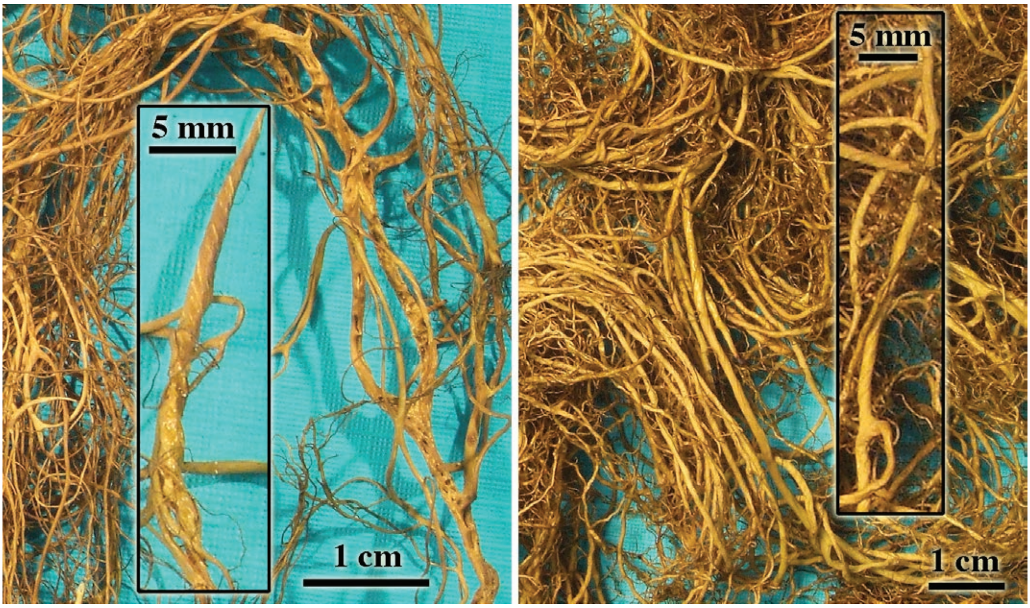

Figure 2. Contorted, pitted main branches with prominent yellow pseudocyphellae typical of toxic "*Bryoria tortuosa*" (left), and smoother main branches without pseudocyphellae typical of edible *Bryoria fremontii* s.s. (right). Photo by Stuart Crawford.

0.35 g of vulpinic acid would start to show some effect, 2.8 g would cause serious illness, and 4.2–5.3 g would be fatal.

The concentration of vulpinic acid in "*Bryoria tortuosa*" has never been adequately quantified, so the potential toxicity of this lichen is not known. The related lichen *Letharia vulpina* is known to contain as much as 5% vulpinic acid (Stephenson and Rundel 1979), so as little as 84 g of that lichen could kill a person. Vulpinic acid is also not particularly water-soluble and very lipophilic (Abo-Khatwa et al. 1996), indicating a potential capacity for bioaccumulation.

Norstictic acid and barbatolic acid are two other secondary lichen compounds sometimes found in specimens of "*Bryoria tortuosa*". Although neither is likely to be as toxic as vulpinic acid, it is still undesirable to eat either of them large quantities. Feeding trials with norstictic acid have shown that although two specialized lichenivores [the slug *Pallifera varia* (Lawrey 1980); and oribatid mites (Reutimann and Scheidegger 1987)] are unaffected by the substance, a generalist herbivore [the caterpillar *Spodoptera littoralis* (Giez et al. 1994)] avoided eating it if there was anything else available. No tests have been conducted on barbatolic acid or on any of its immediate relatives (the benzyl esters), but many other substances in the same general category (the β-orcinol depsides) are known to be biologically active (Kumar and Muller 1999).

There are numerous other species of *Bryoria* found in Secwepemc territory that can easily be confused with wila. All of them contain potentially toxic secondary lichen substances (Brodo and Hawksworth 1977) and should not be eaten. Some contain norstictic acid or barbatolic acid, which are discussed above. Others contain fumarprotocetraric acid, which is bitter (Reutimann and Scheidegger 1987) and has been found to deter feeding for a variety of invertebrates (Giez et al. 1994; Hesbacher et al. 1995; Reutimann and Scheidegger 1987).

Nutritional chemistry

Wila is an important food source for a variety of different rodents and ungulates (Sharnoff 1994), in particular northern flying squirrels (McKeever 1960; Rosentreter et al. 1997) and woodland caribou (Kinley et al. 2003; Rominger et al. 1996). This does not, however, prove that the inferior human gut is capable of obtaining significant nutrition from unprocessed wila.

Numerous researchers have analyzed the protein content of *Bryoria* species, and found that it contains 4–6% protein (Bergerud 1972; Danell et al. 1994; Fujikawa et al. 1970; Kirkpatrick et al. 2001; Nieminen and Heiskari 1989; Pulliainen 1971; Scotter 1965; Solberg 1970; Yanovsky and Kingsbury 1938). This is in agreement with Kuhnlein et al. (this volume), who found that wila contained 4.6% protein (dry wt). Although this protein content is relatively high for a lichen, it is still too low to be nutritionally significant for humans, especially when Pulliainen (1971) found that only half of the protein in *Bryoria* species was digestible.

The fat content of *Bryoria* species has previously been found to vary from 0.43–2.6% (Bergerud 1972; Nieminen and Heiskari 1989; Pulliainen 1971; Scotter 1965; Yanovsky and Kingsbury 1938). Kuhnlein et al. (this volume) report that their single specimen of wila contained 8.1% fat (dry wt), which is more than three times greater than the highest fat content previously reported. However, lichens can produce large quantities of fat-soluble secondary metabolites that can be mistaken for digestible fats by standard analytical methods, resulting in a significant overestimation of fat content. The particular specimen of wila that Kuhnlein et al. analyzed was exceptionally high in vulpinic acid (I examined it and identified it as "*Bryoria tortuosa*"), which is lipophilic and would be measured as fat in their analysis.

Despite its lack of other nutrients, wila does contain significant quantities of carbohydrate. *Bryoria* species have been found to contain 17.7–35.7% water-soluble carbohydrates (Kirkpatrick et al. 2001; Kuhnlein et al., this volume; Yanovsky and Kingsbury 1938). Most of this carbohydrate is lichenin, and some is isolichenin (Common 1991). Lichenin is a (1→3)-(1→4)-β-D-glucan [a polysaccharide composed of many glucose molecules attached together with β-(1→3) and β-(1→4) bonds], and is a common carbohydrate in lichens. It is similar in structure to the β-glucans in cereals that give oatmeal porridge its characteristic gelatinous appearance. Lichenin differs from cereal β-glucans by being a smaller molecule and having a higher ratio of (1→3) bonds. Both of these characteristics give lichenin more powerful gelling properties than oat β-glucans (Cui et al. 2000; Lazaridou et al. 2003).

Lichenin is indigestible to humans. Several in vitro experiments have shown that neither human saliva nor gastric juices are capable of breaking down lichenin (Berg 1873; Brown 1898; Nilson 1893; Saiki 1906). Two feeding trials have been conducted on humans, both showing that negligible quantities of lichenin were absorbed by the subjects (Mendel 1908; Swartz 1911). The structurally similar cereal β-glucans have also been shown to have no caloric benefit to humans (Wisker et al. 1997).

Isolichenin is a (1→3)-(1→4)-α-D-glucan that is also relatively common in lichens, although usually present in lower concentrations than lichenin. Isolichenin has not been as well studied as lichenin, but several in vitro tests have shown that isolichenin is also unlikely to be digested by human saliva or gastric juices (Brown 1898; Hönig and St. Schubert 1887; Karrer et al. 1924).

Källman (1988) conducted a more modern test of lichen digestibility for the Swedish military. Eight soldiers were closely monitored while being forced to survive entirely on boiled *Bryoria* spp. for nine days of strenuous exercise in the high Arctic. Although none died, they all exhibited signs of starvation, and lost an average of 0.9 kg of bodyweight per day over that period. This would require a daily energy deficit of 7,000 kcal, which is 40% greater than Källman's estimate for their daily energy expenditure (he was obviously mistaken). A daily energy expenditure of 7,000 kcal is similar to what has been previously reported for men who are intensely exercising in the high arctic (Stroud et al. 1993), and is near the upper limit of human capability for extreme physical exertion (Shetty 2005). The daily energy deficit of the soldiers was similar to their energy expenditure, showing that they were gaining very little, if any, calories from the lichen.

It is unlikely that the human gut is capable of obtaining very many calories from unprocessed wila, as this lichen contains very little protein or fat, and its carbohydrates are probably indigestible to humans. Kuhnlein et al. (this volume) calculate that wila contains 155 kcal/100 g, but, as explained above, the unique characteristics of lichens resulted in the fat and digestible carbohydrate content of wila being overestimated. Correcting for these mistakes, I estimate that the energy content of wila is only about 35 kcal/100 g. This assumes that wila contains 1.5% fat, 0.5% simple sugars (see Part 3), and 3% polyols (estimated from Gorin et al. 1993).

The carbohydrates in wila may have non-caloric benefits to human health. Some human-indigestible carbohydrates, such as inulin, are digested by beneficial bacteria in our lower intestine and can thus beneficially alter our intestinal microbial community (Kolida et al. 2002; Roberfroid et al. 1998). These beneficial bacteria-enhancing carbohydrates are called prebiotics (Dethlefsen et al. 2005), and have been linked to numerous health benefits (Griffin et al. 2002). Inulases (enzymes that break down the prebiotic inulin) have been found to also break down lichenin (Saiki 1906), indicating that lichenin may have similar prebiotic effects as inulin.

Another indication of the prebiotic potential of lichenin is that the structurally similar cereal β-glucans have been shown to act as prebiotics in rats, promoting beneficial lactobacillus bacteria and reducing detrimental bacteria in their lower intestines (Dongowski et al. 2002). These cereal β-glucans have also been linked to other health benefits. They can reduce blood cholesterol in humans (Ripsin et al. 1992) by increasing the excretion of cholesterol in feces (Lia et al. 1995). As well, they slow the absorption of sugars into the body, thus reducing the spike in blood sugar levels after a meal (Dubois et al. 1995; Hallfrisch et al. 1995; Wood et al. 1994). Given the structural similarity of lichenin and cereal β-glucans, it is quite possible that they could provide the same health benefits.

Although some lichen species can contain significant quantities of cobalamin (vitamin B_{12}), choline, tocopherol (vitamin E), and folate (vitamin B_9), various *Bryoria* species have been tested for all of these nutrients and have not contained significant amounts of any of them (DaSilva and Englund 1974; DaSilva and Jensen 1971; Sjöström and Ericson 1953). Kuhnlein et al. (Chapter 6, this volume) found a significant quantity of iron in wila. This is likely a result of environmental exposure, as lichens are highly proficient at accumulating metals from their environment (Bargagli and Mikhailova 2002). However, no tests have been done to determine the bioavailability of these minerals to humans.

Part 2: The Ethnolichenology of Wila

The Importance of Eating Wila

Wila is traditionally eaten by First Peoples throughout most of its range in North America (see Table 1 and Figure 3 for more details). In the past, this lichen was eaten in large quantities by indigenous peoples in the interior of British Columbia, Washington, and northern Oregon, as well as in parts of Idaho and Montana. Some indigenous peoples in northern California and southern Oregon occasionally ate wila in times of famine, and the Inland Dena'ina of Alaska traditionally used a different, unidentified species of *Bryoria* as a famine food. Coastal First Peoples do not traditionally eat wila, probably because this lichen is uncommon along the coast. Currently, wila is not eaten in large quantities, but some people still cook this traditional food as a special treat.

Several early European travelers in North America were quite disparaging towards wila, and contended that this lichen was "neither palatable nor nutritious" (Blankinship 1905) and "… a most miserable food, which, in a brief space, reduces those who live on it to a pitiable state of emaciation" (de Smet 1847:118). Franchère (1820:279) wrote, "I had the curiousity to taste some of this bread and thought I had put a piece of soap in my mouth …."

But despite being maligned by numerous authors, wila was, and still is, a highly-regarded and delicious food for many people. A century ago, Teit (1909:515) said that the Secwepemc ate "a good deal of black moss", and Dawson (1891:23) noted that it was "said to taste very sweet". More recently, Aimee August, a Secwepemc elder, said that "It's very very good, but it doesn't look good; when you eat it, don't look at it!" (reported in Turner et al. forthcoming). Similarly glowing culinary reports have been recorded among the Okanagan (Mourning Dove 1933; Spier et al. 1938) and the Flathead (Hart 1976; Stubbs 1966). Turney-High (1937) reported that among the Flathead, even the smallest family would harvest over 10 kg of wila every July.

In the past, wila was a major food for numerous Interior Salish nations (Secwepemc, Nlaka'pamux, Stl'atl'mc, Okanagan, Schitsu'umsh, and Flathead), as well as several Sahaptin nations (such as the Nimi'ipuu and Umatilla) and the Ila'xluit (geographic and linguistic neighbors to the Sahaptin). Although wila was a regular food for all of these nations, its widespread occurrence in many inland regions probably ensured that it was eaten in larger quantities when other food was scarce. This practice was recorded for both the Okanagan (Anderson 1925; Franchére 1820; Spier et al. 1938) and the Nimi'ipuu (Lewis and Clark 1804–1806; Spinden 1907–1915).

Other First Nations that traditionally ate wila did not do so on a regular basis. Although these people may have occasionally eaten small amounts of wila when food was plentiful, they mainly reserved this lichen for times of famine. Examples of this are the Inland Dena'ina (Kari 1987), Lower Ktunaxa (de Smet 1847), Niitsitapii (Johnston 1970), Klamath (Coville 1897), and Wailaki (Chesnut 1902).

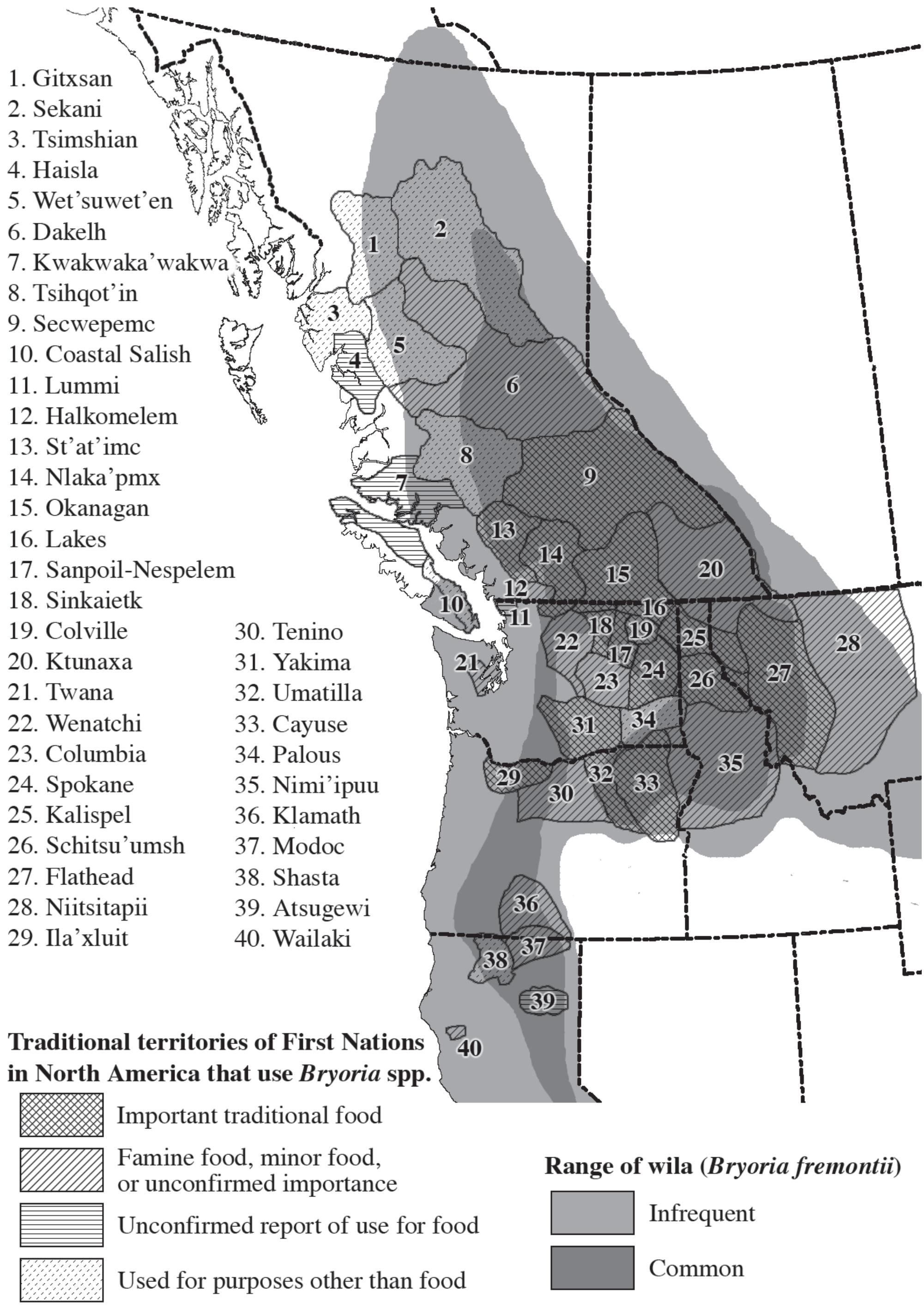

Figure 3. Territories of First Nations that traditionally use Bryoria species, and range of wila (from Goward 2009a, pers. comm.).

The particular importance that wila has among the Interior Salish First Nations is evident in the prominence that this lichen has within their language and stories. Wila is featured in stories of the Secwepemc (Bouchard and Kennedy 1979), Okanagan (Mourning Dove 1933; Spier et al. 1938; Turner et al. 1980), and Stl'atl'imx (Bouchard and Kennedy 1977). Furthermore, both the Okanagan (Turner et al. 1980) and Nlaka'pamux (Turner et al. 1990) languages have a variety of different words for the different aspects of harvesting and preparing wila, and there are places named after wila in both Okanagan (Turner et al. 1980) and Nlaka'pamux (Turner et al. 1990) territory.

Harvesting Wila

Wila often grows high in tree canopies, and thus can be difficult to harvest. The most common way to collect the lichen is to reach up into the tree with a long stick, twist the lichen around the end of the stick (which is sometimes hooked) and then pull the lichen down off the tree (Turner et al. 1980, 1990). This lichen-collecting stick is called ***txipmn*** in the Okanagan language (Turner et al. 1980).

Wila can be collected at any time of year, but it is important to choose the right type of lichen. There are numerous other species of *Bryoria* that look very similar to wila, but that are bitter and mildly toxic. As well, there are some specimens of wila that contain toxic levels of vulpinic acid (Stephenson and Rundel 1979; see Part 1). People who traditionally harvest wila have ways to make sure that they are collecting the right lichen. Some people contend that you can tell if the lichen is edible by the species of tree on which it is growing (Ray 1932; Spier et al. 1938; Turner 1977), or the general location of that tree (Marshall 1977; Turner et al. 1980), but not everyone agrees on which locations and which tree species are desirable. Many people taste the lichen first to make sure that it is not bitter (Palmer 1975; Turner et al. 1980), and some people choose the lichens that are darker coloured (Turney-High 1937).

The late Dr. Mary Thomas, a Secwepemc elder who was very knowledgeable about wila, stressed the importance of picking the right lichen, and detailed the use of colour in this determination:

> When they're green like that [*Bryoria tortuosa*] don't bother with it. Leave it. … That one looks better [points to *B. fremontii*]. The darker the better. … I would take these [*B. fremontii*]. That's a dandy one. … Yes, this is the best one [*B. fremontii*]. The green ones tend to get bitter. It's not as nice as this one here.
>
> That one wouldn't pass [a sample of *Bryoria fremontii* with lots of *B. tortuosa*, *B. capillaris*, and *B. pseudofuscescens* mixed in]. That wouldn't taste so good. Look for where you can find real dark stuff.
>
> I don't know, that's one thing I don't know [is] what difference the tree [makes as to the quality of the lichen]. My mother, as long as it's dark, real dark, that's all she'd look for. And, our granny, we used to go with her. And if she couldn't reach way up, and it was really good, she'd take a long stick with a Y on the end,

> and she'd go push it in there, and turn, and pull it down. You didn't have to climb a tree, just use a fork.

According to Mary, darker specimens of *Bryoria* are better for eating, and ones that look greenish will be bitter and should be avoided. Although it is not possible to use colour to differentiate every individual specimen of *Bryoria* as either edible or toxic, colour may be sufficient to identify the *Bryoria* species assemblages that have lots of edible *Bryoria* and very little toxic *Bryoria*. A simple ecological study that I conducted provides evidence for this, and is described in Part 3 of this chapter.

Cleaning Wila

The importance of properly cleaning wila is stressed by almost every knowledgeable chef. Wila should first be picked through by hand to remove twigs, dirt, other lichens, sap, and other contaminants. Then it is usually soaked several hours to overnight in water, often in running water. While the wila is being soaked, the chef sometimes works it with her hands, or pounds it with a stick or paddle-shaped tool. This thorough washing of wila has been reported among chefs from the following nations:

- Dakelh (Morice 1894);
- Secwepemc (Dawson 1891; L. Harry in Jules 1994);
- Nlaka'pamux (Turner et al. 1990);
- Okanagan (Thompson 1784-1812b; Turner et al. 1980; Wilkes 1845);
- Spokane (Douglas 1914);
- Flathead (Hart 1976; Stubbs 1966);
- Ktunaxa (de Smet 1847);
- Ila'xluit (Spier and Sapir 1930);
- Umatila, Cayuse, and Yakima Sahaptin (Hunn 2005, pers. comm.).

This process of cleaning the wila is called ***kálka*** in Secwepemctsin, and likely helps to remove the toxin vulpinic acid, which is green-yellow and slightly water-soluble (Lauterwein et al. 1995). Annie York, a Nlaka'pamux elder interviewed by Turner (Turner et al. 1990), was aware of this, and said that when the lichen was properly washed "…the green stuff goes out like this. That's what makes it bitter, if you don't do it. … You keep turning it and hitting it and the green stuff just comes out of it…."

Secwepemc elder Lilly Harry said "me7 cqwétkwencwes t'lúne ne séwllkwe. E cwén'wen me7 qwits'encwes, me7 killctc te stulensméke7s" (Jules 1994). This was translated by M. Ignace as "you soak [the wila] in water. The next morning, you wash it [scrubbing it like laundry], picking out the ***stulensméke7s*** [*Letharia vulpina*]." In this case, ***stulensméke7s*** might refer to *Letharia vulpina* (a toxic, bright yellow lichen), or to yellowish/greenish hair lichens in general.

Dr. Mary Thomas also detailed the careful washing necessary to prepare wila:

> When you go to wash it you take all these little things [other lichen species and bits of twig] out of there. You wash it clean, take all this out… I usually like to soak mine for a while, then… you can tell… it's kind of slippery. You know, after it's been soaked and it's been washed… That's when you take it and you work it with your hand like that, and it packs it and then it's ready to bake in a pit cookin'. And when it's done… it'll look like licorice, just all caked up.
>
> …
>
> If you could take it, put it in a bucket, and pull out all of the no-nos in it, and wash it clean, squeeze, you'd squeeze. Change the water about two or three times, then put… it in a cotton cloth and… don't dry it too much, but if you can take it and you work it like that in the cotton cloth, and it starts to form like a piece of dough. It's ready to cook. And I leave it in the cotton and I put it in the pit cookin'.
>
> …
>
> [SC: How long you have to wash it before it turns slippery?] … just depends on if you use warm water. It's better. Nice lukewarm water. Just put your hand and just keep working it, and then pull all the pieces that you [don't want], the light green, and piece of sticks, whatever. And you change it, put some more water, and you can finally feel it like wetted dough. And then you just put it on a—I usually have a cotton piece of white cotton, just the cotton that'll let the water drain through easier, coarse kind of cotton—you put it in that, and you fold it and just squeeze, squeeze, squeeze, squeeze. Get all the water out of it and it forms like a dough, that's when it's ready to bake. I usually bake mine right with—The way my granny used to do it, she used to have mats made out of the inner bark of the maple [*Acer glabrum*]. She used to weave it, and put the cooking in and flop it over like that, and cook it in a pit cookin'. [Then] she'd wash it and hang it for another cookin'. But now I use just ordinary cloth—White cotton cloth I use.

Cooking Wila

Wila is normally cooked in a pit by all of the Interior Salish and Sahaptin nations where it is traditionally eaten as an important food. These cooking pits are similar to those traditionally used to cook many root vegetables. Cooking pit recipes have numerous variations depending on the chef and the location, but the basic strategy is to bury the food in a pit above hot rocks that have been heated in a fire. The food is protected from getting dirty or burned by layers of wet vegetation, woven mats, and/or pieces of cloth. Cooking wila in a pit has been recorded in ethnographic accounts for the:

- Dakelh (Kane 1846-48);
- Secwepemc (Dawson 1891; Palmer 1975);
- St'at'imc (Turner and Davis 1993);
- Nlaka'pamux (Teit 1900; Turner et al. 1990);
- Okanagan (Gabriel and White 1954; Mourning Dove 1933; Ray 1932; Spier et al. 1938; Turner et al. 1980; Wilkes 1845;);
- Ktunaxa (Chamberlain 1892; de Smet 1847; Keddie 1988);
- Schitsu'umsh (Teit and Boas 1928);
- Flathead (Hart 1976; Stubbs 1966; Turney-High 1937);
- Spokane (Douglas 1914);
- Ila'xluit (Spier and Sapir 1930);
- Umatila, Cayuse, and Yakima Sahaptin (Hunn 2005, pers. comm.);
- Nimi'ipuu (Marshall 1977; Turner 1977);

Wila is almost never cooked alone. Instead, it is mixed with alternating layers of roots, berries, and other foods in the cooking pit. This fact may be very significant for the nutritional relevance of wila. A series of pitcooking experiments that I conducted, described in Part 3 of this chapter, indicated that although wila may provide very little nutrition on its own, it can help to greatly increase the amount of nutrients available from the foods with which it is cooked. Some of the foods that wila is traditionally cooked with include:

- Saskatoon berries (*Amelanchier* spp.): Secwepemc (Turner 2009), Okanagan (Gabriel and White 1954; Turner 1977; Turner et al. 1980), and Nlaka'pamux (Turner et al. 1990);
- Camas (*Camassia quamash*): Okanagan (Mourning Dove 1933; Ray 1932; Turner et al. 1980) and Flathead (Hart 1976; Turney-High 1937);
- Onions (*Allium cernuum* and other spp.): Secwepemc (Turner 2009), Okanagan (Ray 1932; Turner et al. 1980), Nlaka'pamux (Turner et al. 1990), Ila'xluit (Spier and Sapir 1930), and Nimi'ipuu (Turner 1977);
- Yellow glacier lily (*Erythronium grandiflorum*): Secwepemc (Loewen et al., Chapter 7, this volume) and Nlaka'pamux (Turner et al. 1990);
- False Solomon's seal (*Smilacina racemosa*): Okanagan (Turner 1977, 1978);
- Biscuitroots (*Lomatium* spp.): Okanagan (Turner et al. 1980);
- Balsamroot (*Balsamorhiza sagittata*): Nlaka'pamux (Turner et al. 1990);
- Wild celery (*Lomatium nudicaule*): Secwepemc (L. Harry in Jules 1994; Turner 2009);
- Cactus (*Opuntia* spp.): Secwepemc (L. Harry in Jules 1994; Turner 2009)

In cooking wila, water is usually added to the pit after it has been covered. This is accomplished by burying a large stick in the pit vertically that goes right from the bottom to above ground level. After the pit is completely covered, this stick is pulled out and water is poured down the resulting hole. A fire is often built on top of the pit, and the lichen is left to cook for anywhere from overnight to several days. When it is dug up it has formed a black, gelatinous dough about a quarter of its original volume.

According to Mary Thomas, the most important part of cooking wila is getting the rocks hot enough. She emphasized the importance of this by recounting a mistake she made in preparing her first wila pitcook, using a process she learned from her mother, Christine Allen. Logs are laid across a pit, a fire is started on top of the logs, and rocks are placed in the fire. By the time the logs burn through and the rocks fall down into the pit, the rocks are supposed to be hot enough for cooking.

> The secret is your rocks have to be good and hot. If they're not hot enough it will not bake it. The first one I did I was in a hurry, I had to get back to Kelowna. And I used 2 x 4s on top of a [pit, and had the] fire [on top of the 2 x 4s] and I put my rocks on it. And hear my mother, I heard that "Oh well" and I thought "Uh oh, I pulled a booboo". Next day when I came to look at my cooking, I brought it out of the pit and I put it on the table, and I looked at it, and it looked like something that a little animal like coyote ate and... I told my mother, I wouldn't eat that, what did I do wrong? And she said "Since when did the Indians have 2 x 4's?" You're supposed to put a log about this big [6 inches in diameter], green, and put your rocks on, and it takes longer [to burn through], that way your rocks are good and hot. They have to be good and hot, that's the secret.

Eating Wila

Wila is often eaten freshly cooked. When it is eaten fresh, sugar is often added (Turner 1977), and sometimes cream (Hart 1976), berries, or fish eggs. If the wila is not going to be eaten right away, it is sun-dried into cakes and stored for future use. Sometimes berry juice is mixed with the wila before it is dried (Turner et al. 1990). These dried cakes can be stored for many years (Dawson 1891; Mourning Dove 1933; Spier et al. 1938). Before being eaten, they are usually boiled in water or soup to rehydrate them. Alternatively, instead of boiling the cakes, some people just soak the cakes overnight in cold water or dip them into soup like crackers (Turner et al. 1980). They can also be powdered and boiled in water to make a porridge (Hart 1976).

Other Ways to Cook Wila

It is always preferable to cook wila in a cooking pit. However, it has sometimes been prepared by simply boiling it in water (Hart 1976; Lewis and Clark 1804–1806; Spinden 1907–1915; Teit 1900). It is generally reported that this produces an inferior product, and it is likely only done when the chef does not have the time for a proper pitcook.

The Okanagan sometimes roast the fresh lichen on a stick over hot coals, turning it frequently. When the lichen is crumbly it is then boiled to the consistency of molasses. This method of preparation is called ***spatk̲án*** (Turner et al. 1980).

Traditionally the Dakelh usually pitcooked wila, but Morice (1894) reported that they sometimes use it to bake a kind of fruitcake. They start with a regular bread dough, and mix in the lichen like one would do with raisins. It apparently helps the bread to rise when it is baked.

Currently, more modern methods of cooking wila are being tested. Some people feel that a pressure cooker does not work very well (Turner 1977); however, clay bakers (Crawford 2007) and crockpots have been used with some success.

Other Uses for Wila

Wila is also used as a medicine by a variety of First Peoples across North America. Other species of *Bryoria* are undoubtedly used along with wila for many of these medicinal purposes. The Okanagan use the lichen for baby medicines (Gabriel and White 1954; Turner et al. 1980), and the Nlaka'pamux use it for removing warts (Teit 1900). The Atsugewi use wila as a poultice for swellings (Garth 1953), and the Secwepemc use it for broken bones and for bandages (Turner 1977). The Sugpiaq also use it for bandages and as a hot compress in medicinal steam baths (Wennekens 1985). The Nimi'ipuu use wila for digestive troubles (Hart 1976), and the Flathead as a general tonic (Turney-High 1937).

Wila can also be used as a pigment. It produces a green dye when boiled in water, which is anomalous from most of the other species of *Bryoria*, which all produce yellow-brown to brown dyes (Brough 1984). The Haisla use different species of *Bryoria* to make a black paint (Compton 1993), and the Lummi use them to make a dark green dye (Stern 1934).

Several different First Peoples in British Columbia, including the St'at'imc (Turner 1998), the Nlaka'pamux (Teit 1900), and possibly the Secwepemc, traditionally made clothing out of wila. Lichen garments were usually only worn by poorer people (Teit 1900), as they quickly absorb water and are unsuitable in wet weather (Turner 1977). The garments were made by twisting together ropes of wila, and weaving them together with plant fibre to form vests, ponchos, shoes, and leggings (Newcombe 1901–1913).

Several other minor uses for wila and other *Bryoria* species take advantage of their fibrous properties. Various First Peoples in British Columbia traditionally mixed these lichens with mud for chinking cracks in houses, as well as using them as liners for moccasins and diapers, and as a predecessor to paper towels for a variety of domestic purposes (Turner et al. 1990).

Stories About Wila

Wila is featured in the stories of several different First Nations. Both the Secwepemc (Bouchard and Kennedy 1979) and the Okanagan (Mourning Dove 1933; Spier et al. 1938) have stories that tell how wila was originally created from Coyote's hair. Wila is also featured in some St'at'imc stories (Bouchard and Kennedy 1977). Some Okanagan people claim that neither men (Turner et al. 1980) nor menstruating woman (Elmendorf 1935–1936) should come near a pitcook when the lichen is cooking, or it will turn out badly, and there is a Nlaka'pamux belief that a bereaved spouse should not eat lichen cake for a full year after the death of their partner (Teit 1900).

In a Secwepemc story (Bouchard and Kennedy 1979), Coyote is marveling at how easily Spider can go up and down his web. Coyote is so impressed that he tries to copy Spider. Coyote climbs up a tree, and then tries to use his fur as a web to slide down. Of course it does not work, and coyote gets stuck. Luckily, Spider comes along and frees Coyote. Some of Coyote's fur is left on the tree, and Spider proclaims that when the people come to live on the land, the fur will be wila, and the people will gather it for food.

There is also a similar Okanagan story (Mourning Dove 1933). In this account, Coyote tries to catch some swans, but they fool him by playing dead. Not realizing that the swans are just faking, Coyote unwittingly ties them to his son and crawls up a pine tree to get a pitch top for kindling. The swans then flew away with his son, and in Coyote's haste to get down to save him his long hair got caught in the tree. The swans drop Coyote's son to his death, and Coyote has to cut off his hair to get free. Coyote then transforms his hair into wila, and pronounces that his valuable hair should not be wasted, but rather it should be gathered by people and the old women should make it into food.

Part 3. Examining the Traditional Methods of Utilizing Wila

There is very little nutritional value in unprocessed *Bryoria* species, and there is the risk that they are toxic. Utilizing these lichens as a major food source, as was done by many indigenous people in the past, requires careful selection and processing. As would be expected, people who eat wila have specific knowledge on how to select the correct lichen and on how to wash and cook it. The remainder of this chapter represents my attempt to help Western science catch up with traditional knowledge in understanding how to eat wila. In order to do this I am considering the three cornerstones of eating wila: the traditional methods of selecting the right lichen, thoroughly washing it, and properly cooking it.

Cornerstone 1: Harvesting Wila

Traditional methods for identifying the wila do not use characteristics that modern lichenology considers reliable, and do not identify individual specimens. These methods may seem inaccurate to a lichenologist, but work very effectively for traditional harvesters of wila. I conducted a simple ecological study and concluded that the accuracy of traditional selection methods may be due to the ecology of arboreal hair lichens and their tendency to form specific species associations. This ecological study is summarized later in this part of this chapter. For additional details please see Crawford (2007).

Cornerstone 2: Washing Wila

Thoroughly washing the wila should help remove any vulpinic acid, which is the major source of toxicity in wila. I washed samples of wila and observed that a yellow effluent was produced, but I did not conduct any further tests to prove it contained vulpinic acid. However, there seems to be little reason to doubt this point, as traditional wila experts have commented that wila is washed to remove a bitter green/yellow substance (Morice 1894; Turner et al. 1990), and vulpinic acid is bitter, green/yellow, and somewhat water soluble (Lauterwein et al. 1995).

Cornerstone 3: Cooking Wila

The carbohydrates contained in raw wila are indigestible, and therefore the raw lichen contains very little caloric benefit to humans. It is possible that traditional cooking methods render wila more digestible, but I conducted a series of pitcooking experiments and determined that this is unlikely. However, I did find that when wila is cooked traditionally with root vegetables it captures nutrients that would have otherwise been lost into the cooking pit, and thereby greatly increases the amount of nutrients available for eating. This experiment and my results are summarized below, after the summary of my ecological study. For additional details on my pitcooking experiments, please see Crawford (2007).

Examining the First Cornerstone of Eating Wila: An Ecological Study to Understand How Traditional Lichen Identification Works

There are 13 species of *Bryoria* found within Secwepemc territory. All of these species, except for *Bryoria fremontii*, contain bitter and mildly toxic compounds. Even within the species *B. fremontii*, some individuals (previously named "*B. tortuosa*") contain harmful levels of the lichen toxin vulpinic acid. Most of these types of *Bryoria* look very similar, and differentiating them can be difficult, yet many knowledgeable elders are able to do this by simply looking at the colour of the lichen. I think that this traditional identification method may work because certain *Bryoria* species tend to be found in association with each other, and I conducted a simple ecological study to test this hypothesis.

Methods of the Ecological Study

Bryoria species were harvested from 80 trees at eight different sites in Secwepemc traditional territory around Chase and Salmon Arm (British Columbia). Conventional lichenological methods, employing chemical tests and a dissecting scope, were used to identify individual specimens of lichen and characterize the *Bryoria* population of each tree.

The lichens were differentiated into eight categories: *Bryoria capillaris*, *B. pseudofuscescens*, *B. implexa* sensu lato, and five different morphotypes of *B. fremontii* (which includes "*B. tortuosa*"). The first morphotype of *B. fremontii* is bright yellow, and therefore very easy to identify with a brief glance. It is also toxic. The next three morphotypes look very similar, and can only be identified on the basis of their pseudocyphellae (a lichen organ), which requires a hand lens. One of these three morphotypes is toxic, another is potentially toxic, and the other is edible. The fifth morphotype is a very deep brown colour, and can usually be identified without a hand lens. It is edible.

The *Bryoria* population of each tree was characterized by the relative abundance of each type of *Bryoria*. A series of Kruskal-Wallis tests determined that trees growing in the same site tended to support similar populations of *Bryoria*. An average *Bryoria* population was then calculated for each site, and subsequent analyses done with these averages.

Certain types of *Bryoria* tended to grow in association with each other, and a series of statistical tests were performed to elucidate these associations. A Spearman rank correlation table suggested that the eight different types of *Bryoria* could be placed into four concordant groups. The types of *Bryoria* within each concordant group tended to grow together, while types of *Bryoria* in different concordant groups did not. A computer program by Legendre (2005a) was used to test each of these groups separately for concordance using Kendall's W, as was recommended in Legendre (2005b), and the concordance of each group was found to be significant. Positive and negative correlations between the four concordant groups were identified with another Spearman rank correlation table.

Results and Discussion of the Ecological Study

Trees growing in the same site tended to support similar populations of *Bryoria*, so the *Bryoria* population of any given tree could be used with some accuracy to predict the *Bryoria* population growing on its neighbor. This means that if someone brought home a sample of wila to show a knowledgeable elder, that elder's opinion of that single sample might be a good indication as to the suitability of the entire site for harvesting wila.

The abundance of certain types of *Bryoria* can also be predicted by knowing the abundance of a different type of *Bryoria* that tends to grow in association with it. This could be very useful, as some types of *Bryoria* are easier to identify than others.

In this study, the three toxic or potentially toxic morphotypes of *Bryoria fremontii* all tended to grow together, so the presence of the conspicuous bright yellow toxic morphotype could be used to predict the presence of the other two potentially toxic morphotypes of *B. fremontii* that are not obvious to the naked eye. Also, the two edible morphotypes of *B. fremontii* tended to grow together, so the presence of the conspicuous deep brown morphotype could be used to predict the presence of the less conspicuous edible morphotype of *B. fremontii*.

A third correlation that I found was that *Bryoria capillaris* and *B. pseudofuscescens* tended to grow in areas that had an abundance of the three toxic morphotypes of *B. fremontii*, and less of the two edible morphotypes. *Bryoria capillaris* is usually very easy to identify because it is usually much lighter in colour than the other *Bryoria* species. At least within my study area (around Salmon Arm, BC), the presence of this distinctive species of *Bryoria* was an indication that the edible morphotypes of *B. fremontii* were probably not very abundant.

Traditional Methods of Identifying Edible Wila Relate to Bryoria Species Associations

Dr. Mary Thomas recommended avoiding greenish or lighter coloured lichen when harvesting wila. Lilly Harry (in Jules 1994) also noted that yellowish lichens (called ***stulensméke7***) should not be eaten, and Turney-High (1937) reported that the Flathead only harvested darker lichens. This strategy would avoid both the conspicuous yellow toxic morphotype of *Bryoria fremontii* as well as *B. capillaris*. In my ecological study, these two types of *Bryoria* were also associated with areas that had a higher abundance of the toxic morphotypes of *B. fremontii*, and less of the edible ones.

I showed Dr. Mary Thomas a variety of samples of *Bryoria* species that I had collected from different trees, and asked her about the suitability of each one for eating. The only samples that she said were ideal were the ones that were composed almost entirely of the edible morphotypes of *Bryoria fremontii*, and she considered the samples that contained large quantities of *Bryoria capillaris* to be inedible.

Aimee August, a Secwepemc elder, described another species of *Bryoria* that she called ***tqwesimáka7*** in an interview with R. Bouchard and D. Kennedy (cited in Turner et al. forthcoming), which she said was:

> …black and pretty much the same as ***wíla*** [*Bryoria fremontii*], but finer. It hangs down as much as two feet, like ***wíla***, but they grow in birch or any tree, but not cottonwood [instead of growing on just Douglas-fir, like wila]. It grows from the damp and fog, in damp places.

She also noted that ***tqwesimáka7*** was good for starting fires, but not for food.

Aimee August's description of ***tqwesimáka7*** sounds like an accurate description of *Bryoria capillaris* and/or *B. pseudofuscescens*. These two species are closely related, and both have finer branches than *B. fremontii*. *B pseudofuscescens* tends to be darker than *B. fremontii*, and *B. capillaris* tends to grow in moister habitats. Avoiding these species of *Bryoria* when collecting wila for food would be a good way to ensure that one preferentially collects the edible morphotypes of *Bryoria fremontii*.

Another factor that may help in selecting edible lichen was not tested in this study. *Bryoria fremontii* can grow much larger than other species of *Bryoria*, and can reach a higher biomass per tree. Therefore, trees that support exceptionally luxuriant populations of *Bryoria* species may tend to have a higher proportion *B. fremontii* compared to other species of *Bryoria*. Also, if you harvest the lichen by pulling down the biggest tufts of lichen, these may tend to be *B. fremontii*.

Conclusions About Traditional Lichen Identification Methods

It is very difficult, if not impossible, to reliably identify individual specimens of *Bryoria* to the species level without using a hand lens, and even more difficult to reliably differentiate the edible morphotypes of *Bryoria fremontii* from the toxic ones. Luckily, species associations exist between some of the different species and morphotypes of *Bryoria* (perhaps because the different types of *Bryoria* have different habitat requirements). Because of this, certain types of *Bryoria* that are easy to identify with the naked eye can be used to predict the abundance of other types of *Bryoria* that are more difficult to differentiate. This study indicates that avoiding harvesting wila in areas with *Bryoria* specimens that are either yellow/green or lightly coloured will result in preferentially harvesting the edible morphotypes of *Bryoria fremontii* while avoiding the toxic morphotypes. This is consistent with the strategy used by Dr. Mary Thomas and other elders for identifying edible wila to harvest.

Examining the Third Cornerstone of Eating Wila: A Pitcooking Experiment to Understand the Nutritional Relevance of Wila

The main carbohydrate in wila is lichenin, which is indigestible to humans. However, wila is traditionally pitcooked for anywhere from overnight to several days. This prolonged cooking may break down the lichenin into more digestible carbohydrates, as has been shown for some other complex carbohydrates (Wandsnider 1997). The ability of a pitcook to break down complex carbohydrates is determined by three factors: temperature (Peacock 1998), acidity (Konlande and Robson 1972; Yamazaki and Matsumoto 1993), and duration (Konlande and Robson 1972 vs. Peacock 1998).

I conducted a series of 17 simulated pitcooks to elucidate how pitcooking could affect the nutritional value of wila. Unfortunately, simulating the pitcooks in a lab could not perfectly mimic the real thing, but it did enable me to do more replicates and have a tighter control over the variables. Wila is traditionally cooked with other foods, so I included camas bulbs in some of the simulated pitcooks.

The Temperature Dynamics and pH of a Cooking Pit

The water that is traditionally added to the pit when cooking wila is important for temperature regulation. Once water has been heated to its boiling point, it requires a large amount of energy to change state from a liquid to a gas before it can continue to increase in temperature. As a result, any water in a cooking pit will strongly regulate the temperature – making it difficult to raise the temperature of the pit much above 100°C. This agrees with the empirical data from Leach et al. (1998) and Pagoulatos (2005), which shows that a pitcook can maintain temperatures of 100°C or slightly hotter for approximately 24 hours. For a more detailed exploration of the thermal dynamics of pitcooks, please refer to Crawford (2007). In order to test the possible variation in cooking pits, I maintained my simulated pitcooks at 100°C for up to 34 hours.

Acidity is useful when breaking down complex carbohydrates. Not only does it help to hydrolyze inulin (Konlande and Robson 1972; Yamazaki and Matsumoto 1993), increased acidity has been used to break down lichen carbohydrates to produce alcohol (Stenberg 1868) and molasses (Diachkov and Kursanov 1945). Potential sources of acidity in a pitcook include the cooking vegetables (pH 4.9–5.6: NIRC 2001), the protecting layers of vegetation (broadleaf trees pH > 5.5: Haas 1941; conifer needles pH > 4.0: Pfeifhofer 1999), and the surrounding soil (pH > 5.0: Bickelhaupt 2007). Based on this information, it seems quite possible for a pitcook to have a pH as low as 5.0, but it is unlikely to drop below a pH of 4.0. In order to account for the maximum acidity possible in a cooking pit, in my simulated pitcooks I tested acidities down to a pH of 3.0.

Experimental Design of the Pitcooking Experiments

I tested for the effect of pH on cooking wila by cooking wila samples at 100°C in simulated pitcooks for 10 hours at three different acidities: pH of 7.0, 5.0, and 3.0. The pH had no effect on the carbohydrate content of the cooked wila, so all subsequent tests were all conducted at a pH of 7.0 to reduce confounding variables.

I also tested for the effect of cooking duration on both wila and camas (*Camassia quamash*), and for any synergistic effect of cooking the two foods together. Food samples were cooked at 100°C in simulated pitcooks for five different durations of time: 6, 10, 18, 26, and 34 hours. These food samples were of three different types: wila, camas, or both wila and camas cooked together. One replicate was done for every combination of cooking duration and food type, resulting in 15 simulated pitcooks.

All wila samples were 10.00 g, and all camas samples were ≈15 g. In the samples of camas that were cooked alone, the wila was replaced with an equal weight of clean cotton felt. Each pitcook was simulated by wrapping a moistened food sample (either wila, camas wrapped in wila, or camas wrapped in cotton) in a piece of cotton gauze and placing it in the middle of a clay baker stuffed with 350 g of cotton felt soaked in 3.0 L of water (see Figure 4). The simulated pitcooks were then heated to 100°C an oven, and kept at that temperature for the duration of the cooking trial.

I dried and ground the samples of cooked food, and did a double extraction with 80% ethanol. I then did a colorimetric microtitre plate enzymatic assay to measure glucose and fructose concentrations for each extract. The extraction method was developed by Yip (2006), and the enzymatic assay was adapted by Yip from the procedure outlined by Campbell et al. (1999). The data was then analyzed with the statistical computing program R, and Akaike's Information Criterion (AIC) was used for model selection (Akaike 1974).

Results from the Pitcooking Experiments

All sugar concentrations are reported percent dry weight. The raw camas contained small quantities of glucose (0.4%) and fructose (2.2%). The concentration of both sugars increased substantially when the bulbs were cooked, to a maximum of 2.7% for glucose and 18% for fructose. The presence of wila had no significant effect on the fructose concentration (paired t-test: $t_{0.5,4} = -0.749$, $P = 0.496$) or glucose concentration (paired t-test: $t_{0.5,4} = 0.107$, $P = 0.920$) of the cooked camas. See Figure 4.

The raw wila contained very little glucose (< 0.5%) and no fructose, and neither sugar increased in concentration when the wila was cooked alone for up to 34 hours. However, when the wila was cooked with camas there was a small but significant (ANCOVA: $F_{1,9} = 14.2$, $P = 0.0016$) increase in the glucose concentration (to a maximum of 1.1%), and a substantial increase in fructose (to a maximum of 5.7%). See Figure 5.

The camas lost a significant amount of mass as it was being cooked (linear regression: $R^2 = 0.68$, $t_{0.05,8} = -4.09$, $P = 0.0035$), losing an average of 29% of its mass when it was cooked for 18 hours or longer. When the wila was cooked with camas, it ended up 5.6% heavier than when it was cooked alone, which was found to be significant (ANCOVA: $F_{1,10} = 13.1$, $P = 0.006$). The wila also absorbed four to five times its weight in water sometime within the first six hours of cooking and retained that amount water throughout the cooking process, regardless of how long it was cooked or of the moisture content of its surroundings.

The camas cooked without wila was wrapped in cotton felt instead. This cotton felt had no increase in glucose concentration (linear regression: $R^2 = 0.27$, $t_{0.5,5} = 1.35$, $P = 0.235$, power = 0.64), but a significant increase in fructose concentration (linear regression: $R^2 = 0.91$, $t_{0.5,5} = 7.16$,

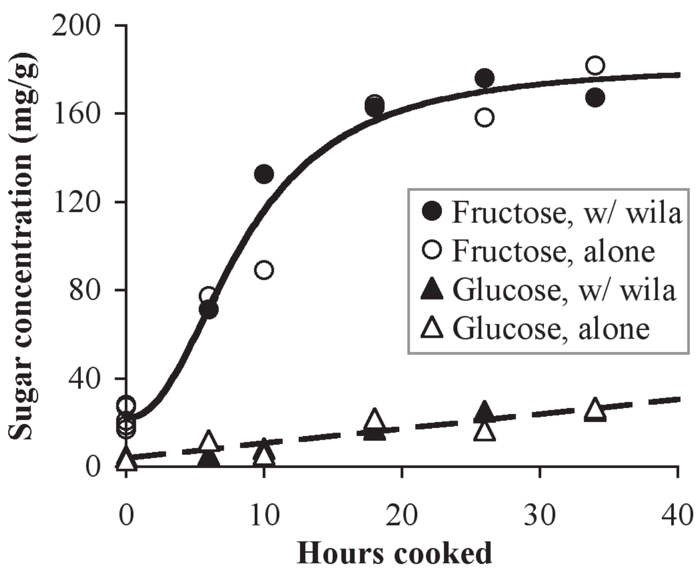

Figure 4. Fructose and glucose concentration in camas bulbs cooked for different lengths of time, both alone and with wila. Best fit lines determined by AIC.

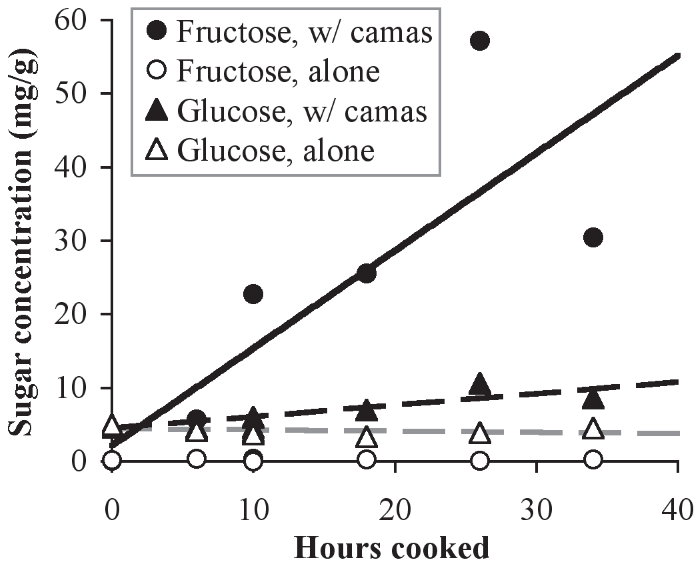

Figure 5. Fructose and glucose concentration in wila cooked for different lengths of time, both alone and with camas. Best fit lines determined by AIC.

P = 0.0008) as a result of being cooked with camas. However, the cotton only accumulated approximately one sixth as much fructose as the wila when it was cooked with camas.

Discussion of the Pitcooking Experiments

The raw camas bulbs contained very little glucose or fructose, but concentrations of both of these sugars increased substantially over time as the camas was cooked and its storage carbohydrates (mostly inulin) broke down into their component sugars (mostly fructose). The camas also lost a significant amount of mass when it was cooked, which is probably the result of water-soluble components leaching out into the surroundings as it cooked.

The raw wila contained very little glucose and no fructose, and there was no increase in either of these sugars when the wila was cooked for up to 34 h, or at a pH as low as 3.0. This indicates that the temperature and pH conditions of a cooking pit are not sufficient to break down the indigestible storage carbohydrates of wila (mostly lichenin) into digestible sugars (glucose). However, the wila was exceptionally adept at capturing nutrients that were being lost from the cooking camas, and was six times better at capturing fructose than an equal mass of cotton. Wila cooked with camas was significantly heavier, and contained substantially more fructose and glucose, than wila cooked alone. Cooking wila and camas together increased the total amount of fructose and glucose in the final food product by an average of 74.2% (range 26% to 122%). See Figures 6 and 7.

Conclusions from the Pitcooking Experiments, and Implications for the Nutritional Value of Wila

The gelling properties of lichenin (the main carbohydrate in wila) allow the cooked wila to absorb large amounts of water and form a delectable gelatinous treat, visually reminiscent of black licorice. Unfortunately, lichenin is both indigestible and too stable to be broken down by the

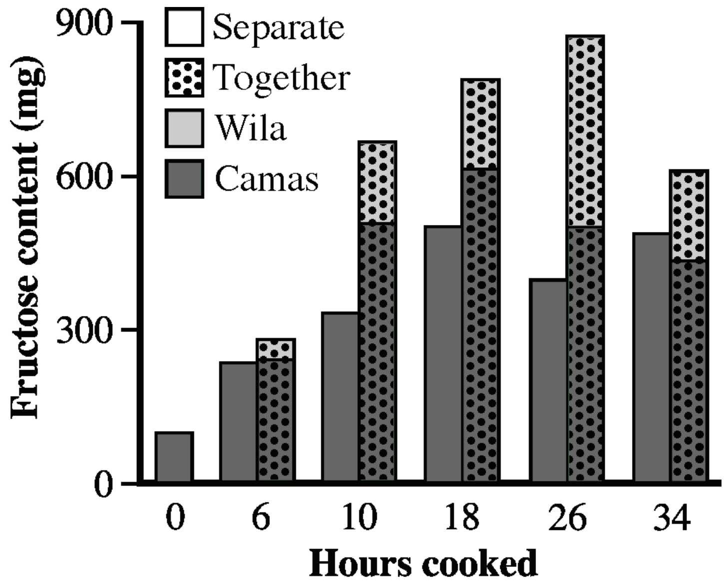

Figure 6. The total fructose content of camas bulbs and wila cooked separately and together. Samples contained 15 g camas and 10 g wila before cooking (wet wt).

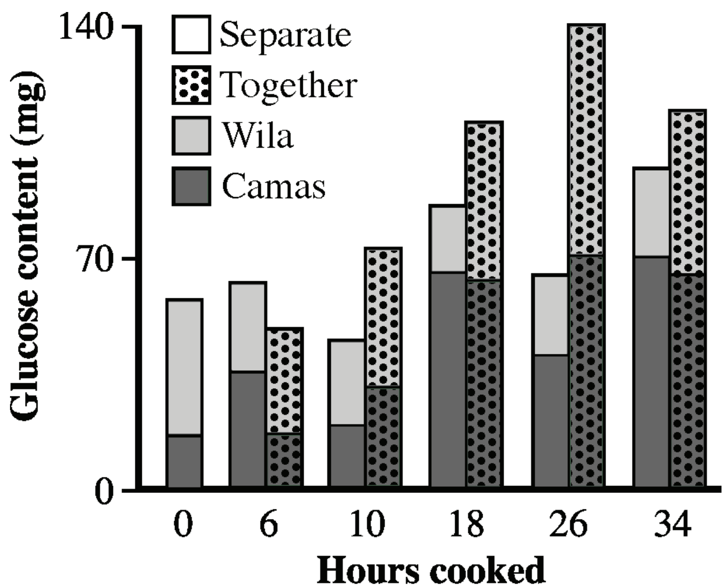

Figure 7. The total glucose content of camas bulbs and wila cooked separately and together. Samples contained 15 g camas and 10 g wila before cooking (wet wt).

conditions of a typical cooking pit, and as a result this delicacy contains very little digestible carbohydrate and has little caloric benefit to humans. Despite this, wila may still confer a significant nutritional benefit in traditional cooking.

When the wila was cooked with camas bulbs it captured significant quantities of digestible sugars that would have otherwise been lost from the camas into the cooking pit. My experiments showed that pitcooking the camas bulbs with wila has the potential of doubling the amount of digestible carbohydrates that are available to be eaten. Given the effort involved in harvesting camas and other root vegetables, if wila can be used to halve the number of bulbs necessary fulfill a person's calorie requirement, then the lichen could be very useful indeed. Wila may also capture other nutrients that are being lost into the cooking pit, but this was not tested.

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Chapter 9. The Importance of Secwepemc Cultural Knowledge in Understanding the Antimicrobial Chemistry of Balsamroot (*Balsamorhiza sagittata*)

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Abstract

Traditional plant knowledge of the Secwepemc Nation was key in guiding a phytochemical investigation of the antimicrobial properties of balsamroot, Balsamorhiza sagittata (Pursh) Nutt., in its dual roles as food and medicine in Secwepemc culture. Pitcooked roots prepared as traditional food and boiled roots prepared as traditional medicine were analyzed for their general antimicrobial properties and for the presence or absence of the polyacetylenic compound thiophene E, which may be toxic if consumed regularly. The methods were designed to more closely approximate what is ingested in balsamroot-containing diets and used in medical regimes compared with standard antimicrobial activity screening and phytochemical procedures. Combined results of bacterial overlay spot tests, thin layer chromatography and agar overlays, mass spectra and GC-MS chromatography showed that balsamroot processed as medicine for topical use did contain bioactive thiophene E while that processed as food for consumption did not. The results show that traditional Secwepemc processing methods of balsamroot for food and medicine differentially alter the phytochemical composition and biological activities of the plant in ways that can be considered beneficial for human use. Specifically, pitcooking and peeling eliminated antimicrobial compounds in roots prepared as food, whereas boiling made available antimicrobial and other biologically active compounds in roots prepared as medicine. The results shed a new light on the antimicrobial chemistry of balsamroot as food and medicine in Secwepemc and other Interior Salish cultures.

Keywords: *Secwepemc, balsamroot, antimicrobial properties, ethnoecology, phytochemistry*

Introduction

An important question that is often overlooked during the laboratory analyses of traditional plant foods and medicines is how closely the analyses relate to the cultural context of plant use. Standard laboratory plant extraction and assay procedures (e.g., for assessing antimicrobial properties

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of medicinal plants) are largely designed to maximize time-efficiency and cost-effectiveness. For example, the work described in this chapter is part of a larger study that involved screening of 68 plant species for antimicrobial activity (i.e., the ability to inhibit bacterial, fungal, and viral growth *in vitro*). The plants were selected using the collective ethnobotanical information shared with researchers by Secwepemc elders who were part of the Secwepemc ethnobotany project, based on the criteria that the documented traditional or contemporary uses implied antimicrobial activity. While 88% of plant species tested had antibacterial activity, 75% had antifungal activity and 28% had antiviral activity (Bannister 2000), it was unclear how the biological activity of extracts tested under laboratory conditions (i.e., *in vitro*) compares with the activity of plant medicines prepared and used by traditional practitioners (i.e., *in situ*). If chemical analyses of plants are to further an understanding and appreciation of plant-human interrelationships and to be of value to the Indigenous originators of the knowledge, then we think approximating (as closely as possible) the cultural context for use is essential. In this chapter, we have combined traditional knowledge with some scientific tools and techniques to help us better understand the antimicrobial properties of balsamroot in its dual roles as food and medicine in Secwepemc culture. [Note: Dr. Mary Thomas, coauthor of this paper, passed away in 2007 (see also Chapter 10); her knowledge and expertise, particularly of the preparation and use of balsamroot as food and medicine, are central to this work.]

Balsamroot in Secwepemc Culture

In Secwepemctsin, balsamroot is called ***tsétsʼelq*** which apparently derives from the lexical root tsʼelq (Kuipers 1974), not further analyzable. A name used for the above-ground flowering plant is tsʼelqenúpye7 (tsʼelq+qn = head, top + -upye7 = lex. Suffix “flowering/above ground part of plant”—Marianne Ignace, pers. comm. 2009). In botanical Latin, balsamroot is known as *Balsamorhiza sagittata* (Pursh) Nutt., referring to the balsam-like aroma of its root and the sagittate or arrow-shape of its leaves. It is assigned to the aster plant family (Asteraceae) (Chambers 2001; Hitchcock and Cronquist 1973; Parish et al. 1996). Locally, it is called “sunflower”, “spring sunflower” or as we will refer to it in this chapter, “balsamroot” (cf. Turner et al., Chapter 12, this volume).

Balsamroot is widespread in the hot, arid climate of the Interior Plateau region of British Columbia. It is often abundant on dry, south-facing grassy hillsides or in open forests at mid to low elevations, and it also occurs on warm, dry slopes at subalpine elevations. Its yellow, singly stalked flower heads (composed of both disk and ray flowers) bloom as early as April at lower elevations. The numerous, large leaves and stems are covered with a thick network of whitish leaf hairs, which give a silvery tinge to the aerial parts. The deep-growing taproot of this herbaceous perennial with its thick, woody bark-like outer layer seems well-adapted to growth on dry soils (Chambers 2001; Hitchcock and Cronquist 1973; Parish et al. 1996; Peacock 1998, 2008).

Balsamroot is known as an important food and medicine to the Secwepemc, as well as other Interior Salish peoples (cf. Turner et al. 1980, 1990) (Figures 1A and B). In fact, it has been referred to as “one of the most versatile food plants used by the peoples of the southern interior” due to its edible roots, root crowns, young shoots, and seeds (Kuhnlein and Turner 1991; Turner

1997:93), and the late Secwepemc Elder Mary Palmantier (Dog Creek Band) called it "the plant to end all plants" (Turner et al. forthcoming). In the past, the pitcooked root was an important food staple for Secwepemc and other Interior Salish peoples (Ignace 2008; Peacock 1998, 2008). While the traditional role of balsamroot as a food source has now been superseded by foods easier and faster to harvest and process, balsamroot still remains important in Secwepemc medicine. Interestingly, and key to our investigation, just as in the traditional processing of balsamroot for food, the preparation of roots for medicine also requires heat.

As Secwepemc medicine, the resinous roots of balsamroot are used to treat a variety of skin ailments, including infections. For preparing medicine, it is recommended that large-sized roots (i.e., greater than 2 cm across the top of the root crown) are dug *after* flowering, in mid-summer, when the medicinal qualities of the root are believed to be highest. The roots are then boiled in water and left to stand until a pitch-like layer (oleoresin) forms at the surface. The oleoresin is collected and applied directly to sores or skin infections while the cooled resinous water can be used as a soaking solution or wash for infected areas. The oleoresin can be mixed with mashed plantain (*Plantago major*) to make a healing salve.

The medicinal uses of balsamroot suggest that the plant might have antimicrobial properties (i.e., the ability to kill or inhibit the growth of microorganisms). Consistent with this, both antibacterial and antifungal activities were found in the roots of balsamroot through antimicrobial activ-

Figures 1A and 1B. Balsamroot *Balsamorhiza sagittata* (Pursh) Nutt. A. In flower. B. Root dug for medicine.

ity screening of Secwepemc medicinal plants (Bannister 2000). Previous studies also have reported antibacterial and antifungal activities in standard laboratory bioassays of methanolic extracts of dried, raw roots (McCutcheon et al. 1992, 1994). Furthermore, a sulphur-containing antibacterial compound, referred to as thiophene E (Arnason et al. 1980; Page 1997), was isolated and purified from the raw roots by Matsuura et al. (1996) (Figure 2). The chemical name used for this polyacetylenic compound by Matsuura et al. (1996) is 7,10-epithio-7,9-tridecadiene-3,5,11-triyne-1,2-diol which differs from the name for the same compound assigned by Balza et al. (1989) and used by Balza and Towers (1993). For simplicity, only the common name thiophene E will be used here.

The presence of these compounds and their properties seem consistent with the traditional use of the roots as a topical treatment for skin infections, except for the fact that in all cases, the antimicrobial activities and the presence of the antibacterial compound thiophene E were detected in *methanol* extracts of *raw* root samples. However, Secwepemc instructions specify that *heat* (i.e., boiling in water) is required in the medicinal preparation of balsamroot. Since many plant compounds and their biological activities are unstable to heat, we wondered whether antimicrobial root compounds (including thiophene E) would be present and active in Secwepemc medicinal preparations of balsamroot, or if they would be destroyed by the boiling process.

While antimicrobial compounds in plants may have medicinal value in treating certain microbial-based infections, these compounds are not necessarily considered healthy if regularly consumed as part of the diet. As an example, while thiophenes have antimicrobial activity, they also are generally noted for their wide-ranging toxicity to a number of different organisms (e.g., Champagne et al. 1986; Dojillo-Mooney et al. 1999; Hudson et al. 1986; Towers et al. 1997;). The toxicity of thiophene E, combined with the nutritional and medicinal duality of balsamroot, raised a second question for us. If antimicrobial root compounds were found to be stable to the heat required for boiling, then would they also be stable to similar temperatures used in pitcooking roots for food? If so, were potentially *detrimental* compounds being consumed (alongside the carbohydrate and other nutrients) in traditional balsamroot-containing diets, or did traditional food processing methods somehow eliminate these compounds from the roots?

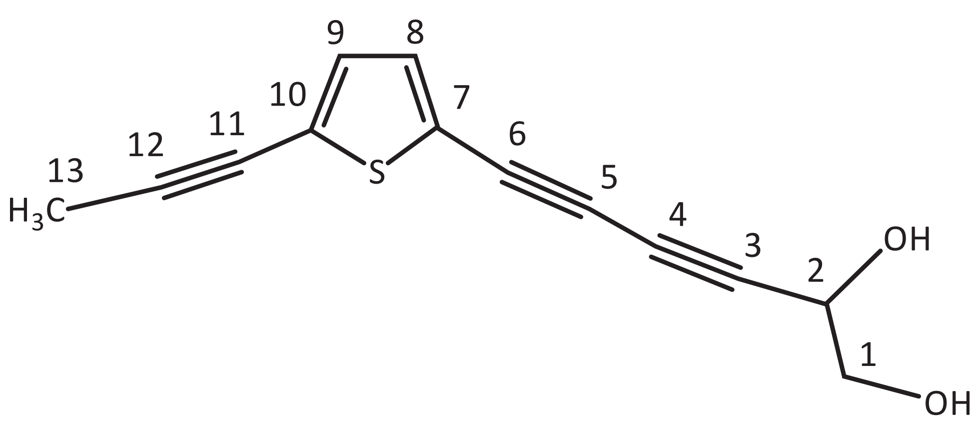

Figure 2. The structure of thiophene E or 7,10-epithio-7,9-tridecadiene-3,5,11-triyne-1,2-diol showing the numbering system used by Matsuura et al. (1996).

Research Objectives

This research on balsamroot was inspired by the questions and concerns outlined above, and guided by a series of three related objectives:

1) To determine whether or not compounds such as thiophene E are *present* in balsamroot "the medicine" (i.e., in the oleoresin and/or in the cooled resinous water prepared by boiling); if so,
2) To determine whether or not compounds such as thiophene E *retain antimicrobial activity* after heat processing for medicine; if so,
3) To assess the antimicrobial properties of balsamroot "the food" (i.e., roots heat-processed by pitcooking in earth ovens).

Materials and Methods

Ethnobotanical Information

Ethnographic information on balsamroot was provided by Secwepemc Elders and other community members who participated in the Secwepemc Ethnobotany Project and this information is documented in a Secwepemc Ethnobotany publication in preparation (Turner et al. forthcoming). Further details about the collection, preparation and medicinal importance of roots of balsamroot were discussed between the authors of this chapter over the period of 1995–1999, in informal open-ended interviews. Conversations often were documented by written notes or photographs. Information subsequently was confirmed for accuracy and for permission to be included here.

Plant Collections

Balsamroot root samples were collected from the upper slopes of the Secwepemc traditional root digging ground known as ***Ck'emqenétkwe*** or "Komkanetkwa," translated as "inside and on top of an area where waters meet or come together at an angle" (R. Ignace 2008; Ignace and Ignace this volume; see also Peacock 1998:1; Peacock and Turner 1995) on Kamloops Indian Reserve #1, above Kamloops, British Columbia. Raw root samples were first collected in July of 1996 with the assistance of Nancy Turner, Sandra Peacock, and Darrell Eustache (Simpcw First Nation), and collected again in July of 1998 with the help of Sandra Peacock. Roots (approximately 10–15 cm long by 1.5–3.0 cm wide) were harvested after the plants had flowered and then air-dried in paper bags for several days. Plants were stored at room temperature until further use.

Pitcooked root samples were provided by Sandra Peacock from a pitcooking reconstruction that took place at the UBC research station near Clearwater, BC (Peacock 1998, 2008; see also Loewen et al., Chapter 7, this volume). The following is a brief summary of the collection and preparation of the samples (see also Peacock 1998, 2008). Balsamroot samples were collected for nutritional studies (Mullin et al. 1997; Peacock 1998, 2008) in July of 1996. Roots (approximately 10–12 cm long by 1–2 cm wide) were harvested after the plants had flowered and were subsequently refrigerated and then frozen prior to pitcooking. It should be noted here that the harvesting time (July) does not coincide with the prescribed harvesting times noted by elders, which is *before* bloom, i.e., in April or May, depending on elevation. Unpeeled balsamroot samples (wrapped in gauze) were roasted in a traditional Interior Salish pitcooking reconstruction. Roasting pit temperatures were monitored hourly with the aid of temperature probes. Over the total 20-hour cooking session, a maximum temperature of 99°C was achieved and sustained for 5 hours, after which the temperature gradually declined to approximately 60°C. Immediately after cooking, samples were refrigerated and then frozen at –20°C until further use.

Plant Extracts

All solvents used in extractions were American Chemical Society (ACS) grade and purchased from Fisher Scientific (Fair Lawn NJ) unless otherwise stated. All extractions were carried out at room temperature unless otherwise noted. All plant extracts were stored at 4°C until use.

Boiling Water Extractions of Roots

Boiling water extractions were used to isolate the oleoresin from raw root samples, on two separate occasions. In the first extraction, approximately 180 g (dry weight) of raw roots were boiled in 1.0 litre of distilled water for 2 hours and the mixture was allowed to cool to room temperature. Droplets of hot oleoresin in the form of yellow oil beads were retrieved from the surface of the water using a glass Pasteur pipette, allowed to harden into a sticky pitch-like substance, and rotary-evaporated to remove water. This oleoresin (800 mg) was dissolved in methanol to a final concentration of 100 mg/ml. After boiling, roots were removed and the remaining resinous water was cooled and filtered through Whatman® No. 1 filter paper (Maidstone, England) to remove particulate matter, rotary-evaporated to dryness in a tared rotary flask at 30–37°C in a waterbath, and re-suspended in aqueous methanol (50%) to a final concentration of 500 mg/ml.

In the second extraction, approximately 1 kg (dry weight) of raw roots was boiled in 10 litres of distilled water for 2 hours. Hot oleoresin (3 g) was collected from the surface of the boiling water as indicated above. A further 4 g of hardened oleoresin were retrieved from the cooled resinous water after refrigeration at 4°C. The oleoresin was dissolved in ethylacetate and vacuum filtered through Whatman® glass fiber filters (Clifton NJ) to remove particulate matter, then rotary-evaporated to remove solvent and weighed (total oleoresin weight = 7 g).

Pitcooked root samples were also subjected to a boiling water extraction for oleoresin isolation. Approximately 90 g (dry weight) of pitcooked roots were boiled for 1 hour in 500 ml of distilled water and then allowed to cool to room temperature. Approximately 90 mg of oleoresin were retrieved from the surface of the water and dissolved in methanol to a final concentration of 100 mg/ml. The cooled, resinous water was filtered, evaporated, and then dissolved in aqueous methanol (50%) to a final concentration of 500 mg/ml. The boiled, pitcooked roots were dried for subsequent methanol extraction, as described below.

Methanol Extractions of Roots

The bark was removed from dried samples of raw roots, pitcooked roots, and pitcooked/boiled roots. For each of these three samples, both the bark and the peeled roots were ground separately in an electric coffee grinder, and then extracted in 3 x 300 ml methanol over several hours. For each of the resulting 6 extracts, the methanol washes were combined, evaporated to dryness and then dissolved in methanol to a final concentration of 200 mg/ml.

Microorganisms

A variety of bacteria (Table 1) and fungi (Table 2) were chosen for assays in vitro to examine the antimicrobial properties of balsamroot extracts. The test microorganisms were selected from available laboratory collections and represent a standard range of morphological and physiological characteristics and thus a range of potential targets for antimicrobial action of the phytochemicals within the extracts. All bacteria and fungi were originally wild type strains that were maintained in culture, from the former laboratory collection of the late G. H. N. Towers (Department of Botany, UBC).

Antibacterial and Antifungal Disk Diffusion Assays

All methods and materials for disk diffusion assays, including microorganisms, were the same as those described in Bannister (2000). Antibacterial and antifungal activity in vitro were assessed for methanolic extracts of raw and pitcooked balsamroot samples, and boiling water-extracted oleoresin samples using the standard disk diffusion method (Lennette 1985) and the microorganisms listed in Tables 1 and 2. Sterile filter paper disks were impregnated with approximately 2 mg of root extract.

Table 1. Bacterial species tested in inhibition assays balsamroot extracts.

Species	Morphological Characteristics[a]
Bacillus subtilis	Gram positive, bacilli
Staphylococcus aureus K147	Gram positive, cocci, Methicillin sensitive strain
Staphylococcus aureus P0017	Gram positive, cocci, Methicillin resistant strain
Enterococcus faecalis	Gram positive, cocci
Escherichia coli DC-2	Gram negative, bacilli (enteric)
Pseudomonas aeruginosa 187	Gram negative, bacilli (non enteric)
Mycobacterium phlei	Acid fast, bacilli

[a] All strains are wild type except *S. aureus* P0017.

Table 2. Fungal species tested in inhibition assays using balsamroot extracts.

Species	Classification[a]
Aspergillus fumigatus	filamentous, systemic (opportunistic)
Microsporum gypseum	filamentous, superficial (dermatophyte)
Trichophyton mentagrophytes	filamentous, superficial (dermatophyte)
Candida albicans	yeast, superficial or systemic (opportunistic)
Saccharomyces cerevisiae	yeast, non pathogenic

[a] Both yeasts and filamentous fungi are represented.

Bacterial Overlay Spot Tests

A simple and semi-quantitative method for comparing the relative potency of antibacterial activity in balsamroot extracts was developed using a bacterial agar overlay assay, which is a modification of the agar dilution assay (Washington 1985), and employs the same rationale as in the thin layer chromatography agar overlay (Saxena et al. 1995). As this method circumvents the radial diffusion requirement of the disk diffusion assay, it increases the likelihood of detecting antibacterial activity of non-water soluble compounds.

Two-fold serial dilutions (diluted in methanol and mixed by vortexing) of 200 μg/ml crude methanol extracts of raw and pitcooked roots were spotted (3 μl/spot) onto quadrants of two 8 x 8 cm silica gel type 60 F_{254} alumina backed TLC plates (EM Science, Gibbstown NJ) and solvent was evaporated. The TLC plates were placed in 9 x 9 cm Falcon® petri dishes (Becton Dickinson & Co., Franklin Lakes NJ) and overlayed with 10 ml molten Muller Hinton agar (50°C) containing 0.002% phenol red indicator (Sigma Chemical Co., St. Louis MO) and 10^4–10^5 cfu/ml bacteria (10 μl of a 2 ml overnight culture grown Muller Hinton broth at 37°C with shaking in a 14 ml sterile polypropylene tube). The molten agar was poured over the TLC plates to form a layer approximately 1 mm thick and allowed to solidify. One plate was exposed to UV-A light (254 nm) for 30 minutes irradiation at 5 W/m^2 to test for light-activated activity, and then both plates were inverted and incubated overnight at 37°C. The plates were sprayed with a tetrazolium-containing salt, which was an aqueous solution of methylthiazolyltetrazolium chloride (MTT) 5 mg/ml (Sigma Chemical Co., St. Louis MO), to darken selectively the areas of bacterial growth and aid in visualisation of zones of growth inhibition due to enzymatic conversion of the normally colourless tetrazolium to a deep red coloured insoluble formazan (Hamburger and Cordell 1987). Zones of bacterial growth inhibition indicated the minimum amounts of extract (in mg) that were active. Bacterial cultures of *B. subtilis, S. aureus* K147 (methicillin sensitive) and *S. aureus* P0017 (methicillin resistant) were used in separate assays to test 2-fold dilutions of crude extracts ranging from 600 μg to 9 μg.

Thin Layer Chromatography (TLC) and TLC Agar Overlays

Antibacterial compounds in methanolic extracts of the raw, pitcooked, and boiled/pitcooked balsamroot samples were compared using the thin layer chromatography (TLC) agar overlay technique as described by Saxena et al. (1995). Approximately 200 μg of each extract, along with purified thiophene E standard (provided by Jon Page, Department of Botany, UBC), were spotted on five identical 8 x 8 cm silica TLC plates, solvent was evaporated and the plates were placed in a chromatography chamber containing a 1:1 solvent mixture of benzene and ethylacetate. The samples were developed (7 cm), removed from the chamber, and residual solvent was evaporated for 3 hours in a fumehood. One plate was viewed under UV light (254 nm and 366 nm), then sprayed with vanillin-sulphuric acid (VSA) reagent (0.5 g vanillin dissolved in 100 ml sulphuric acid-ethanol, 40:10) for detection. Two of each of the other plates were overlayed with *B. subtilis* or *S. aureus* (methicillin sensitive), and one each of these was exposed to 30 minutes of UV-A irradiation at 5 W/m^2, then all were incubated at 37°C overnight and visualized by spraying with MTT, as described in the previous section. Antibacterial compounds were evident as lighter zones of growth inhibition against a darker purple background of bacterial growth.

Bioactivity-guided Isolation of Antimicrobial Compounds from Balsamroot Oleoresin

A schematic summary of procedural steps taken for the bioactivity-guided isolation of thiophene E from boiled balsamroot oleoresin is shown in Figure 3. All solvents were ACS grade (unless otherwise noted) and purchased from Fisher Scientific (Fair Lawn NJ). Column chromatography was carried out using silica gel type 60, 70–230 mesh size (BDH Chemicals Ltd, Poole, England). Analytical TLC was carried out using 8 x 8 cm silica gel type 60 F_{254} alumina backed TLC plates (EM Science, Gibbstown NJ). Preparative TLC was carried out using silica gel type 60 F_{254} pre-coated glass plates (20 x 20 cm) of 250 μm thickness (EM Science, Gibbstown NJ).

Balsamroot oleoresin (6 g) was extracted with hexanes (3 x 30 ml) and the hexane soluble fraction was rotary-evaporated and weighed (3.4 g). The hexanes insoluble fraction (2.3 g) was dissolved in 10 ml ethylacetate. To the ethylacetate solution, 100 ml water were added and the solution was mixed well and left to separate overnight. One drop of concentrated hydrochloric acid was added to acidify the solution (pH 3) to assist in separation of the two layers.

The ethylacetate soluble fraction (1 g) was mixed with silica (5 g) in hexanes and applied to an open chromatography column consisting of silica (150 g) packed with hexanes. Sixty fractions (200–400 ml each) were collected as the polarity of developing solvent was increased by gradual addition of ethylacetate as follows: 100% hexanes; hexanes:ethylacetate (100:1; 50:1; 25:1; 25:2; 25:4; 25:8; 25:16; 1:1; 1:2); 100% ethylacetate; followed by a methanol wash. The fractions were

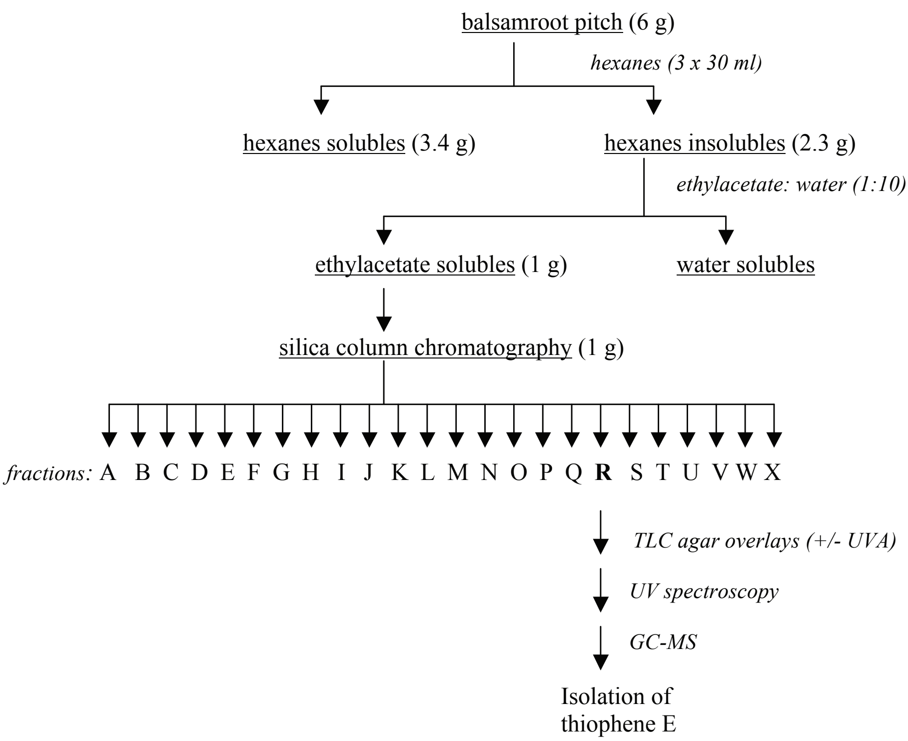

Figure 3. A schematic summary of procedural steps taken for the bioactivity-guided isolation of thiophene E from boiled balsamroot oleoresin.

examined by TLC (developing solvent hexanes: ethylacetate 1:1) and visualised with VSA reagent (plus heat), and fractions with similar chemical profiles were combined. Antibacterial properties of the fractions, as well as of thiophene E standard, were assessed using TLC agar overlays with *B. subtilis* in the presence and absence of 30 min UV-A irradiation at 5 W/m^2. One fraction (fraction R) displayed antibacterial activity, Rf value (Rf = 0.16 in H:EA 1:1) and UV spectral characteristics similar to those of thiophene E and so was subjected to GC-MS for verification of the presence of thiophene E.

Gas Chromatography-Mass Spectrometry (GC-MS)

Balsamroot oleoresin, root extracts, and thiophene E standard were analysed by Nikolay Stoynov (Department of Chemistry, UBC) using GC-MS. Each sample was dissolved to ~1 mg/ml in toluene-dichloromethane (8:2). The analysis was performed using a Saturn 2000 GC-MS (Varian) including autosampler 8200, gas chromatograph 3800, mass spectrometer 2000, Saturn system control and SatView processing program. The analyses were performed under the following conditions: injection volume 1 μl, injector temperature 300°C, split ratio 10, capillary column VA-5MS, 30 m x 0.25 mm, particle size 25 μm (5% dimethylpolysiloxane, 95% diphenylpolysiloxane, low bleed), carrier gas helium, constant pressure 25 psa, column temperature 100°C from 0.00 to 3.00 min; 100°C→150°C (80°C/min) from 3.0 to 3.62 min, 150°C from 3.63 to 8.63 min, 150°C→280°C (40°C/min) from 8.63 to 11.88 min, 280°C from 11.88 to 46.88 min, transfer line temperature 170°C, ion trap mass spectrometer temperature 230°C, electron multiplier voltage 1900 V, and scanned range *m/z* 40–650.

Results

Antimicrobial Activity in Balsamroot Preparations

The antimicrobial profiles of methanolic extracts of both raw and pitcooked balsamroot samples (whole roots, inner roots, and outer roots), balsamroot oleoresin (extracted from raw and pitcooked roots by boiling water and then dissolved in methanol), and the cooled, resinous-water are summarized in Table 3. Extracts of all samples tested, except for the edible portion of the cooked root (i.e., inner root, pitcooked), inhibited the growth of both dermatophytic fungi (*M. gypseum* and *T. mentagrophytes*), the acid fast bacteria (*M. phlei*), and one or both of the Gram positive bacteria (*B. subtilis* and *S. aureus*), based on disk diffusion assays. No activity in any of the extracts was found in assays against the two Gram negative bacteria, *E. coli* and *P. aeruginosa,* the opportunistic yeast *C. albicans,* nor the opportunistic fungal pathogen *A. fumigatus* (data not included in table).

A comparison of the antibacterial activity of raw and pitcooked roots by bacterial overlay spot assays indicated that the highest concentration of activity was in the bark. Table 4 summarizes the results of these assays in vitro using *B. subtilis, S. aureus* (methicillin sensitive) and *S. aureus* (methicillin resistant).

Table 3. Summary of antibacterial and antifungal activity profiles of methanolic extracts of raw and pitcooked balsamroot samples and boiled oleoresin from raw and pitcooked roots, based on disk diffusion assays. A "+" indicates inhibition of bacterial growth (zone of inhibition > 2 mm) and a "–" indicates no inhibition.

	Microorganism[a]				
Balsamroot Sample[b]	**Bs**	**Sa**	**Mp**	**Mg**	**Tm**
Whole root (raw)	+	+	+	+	+
Inner root (raw)	+	+	–	+	+
Outer root (raw)	+	+	+	+	+
Oleoresin (raw, boiled)	+	+	+	+	+
Resinous water (raw, boiled)	+	–	–	+	+
Whole root (pitcooked)	+	+	+	+	+
Inner root (pitcooked)	–	–	–	–	–
Outer root (pitcooked)	+	+	+	+	+
Oleoresin (pitcooked, boiled)	+	+	nt[c]	nt	nt
Resinous water (pitcooked, boiled)	+	+	nt	nt	nt
Inner root (pitcooked, boiled)	–	–	nt	nt	nt
Outer root (pitcooked, boiled)	+	+	nt	nt	nt

[a] Abbreviations of microorganisms are as follows: Bs = *Bacillus subtilis*, Sa = *Staphylococcus aureus*, Mp = *Mycobacterium phlei,* Mg = *Microsporum gypseum*, Tm = *Trichophyton mentagrophytes.*
[b] Samples were assayed at ~2 mg per disk.
[c] nt = not tested.

Table 4. Combined results of bacterial overlay spot assays using methanolic extracts of: raw outer roots, pitcooked outer roots, raw inner roots, and pitcooked inner roots. The amount of extract (µg) that inhibited growth is indicated for each bacterial species. Lack of antibacterial activity is indicated as "–", while "(+)" indicates a hazy (rather than a clear) zone of inhibition.

	Zone of inhibition (mm)						
Sample and Microorganism	**600 µg**	**300 µg**	**150 µg**	**75 µg**	**38 µg**	**19 µg**	**9 µg**
Raw outer roots:							
B. subtiltis	9	8	8	7	5	(3)	(3)
S. aureus (methicillin sensitive)	8	6	6	4	(3)	–	–
S. aureus (methicillin resistant)	7	5	5	4	(3)	–	–
Pitcooked outer roots:							
B. subtiltis	9	7	6	5	3	(2)	(+)
S. aureus (methicillin sensitive)	6	5	5	4	+	(+)	–
S. aureus (methicillin resistant)	5	4	4	(3)	(+)	(+)	–
Raw inner roots:							
B. subtiltis	4	3	–	–	–	–	–
S. aureus (methicillin sensitive)	(+)	–	–	–	–	–	–
S. aureus (methicillin resistant)	(+)	–	–	–	–	–	–
Pitcooked inner roots:							
B. subtiltis	–	–	–	–	–	–	–
S. aureus (methicillin sensitive)	–	–	–	–	–	–	–
S. aureus (methicillin resistant)	–	–	–	–	–	–	–

The Isolation of Thiophene E from Boiled Oleoresin

Figure 4 shows a triplicate series of 3 TLC plates and TLC overlays of boiled oleoresin and the final 24 fractions (A to X) resulting from bioactivity-guided partitioning of the boiled oleoresin. Figure 4A (upper series) shows TLC plates developed in benzene:ethylacetate (1:1) and sprayed with VSA reagent (plus heat) for detection. Figure 4B (middle series) shows the antibacterial activity of each of the fractions (using *B. subtilis*) without UV-A light exposure prior to incubation, and Figure 4C (lower series) shows the antibacterial activity of the fractions (using *B. subtilis*) with UV-A light exposure. The presence of multiple antibacterial compounds is evident by the lighter zones of growth inhibition against the darker stained bacterial lawn (refer to Figure 4B

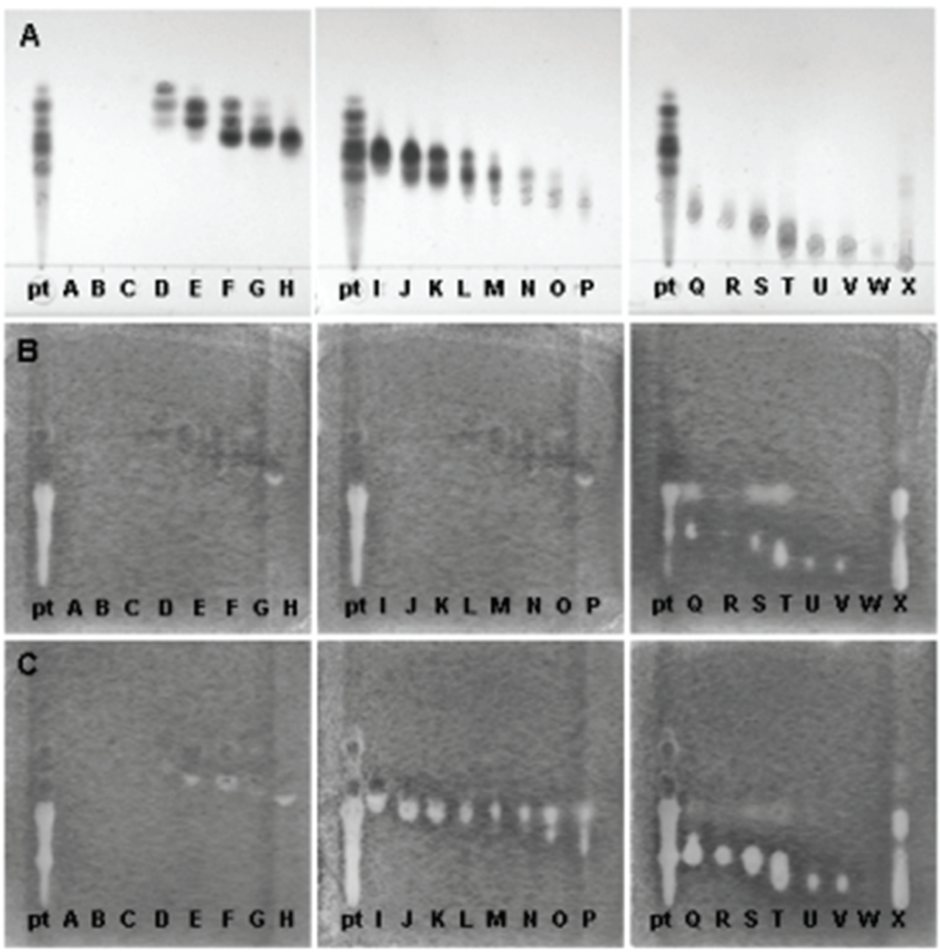

Figure 4. TLC overlay series showing fractions A to X derived from bioactivity-guided partitioning of boiled balsamroot oleoresin on silica column chromatography. A. (upper series) TLC plates visualised with VSA reagent (plus heat). B. (middle series) TLC plates overlayed with *B. subtilis* and incubated without exposure to UV-A light. C. (lower series) TLC plates overlayed with *B. subtilis* and exposed to UV-A light for 30 min prior to incubation, in order to observe UV light-dependent or UV light-enhanced antibacterial activity. The first lane in each plate is crude oleoresin (pt).

and 4C). For some of these compounds (e.g., fractions I to R), antibacterial activity appears to be either enhanced or dependent on exposure to UV light (compare Figure 4B with 4C).

Results of TLC and TLC overlays indicated that thiophene E was most likely present in fractions Q and R, based on comparisons of the Rf values and the characteristic UV-enhanced activity of thiophene E (Matsuura et al. 1996). However, TLC plates visualised by a strongly oxidizing agent (ammonium molybdate reagent) indicated that fraction R was the more pure of the two fractions and thus likely to contain a higher concentration of the putative thiophene E, so fraction R (Figure 5) was chosen for further analysis by GC-MS.

GC-MS analysis of fraction R and thiophene E standard (Figure 6) confirmed the presence of thiophene E in fraction R, and thus in balsamroot oleoresin. Both mass spectra show mass ion peaks of the same relative intensity at mass/charge ratio (m/z) = 170, 126, and 93 (Mass Spectrum 1 compared with Mass Spectrum 2), and identical elution peaks at 9.2 minutes (Chromatogram 1 compared with Chromatogram 2).

The expected molecular ion peak at $m/z = 231$ $[M \bullet H]^+$ or $m/z = 230$ $[M]^+$ for thiophene E ($C_{13}H_{10}SO_2$) was not observed in either of these two spectra under the conditions that they were run, presumably due to pyrolysis (i.e., decomposition by heating) occurring before the compound entered the mass spectrometer. In the procedure used, the sample evaporates (at 300°C) and passes through a capillary column (containing non-polar silanized silica gel) for about 1 minute before it enters the mass spectrometer. In this procedure, pyrolysis resulting in loss of the intact molecule is not uncommon. The prominent signal at $m/z = 170$ likely corresponds to loss of the terminal ethane diol (R-OH-CH_2-CH_2-OH) to give an ethene diol fragment (OH-CH=CH-OH).

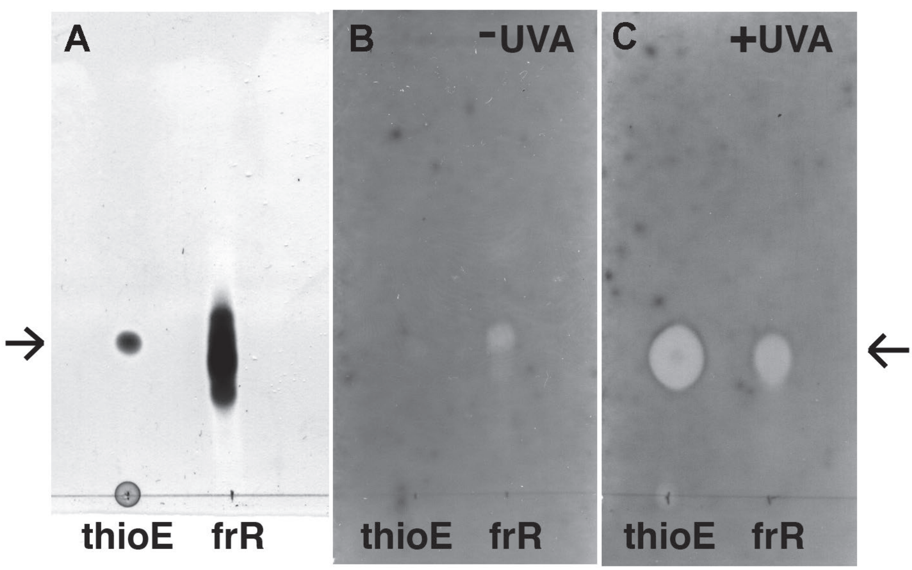

Figure 5. Thin layer chromatography overlays (using *S. aureus*) comparing antibacterial activity (± UV-A light exposure) of thiophene E standard (lane 1) and crude thiophene E from fraction R (lane 2) isolated from boiled balsamroot oleoresin. A. TLC plate visualised by ammonium molybdate reagent (plus heating). B. TLC overlay incubated without exposure to UV-A light. C. TLC overlay exposed to UV-A light for 30 minutes. The arrow indicates the location of thiophene E.

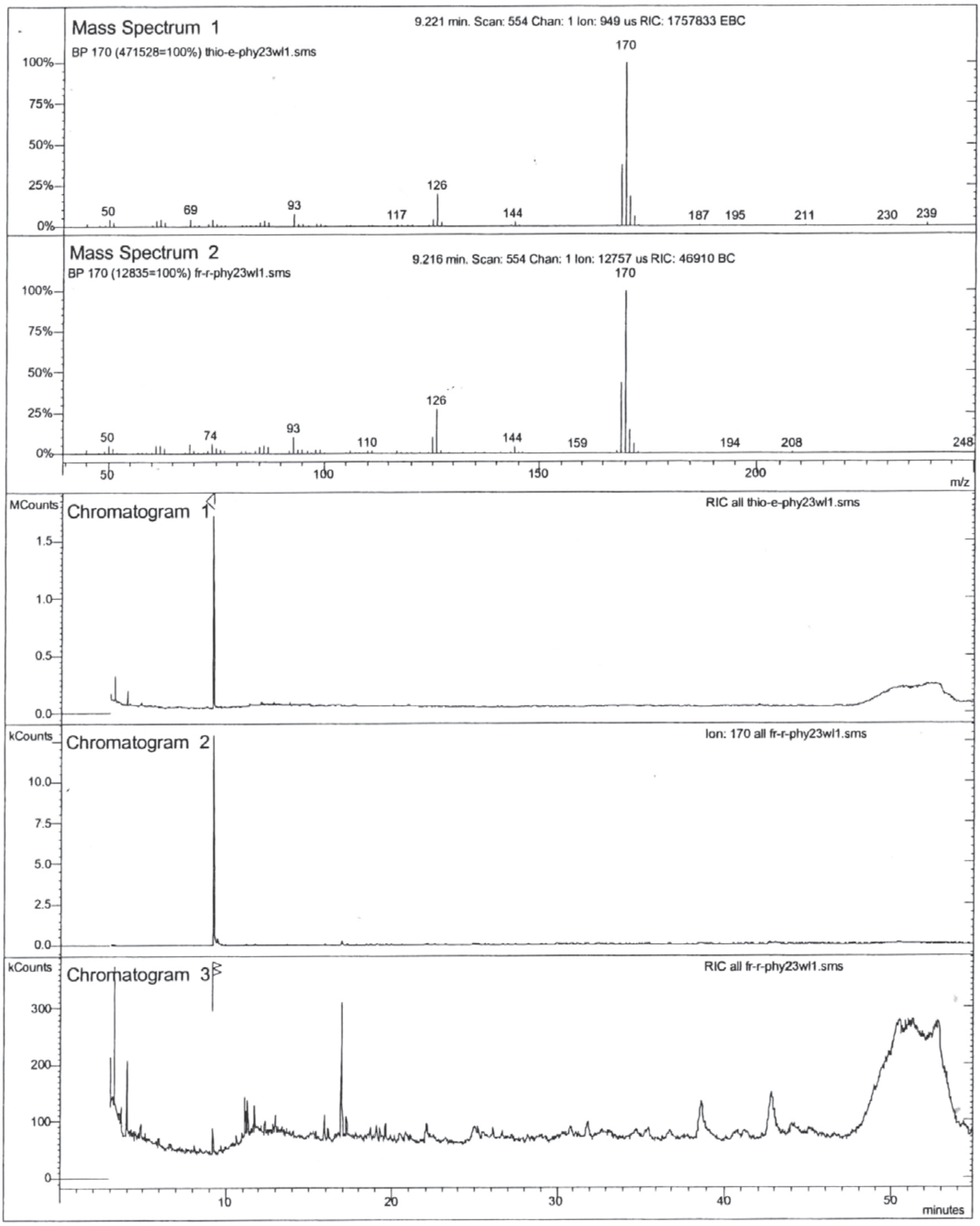

Figure 6. GC-MS chromatograms of thiophene E standard compared with crude thiophene E isolated from boiled balsamroot oleoresin (fraction R). The total ion chromatogram of thiophene E ($m/z = 40$ to $m/z = 250$) is shown in Chromatogram 1. The selected ion chromatogram at $m/z = 170$ for fraction R is shown in Chromatogram 2 while the total ion chromatogram for fraction R ($m/z = 40$ to $m/z = 250$) is shown in Chromatogram 3. A comparison of the mass spectra at 9.2 minutes confirms the presence of thiophene E in boiled balsamroot oleoresin.

Localisation of Thiophene E and Antimicrobial Activity in Balsamroot as Food

Mass spectra and GC-MS chromatograms of methanolic extracts of the inner and outer portions of both raw, dried roots and pitcooked roots (Figure 7) confirm that thiophene E is present in all root samples *except* the pitcooked inner root (i.e., the part of the root that is consumed as food). The elution peak at 9.1–9.2 minutes (i.e., the "flagged" peak in GC-MS Chromatogram 1) with mass ion peak $m/z = 170$ characteristic of thiophene E standard (Mass Spectrum 1) is also found in GC-MS Chromatogram 2 and Mass Spectrum 2 of the raw outer roots, GC-MS Chromatogram 3 and Mass Spectrum 3 of the pitcooked outer roots, and GC-MS Chromatogram 4

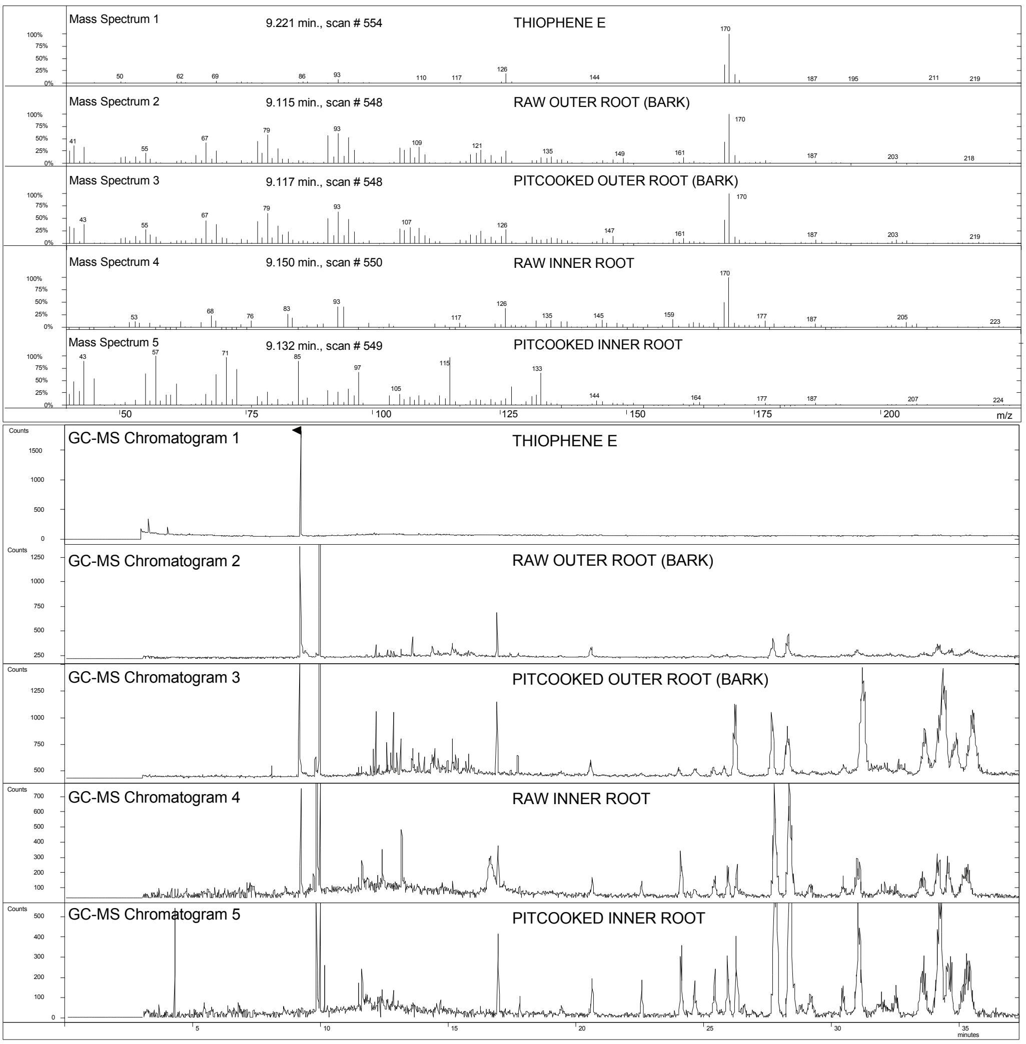

Figure 7. Mass spectra and GC-MS chromatograms of thiophene E standard compared with methanolic extracts of raw and pitcooked root samples. The total ion chromatogram of thiophene E is shown in Mass Spectrum 1 while the selected ion chromatograms at $m/z = 170$ are shown in Mass Spectra 2–5. The GC-MS chromatograms at 9.1–9.2 minutes confirm the presence of thiophene E in all samples except the edible portion of the pitcooked root (pitcooked inner root).

and Mass Spectrum 4 of the raw inner roots. However, the elution peak at 9.1–9.2 minutes with mass ion peak $m/z = 170$ is *not* observed in GC-MS Chromatogram 5 and Mass Spectrum 5 of the pitcooked inner roots.

A second antibacterial compound (i.e., located above thiophene E on the TLC plate) also occurs in both the raw and pitcooked outer portion (i.e., bark) of the roots (Figure 8A and B, lanes 2 and 3). Comparison of the two overlays indicates that the antibacterial activity of this compound is not UV-A light-dependent. The identity of this compound is presently unknown but its purification and identification would be of interest in further research on balsamroot.

Figure 8 confirms that thiophene E retains antibacterial activity in pitcooked roots. This figure shows a comparison of thiophene E standard (lane 1) with methanolic extracts of raw and pitcooked root samples (lanes 2–5) by TLC overlays (using *S. aureus*) in the presence and absence of UV-A light exposure. The overlay at right (Figure 8B) shows the UV-A light-activated antibacterial activity of thiophene E (indicated by an arrow) in the outer portions (i.e., bark) of both raw (lane 2) and pitcooked (lane 3) roots, as well as in the inner portion of raw roots (lane 4). However, there is no antibacterial activity detected in the inner portion of pitcooked roots (lane 5), which is the part of the root considered edible.

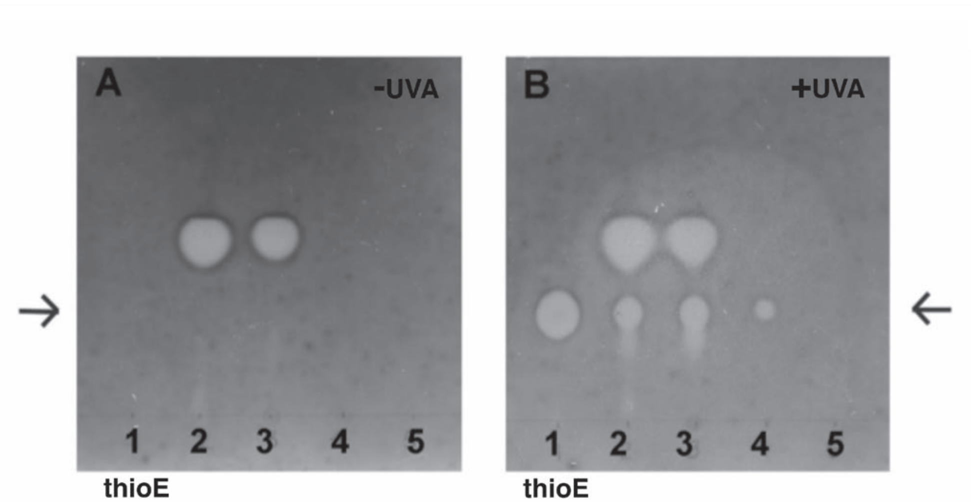

Figure 8. Thin layer chromatography overlays (using *S. aureus*) comparing antibacterial activity of thiophene E standard (lane 1) and methanolic extracts of raw and pitcooked roots (lanes 2–5), with and without UV-A light exposure. A. The overlay without exposure to UV light. B. The overlay with a 30-minute exposure to UV light. Antibacterial activity due to thiophene E (indicated by the arrows) is observed in all samples except the edible portion of the pitcooked root (pitcooked inner root) in lane 5. Lane assignments are as follows: 1: thiophene E standard; 2: raw outer root (bark); 3: pitcooked outer root (bark); 4: raw inner root; 5: pitcooked inner root.

Discussion

We found the antimicrobial properties of balsamroot to be far more complex than we anticipated at the onset of this research, based on previous analyses (Matsuura et al. 1996; McCutcheon et al. 1992, 1994). It is clear that what we have examined describes only a fraction of the total antimicrobial compounds (and these are only a fraction of the total biologically active compounds) that exist in the plant. However, the results of this research indicate clearly that traditional Secwepemc processing methods of balsamroot for food and medicine do alter the phytochemical composition and biological activities of the plant. This point is especially interesting given the nutritional and medicinal duality of balsamroot as a plant resource in Secwepemc and other Interior Salish cultures, as we discuss below.

Thiophene E and Antimicrobial Properties of Roots

The results of assays in vitro confirmed that the oleoresin of balsamroot that is used as a treatment for skin infections does have antibacterial and antifungal activity, as does the cooled resinous-water used as a soaking solution for wound healing—even after exposure to extreme heat treatment by boiling. Furthermore, it was shown conclusively that the previously identified antibacterial compound thiophene E is *present* and *active* in the oleoresin, along with an undetermined number of other (as yet unidentified) antimicrobial compounds. These results suggest that thiophene E may indeed play a role in the medicinal properties of (heat-processed) balsamroot to treat skin infections, as described by Secwepemc Elders. This result is somewhat unexpected as, according to Bohlmann et al. (1980), most acetylenes, especially polyacetylenes (such as thiophenes), are thermally unstable. However, these results also indicate that the antimicrobial nature of the oleoresin is chemically complex, so that the antimicrobial activity cannot be attributed solely to thiophene E. While the identities of the other antimicrobial compounds in the oleoresin remain unknown, the possibility exists that some of them are also of the same chemical class (i.e., polyacetylenes), as these compounds tend to co-occur in plants (Towers et al. 1997).

Without an ethnographic reference to purposeful exposure of the oleoresin to ultraviolet light (e.g., in sunshine), however, it is difficult to assess the contribution of thiophene E to the overall antimicrobial properties of the oleoresin when used in the traditional medicinal context. Matsuura et al. (1996) showed that the minimum inhibitory concentration of thiophene E is in the order of 50–100 μg/ml for *S. aureus* and *B. subtilis* without light exposure, and 25 μg/ml in the presence of UV light. Although the antibacterial activity of crude thiophene E isolated from roots was not quantified in this study, the activity observed by TLC overlays suggests that the difference between the UV-A light-exposed and the non-UV-A light-exposed compound may be greater than the two- to four-fold difference reported by Matsuura et al. (1996), as negligible activity was observed for thiophene E in the absence of UV-A light exposure. Other studies have shown that many thiophenes are completely inactive in the absence of UV irradiation (Constable and Towers 1989; Hudson and Towers 1991). The light-mediated or "photodynamic" (Towers et al. 1997:395) biological activities of thiophenes involve an oxidative process that leads to the generation of singlet oxygen, which may damage a number of cellular molecules such as unsaturated lipids, proteins and nucleic acids. The main targets of thiophenes are believed to be cell membranes (Hudson and Towers 1991; Towers et al. 1997).

Analysis of pitcooked roots revealed that antibacterial activity is present, but it is diminished to undetectable levels, based on assays in vitro, by removal of the outer bark-like covering after pitcooking. Our observations of pitcooked roots indicated that cooking draws the oleoresin out of the edible portion of the root where it hardens onto the inner wall of the outer bark, which is removed prior to consumption. Consistent with this observation, analysis by GC-MS confirmed that thiophene E is present in pitcooked roots, but is completely localised to the bark-like covering. From the combined results, it can be concluded that the edible portion of the root is free of detectable antibacterial properties when prepared for consumption following traditional Secwepemc cooking methods. In this case, pitcooking and peeling may be considered forms of detoxification. Thus, our specific concerns raised by the routine consumption of the potentially toxic compound thiophene E, as well as other antibiotic-like compounds, in traditional balsamroot-containing diets were largely alleviated by this study.

The Role of Heat in Differential Processing of Balsamroot

The comparison of the antimicrobial and chemical properties of the roots of balsamroot prepared as food and medicine has contributed to a deeper understanding of the importance of heat as a differential processing method—essentially creating multiple uses for a single plant part. In this case, heat is crucial in both nutritional and medicinal applications, albeit apparently for different reasons. In the nutritional context, heat and other factors are required to increase the availability of carbohydrate by a process of chemical degradation, which relies on the heat-, acid- and moisture-sensitive nature of inulin (Peacock 1998, 2008). In the medicinal context, however, heat applied by boiling makes available water-soluble compounds (in the resinous-water) and water-insoluble compounds (in the oleoresin), both of which must be chemically stable (in terms of their biological activity) to extreme heat exposure. An understanding of the utility of balsamroot as both food and medicine, and the "discoveries" of antibacterial properties of the processed bark and oleoresin would not have been possible without the guidance of Secwepemc Elders who shared knowledge of their traditional preparation methods and uses. Thus, cultural knowledge has played a key role in these research findings, and this research in return, has underscored the sophistication and utility of past and present Secwepemc plant knowledge.

One interesting question left unanswered from ethnographic information is whether the outer bark-like covering of the root was typically *removed* prior to pitcooking for food and/or boiling the root for medicine, or whether it was *left intact* during heat processing—an historical detail that could have implications for the chemistry underlying balsamroot processing. Elder Mary Thomas indicated that the roots could be peeled before or after cooking, while Elder Lilly Harry from Dog Creek and Josephine Wenlock from Chu Chua (Simpcw) recalled that the roots were dug and beaten to remove the outer covering prior to cooking, and the late Elder Aimee August's description is one of peeled roots skewered on a stick (Turner et al. in prep.). This study has shown that the prior removal of bark from the root is not *necessary* to collect oleoresin by boiling, although it may affect the quantity of oleoresin released from the root. Prior removal of the bark also would eliminate much of the dirt (presumably undesirable), which would otherwise collect in the cooled resinous water used as a wash; Mary Thomas did indicate that if the root is left unpeeled, then the bark should be cleaned well (Turner et al. forthcoming).

As previously mentioned, when the root is used in food preparation, the bark is significantly easier to remove *after* pitcooking. While it has been proposed that acid is essential for hydrolysis of inulin to fructose, and that volatile organic acids are provided by addition of other plant stuffs to the earth oven (Peacock 1998, 2008), results from this study indicate it is likely that unpeeled balsamroot itself is sufficiently acidic to catalyse the hydrolytic cleavage, since the pH of boiling water extracts of root (unconcentrated) was recorded as pH 5. The outer bark would also help to retain both heat and moisture once the core of the root reached the minimum temperature required for inulin conversion—a situation likened to "a self-basting turkey, roasting in its own juices" (Bannister and Peacock 1998:11). Peacock (1998 and 2008) found no significant difference between peeled and unpeeled roots in conversion of inulin to fructose or oligofructose. However, in addressing this question, more than just chemical and energetic efficiencies of food preparation should be considered; for example, factors such as flavour may have played a role. Perhaps the root just tastes better (or at least tastes better to some) when it is cooked without the bark, as its flavour would be more influenced by other plants in the earth oven.

Likewise, beliefs and rituals may have governed root preparation to some degree. Turner et al. (1990:177) note a number of rituals that were observed by the neighbouring Nlaka'pmx (Thompson) peoples (located to the south-west of Secwepemc territory) as recorded by ethnographer James Teit in 1900. These early ethnographic records suggest that the plant was very highly esteemed, as indicated by a prayer addressed to "the Sunflower-Root" by young people partaking in their first plant products of the season: "I inform thee that I intend to eat thee. May 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). Omission of this prayer was said to "make the person partaking of the food lazy…" (Teit 1900:349).

Certainly, participating in the labour-intensive process of root harvesting would have likely staved off laziness, although it is unclear if the root would have been as difficult to dig in the past as it is today from places like Ck'emqenétkwe—where soil compaction and extensive turf build-up resulting from relatively recent factors such as cattle grazing, introduced grass species, and lack of regular seasonal root harvesting have presumably altered the harvesting experience. While it may no longer be possible to corroborate some of the historical details of balsamroot harvesting and processing with certainty, the widespread references to its past use certainly suggest that the plant was worth the significant effort of preparation, and clearly recognised for both its nutritional and medicinal importance. As indicated by the late Elder Lilly Harry in an excerpt from a direct translation by Mona Jules of Lilly Harry's narrative ***Re Stq'elsém*** ("Open-pit Cooking"): "Balsamroot is very hard work. Lichen (*Bryoria freemontii)* is easy… but balsamroot requires many things," which she calls "tmelméscen" or "medicine plants for pitcooking," [t = on top + melm = medicine + -éscen = rock(s)], the most notable among these being shrubby penstemon (*Penstemon fructicosus*), also identified as an important cooking pit liner by several other elders from the Northern Secwepemc communities (Marianne Ignace, pers. comm. 2009) .

Toward a Deeper Understanding of Human-Plant Interrelationships

The antimicrobial analyses presented here have provided a new perspective at the chemical level on the relationship between Secwepemc people and balsamroot as a food and medicinal plant resource. The majority of chemical research on traditional food or medicinal plants treats the human use of plants as a largely passive exercise, and views species identification as the central criterion upon which to base a study. Our research highlights the active role that humans can play in altering the phytochemical composition and properties of plants to enhance, release, or even create nutritional and medicinal value. Cultural traditions and technologies such as plant selection, harvesting seasons and methods, processing, and differential uses all have the potential to alter qualitatively and/or quantitatively the phytochemical repertoire of a given plant. Our combined research on the traditional heat processing and use of balsamroot as a Secwepemc food and medicine supports this claim. Indeed, heat is one of many well-recognised technologies for altering the character of food and expanding food resources, for example, by making a plant more palatable or more digestible, or by eliminating toxic or unpalatable plant constituents (Johns 1990; Johns and Kubo 1988). Interestingly, the processing of roots of balsamroot as food and medicine provides an opportunity to observe all of the above. Pitcooking and peeling eliminated antimicrobial compounds in roots prepared as food, and served to “favorably alter the nutrient/toxin ratio” (Johns 1990:243), whereas boiling made available antimicrobial and other biologically active compounds in roots prepared as medicine.

Upon examining this “altered character” of processed balsamroot, a clear distinction between food and medicine can no longer be made. Ford (1994:30) claimed that

> the distinction between food and medicine is an artifact of Western specialization … Most cultures, in fact, classify all plants (and many animals) taken internally into a unified taxonomy. Illness may result from overindulgence of one, the exclusion of another, or the consumption of almost any substance under culturally inappropriate circumstances.

For this reason, he suggested that it is appropriate to incorporate gastronomy into ethnobotanical (especially ethnomedicinal) studies, and indeed such a study on processed and unprocessed roots of balsamroot would be of tremendous value in assessing the net effects of balsamroot-containing diets on gut microflora, and thus on their human hosts (see also Etkin 2006).

Some studies have shown various health benefits of inulin and dietary fructans (i.e., the major type of carbohydrate found in balsamroot). One of the benefits of inulin is the ability to stimulate colonic health by serving as a preferential substrate for the growth of “beneficial” intestinal bacteria (e.g., *Bifidobacterium* spp.), which subsequently out-compete potentially pathogenic species (e.g., *Escherichia coli*) in microbial colonisation of the human colon (Gibson et al. 1995; Van Loo et al. 1995; Wang and Gibson 1993; see also Loewen et al., Chapter 6, this volume).

The presence of selective bacterial growth-*promoting* properties of inulin in balsamroot provide an interesting contrast to the growth-*inhibiting* properties of the antibacterial compounds found in the root. Indeed, at least initially, these properties seem ironic, especially considering *Bifidobacterium* spp. are Gram positive, and thus may be susceptible to thiophene E and other compounds that are inhibitory to the Gram positive species of bacteria assayed in vitro. However, these opposing properties of the root may now be considered in the context of balsamroot processed as food, i.e., in terms of the properties of the *edible* portion of the pitcooked root, which appears to be free of antibacterial compounds.

There is increasing interest in the nutritional value, possible health benefits, and commercial potential (at both the local and international levels) of extracted inulin and inulin-containing foods such as balsamroot. Inulin is considered a "prebiotic," a non-digestible food ingredient that stimulates growth of probiotic bacteria in the colon such as bifidobactera, while Inulin-containing foods have received attention in North America as "functional foods" and have established markets in Japan and other parts of Asia and Europe (Kelly 2008; Mullin et al. 1997; Roberfroid 2000). Concern has been expressed about the potential for market demand to exceed sustainable wild harvesting given the potential of balsamroot as an "exotic native vegetable", a possible commercial source of short chain inulin, and its use in a variety of other economic or ecological applications (e.g., ornamental, restoration) (Chambers et al. 2006). Such commercial ventures merit consideration of the ramifications for Secwepemc and other Aboriginal peoples who have been guardians of the knowledge of balsamroot processing for food and medicine. If all contributors and stakeholders are appropriately acknowledged and benefits shared equitably, however, this situation may hold significant promise for mutually beneficial collaborations between local communities, government, and industry for co-management and co-development of balsamroot as a multi-functional, renewable natural resource.

In conclusion, this research has assisted in addressing some intriguing questions about the nutritional and medicinal uses of balsamroot. By paying careful attention to traditional technologies in our phytochemical investigation, a fuller appreciation has emerged of the significant alterations that humans can bring about in the chemistry of the plant. Grounding our chemical research in cultural knowledge has enabled us to more closely approximate what is ingested in balsamroot-containing diets and used in medical regimes. We believe that this increases the relevance and hopefully the usefulness of the research to Secwepemc people compared with standard antimicrobial activity screening and phytochemical procedures.

We predict that many genuine leaps in understanding within traditional plant research have and will emerge from the synergy in actively engaging different perspectives, approaches, and knowledge systems in the research process. An approach that more fully embraces and acknowledges the intellectual and practical contributions of Indigenous societies also requires a deeper level of researcher commitment and community support than typically has been found in academic research.

Receptivity to, and support for, such an approach has increased in Canada since the research described herein was completed, as articulated over the last decade in national research ethics policy, federal funding opportunities, and the strategic vision of many universities. In particular, national research ethics guidance provided by the Canadian Institutes for Health (CIHR) *Guidelines for Health Research Involving Aboriginal People* (2007; Archived in 2010; see http://www.cihr-irsc.gc.ca/e/29134.html) and the revised second edition of the *Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans* (2014; see http://www.pre.ethics.gc.ca/eng/policy-politique/initiatives/tcps2-eptc2/Default/), and international guidance offered by the *Interna-*

tional Society of Ethnobiology Code of Ethics (2006 with 2008 additions; see http://ethnobiology.net/code-of-ethics/) encourage the kind of meaningful research partnerships to which we have aspired. We hope the research presented here will inspire further studies to rise to these challenges—for we are certain that this collaborative research represents just the "tip of the root crown" in unearthing a new level of plant-people interactions and deepening our collective understanding of the meaning of plants such as balsamroot in Secwepemc and other Interior Salish cultures.

Respect for Secwepemc Responsibilities, Rights, and Interests in Cultural Knowledge

The cultural information upon which this research is based has been generously provided by Secwepemc people in a spirit of sharing, out of respect, responsibility, and pride for their culture and traditional values, their awareness of and concerns for biological and cultural diversity, and their desires to combine knowledge systems to better understand and protect all of the above. Any research involving Indigenous cultural knowledge—medicinal plant research in particular—raises challenging and complex issues about protecting Indigenous interests, rights, and responsibilities in the knowledge and related biological or genetic resources. The former *CIHR Guidelines for Health Research Involving Aboriginal People* (2007:17) underscore the

> need for researchers to understand and respect Aboriginal world views, particularly when engaging in the sphere of traditional and sacred knowledge, and the corresponding responsibility that possession of such knowledge entails. Researchers should understand the broader senses of accountability in order to understand the responsibility they have when entering into a research relationship with Aboriginal people (CIHR 2007:17).

Moreover, Article 7 states that

> Aboriginal people and their communities retain their inherent rights to any cultural knowledge, sacred knowledge, and cultural practices and traditions, which are shared with the researcher. The researcher should also support mechanisms for the protection of such knowledge, practices, and traditions (CIHR 2007:22).

Chapter 9 of the current version of the *Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans* (TCPS2 2014:117–137) offers more explicit guidance and requirements regarding Aboriginal community engagement (Article 9.1), respect for community customs and codes of practice (Article 9.8), use of research agreements (Article 9.11), collaborative research (Article 9.12), mutual benefits in research (Article 9.13), and intellectual property related to research (Article 9.18), among many other aspects of research involving Aboriginal peoples of Canada.

At the time our research was undertaken, however, helpful ethical guidance at a practical level was sparse. The *CIHR Guidelines* were not yet in existence, the specific Aboriginal research guidelines found in Chapter 6 of the former *Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans* (1998) were officially in abeyance awaiting a lengthy review and revision process that was complete in 2010 and revised again in 2014 (see Chapter 9 "Research Involving the First Nation, Inuit and Métis peoples of Canada" http://www.pre.ethics.gc.ca/eng/policy-politique/initiatives/tcps2-eptc2/Default/), and the *ISE Code of Ethics* (2006) was in early stages of development. Yet, global interest in bioprospecting based on traditional knowledge (i.e., the search for commercially valuable compounds from plants, animals, or micro-organisms) was at an all-time high, particularly bioprospecting using the published ethnobotanical literature. In undertaking this research, therefore, we developed a letter of consent to articulate our mutual agreement on how to address the potential issues that we foresaw might arise as a result of the research. The agreement included acknowledgement of "the ownership of the traditional plant knowledge by the Secwepemc peoples," and a commitment that

> all publications will acknowledge the contribution of the Secwepemc people and individual elders, and will state that the Secwepemc Nation has control over access to the traditional plant knowledge, as well as to potential development of any marketable products (such as drugs or pharmaceutical) that may be discovered as a result of the traditional knowledge shared during the course of this research.

While our agreement offered us a degree of comfort in our research relationship, it did not cover potential use of the results by third parties and the issues that might result (discussed in Bannister and Barrett 2001, 2004, 2006). On completion of K. Bannister's PhD dissertation (Bannister 2000), it was agreed that the dissertation would be put in restricted access (i.e., not publically available) for a period of time to enable sufficient time for community review and decisions over what should be published. The dissertation remained in restricted access for over six years in total, but the decision, and the story behind it, caught the interest of the academic and wider media (Dalton 2002; Guterman 2006) and has since led to innumerable opportunities to raise awareness and contribute more widely to the understanding of ethics and equity in research partnerships between academic researchers and Indigenous communities (Bannister 2004, 2005, 2007, 2009; Bannister and Solomon 2009, Hardison and Bannister 2011). Though unanticipated at the onset, sharing not only our scientific understandings but also the philosophical and practical lessons from our work, and continuing to learn what it means locally, nationally, and internationally to build meaningful research partnerships with Indigenous communities has been a gratifying and timely outcome of our research.

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Chapter 10. "Everything Is Deteriorating": Environmental and Cultural Loss in Secwepemc Territory

Mary Thomas[†], Nancy J. Turner[‡], and Ann Garibaldi[§]

Abstract

*This chapter reflects observations and experiences of the late elder Dr. Mary Thomas, of changes in species and habitats over the eastern part of the Secwepemc homeland. Over her lifetime, she observed increasing deterioration of harvesting areas, due to a combination of different impacts, especially overgrazing of livestock, introduced weeds such as couchgrass and reed canary grass, and reduced water flows and water quality in many creeks and rivers. Growing up in the vicinity of Salmon Arm and Chase in the 1920s and 1930s, she enjoyed an abundance of songbirds and wildlife, and was able to harvest large quantities of berries, like saskatoon berry (**speqpéq**), root vegetables, such as yellow glacier lily (**scwicw**) and spring beauty (**skwakwína**), and culturally important materials such as hemp dogbane (**spets'i**), cattails (**kwtállp**), and birchbark (**qwllín**) with her family. Major agents of environmental change include agriculture and ranching; railway and highway construction; urbanization; water diversions for irrigation and other purposes; industrial forestry; poor fisheries practices; mining; tourist development and protected areas; and fire suppression. In this last case, the Secwepemc used to maintain open habitats for game, berries and root vegetable production using controlled burns. All of these impacts have affected people's ability to harvest sufficient healthy traditional food. Fortunately, there are opportunities for restoration of some of the affected species and habitats; for example, wapato (**ckwalkwalul̓s**), which had been extirpated from the Salmon River estuary where it was once abundant, has been restored in several places and may once again be used as a nutritious root vegetable.*

Keywords: *Secwepemc, environmental change, invasive species, pollution, ecological restoration*

† Dr. Mary Thomas (1917–2007), of Neskonlith First Nation, Salmon Arm, BC, was the major inspiration for this paper, which was written when she was still alive. Therefore, it is fitting that she should be first author on this paper.

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Note

This paper is based in large part on the knowledge and recollections of Dr. Mary Thomas, a beloved Secwepemc Elder and cultural specialist (Figure 1), who passed away in the summer of 2007. Mary grew up near the towns of Salmon Arm and Chase, British Columbia spending much time with her parents and her two grandmothers, who taught her how to live on the land according to the traditional values of the Secwepemc. In writing this paper, Nancy Turner and Ann Garibaldi share Mary Thomas' message and concerns as she taught them, adding in, where appropriate, the knowledge, and perspectives of other Secwepemc knowledge holders. Mary often expressed, in her native Secwepemctsin, the importance of caring for the environment, and the value of Secwepemc lifeways and culture. She worked hard to keep alive the Secwepemctsin names of the important places of Secwepemc territory, of plants and animals, as well as the connections between people and all living things that are reflected in the language. The changes Mary had witnessed in Secwepemc territory restricted her family's and community's ability to practice traditional activities and maintain the traditional Secwepemc teachings. In response, she tirelessly

Figure 1. Dr. Mary Thomas with a birchbark baby cradle she had made, ca. 1994. Photo by Robert D. Turner.

worked to raise public awareness of the environmental changes, and collaborated with researchers to restore the habitats, species, and associated cultural knowledge that have been lost or depleted.

Introduction

> 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 [weeds and grasses]. 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. (Mary Thomas, interview with N. Turner, 1994)

> The mouth of the Salmon River used to have a lot of ***etsmáts'*** [water-parsnip], ***ckwalkwalul's*** [wapato], bulrush, mint—now is covered in couchgrass and the cattle have trampled it, so that even the bulrush has disappeared. (Mary Thomas, interview with NT, 1995)

> I look around in the areas I was raised and born, the bluebirds that used to be aplenty. I don't see one bluebird anymore. We used to go down to the mouth of the river with all the plants that our grandparents dug in the spring to feed on. There's not one plant left down there. Let alone a cattail where the birds used to sing beautiful music. You don't hear that anymore …. (Mary Thomas, interview with AG, 1998)

Few people would question that British Columbia, like most other places in the world, is experiencing significant environmental change. Provincial reports, academic findings, and experiences that local Aboriginal peoples report use various indicators to represent this change, including decreases in fish and wildlife populations, introduced species' impacts on ecosystems, and reduced water quality and abundance (Burnett et al. 1989; Fenger et al. 1993; Halter 2011; Harding and McCullum 1994; IPCC 2008; Ministry of Environment, Lands and Parks 2000; Turner and Turner 2008). For Aboriginal peoples occupying lands and communities throughout the province, this situation of environmental degradation has been obvious for many decades. Environmental deterioration is threatening not only their subsistence needs, but their cultures and languages and in turn their very survival as distinct peoples (Turner et al. 2008).[1]

In this chapter we provide some specific examples of environmental impacts and losses over the past century in Secwepemc territory, and discuss their direct and indirect effects on Secwepemc people and habitats. Recognizing and documenting the environmental deterioration is, Mary always said, the first step to stopping it. We then propose ways in which some of these effects can be amended and the ecological integrity restored. Conservation per se is not enough; too much has already been lost. Rather, focused and proactive ethnoecological restoration is required to bring back the health and well-being of both the environment and communities that inhabit them.

Witnessing the Changes

Ecosystems, species, cultures. and languages are always changing, always evolving and developing. New features are created, older ones lost. In fact, change, whether caused by natural occurrences or by human activities, is an agent of survival and renewal. Capacity to adapt to change—resilience—is a major feature of both ecosystems and cultures. Resilience has three defining characteristics: (1) the amount of change the system can undergo and still retain the same controls on function and structure; (2) the degree to which the system is capable of self-organization; (3) and the ability to build and increase the capacity for learning and adaptation (Resilience Alliance 2010). Generally speaking, productive social change—change to which people can adapt—is slow and gradual, whereas rapid or unpredictable change that is more challenging for people to respond to is often destructive (Berkes and Folke 1998; Gunderson et al. 1995; Turner and Turner 2008). It is this latter type of environmental change and the cultural shifts in response to this change, seen and felt over the course of a single human lifetime (sometimes even within a decade or a few years), which we document here.

Environmental change, even relatively rapid change, often goes unnoticed, or its effects and ramifications not appreciated, by those that are not directly reliant on the ecosystem in which they live. Most people think only of the ecological and cultural present, and have difficulties conceptualizing a different scenario from what is directly before them. Historians like Alfred Crosby, in his book *Ecological Imperialism* (1986), have documented broad, wide-ranging changes in species and ecosystems on a global scale. In this chapter, we are focusing on the local scale, and it is the testimonies and insights of Aboriginal elders like Mary Thomas that are so critical in documenting this level of change. Through their own experiences, they have marked these changes and mourned the loss of important places and species. Ecologists often try to quantify the resilience of ecosystems by looking at changes in plant species composition (Dynesius and Hylander 2007; Hamilton and Haeussler 2008). Here, we also identify change in species composition, including a reduction of some culturally important species like wapato (*Sagittaria latifolia*) and an increase in others (e.g., reed canary grass, *Phalaris arundinacea*). Personal experience and oral testimonies such as we present here provide another lens, another "way of knowing" that can complement ecological science. This kind of information can both stand alone as evidence of changing ecosystems, and can also help to identify situations that require further scientific study and documentation.

The Secwepemc are not alone in their concerns about environmental deterioration. Aboriginal peoples across Canada, as in many parts of the world, have deep cultural associations with the land, causing emotional and cultural responses to landscape and ecological degradation (Turner et al. 2008). Most of the alterations to species and landscapes have been imposed without any consideration for or consultation with Aboriginal people within whose traditional lands they have occurred. This deterioration has often directly impacted culturally important resource species and, with them, the cultural fabric and lifestyles of Aboriginal Peoples.

An example of environmental loss from just north of Secwepemc Territory is described by Stoney Creek Dakelh elder Mary John:

> When I was a small girl, the land, the rivers and creeks and lakes, were full of life—birds and animals of all kinds were as much a part of the landscape as trees and clouds and sun. Now I can travel five hundred miles in any direction from our village and not see so much as a field mouse. I think with sadness of those trips to the hunting grounds when I was a child and I remember our land as it used to be (John and Moran 1988:30).

Often industrial and economic interests are prioritized above ecological preservation within western society. Gwaganad (Diane Brown), a Haida woman and a practicing traditional herbalist, expressed this cultural link eloquently in talking about the loss of forests of Haida Gwaii to industrial logging:

> … So I want to stress that it's the land that helps us maintain our culture. It is an important, important part of our culture. Without that land, I fear very much for the future of the Haida nation. Like I said before, I don't want my children to inherit stumps. I want my children and my grandchildren to grow up with pride and dignity as a member of the Haida nation. I fear that if we take that land, we may lose the dignity and the pride of being a Haida…. (Gwaganad 1990:50–51).

Throughout Mary Thomas' life, she witnessed many forms of environmental deterioration, in many places and under many situations. Some of the impacts were immediate and obvious, others more subtle and therefore, perhaps, more insidious. In the following sections, specific examples of environmental impacts observed by Mary and others are presented. The inspiration to present Mary's concerns in this chapter is, in part, a response to a comment she made during lecture at the University of Victoria (February 2001):

> I'm one of the elders that was fortunate to grow up and experience the beautiful times, the richness of our mother earth. I went with my grandmother and we did a lot of learning from the way they survived. Their connection to Mother Nature was something beautiful to learn. And I've seen in my 81 years, a big change—and I'm afraid not for the best. And I am really worried. And that's why I asked the question, do we care enough about the future of our young people? Not just my young people—all young people.[2]

Causes of Environmental Destruction

Many detrimental changes, as experienced by Mary Thomas and other Aboriginal people, have come about directly or indirectly as a result of human agency. Some of these are particularly significant in the context of cultural values for the land and water and the species they support. Table 1 summarizes some of the major perceived agencies of environmental change within Sec-

Table 1. Some major agents of environmental change in Secwepemc territory based on observations and experiences of Mary Thomas and other Secwepemc people.

Agency of Change	Specific Places: Example(s)	Biophysical Impacts	Cultural Impacts
Agriculture and Ranching	Salmon River watershed and estuary; Neskonlith Meadows; ***K'emqenétkwe*** (Scheidam Flats), Pinantan Lake region; many valleys, meadows and open forests	Loss of natural habitats in valley bottoms; invasive species; overgrazing; water depletion; loss of estuarine and river habitat (Note: there are at least five cottonwood associations that are red- or blue-listed)	Depletion and loss of many resource species (e.g., salmon; wapato, water-parsnip; cattail, Indian hemp; highbush cranberries; balsamroot, glacier lily, spring beauty, bitterroot, badgers, elk, caribou, burrowing owls)
Railway and highway construction	South Thompson River Valley, and along s shore of Shuswap Lake; Kamloops area including Kamloops reserve	Habitat fragmentation; changes in watercourses; loss of wetlands; many invasive species; road kills of birds and mammal species like badger and porcupine (which are in serious decline)	Loss of peatlands and species such as bog cranberry; reduced access to and alienation of important habitats; decline in sense of peace
Urbanization and Population Growth	Chase and Salmon Arm; Kamloops and vicinity	Loss of habitats; loss of species; pollution; invasive species	Depletion of and loss of access to many culturally important plants and animals; loss of camping areas, sacred sites; loss of ability to burn and other management activities; decline in sense of empowerment
Flood Control, Irrigation and Other Water Diversions	Salmon River estuary (Figure 2)	Habitat loss, especially deterioration and loss of much riverine habitat; alteration of water temperatures; fluctuation of water levels; sedimentation; pollution	Loss of culturally important species (e.g., wapato, cattail, salmon fry, ducks; all fish stocks are in serious decline; white sturgeon and bull trout have been virtually extirpated); changes to availability of traditional foods
Industrial Forestry Practices	Wap Valley; Deadman's Creek and Criss Creek watershed; Mount Ida; Fly Hills	Loss of biodiversity; intentional elimination of some native species (e.g., birch); loss of access; general competing access from public; massive road construction; pesticide applications; introduced species; altered hydrological cycles	Fewer birch trees; loss of food and medicine plants (e.g., Labrador tea, subalpine fir); loss of game; depletion of water table, streams (and the species that rely on them: coho, steelhead); inability to practice burning and other traditional management activities; increased forest fire hazard; extirpation of caribou
Poor Fisheries and Wildlife Management and Control	Shuswap Lake; Thompson River; general mountain habitats in Shuswap territory	Habitat loss; impacts of introduced species	Loss of coho and sockeye salmon, steelhead and other fish species, ducks; fewer game species of many types; deterioration in the quality of fish stocks (e.g., large, deep-bodied trout formerly at Tunkwa)
Mining	Blackdome Mountain (Noranda); Afton Mine; Highland Valley Copper; Logan Lake	Loss of habitat; pollution; physical destruction of mountaintop; destruction of landscape that bears cultural and historic memory; dramatically increased hunting and fishing pressures from added populations; dust	Loss of medicine and food plants; reduction in fish and game; introduced species; restriction of access; loss of sacred areas

Table 1 continued.

Agency of Change	Specific Places: Example(s)	Biophysical Impacts	Cultural Impacts
Tourist Development, including Ski Development	Speedboats and house-boats on Shuswap Lake; hikers and bikers on Tod Mountain; Paul Lake; Mount Lolo; “Sun Peaks”; bikes and ATV’s on Tunkwa, Duffy Lake and lower elevation grasslands and riparian areas	Intrusion into traditional lands; loss of upland/mon-tane habitat; deterioration of freshwater habitats; introduction of weeds, soil compaction and erosion	Loss of sacred areas, traditional camping spots, many plant food and medicine resources; distur-bance of wildlife; habitat altera-tion; negative change to peace and wellbeing supported by sacred areas
Parks and Protected Areas Establishment	Trophy Mountains; Wells Gray; Mount Revelstoke	Increased public use; restricted traditional use, including exclusion of fire as habitat management	Loss of sacred areas, traditional camping spots, resources; loss of access to use of resources
Fire Suppression, Prohibition of Traditional Management Practices	Mount Ida; Neskonlith Meadows	Habitat change; increas-ingly drastic forest fires	Fewer berries, smaller root veg-etables; less game; loss of healthy pine forests and all associated species including pitch pine tops and needles for basketry; loss of meadowlands; reduced streams and groundwater; decline in abil-ity to practice traditional steward-ship actions

Figure 2. Salmon River estuary, Neskonlith Reserve, Salmon Arm, BC, 2012, showing the arrow-shaped leaves of re-planted wapato (*Sagittaria latifolia*) in the foreground, railway with train in background. Photo by Nancy Turner.

wepemc territory—as observed by Mary Thomas—and provides examples of places where the effects have been noted, as well as notations on the impacts themselves, both biophysical and cultural. These are described in more detail in this section.

Agriculture and Ranching

Enforced conversion of First Peoples to agricultural and ranching lifestyles, a major goal of the colonial government officials, has been a major force of change during Mary Thomas' lifetime (Turner and Brown 2004).

> When the Europeans came and the Department of Indian Affairs and the churches started taking over our lives, and they formed what they called the reservations, then our people were taught the European way of life, like planting potatoes and carrots and all the vegetables, and slowly they began to forget their natural foods (Mary Thomas, interview with NT, June 1994).

Mary Thomas recalled the dilemma her parents faced in transforming their own lifestyles from traditional stewardship to agriculture on a European model:

> But my father and mother, I guess they were willing learners; they were really busy clearing land, which was not traditional with us, cutting down trees—you can imagine what they had to go through, because of their connection to Mother Nature. I often heard my mother talk about this, that it wasn't their way of life, but they had no choice, they had to accept the way they were taught, how to survive, was to chop down all these trees and cultivate it into European way of living. I guess that's where we began to lose a lot of the traditional foods. And it was hard work going out and getting that stuff, and I guess it's equally as hard to put in a garden and keep it weeded and everything but the sad part is losing the traditional values (interview with NT, June 1994; see also Ignace and Ignace, Chapter 2, this volume, which also discusses some of these issues).

Fortunately for Mary and other Secwepemc, some of the people, including her own grandmother, refused to abandon traditional plant gathering activities in favour of agriculture:

> We were fortunate when we were little, we used to be able to go with [my grandmother[3]], and I have such really happy memories of her, going out and collecting a lot of these traditional plants.... I consider myself really fortunate to be able to remember a lot of this.

The new agricultural practices resulted in deforestation and habitat loss, especially along the river valleys, and sidehills where ranching was, and is, widely instated (Figure 3). Agriculture and ranching have had many other consequences, not only for the Secwepemc, but for habitats and peoples throughout the southern interior of British Columbia, particularly in the grasslands.

Figure 3. Deteriorated habitat from cattle grazing, Salmon River estuary. Photo by Nancy Turner.

There are, in fact, very few areas of original grassland left (Whitford and Craig 1918; Hebda 2007). Virtually all existing rangelands have high proportions of introduced species, including intentionally planted forage species like crested wheatgrass (*Agropyron cristatum*) and white clover (*Trifolium repens*) (Turner and Brown 2004). Many other weedy species such as houndstongue (*Cynoglossum officinale*), burdock (*Arctium minor*), mullein (*Verbascum thapsus*), knapweed (*Centaurea* spp.), and toadflax (*Linum dulcamara*), were introduced unintentionally but have established themselves widely, usually to the detriment of native species.

Upland ranging of cattle and horses, common on Secwepemc reserve lands as well as on private landholdings and Crown lands, has resulted in severe trampling and overgrazing of many culturally important species such as Indian celery (*Lomatium nudicaule*), cow-parsnip (*Heracleum maximum*) (Figure 4), and almost all the traditional root vegetable species – including nodding onions (*Allium cernuum*), yellow glacier lily (*Erythronium grandiflorum*), and spring beauty (*Claytonia lanceolata*) (see Ignace et al. Chapter 12, this volume). In the hills above the south and north banks of the South Thompson River numerous Secwepemc place names recorded by the late Neskonlith elder Ike Willard (b. 1896, d. 1979) attest to once prolific root plant gathering areas, all of which have been turned into hay fields and pasture in the last 50 years, with no trace left of the native root vegetables (spring beauty, desert parsley (*Lomatium macrocarpum*), chocolate tips (*Lomatium dissectum*), yellow glacier lily, nodding onions, etc.) that gave places like ***Pellskwakwina*** ("has Indian Potatoes"), ***Pellgayu7*** ("has chocolate tips") or ***Pellscwicw*** ("has glacier lilies") their names.

Figure 4. Cow-parsnip (*Heracleum maximum*), one of the species noted by Mary to have been depleted by grazing. Photo by Nancy Turner.

When livestock are excluded from areas by fencing, some of these species can recover quickly. However, Noss and Cooperrider (1994:221, 232) maintain that "Grazing is the most severe and insidious of the impacts on rangelands," and "If individual plants are continuously grazed so that they cannot store enough energy for their reserves to last through the dormant season and regrow during the next season, they will eventually die out" (see also British Columbia Ministry of Agriculture 2003; Turner and Brown 2004).

Along the watercourses such as Paul Creek, Salmon River, and Deadman's Creek, there is also erosion and pollution caused by livestock. Soil compaction is another effect of livestock grazing. Mary Thomas noted that the traditional digging stick is now useless for extracting wild root vegetables like yellow glacier lily (see introductory quotation). She recalled that formerly her granny used to be able to loosen the soil easily just with her digging stick, and the children would follow behind, collecting up the roots she turned up and putting them in her basket. Commenting on root gathering efforts in the 1990s, Mary Thomas said she needed to have her grandson use a big crowbar just to penetrate the hard earth.

Inevitably, too, the deterioration of the land and the change to an agricultural lifestyle has resulted in a loss of knowledge and understanding of the traditional ways of managing plants and other resources, and of the cultural aspects of using native species.

Railways and Highways

Building and widening of the Canadian Pacific and Canadian National railways since the late 1800s and early 1900s, and of the Trans-Canada and Yellowhead highways, as well other major roads through Secwepemc lands since the 1960s, has resulted in severe habitat fragmentation and loss, as well as disruption of hydrological systems, introduction of exotic weeds and loss of plants and wildlife (Figure 5). For example, Mary recalled that there was an extensive peat bog right near Salmon Arm, towards Taft, where the people used to gather their bog cranberries (*Vaccinium oxycoccos*) and creeping snowberries (*Chiogenes hispidula*) (Figure 6). The Trans-Canada highway was built right through this bog, and today people have to travel to distant boggy areas, such as Wap Valley, to find these berries. Mary Thomas said that the original name for Salmon Arm derived in Secwepemctsin from its extensive patches of soapberries (*Shepherdia canadensis*).[4] Mary recalled that there were also immense and productive patches of wild raspberries (*Rubus idaeus*) and cow-parsnip (*Heracleum maximum*). Now, although these plants still exist there, they are much less abundant, and are generally inaccessible to Secwepemc people.

Mary Thomas was heartsick to see the numbers of wildlife killed by trucks and cars along the highways. She said, "seeing an animal killed on the road … it's so painful …. The poor things, they have nobody to speak up for them" (interview with NT, 1998). She also had great concerns about the use of weed killers, insecticides, and other types of pollution along roads and railways. She believed these chemical pesticides to be highly detrimental to wildlife, especially bees ("all the little pollinators"), whose numbers had decreased noticeably in recent years from her own observations.

Figure 5. Railway line passing through Neskonlith reserve at Salmon Arm, showing right-of-way crowded with introduced weeds. Photo by Nancy Turner.

Figure 6. Wild berries from Wap Valley, showing creeping snowberries (*Chiogenes hispidula*) and a few bog cranberries (*Vaccinium oxycoccos*) (lower right). The other berries pictured are: top, from left to right: red-osier dogwood (*Cornus stolonifera*), highbush cranberries (*Viburnum opulus*), oval-leaved blueberries (*Vaccinium ovalifolium*) and a few black mountain huckleberries (*Vaccinium membranaceum*); middle, left: swamp gooseberries (*Ribes lacustre*); centre of photo: saskatoon berries (*Amelanchier alnifolia*); middle, right: wild raspberries (*Rubus idaeus*); lower left: thimbleberries (*Rubus parviflorus*). Photo by Nancy Turner.

In some senses, these same railways and highways have actually facilitated peoples' travels to resource harvesting areas and have thus increased accessibility of the Secwepemc and others to some areas. People can drive to places like Mount Revelstoke, Mount Ida, and Tod Mountain which were formerly accessible only by horseback or foot. Railways and roads also provided access to markets for Secwepemc people participating in the new market economy. Some people, for example, sold wild blueberries and game to the Canadian National Railway for use in the dining cars, or to stores and markets along the highway. However, at the same time, railways and highways have reduced accessibility to traditional lands by opening them up to the general public for hunting, recreational use, and acquisition of private property. The crisscrossing paths of logging roads, secondary roads, and other routes have also obscured traditional trails formerly used by resource gatherers. Thus, the effects of these transportation systems on the environment and cultural integrity of the Secwepemc must be recognized and efforts made to reconcile the different needs and impacts. In higher elevations, roads and snowmobile tracks are allowing the predators easy access to their prey species; this may be a significant factor in the decline of the mountain caribou. Many miles of road that did not even exist years ago are being plowed and kept open all winter in the Upper Deadman and Bonaparte plateau as well as elsewhere, wherever they are logging.

Urbanization and Population Growth

Urbanization and increased density of settlement by non-Aboriginal people along highways, and waterways like Shuswap Lake, have contributed to the loss of natural areas and the exclusion of Secwepemc from their traditional places. Mary Thomas recalled one of the saddest times in her young life, when she and her siblings went with their father and mother by boat to a camping place where they had been going for many years. This time, when they pulled their boat up on the shore, a man came down and ordered them to leave and never to come back. He was the local store owner, and he had bought the property and didn’t want Aboriginal people coming to “his” property. Her mother was angry, and said she would never again take her handmade gloves into his store to sell. But her father just told all the family to get back in the boat and rowed away, the tears streaming down his face. It was the first time Mary saw her father cry. This is the personal side of First Peoples’ loss of access to their lands; it has been experienced over and over again during colonization and up to the present day for the Secwepemc and others (Shuswap Nation Tribal Council 1989; see also Ignace and Ignace, Chapter 2, this volume).

Flood Control, Irrigation, and Other Water Diversions

Diversion of the Salmon River estuarine channel, for flood control and to accommodate boats along the immediate shore of Shuswap Lake, changed or eliminated key habitats for aquatic root vegetables and fibre species (see Table 1). Industrial irrigation also has depleted the water in many creeks and rivers in Secwepemc Territory, resulting in changes in temperature and other effects that are deleterious to fish stocks. Mary Thomas (1998) has observed the changes in these systems first hand:

> …I left the reservation 33 years ago. I went to look out, to see what is there out there, what is living in a city like. But I always kept calling back, calling back, to where I was born and raised. And every time I came back, I saw a lot of difference. That river [Salmon River] one time used to be just full of sockeye salmon. In the fall, there was spring salmon went up, coho salmon went up to spawn. They were getting less and less. And I’d ask why, what is happening? When I seen the water [level] going down. My people used to go down that river to torch for fish at night and they’d spearfish. Now, you couldn’t even get a boat to go down that river. It’s getting less than ever. And not only that, it’s the Thompson River. There’s just a trickle….

Mary recalled how upset her mother was one year, when they drove along the South Thompson River. Her mother was quite elderly at the time, and when she saw how low the water was, she could not believe it. She had never seen it so low in her entire life. Mary tried to explain to her that the water was being used for irrigation, but her mother thought only about what it must be doing to the fish, and that they would not have enough water to swim in.

Another concern is the lack of water in the small creeks and tributaries up in the mountains that run into the main river systems (Mary Thomas 2001):

> When I was just a young child and we used to go with our parents up Mt. Ida. We would ride saddle horses, and my mother would go up to a great big birch tree and she would get her bark for her baskets, and my dad would hunt, and we would pick berries … and everywhere we could come across, there was water to drink. There was creeks, creeks up there galore ….
>
> Oh-h-h! it was so-o-o beautiful! Every little ways there was a creek. The horses would drink. We'd have a drink. If it was a hot day we'd splash ourselves with cold water. We went up there in the spring with the logging company and the forestry [spring of 2000]. When there should have been lots of water coming down. There wasn't one creek ….

The drastic decrease in water, especially in upland areas, is due in part to forestry practices, a general increase in provincial water use, and to the global warming trend (Ministry of Environment, Lands and Parks 2000).

Industrial Forestry Practices

Forestry practices, especially clearcutting and plantation forestry, have further reduced biodiversity over much of Secwepemc territory and have also resulted in exclusionary policies against the Secwepemc. Mary Thomas often expressed dismay at witnessing large-scale tree cutting (interviews with NT, 1994):

> We don't realize what we did to Mother Nature after cutting down all that old growth; for survival—a lot of them offered something that helped keep our health balanced. There's a lot of things we can't find anymore, because of the old growth. It has its purpose, not only by being a big tree; there were things that came out of that tree that helped the other plants around it. So without the old growth I guess we're losing a lot.
>
> It's harder to find birch now—I have to walk for miles now before I can get a decent piece of bark [for baskets].
>
> It is hard to get cedar roots anymore; all the big old cedars of the valleys have been cut down.

Other industrial forestry practices, such as the application of herbicides and pesticides, and the use of sheep in clear-cut areas to control the growth of competing plants after logging, are of concern to the Secwepemc. Sheep browse many wild plants, and introduce seeds of exotic or disturbance loving species. Mary worried that herbicides used to suppress the growth of leafy shrubs and trees, and the pesticides applied to kill forest pests like mountain pine beetle were contaminating streams and rivers and reducing the quantities of berries, insects, and other foods available to songbirds and other wildlife (cf. her comments on bluebirds in the introductory quotation). She also noted (interview with NT, 1994) that many types of berries, notably Oregon-grapes (*Mahonia aquifolium*), black huckleberries (*Vaccinium membranaceum*), and saskatoons (*Amelanchier alnifolia*), have been quite wormy in recent years; their quality has deteriorated noticeably. Mary attributed this decline in berry quality to the reduction of insect-eating birds because of widespread use of insecticides. She suggested that it was possibly also due to a reduction of cavity-nesting birds because of logging of nesting trees, or even to reduced habitat of migratory species in far-away tropical and subtropical forests. Notably, Mary's concerns are borne out in recent research demonstrating the devastating effects of insecticide use on native bumblebees and other insect pollinators (Halter 2011).

Furthermore, Mary was concerned that the removal of broad-leaved species such as hazelnuts (*Corylus cornuta*), cascara (*Frangula purshiana*), birch (*Betula papyrifera*), and aspen (*Populus tremuloides*), has reduced the available food for a host of small animals, birds, and insects. For example, Mary noted that squirrels used to be much more common in the Wap Valley area, before the hazelnut bushes were cut down during clearcutting.

Mary summarized her concerns about forestry practices at the *Helping the Land Heal* Conference (1998):

> You take the Forestry. I sat in on many of their meetings. And I looked around at what they were doing, and I saw the destruction that was going on. I looked at the streams, where they'd logged right down to the streams, and it didn't hold back the water—it just eroded and filled out little rivers that feed the big rivers. It seemed like it was just a snowball of terrible things happening. When they tree planted, I went up there personally to look at what they were doing. They hired some of my boys to go and tree space. I went up there and I looked at what they were doing, and I certainly didn't like what I was seeing. It really hurt me, because I was taught that we were connected to Mother Nature, we were not superior. We are a part of Mother Nature. If we destroy Mother Nature, we are destroying ourselves....

Poor Fisheries and Wildlife Management

Many Secwepemc people believe that over-fishing, over-hunting, as well as a reduction in habitat, have reduced the abundance and diversity of salmon and traditionally used game. This has multi-layered effects on the ability of Secwepemc people to practice traditional hunting and fishing activities. For example, introduced species like the common carp (*Cyprinus carpio*) in lakes, have severe impacts on native species by displacing aquatic vegetation or out-competing existing fish for resources. Carp inhibit the growth of some aquatic plants, including the traditionally important root vegetable wapato (*Sagittaria latifolia*), through their feeding patterns which dislodge young seedlings and increase water turbidity. Detrimental carp activity on aquatic resources has been documented in the Columbia River basin (Darby 1996), the Great Lakes (Chow-Fraser 1999) as well as Salmon Arm (Garibaldi 2003). While carp not only affect valued traditional fish species, they impact availability of traditional food sources.

Current transportation and recreational activities also impact traditional resources. Salmon fry are sometimes washed up on the beach by powerboats. Mary's family members observed many of these small salmon dying along the shoreline of Shuswap Lake when they went out to test a birch-bark canoe they had made. Mary also noted that, because of low water in the Salmon River from irrigation, at times salmon are no longer able to travel up spawning channels. Even the houseboats on Shuswap Lake were worrisome for Mary Thomas (conversation with NT and AG, February 2001):

> … And they [Mary's grandchildren] found something that was very, very disturbing. It was a quiet, hot sunny day, so therefore there were a lot of speedboats out on the lake. And these speedboats were not only staying in the middle of the lake, they're coming right along the lakeshore and creating a lot of big waves. Mother Nature has her own way of dealing with the creatures that live in water. They know when there's going to be a big storm. They get right down on the bottom, the little fingerlings, the little tiny fish, and they stay there until the storm is over. But they don't know when a speedboat is going to come along. And this is what the little children saw…. Here were these little fingerlings taken by the speedboat wave and pushed up onto the rocks. And they're there, thrashing around, trying to get back into the water. Some made it, some didn't. And the children saw a whole bunch of bodies of the baby fish that were cooked and dried right on the rocks. What a horrible thing for children to see!

Mining

In 1991, Ron Ignace, then Chair of the Shuswap Nation Tribal Council, Marianne Ignace, Nancy Turner, Brian Compton, and a group of Secwepemc people including elders Lilly Harry and Mary Palmantier from Dog Creek, traveled up to Blackdome Mountain, a traditional medicine-gathering area for the Secwepemc of Dog Creek and Canoe Creek. Entire families had been going up to Blackdome over many generations. As well as gathering medicines such as mountain valerian (*Valeriana sitchensis*) and mountain dryas (*Dryas octapetala*), Secwepemc women have picked blueberries (*Vaccinium caespitosum, V. membranaceum*) and gathered whitebark pine nuts (*Pinus albicaulis*), and trapper's tea (*Ledum glandulosum*), while Secwepemc men hunted deer and other game. In 1991 we found a massive mine established by Noranda, and the entire mountaintop was fenced off. The mine was in the process of closing, but it left a legacy of destruction, with a mountaintop so riddled with shafts and tunnels that it would no longer be safe for people to walk there. It is just one example of how Aboriginal people are alienated from their lands and resources, and one that had brought great sadness and frustration to the Secwepemc. Lilly Harry compared the mountaintop to a fresh hide that had been thoroughly scraped clean. She said it would take years for the plants to return, if they ever did. Most of the plants she was familiar with were buried under tons of rock and water channels had been changed through the mine development and road building (Figure 7). Lilly Harry recalled (interview with NT, 1991), "This is where the old people came to make medicine; it was always here when you needed it."

Figure 7. Remains of abandoned mining operation and contaminated landscape, Blackdome Mountain, former medicine harvesting place for Secwepemc from Dog Creek area and elsewhere. Photo by Nancy Turner.

More recently, Secwepemc Bands like Tk’emlups and Skeetchestn have begun to establish more collaborative working relationships with the Province and mining companies to ensure that mining development occurs in an environmentally and culturally sustainable manner (Ministry of Energy, Mines and Petroleum Resources, News Release, March 28, 2008 http://www2.news.gov.bc.ca/news_releases_2005-2009/2008EMPR0018-000430.pdf). However, mining continues to pose a major threat to the environment and food safety, as highlighted recently by the controversy over Taseko Mines Ltd.’s proposal to develop Prosperity Gold-Copper Mine at Teztan Biny (Fish Lake) in Tsilhqut’in territory (Canadian Environmental Assessment Agency 2011), with impacts from the associated hydroelectric power feed affecting Canoe Creek/Esk’et territory. It is important to note that mining can have very long term, virtually irreversible impacts as in the case of Jack of Clubs Lake in Barkerville, which is still polluted almost 150 years since mining occurred there. The New Gold mine anticipates that it will take up to 400 years for their pit to fill up with water at which point how it will impact groundwater is unknown. Mine prospecting and proposed mining sites have hugely increased in recent years, especially with the world market prices for gold and copper rising. Not only the mine sites themselves, but the tailings ponds, housing, provisions for electricity, roads, and other related developments all have potential destructive influences on local communities and environments (IHRC 2010).

Tourist Development, including Ski Developments

Ski developments and other types of tourist development have impacted a number of areas within Secwepemc territory, particularly in the mountains and high elevation sites, where thin soils and low rates of plant growth result in high vulnerability to erosion and construction impacts. One example is with the massive ski resort development at ***Skwelkwek'welt*** (formerly Baldy Mountain, now called Sun Peaks). This area was especially important for harvesting edible roots, berries and medicinal plants, and for fishing and spiritual cleansing, and was used by several Secwepemc communities, including Kamloops, Neskonlith, and Adams Lake. In 2000 and 2001, a major expansion of the existing ski resort area by Nippon Cable and Sun Peaks Resort caused tremendous concern for some Secwepemc and other First Peoples. The project, which was approved in 2001, included further construction of ski runs and lifts on Mt. Morissey; eventual development of five skiable mountains; construction of a major hotel; expansion of an existing golf course; construction of townhouses on McGillvray Creek; and creation of a year-round resort complex to bring thousands of tourists annually into the territory (Sun Peaks Resort 2011). A group of concerned Secwepemc established the Skwelkwek'welt Protection Center to raise awareness of the potential ecological and cultural impacts of the development. They noted that the Sun Peaks Ski Resort is located within the 1862 Neskonlith Douglas reserve lands, which were cut off by Joseph Trutch in 1866, but are still within Secwepemc traditional territory. They further concluded that these lands and their resources, including potential income options, would be under negotiation in any kind of Treaty settlement (Secwepemc Cultural Education Society 2011).

The Secwepemc that were protesting the development maintained that they were not meaningfully consulted about it, and that they did not give their consent either to the ski development as it existed or to the massive expansion project, although some Secwepemc have participated in negotiations around the plans as part of local economic development. Still, many Secwepemc remained adamantly opposed to this development at ***Skwelkwek'welt*** and other traditional use areas, with concerns over impacts to plants, sacred medicine gathering areas, wildlife, and drinking water. The "Sun Peaks Resort" development was allowed to proceed in 2001, leaving many Secwepemc feeling frustrated and deeply concerned about increasing deterioration and loss of their Indigenous lands (cf. SchNEWS of the World 2002).

Mountains are particularly significant for peoples' spiritual training and medicine gathering. Many mountains, including ***Kela7scen*** (Mount Ida), Trophy Mountain, and Blackdome, mentioned previously, are considered to be sacred areas, used for vision quests and other ritual activities. Furthermore, as Mary Thomas (interview with NT, 1994, Mount Revelstoke) pointed out, the best medicines are found in mountainous areas:

> The old people would say medicines that grow up in the high mountains they believe have more strength than the ones that you pick down below. Because here you're closer to the mountain, which they appreciated, and the clear air, with all the water fresh from the mountain snow—it made the growing of the plants more powerful.

Parks and Protected Areas

Even the official designation of parks and protected areas has resulted in environmental change and has affected Secwepemc people's accessibility to key areas within their territory. We learned this problem firsthand when we traveled to Mount Revelstoke National Park in July, 1994 with

Mary Thomas and Dawn Loewen, then a Masters student studying ***scwicw*** (yellow glacier lily) with Mary (see Loewen et al., Chapter 7, this volume). Mary recalled the happy times when, as a child, she would travel to Mount Revelstoke by horseback with her parents and other families:

> This place brings back memories. When you're a little girl, and families were still intact and still practiced a lot of the natural way—our people survived many, many years .... I can remember as a little girl running, hopping, skipping, jumping through all these beautiful flowers—I think that's one of the happy memories I that have. And we [children] did take part in the gathering of food. When the food, especially the potatoes—that was one of the diets through the winter, and they had to collect a lot of that. What they did was they collected the glacier lily and spring beauty, ***scwicw*** and ***skwakwína***, down in the bottom. When that was completely finished then our people came up to the plateaus. They hunted up here, they picked huckleberries, they gathered more glacier lilies and spring beauties, and those were brought down to the valley and stored for the winter. And not only that—you can tell the difference in the air. The children were taught to respect Mother Nature and to appreciate it, and when you breathe in this cool air and you can imagine yourself sleeping out here in open air—we just had a little lean-to, and you're breathing in this beautiful mountain air. And when you're breathing, even now you can smell the air has that ***melanllp*** [subalpine fir] smell, from the beautiful boughs, the trees—you can smell that. And every time you smell that beautiful smell of Mother Nature's creation, you appreciate it, you love it, you're a part of it—you become a part of it. So I think those are the happy memories I can really appreciate today, because we very seldom come to these areas where there's a lot of beautiful flowers yet. Hopefully we can preserve and maintain this for the generations to come.

Yet, when Mary Thomas tried to tell the young woman interpreter for Parks Canada that she used to come to Mount Revelstoke as a child, the young woman said, "Oh, no! The Indians never came to Mount Revelstoke! I read that in the Archives." It seems that the Secwepemc people have been written out of the history of such places, and are often excluded, even by those who should know differently. Although there are important plants there, including ***yi7ut*** (*Ligusticum canbyi*) and ***kikwa*** *(Valeriana sitchensis*), both important Secwepemc medicines, people are not allowed to harvest these medicines as they did for generations within what is now a national park.

The Trophy Mountains are another traditional Secwepemc site, used for hunting, root-digging, and berry-picking, as well as for spiritual training and medicine gathering. This area is now part of Wells Gray Provincial Park. Despite the long-standing use and occupation of the area by Secwepemc people, local histories and guides of the region (e.g., Neave 1995) scarcely mention them. At least unofficially, however, Secwepemc are permitted access to this area, and are allowed to harvest their traditional foods and medicines.

Fire Suppression and Prohibition of Traditional Management Practices

Many Aboriginal elders maintain that excluding them from practicing their traditional management techniques on plants and habitats has resulted in general deterioration of their resources. Fire suppression policies are a good example of this. Since the turn of the last century First Peoples in many parts of North America have been forbidden to burn over landscapes as they had in the past (Boyd 1999).The advantages of periodic burning were well known (Turner 1999). Mary Thomas (interview with NT, 1994), for example, stated:

> Yeah, a lot of people couldn't believe that our people deliberately burned a mountainside when it got so thick, nothing else would grow in it. They deliberately burned it, at a certain time of the year when they knew there was rains coming, they'd burn that, and two years, three years after the burn there'd be huckleberries galore and different vegetation would come up that was edible.

The suppression of burning was a source of frustration and regret. Stl'atl'imx elder Baptiste Ritchie of Mount Currie recalled,

> They used to burn one hill and use the other … 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. Because they changed our ways … Then we forget the good food of our earliest forefathers. Now they have disappeared because the hills grew weedy and no-one seems to tend them, no-one clears there as our forefathers did so thoroughly …. There we went berry picking long ago. Now nothing. The food plants have now all gone. They have 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 (from "Burning Mountainsides for Better Crops", quoted in Turner 1999).

Mary Thomas (February 2001) cited the wildfire that occurred on Mt. Ida in the summer of 2000 as an example of what can happen if people don't burn over an area regularly; the fuel load accumulates, and when an unregulated fire does occur in the hot summertime, it rages unchecked through a forest.

> If people could only see the damage that's been done. It [the burn] goes right up the top of that mountain and it goes quite a bit into the Salmon River. It's the fire that's just burned the whole valley. Nobody's saying anything. I guess I'm the only one ….

Thus, not only do the berries, root vegetables, and other resources diminish and deteriorate in the absence of periodic fire, when a fire does occur, it is much more drastic, burning all the trees and ground cover and opening the slopes to erosion and to invasion by weedy species. Another, perhaps indirect result of fire suppression policies is the vast and destructive infestation of mountain pine beetle (*Dendroctonus ponderosae*), in which vast tracts of lodgepole and ponderosa pines have been killed. The British Columbia Ministry of Forests, Lands and Natural Resource Operations (2010) estimates that the mountain pine beetle had by then decimated a cumulative total of 726 million cubic metres of timber since the current infestation began over two decades ago. The cumulative area of B.C. affected to some degree about 17.5 million hectares, and much of this is in Secwepemc territory. Not only are the forests damaged and made more vulnerable to wildfires but people are no longer able to use the edible nutritious inner bark of the pines as a food (Dilbone 2011).

The destruction of the forest by the mountain pine beetles has been further compounded by the practice of “salvage logging,” of as much of the pine beetle kill as possible in the wake of the infestation. This led to vast kilometers of roads being hastily constructed throughout affected forest areas. Moreover, pine beetle infested forests were then clear-cut of even groves of poplars, spruce and birch to name a few, which further scarred the land with all the understory being destroyed. Clear cutting was carried out across streams without leaving any setbacks and right down to the edge of lakes which, one the one hand, exposed the water to the sun, thereby impacting the water temperature; and on the other hand, destroyed the wildlife corridors and denied the wildlife their browse. With the forest clear-cut, the snowmelt is flushed down the mountain side, carrying with it a high quantity of silt which then becomes deposited down streams in spawning beds of the salmon. Thus, the clear-cutting of the forests has had a negative domino effect on the environment and the ecosystems of the Secwepemc land and that of other Aboriginal nations similarly affected.

Loss and diminishment of berries and root vegetables are also attributed to the fact that people are no longer pruning and tending the berry bushes, and are no longer tilling the soil with their digging sticks when they harvest the roots. It is a downward cycle: lack of human care and attention is due in part to cultural loss, changes in diet, and to alienation of people from their lands. In turn, it results in deterioration of the resource, which means even less use and management (Peacock and Turner 2000).

Species Declines: Cumulative Effects of Environmental Degradation

The cumulative result of the impacts described in the previous sections is a decline in many indigenous resource species of the Secwepemc, ultimately resulting in a reduction of opportunities for practicing cultural traditions. Table 2 itemizes over 35 species of culturally important plants that Mary Thomas observed to be in decline because of lack of access, lack of burning or other management, habitat loss, pollution and other encroachments within the Secwepemc homelands, especially in the vicinity of Salmon Arm.

As well as the numerous plants noted in Table 2, Mary Thomas has personally observed major decreases in populations of many types of animals over her lifetime. These include large ungulates (mule deer, caribou, elk); other mammals (black bear, red squirrels, muskrat, beaver, badger,

Table 2. Secwepemc plant resources specifically identified as having been impacted by environmental change (listed alphabetically by their common English names; based on observations and testimony from Mary Thomas and other Secwepemc elders; supplemented by observations of Marianne Ignace and Ron Ignace).

Resource species; Secwepemc name(s); Traditional use	**Noted impact to resource species**
Balsamroot (*Balsamorhiza sagittata*); ***tséts'elq*** (W, E[1]); OR ***smúkwe7cen*** (Enderby); edible shoots, taproots, flowerbud stalks; roots, leaves for medicine	Plants used to be much higher and more robust; as high as a horse's belly (e.g. at Neskonlith Meadows, as of ca. 2000, but now said to have increased in abundance – MBI, pers. comm. 2011)
Bergamot, wild (*Monarda fistulosa*); ***cwecw7ú7cw***, ***cw7ecw7ú7cw*** 'smell-smell' (any mint); OR ***tegwe7tígwe7*** (E); used for tea; smudge against mosquitoes	Used to be much more common around Salmon Arm
Birch, paper (*Betula papyrifera*); ***qwllín*** (bark); ***qwl-línllp*** (tree); bark used for containers of many types	Used to be many more trees suitable for basket-making; many intentionally killed in forestry to grow conifers
Bitterroot (*Lewisia rediviva*); ***llek'wpín*** (W); OR ***spit'm*** (Mary Thomas), ***spít'a*** (Aimee August) (E); taproots eaten—widely traded	Used to be common in SE and SW part of Sec-wepemc territory; hard to find now due to ranching activity; entirely disappeared from the Kamloops area
Blueberries, mountain (*Vaccinium caespitosum*), ***sesép***, and other blueberries; berries eaten in large quantities	Used to be common at Yard Creek and up in the Fly Hills; now hard to find and plants generally less productive
Cascara (*Frangula purshiana*; syn. *Rhamnus purshi-ana*); ***llénllen*** (W), ***llánllen*** (E); bark used as tonic, laxative, and for other medicinal purposes	Used to be large plant populations in the Wap Valley; diminished due to clearcutting and forestry practices
Cattail (*Typha latifolia*); ***kwtellp*** (W), ***kwtallp*** (E); leaves used for mats; rhizomes used for carbohy-drate; seed fluff used for diapers; wildlife habitat	Used to be extensive patches at mouth of Salmon River; now taken over by weeds, since river re-channeled; formerly prolific in wetlands or slough at Kamloops reserve #1 where industrial park was built in 1970s; now all but disappeared.
Coltsfoot, arrow-leaved (*Petasites sagittatus*); Sec-wepemc name not recalled; formerly sought by girls and women for use in making absorbent menstrual pads	Formerly very common near Salmon Arm and in wet meadows; now scarcely occurs anywhere around
Cedar, western red (*Thuja plicata*); ***7éstqwp, 7es-tqwllp*** (W), *7astqw* (E); roots and bark used for bas-ketry and other purposes; boughs used medicinally	"It is hard to get cedar roots anymore; all the big old cedars of the valleys have been cut down" (MT)
Chocolate lily (*Fritillaria affinis,* syn. *F. lanceolata*); ***saq̓am̓cwa***; OR ***seqw'e7s***; ***qéq'me*** (W); bulbs eaten	Formerly common around Neskonlith Meadows and other areas; now hard to find
Chocolate tips (*Lomatium dissectum*); ***geyu7*** (W), ***gayu7*** (E); taproots and very young shoots eaten; older plants medicinal	Formerly common along the banks of the South Thompson River; now hard to find
Cow-parsnip (*Heracleum maximum,* syn. *H. lana-tum*); ***xwtellp*** (W); ***xwtallp*** (E); young shoots peeled and eaten in spring; roots used for medicine	Used to be plenty at the mouth of the Salmon River and around Salmon Arm; now hard to find;
Cranberries, bog (*Vaccinium oxycoccos*); ***s̓teqs̓tiyúse7***, ***seketúcwe7*** (Kuipers 2002) (W), ***sketúcw*** (E); berries eaten	Formerly common in boggy wetland in Salmon Arm area; eliminated by the highway
Cranberries, highbush (see under Highbush cranberries)	

Table 2 continued.

Resource species; Secwepemc name(s); Traditional use	Noted impact to resource species
Creeping snowberry (*Chiogenes hispidula*); ***elkékllp, e7lkekllp*** (lit. “little kinnikinnick plant”); plants and berries made into tea and bathing solution for pregnant women; berries eaten	Formerly common in boggy wetland in Salmon Arm area; eliminated by the trans-Canada highway construction
Devil’s club (*Oplopanax horridus*); ***(s)k’etse7ellp*** (W), ***(s)k’atse7állp*** (E); inner bark an important spiritual medicine	Populations along creeks have disappeared as the creeks have dried up, according to Mary Thomas (Lantz 2001)
Dryas, mountain (*Dryas drummondii*, *D. octa-petala*); ***sqwí7qwe7éllp;*** whole plants an important medicine	Formerly common around Blackdome Mountain; now hard to find, due to mine (Mary Palmantier, interview 1991)
Glacier lily, yellow (*Erythronium grandiflorum*); ***scwicw;*** bulbs formerly eaten in large quantities	Bulbs used to be much larger and easier to dig (e.g., at Neskonlith Meadows)
Hazelnut (*Corylus cornuta*); ***qé7p’cw*** (W), ***qá7p’ucw, qá7p’cw*** (E); nuts eaten by people and squirrels	Used to be common in Wap valley, especially along the river
Highbush cranberries (*Viburnum opulus*, *V. edule*); ***t’nis*** (W), ***t’anís*** (E); berries eaten; formerly harvested in large amounts	Formerly common and productive at the mouth of the Salmon River; now you can hardly find any
Huckleberries, black (*Vaccinium membranaceum*); ***sesép*** (also *V. caespitosum*) berries highly prized; formerly (and still) harvested in large amounts	Berries are small and wormy compared with what they used to be like; hard to find
Indian celery (*Lomatium nudicaule*); ***k’utse*** (W); ***k’útsa*** (E); young greens eaten; rich in vitamin C; seeds used for tea and flavouring	Heavily overgrazed (e.g. in Enderby area)
Indian hemp (*Apocynum cannabinum*); ***spéts’en*** (W), ***spets’a7, spets’i*** (E); stem fibres formerly an important cordage and netting material	Used to be “acres” of it at Salmon River estuary; now much more restricted; also formerly prolific on Kamloops Reserve #1 at Industrial Park, but now rare.
Lovage, Canby’s (*Ligusticum canbyi*); ***ye7ut, yi7ut;*** roots an important medicine	Formerly collected at Tod Mountain and Mt. Revelstoke; now you cannot get access to it there
Mariposa lily (*Calochortus macrocarpus*); ***líltse*** (W); ***líltsa*** (E); bulbs formerly eaten	Eaten by cattle and sheep (Palmer 1975)
Mint, Canada (*Mentha arvensis*); ***cwecw7ú7cw, cw7ecw7ú7cw*** ‘smell-smell’ (mint, general); plants used as beverage and medicinal tea, and smudge for mosquitoes	Used to be lots at mouth of Salmon River; now taken over by weeds and river diversion
Onion, nodding (*Allium cernuum*); ***qwléwe;*** bulbs pit-cooked and eaten in large quantities	Eaten by cattle and sheep (Palmer 1975); much smaller than formerly
Oregon grape (*Mahonia aquifolium*); ***sts’al’s, sts’el’sa*** “bitter”; berries formerly eaten; stems used for medicine	Berries are small and wormy compared with what they used to be like
Penstemon, shrubby (*Penstemon fruticosus*); ***segwsésegwt*** (W), ***sagwsásagwt*** (E); valued for its beautiful flowers; plants formerly used to flavour food in pit-cooking	Formerly common at the base of Blackdome Mountain and elsewhere; now hard to find (Mary Palmantier, interview 1991; see also Lilly Harry story)
Pines, lodgepole and ponderosa (*Pinus contorta, P. ponderosa*); ***qwli7t*** (W, E), ***qweqwlí7t*** (E, plural); edible tissues: ***sti7q’wel’q; cambium*** and inner bark tissues eaten in spring; wood used in construction of houses and drying racks	Vast areas of pine forest and individual old pine trees in the valley bottoms have been killed by mountain pine beetle, attributed in part to past forest fire suppression and possibly to climate change

Table 2 continued.

Resource species; Secwepemc name(s); Traditional use	Noted impact to resource species
Pine, white-bark (*Pinus albicaulis*); ***stsek'*** (seeds); ***stsek'éllp*** (W); seeds formerly widely sought as food by people and wildlife (Clark's nutcracker is also called "white-bark pine bird")	Formerly more common and productive at timberline; now succumbed to white pine blister rust (introduced); access to trees has been reduced due to mining
Raspberries, wild (*Rubus idaeus*); ***s7éytsqwem*** (W), ***s7aytsqwu*** (E) (berries); berries formerly gathered and eaten in quantity	Formerly extensive patches along the lakeshore at Salmon Arm; now very few and inaccessible
Saskatoon berries (*Amelanchier alnifolia*); ***speqpeq7úw'i***, or ***speqpéq*** (W, E); berries eaten in large quantities; branches for arrows, basket rims, sweat lodges	Berries are small and wormy compared with what they used to be like; people don't prune them anymore; grew well after burning
Soapberries (*Shepherdia canadensis*); ***sxusem*** (W), ***sxúsa*** (E) (berries); berries whipped for special confection and made into refreshing beverage; branches used in medicine	Formerly abundant around Salmon Arm; now all private land and urban development; people don't prune them anymore; grew well after pruning and burning
Spring beauty, or wild mountain potato (*Claytonia lanceolata*); ***skwenkwínem*** (W), ***skwakwína*** (E); corms formerly eaten in large quantities	Formerly much larger; people dug them at Yard Creek, Tod Mountain and elsewhere; now "really small" due to cattle trampling, lack of burning, lack of harvesting
Strawberries, wild (*Fragaria virginiana* and *F. vesca*); ***tqítq'e*** (W); ***tqítq'a*** (E) (berries); berries formerly gathered and eaten in quantity	Not as common or productive as formerly; often hard to find
Tiger lily (*Lilium columbianum*); ***text'sín'*** (W), ***taxt'si7***, ***taxt'sin'*** (E) (cf. ***text***, ***taxt*** "bitter"); bulbs formerly eaten	Bulbs much smaller than formerly; due to lack of burning
Tule (*Schoenoplectus acutus, S. tabernaemontani*); ? ***stnáltcw*** (Aimee August); pithy stems used for mats; possibly for small boats	Formerly very common around Shuswap Lake; now more restricted
Wapato (*Sagittaria latifolia*); ***tseckwelkwelúl's*** (W), ***ckwalkwalús***, ***ckwalkwalul's*** (E) "yellowed/jaundiced eye"; tubers formerly cooked and eaten in large quantities	Used to be lots at mouth of Salmon River; now taken over by weeds; possibly affected by introduced carp; former habitat is seriously polluted (Garibaldi 2003)
Water-parsnip (*Sium suave*); ***etsméts'*** (W), ***etsmáts'*** (E); roots formerly eaten in large quantities	Used to be lots at mouth of Salmon River; now taken over by weeds

[1] W = Western dialect of Secwepemctsín; E = Eastern dialect.

porcupine); birds (coots; ducks of many types; blue grouse, bluebirds; meadowlarks, red-winged blackbirds; many types of songbirds); fish (Salmon, including springs, sockeye, coho; freshwater lingcod, bull trout, steelhead, white sturgeon); freshwater mussels, cicadas, frogs, and snakes. All of these have cultural significance, as sources of food, materials, and ecological indicators.

A Philosophy for Ethnoecological Restoration

From these examples, one can see that environmental deterioration, along with other impacts of western society, has resulted in a severe erosion of peoples' cultural fabric (cf. Turner et al. 2008). Whether it is loss of traditional food, medicines, or cultural materials for basketry and other traditional practices, or of sacred and important historical sites, the rivers, or the peatlands, the sum of all of it is loss of cultural richness, because the culture and language are intimately tied to these things.

Impacts from development on the land and its waterbodies affect the physical patterns of Secwepemc land use. Changes in species composition, declines in culturally valuable wildlife species populations, and inability to access culturally valuable areas due to industrial development are among the environmental changes Secwepemc people are forced to respond to when carrying out cultural activities. When the environmental changes are profound or significantly alter not only the vegetation, but also the landforms and associated water systems, an even greater burden is placed on the culture to adapt.

The close cultural association with environment and place is critical to the maintenance of healthy culture and has been well documented in other jurisdictions and cultures (cf. Ingold 2000; Johnson and Hunn 2010; Thom 2005; Thornton 2008). The knowledge, values, activities, symbols, stories, and memories learned and reinforced year after year while members are exercising their land based rights have helped to maintain Secwepmec people's connection to the land and support that cultural linkage across generations. Changing the land has significant impacts on this type of generational learning and knowledge transfer.

Mary Thomas held a deep responsibility for educating others about the environmental losses identified in the previous section, and, at the same time, speaking about their cultural meanings. She considered culture, language, and environment to be inseparable. The traditional Secwepemc philosophy held by Mary and other Elders was one of valuing and looking after the land and the other life forms sharing Secwepemc lands and waters, encapsulated in the Secwepemc concept ***yucwmína*** or ***yucwmenúl'ecwem***, "look after the land" (see also Turner et al. Chapters 2 and 12, this volume; Ignace 2008; Ignace and Ignace 2013; see also Jacks 2000). This philosophy has been a key to successful stewardship of Secwepemc homelands for millennia. Taking even a part of a tree or plant required serious contemplation and an expression of thanks. Mary recalled, "My mother never took a piece of bark off a tree without acknowledging. She always acknowledged—she said her prayer and a thanksgiving before she put a cut into a tree." Her mother, Christine Allen, also always said, "Thank-you, thank-you, thank-you!" for any berries or other food that was given to her, before she ate them.

For the Secwepemc, culture, and ecology are entwined; the health of one is dependent on the health of the other. Therefore, if we are to practice restoration that is meaningful, both ecologically and socially, both must be considered. Table 2 outlines impacts to a suite of culturally important species, each with its own specific causes. But each species or system that supports them have cultural value, and thanks to the many Aboriginal people who have and continue to share their knowledge of species we have an opportunity to engage in effective and socially significant restoration. This is, indeed, beginning to happen in many places, and the work that Ann Garibaldi (2003) did working with Mary to restore the wapato at the mouth of the Salmon River is a good example.

Mary Thomas was raised in a world of profound change, but at the very foundation of her teachings, as much a part of her until her death as it was seven or eight decades ago, was a deep respect for and love of Nature. Her grandparents instilled this respect in her and her siblings through stories, through example, and through experience, right from when Mary was a small child. Not only Nature, but humans themselves, were part of the value system she grew up with.

For Mary, water was the life-giving matrix that bound the entire system together:

> I sat by a little brook, up above my house and did my meditation…. I sat by that brook. I meditated—and I wondered, "where is all this water coming from? Will it every empty? And where is it going? Will it ever fill up over there?" And I sat there and meditated. And I could hear my grandmother speaking. "You are a part of it child, you are a part of it. You're the one that makes this go—you believe in it." And it made me feel really energized. Ever since that time, I could always think of my grandmother. We are a part of water; she's cleansing. If you feel sad inside, go to the water. Have a good drink and do your meditation. Splash yourself with the water. These are the connections to Mother Nature that I learned, and I've tried to practice it all—it's really hard, because when you're living in the city, it's hard to find the places to do your meditation. But I still hang on to those values, and I try to teach our young people the best way I can.
>
> We know time goes forward. You cannot turn history back. We have to adopt in a new lifestyle, but we cannot forget the philosophy and the values of our culture, the understanding that was passed down to us by our elders: to respect Mother Nature.

It is this value and respect for the entire environment—the water, the land, the trees, the animals, and all the smaller beings—that is a key to ethnoecological restoration; it is more than an effort to restore the ecosystems. It requires restoring the cultural knowledge and values that are tied together with them and that have been enacted on the peoples' territory from generations back. Many other Indigenous elders have stressed this notion of interrelatedness and respect (Turner 2005; Turner and Atleo 1998). The traditional values about the land and the plants and animals that Mary learned in her childhood are more important than ever before. Without peoples' knowledge of and appreciation for the environment, and without knowing the essential details of ecological relationships and environmental change, the lands and waters simply cannot be sustained. Observing and understanding the changes, and valuing what was there originally, are the first steps to regaining what has been lost.

To engage in ethnoecological restoration, there needs to be a recognition and re-instatement of Aboriginal people's agency in the process, their traditional land use tenure traditional land tenure and management systems, under the guidance of the knowledge holders. Guided by their advice, cautious experimentation with traditional burning, substitution of single-purpose industrial use with diverse and sustainable forest uses, and protection from overgrazing of specific vulnerable habitats (e.g., wetlands and upland meadows) should be considered as key elements in modern conservation and restoration. Cultural keystone species should be identified (cf. Garibaldi and Turner 2004), and restoration programs should be focused around these special species and their habitats.

Cultural education programs have been established in various communities, but Secwepemc practices and teachings need to be even more widely supported so that younger Secwepemc and non-Secwepemc alike can better understand and experience the importance of the lands and waters and the species they sustain. Everyone needs to continue learning, just as Mary herself did over her entire lifetime. Understanding the important contributions of the birch tree (*Betula papyrifera*), a cultural keystone species for the Secwepemc, is a good example of an ongoing learning process (cf. Turner 2008). It is a tree that provides its bark for containers and cradles, but which also contributes much more in the ecological and cultural web:

> I used the birch tree [as an example] to help the understanding of our culture. I remember my elders telling me about the difference between the evergreen and the leafy trees. And I had to really look into it in depth and do a study what they meant about it. So I used the birch tree…, to prove to Forestry that what they were doing was not right. When they tree-planted an area, a few years later, they want to tree space—and they cut every leafy tree out of the way and left only the evergreens that they planted. I happened to be on a committee that was working with the forestry because our leaders are saying we need to be a part of the decision making. And I was elected to be one of the people to work with Forestry. And I felt the only way I could be heard was to prove a point. So I went and I—I did a video on the birch tree, its purposes, how valuable that tree is to us.
>
> The birch bark is my basket, the burl [fungus] on it was what we use to carry the fire from one place to another. [I wanted to learn] the whole thing about the birch tree, right down to the sap. I cut a piece on a tree about two inches and made a little home-made spigot out of birch bark and I stuck it into the tree. Right away it started dripping. I got a gallon of sap in the morning—a gallon of sap in the evening. For a whole week that's what I was getting. And I made syrup out of it—beautiful syrup. After one week, I mud-packed it and let it heal itself. Now, can you just imagine three to four weeks, the sap goes up that tree to start the leaves. Can you just imagine how much sap, if left alone, is in that ground? That goes up that tree and it is up there all summer long, creates leaves, collecting solar energy—the wind, the rain, the sun. In the fall, it goes back down into the earth. The leaves drop, it creates compost. And the other plants live on those, the sap that goes back in the ground.
>
> And when you compare that… with the evergreens, all you see is dead earth under the evergreens. All they release is turpentine…. I haven't gone to school of any kind, but these are expertise that I learned from my elders. Now when all that [birch] sap goes back into the ground, other plants feed from it. And that was the point I had to get across to the Forestry. Leave some of our trees alone—let them grow. Because they are not a long lifespan type of tree. They only last so long and then another one will take over and they die….

Recent scientific riparian research findings as well as B.C. legislation in the Fish Protection Act are beginning to recognize the importance of leaf litter fall mainly from deciduous species into the minor tributary streams. This helps to feed the "bottom" of the whole aquatic food web upon which all fish are dependent. The B.C. Riparian Areas regulation requires a 30-meter Streamside Protection and Enhancement Area (SPEA) on each side of all fish-bearing and direct tributary streams partially for this reason. Furthermore, the close and dependent relationship between birches and other forest species is confirmed by Simard et al. (1997) in relation to ecological services provided by birch to Douglas-fir, through their associated mycorrhizal fungi.

In summary, the following are concepts for ecocultural restoration informed by our work with many Aboriginal elders, including Mary Thomas:

1. Work with Aboriginal elders and longtime residents of an area (especially an area that has/had valuable plant and animal habitats and is threatened; e.g., the Salmon River estuary and floodplain) to document observed environmental change and its impact on cultures;
2. Use other resources (archives, photographs, diaries, naturalists' and explorers' journals, sediment cores, pollen analyses, tree ring analyses, archaeological research) to determine extent and timing of environmental change;
3. Undertake a detailed inventory of culturally important habitats in a given area;
4. Explore ways to re-introduce a species into areas they formerly inhabited;
5. Educate others (including non-Aboriginal, non-Secwepemc people) about the cultural and ecological importance of these species and habitats, by engaging their help in restoring them;
6. Respect the trees and other plants, the fish and the wildlife, never thoughtlessly destroy them, and seek to maintain them;
7. Continue to use, with respect, the resources that you need, without destroying them; for those uses that have been forgotten, learn about them again;
8. Use adaptive management; constantly observe what is happening to the species and habitats, and if they are being impacted, take steps to change practices of use or harvesting to reduce this impact; let them guide practices and approaches.
9. Engage Secwepemc community members, including youth and elders, and work with outside stakeholders to fence off historically and culturally important harvesting areas, and then rehabilitate and/or enhance important food and medicine plants.

To date, there has been little systematic accounting of the environmental deterioration as witnessed by Aboriginal Peoples in the Secwepemc or neighbouring territories (but see Markey et al. 2005). The complex problems of biodiversity loss and change and their relationship to human activities can only be alleviated if they are recognized and assessed, and if people become sensitized to them through education. We close with Mary's words (1998, 2001):

> We are all in the same boat. We're all going to have to paddle that same boat together .... We are here together, and there's no way we can push anybody out. We have to learn to stand together .... We have to work hand in hand with the

> already established people like the forestry, environmental people, watershed and everybody … Let's heal Mother Earth—she's suffering. She's giving us a lot of warning. And this is something that my grandfather told me when I was just a little girl. And I thought, "Oh, what does he know?" I thought I was smarter than him because I had a few years schooling at the residential school. But I can see that and I can hear that voice ….
>
> How else can you heal unless you go back to your Mother?

Notes

1. One example, identified by Halter (2011) is that yellow glacier lily (*Erythronium grandiflorum*) is blooming significantly earlier in part of its range and the bumblebees that pollinate this flower are not available at that time, leading to an overall reduction in seed propagation of this culturally important species.
2. Throughout her English narrative, Mary uses the term "Mother Nature". Indeed, she was often called "Mother Nature" herself. Clearly, her comments are aimed at the non-Secwepemc speaking audience of ethnobotanists, resource managers, general public, and young aboriginal people, because the concept "Mother Nature" as such does not exist in Secwepemctsin. In Secwepemctsin discourse, nature is neither thought of as female or as mother, nor is there a term that comprises the same as the English concept—which has its very own history. The term and phrases that Secwepemc speakers/elders use are: ***tmicw***, ***re-tmicw-kt***, or ***re tmicws-kucw***. It means "land," or "earth," and with the –***kt*** suffix, "our land" (all inclusive), and with the –***kucw*** suffix (exclusive) "our land, but not yours," [the addressee's], when addressing non-Secwepemc outsiders. ***Tmicw*** conveys a sense of the land as it contains all living creatures, but also the geographic landforms as well as weather—all perceived as powered by previous interactions on the land and as volitional. ***Tmicw*** is thus perceived as being inherently animate and interacting with people, but also situated within and among Secwepemc people, their knowledge, guardianship, laws, and rights to existence in their territory. "Mother Nature", by contrast, tends to exist in an environmentally driven, universalist approach to guardianship of the land. In her tireless environmentalist advocacy and practitioner's work interacting with non-Aboriginal people, Mary astutely put this principle to work as she talked in English to outsiders.
3. Mary's grandmother was Mrs. Dick Andrew; her baptismal name was Marguerite. She lived to a very old age, perhaps 109 or even older.
4. This is possibly referring to the reserve name at Neskonlith in Salmon Arm, IR #3, Switzmalp, which may be derived from ***sxuseméllp***, the name for *Shepherdia canadensis* or from ***Scitseméllp*** ("cut or shear plants"), the latter referring to people gathering ***pesnúl'ten*** (probably reed canary grass), in the area, as was reported to Randy Bouchard and Dorothy Kennedy by Secwepemc elders Bill Arnouse and Stanley Johnny—see Bouchard and Kennedy 1991 (Marianne Ignace, pers. comm. 2011).

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Chapter 11. Coyote, Grouse, and Trees: Secwepemc Lessons about Ethnobiological Knowledge

Marianne B. Ignace†, Nancy J. Turner‡, and Ronald E. Ignace§

Abstract

By way of a detailed analysis of the Secwepemc ***stsptekwll*** *or story about "Coyote Juggles his Eyes," this essay explores how Secwepemc traditional narrative encodes and expresses, in often subtle ways, ecological connections between people, plants, and animals. After comparing various versions of the Coyote Juggles his Eyes, our essay focuses on the late Simpcw (North Thompson Shuswap) elder Ida William's narration of the story. In her telling, Sk̓elep (Coyote), after losing a gambling contest, has to put to use his knowledge of biogeoclimatic zones and tree indicator species to find his way home from the high plateau. Our essay also discusses how narrative style, verbal poetry, and word play all contribute to the story as it can and should be read as a way in which Traditional Ecological Knowledge (TEK) among Secwepemc people productively and pedagogically existed in stories.*

Keywords: *Secwepemc, ethnobotany, ethnoecology, TEKW in narrative, Coyote stories*

Coyote's Story

1) **M-nes ne secplúl̓k̓w re senxwéxwlecw.**[1]
   Coyote[2] went to a gathering

2) **M-séysus.**
   He gambled.

3) **Xwexwéyt te stem re t̓ecwentéses re qelmúcw.**
   And he beat the people at everything.

4) **T̓cwum xwexwéyt.**
   He won everything.

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5) **M-k̓úcsentem yerí7 te qelmúcw.**
The people envied him.

6) **M-tsúnctem es neq̓citem te spipyúy7e, es kwéctem te ckwt̓ústens.**
The [bird] people wanted to steal them and take them from him.

7) **Yerí7 re setsé7.**
And there was Raven.

8) **M-tsuns-ekwe es kwéctems te ckwt̓ústens re setsé7,**
Raven wanted to take his eyes away from him.

9) **M-tsuns-ekwe, "Xelxlíp, xelxléq'!"**
He told the Coyote, "Throw them up high and stick them back in."

10) **Kwéctem te ckwetkwt̓ústens.**
[Coyote] had his eyes taken from him.

11) **Klléksmentmes es pelq̓ílcs.**
They let him go to return home.

12) **M-plépes re senxwéxwlecw.**
And Coyote was lost.

13) **T̓7ek telrí7,**
He went along the way from there,

14) **mesmúsens stéµi es pepéns es k̓úlems te ckwetkwt̓ústens.**
and he felt for something he could find to use as eyes.

15) **Pelmíns re elk, re elkéllp te speqpéq,**
He found some kinnikinnick, some kinnikinnick berries (Figure 1).

16) **m-kwénses, xelxílqenses ne ckwt̓ústens.**
And he took them and stuck them in his eyes.

17) **M-wíkmes, k̓émell petéw̓s put ks le7s ks wíkems.**
He could see, but he couldn't see too well.

Figure 1. Kinnikinnick berries (***elk***; *Arctostaphylos uva-ursi*). Photo by Nancy Turner.

18) **M-sesúxwenstes ṭe m-ṭ7ek,**
And he went down along the way,

19) **m-séwenses re tsreprép,**
and he asked the trees,

20) **"Stem̓i ye7éne tek tsrep?"**
"What kind of tree is this?"

21) **Emétctmes te skwest.s re tsrep: "Seléwllp."**
The tree told him its name: "White Pine."

22) **Ṭ7ek ṭri7 re senxwéxwlecw,**
Coyote went along the way again,

23) **Ṭri7 m-séwenses nerí7 nek̓ú7 te tsrep,**
He asked this other tree,

24) **"Stém̓i tek tsrep-k?"**
"What kind of tree are you?"

25) **"Ṭsellp ren s7emetentsútst."**
"Spruce is what I call myself."

26) **Tsut re senxwexwlecw, "yeri7, yeri7 ren sesúsxwenst!"**
Coyote said, "That's it, I am going down!"

27) **M-séwens cuy̓tsem,**
He asked someone again,

28) **"Stém̓i ye7éne te tsrep-k?"**
"What kind of tree are you?"

29) **"Melénllp".**
"Subalpine Fir."

30) **ˇ7ek ṭe m-sesúxwenst, m-séwenses re tsreprep,**
He went on down, and he asked [another] tree,

31) **"Stém̓i tek tsrep-k?"**
"What kind of tree are you?"

32) **“Mulc.”**
“Cottonwood.”

33) **“Yerí7, yerí7 ren sme7é7ey,” tsut-ekwe re senxwéxwlecw.**
“That’s it, I’m getting close!” said Coyote.

34) **Yerí7 re m-st̓7ek, séwens nek̓u7 le tsrep.**
Here he came, and he asked another tree.

35) **M-tsúntem, “q̓wlséllp.”**
He was told, “Willow.”

36) **M-sesúxwenst cwúy̓tsem,**
He went down again,

37) **m-sulltímcwes, “stém̓i le tsrep?”**
and asked around, “What kind of trees [are there]?”

38) **“Meltéllp.”**
“Trembling aspen.”

39) **“Yerí7 ren sme7é7ey!”**
“There, I’m close!”

40) **Qwetséts telrí7 re sk̓elép, telri7 re senxwéxwlecw,**
Coyote, the one they call the “groundrunner”, left again,

41) **T̓rí7 m-sulltímcwes,**
and he asked around again,

42) **“Stém̓i ri7 tek tsrep?”**
“What kind of trees are there?”

43) **M-lexéy̓ectem, tsúntmes, “speqpqéllp.”**
And he was told, they told him, “saskatoon bushes.”

44) **“Yerí7 ren skíktsc.”**
“I have arrived,” [he said].

45) **Le-kítscwes, re spipyúy7e m-tsúnses, “Xelxlíp xelxléq.”**
When he had arrived, the birds told him, “Throw them up high and stick them back in!”

46) Must.s-ekwe.
Four times, they said, he did that.

47) Yerí7 re spelq̓ílcs re ckwetkwt̓ústens.
And his eyes came back.

48) M-wíkmes cwúy̓tsem.
And he could see again.

49) M-yews ri7 re sle7s re senxwéxwlecw.
And Coyote was all right again.

50) M-w7écwes telrí7.
And he carried on from there.

Introduction

In July 1987, Secwepemc storyteller Ida William (Figure 2) told the above ***stsptékwll***,[3] or "story" to Marianne Boelscher Ignace, who tape-recorded it and later transcribed and translated it in collaboration with Ron Ignace and Mona Jules.

The late Mrs. William (b. 1912, d. 2000) was acknowledged by her own community as one of the last Secwepemctsin (Shuswap language) storytellers among the Símpcwemc or North Thompson Shuswap. Her parents were Eddie (Edgar) Fortier, a Métis whose mother, Josephine Nexwitemxésq̓t, was Simpcwemc, and Mathilda Fortier, herself the daughter of Judith (Sudít) and George Sisyúlecw (born ca. 1840, d. 1919) from the North Thompson. Sisyúlecw had worked with ethnographer James Teit in 1900 in compiling a series of ***stsptékwll,*** which were later included in Teit's monograph *The Shuswap* (1909:737). Unlike other researchers associated with the Jesup North Pacific Expedition, like Franz Boas and John Swanton, James Teit did not record Secwepemc texts verbatim in the aboriginal language, but retold them in English, in abbreviated form and in Victorian prose (see Maud 1982; Teit 1909; Wickwire 2005). Thus Teit's published work on Secwepemc stories unfortunately does not preserve the richness of Secwepemctsin oral literature in either style or content. However, some of George Sisyulecw's and his contemporaries' storytelling is preserved for us through Mrs. William's recollections and renditions of her grandfather's stories, which she heard from him told in Secwepemctsin as a child.

Accompanying Mrs. William's skill and interest in storytelling was her knowledge of the plants and fauna of her homeland. As a young girl, she learned about medicinal plants from her mother, Mathilde, who had trained as a ***t̓kwilc*** (medicine person), although Mathilde's training, sadly, was interrupted by the missionaries' influence. Mrs. William also frequently accompanied her maternal aunt Sulyén, to go hunting and plant gathering, and also learned from other grandmothers and grandfathers,[4] some of whom were practicing medicine people, and had experienced life in Secwepemcúl̓ecw before the profound impact of diseases, missionaries, and settlers during

Figure 2. Simpcw Elder Ida William in a huckleberry patch at Raft River. Photo by Marianne Ignace.

the second part of the nineteenth century. Mrs. William had enormous knowledge of the names and uses of Secwepemc medicinal plants and food plants (see Turner et al., forthcoming), and of the habits and characteristics of local animals, especially birds. She could imitate birdsongs, and knew the connotations, translations, and associations of birdsongs and other animal vocalizations in Secwepemc culture and language. It is thus not surprising, then, that Mrs. William's rendition of the "Coyote Juggles his Eyes" story makes extensive use of knowledge about plants, animals, and the environment, and, as we will show in this article, her story is a fine example of traditional Secwepemc ways of teaching and disseminating knowledge about the Secwepemc environment through the medium of stories.

In this essay, we will explore the connections between Secwepemc plant and animal knowledge in storytelling. In recent decades, indigenous peoples' knowledge about the environment has received wide attention from the environmental movement, from managers of resources, and from international organizations. Indigenous knowledge about the environment, has been widely incorporated into the public discourse of western bureaucrats and environmental activists and indigenous activists alike (see Cruikshank 1998; Posey 1990; Richardson 1993; Turner et al. 2000—see also Chapter 12 this volume); however, as Cruikshank has pointed out,

> in a form that satisfied a North Atlantic preference for classificatory studies, projected as traditional ecological knowledge or TEK. *Thus recast, indigenous knowledge continues to be presented as an object for science rather than as a system of knowledge that could inform science* (Cruikshank 1998:50; our emphasis).

As Cruikshank further argues, this reification of TEK within the context of the practices and intentions of state management of resources then tends to redefine Indigenous cultures through western categories. The language of TEK itself has tended to be removed from particular indigenous peoples' worldview and ways of expressing it in language and thought. TEK discourse, as it is used in studies that sanction management regimes and control over resources, is generally codified and tabulated in order to make it conform to the objectives and practices of bureaucratic management strategies driven by nation states rather than by indigenous peoples' own ways of presenting and disseminating knowledge about the land, notably through narrative. The same often holds true for Traditional Use Studies and cultural impact assessments carried out by or for Indigenous groups, usually with state funding. As Markey, who analysed a large body of Traditional Use data in support of her point has noted, "[Traditional Use Studies] do not typically represent the perspectives of Indigenous peoples about their relationships to the landscape, their world view, and their interpretations of the past" (op.cit.:9).

In spite of these concerns about the appropriation of Traditional Ecological Knowledge by state-run management systems, ethnobiologists and anthropologists have produced a significant body of literature about local systems of knowledge and management practices of particular indigenous peoples, indeed shedding light on the particular workings of such systems of ecological and ethnobiological knowledge, and the details of practices and the belief systems underlying them (see, e.g., Anderson 1996; Berkes 2012; Feit 2005; Hunn 1991; Nelson 1983; Peacock and Turner 2000; Posey and Balee 1989; Sewid-Smith et al. 1998; Tanner 1979; Turner 2005; Turner and Atleo 1998; Turner and Lepofsky 2013; see also Ignace 2008).

By contrast, it has generally been the domain of linguists to analyse the conventions, meanings, and content of the Indigenous language discourse that informs such management practices. Rarely, however, have ethnobiologists, anthropologists, and linguists examined *how* aboriginal people who speak their own language—whether in everyday discourse, in oral histories or oral traditions—actually transmit knowledge about the environment through language-specific ways and in the discourse conventions particular to their cultures and societies.[5] This essay is intended as a contribution to this topic. We have begun above with a particular story, which, in the Indigenous language of the storyteller, tells about the travels, deeds and misdeeds of Coyote on the surface. Beyond that, at a deeper level, it demonstrates the storyteller's, and Secwepemc people's, connection to the animals and plants in the land, and how they are perceived as being connected by sharing characteristics, environment and habitat. In addition, it tells us about Secwepemc narrative conventions of how environmental knowledge was and is disseminated in Secwepemctsin.

If read in the language of resource managers and biologists, the story describes a significant list of ecological indicator species, observations about physical and etiological characteristics of fauna and flora, and their connection within an ecosystem. The discourse about these, however, differs significantly from the discourse of sciences. Moreover, our point is that the biological messages embedded in these stories are by no means self-evident. They deserve explanation and interpretation across languages, and across cultures. Stories also connect social messages with environmental messages. At the end of this article, we will return to the significance of storytelling discourse in the context of disseminating and transmitting knowledge about the environment. As we sit removed from the landscapes and environments in which these animals and plants interact with humans, we need to piece together the connections. People who lived on the land, however, experienced these links.

Coyote Stories in Secwepemc Culture and the "Coyote Juggles his Eyes" Theme[6]

Among the Secwepemc, as among the other Interior Salish peoples and many other aboriginal peoples of Western North America, Coyote is the Trickster-Transformer *par excellence* (see Bright 1987). According to the Secwepemc view of the origins of this world and of their homeland, ***Secwepemcúl̓ecw***, Coyote did not create the world himself; rather, he was sent by "Old One", the Creator, or "Chief of the ancient world," who "sent him to travel over the world and put things to rights" (Teit 1909:595). Old One was the powerful benefactor of humankind and the land, causing rain to happen and water to flow, introducing the fauna and flora of the area, and teaching the Secwepemc and their neighbours essential skills and arts like catching food and preserving it, making baskets, snowshoes and canoes, and sweat-bathing. Old One also gave people the gift of diverse but related languages (Teit 1909:596). Coyote, who then put the world into the present shape that Secwepemc find it in, is cunning but foolish, boastful, lecherous, and insatiable. His actions are caused by ambiguous motives and are unpredictable, and consequently, the present world is ambiguous and unpredictable. But Coyote's actions are also funny, and last not least, they provide moral lessons to present and past generations of Secwepemc on how **not** to behave. At a simple educational level (Ron Ignace would call this the "grade-school level" of ***stsptékwll***), stories explain the status quo: Why the chipmunk has stripes on his back, or why the coyote has shriveled, ugly looking paws. At a deeper level, and told from the point of view of people descended from many generations of people who lived in, and harvested the resources of, a particular environment, the stories of Coyote and other creatures tell about connections within that environment. Moreover, the coyote as a natural species (*Canis latrans*), and its connection to the stories, is the present world's and present people's immediate connection to their past story world.

In the Secwepemc language, Coyote—both the natural species and the Trickster-Transformer—is called ***sk̓elép***,[7] although the North Thompson Secwepemc and the Sexqéltkemc (Eastern Shuswap) also call him ***senxwéxwlecw***, literally "groundrunner" (prefix **s(e)n** – "the highest among others of the kind," + ***nexw*** – "to run [like an animal], especially a coyote," reduplicated to ***nexwéxw***; + -***lecw*** – lexical suffix. – "ground; earth").

A common theme of Secwepemc Coyote stories, and of Trickster Transformer stories throughout Western North America and other parts of the indigenous world, involves plots or sub-plots where Coyote copies the actions of others, only to have them backfire on him. Some of these actions involve copying the food-producing skills of other animals, only to have it reinforced that they are unique to those species. For example, in the story "Coyote and his Hosts" (see Bouchard and Kennedy 1979; Teit 1909; also Ron Ignace 2008:350–358), Coyote tries to imitate the talents of other animals, who, like Grizzly Bear, are partly endowed with supernatural powers, and partly rely on their natural abilities to produce cambium or fish. Not knowing which tree to harvest the cambium from, and confounding the outer bark (***p̓elén̓***) with the cambium layer (***st7íq̓wel̓qw***), Coyote is unsuccessful in copying these ways.[8]

The theme "Coyote Juggles his Eyes" is common throughout the folklore of aboriginal peoples of Northwestern and Southwestern North America, and has been recorded in numerous versions among aboriginal peoples from the Plateau south to the American Southwest. Some of these versions include Mourning Dove's Okanagan story (1933), a Thompson (Nlaka'pamux) version mentioned by Teit (op. cit.:633), and several Secwepemc versions, including one collected by Teit (1909:632–633), as well as Randy Bouchard's and Dorothy Kennedy's translation of a version from the late Kamloops/Neskonlith elder Ike Willard (Bouchard and Kennedy 1979). A short and fragmented version of the story was recorded by linguist Dwight Gardiner from Secwepemc elder Mrs. Lilly Harry of Dog Creek (see Jules 1994). Linguist Aert Kuipers also recorded a longer version from Lilly Harry (Kuipers 1989). In essence, all versions of the story share the theme of Coyote copying another creature's—in all cases a bird's—invitation to "throw [the eyes] up and stick them back in", losing his eyes as a consequence, and then embarking on a journey to retrieve his eyes.

Teit's Shuswap version, not from ***Sisyúlecw*** but from storyteller "Sixwilexken" (***Sexwélecken***) of Big Bar, summarized and re-told in English prose by Teit, explains why Coyote has red eyes. This version has a much shorter plot than Mrs. William's:

> ***Holxolip*** [***xelxelip***][9] was in the habit of amusing himself with his eyes by throwing them up in the air and letting them fall back again in their orbits. When doing this, he called out, "Turn around, stick fast!" ("***Xa'lxale'k, xeqxe'qa!***"). Coyote came along, and, seeing him do this, he thought he would do the same. Taking out his eyes and throwing them up, he called out the same words; but his eyes would not fall back into their orbits properly. He tried many times; but even when they did happen to fall back into their proper places, they would fall out again. Meanwhile Raven came along, and, seeing Coyote throwing up his eyes, he seized them and made off with them. Coyote was now completely blind, and said to himself, "What a fool I was to attempt doing a thing I knew nothing about. If I could only get some bearberries [kinnikinnick], I could make very good eyes of them." He crawled about on the ground, feeling for bearberries, but he could find none. Finally he found some rose-bushes, and, taking two rose-berries, he put them in his orbits, and was then able to see: but his eyes were now large and red, and he could not see as well as formerly (Teit 1909:632–633).

Ike Willard's Version

Ike Willard (b. 1896, d. 1976) was originally from Tk̓emlúps (Kamloops) but married into the Neskonlith Band in his youth.[10] His version (recorded by Bouchard and Kennedy in 1972) elaborates on the above plot, adding detail and a subsequent sub-plot to it: Coyote copies Blue Grouse (*Dendragapus obscurus*, ***sesúq̓w***) who calls out "***xelxléq***"—likely inspired by the male blue grouse's natural resonating hooting sound produced during mating season, in order to attract a female. Coyote interprets "***xelxléq***" [plural form of ***xleq***—"stuck in a narrow place"] as pertaining to the eyes "stuck back in," marveling at Blue Grouse's ability to throw his eyes up in the air and pop them back in the sockets. Coyote thus copies Blue Grouse by popping his eyes out and throwing them up, and Raven flies by, stealing his eyes. Coyote is left wandering around blindly. He uses his knowledge of trees as ecological indicator species to orient himself as he wanders aimlessly along the slopes, trying to find a source of water to quench his thirst. The trees he encounters and that are named in the story are the species found at mid to lower elevations in Ike Willard's home area near Chase, and progressively involve trees or shrubs that grow near sources of water. They involve the sequence:
1) ***tseqwél̓qw*** ("red sticks" - unidentified, probably an alternate form of 8); 2) Ponderosa Pine, ***s7etqwllp***; → 3) (Douglas) fir, ***tsqellp***; → 4) lodgepole pine, ***qwli7t***; → 5) Douglas maple, ***tswéllten***, → 6) willow, ***q̓wlséllp*** → 7) alder, ***kwle7éllp***, and → 8) red willow/red osier dogwood, ***tseqwtseqwéqwel̓qw***.[11] Each time Coyote encounters a tree which, as an ecological indicator, is associated with water, Mr. Willard, taking the voice of Coyote, says, "I'm getting close." In Ike Willard's version, the plot continues with Coyote killing old Willow Grouse (***sunéc***) woman by exposing her to stinging nettles (***swecwmem̓llp***),[12] stealing her eyes, and then accompanying her daughters to Raven's feast where the latter boasts about stealing Coyote's eyes and shows them off. Coyote recovers his eyes and escapes.

Lilly Harry's Version

This variation of the story was narrated in Secwepemctsin by the late Dog Creek elder Lilly Harry, and recorded by linguist Aert Kuipers during the 1970s or early 1980s. It was subsequently translated with the help of Mrs. Harry's niece Mary Palmantier and published as "Coyote and the Birds" (Kuipers 1989:45–48). At the onset of the story, Coyote enters a pithouse and, pointing to his sore feet with cracked heels, asks the children in the house for pitch to cure his cracked heels.[13] The children are the offspring of Blue Grouse (*Dendragapus obscurus*) or ***sesúqw***, Prairie Chicken or Sharp-tailed Grouse (*Tympanuchus phasianellus*), ***sqwúmqe***, Willow Grouse (*Bonasa umbellus*) or ***sunéc***, and Franklin's Grouse (a.k.a Spruce Grouse, *Dendrapagus canadensis*) or ***sxó7xe***—the four species of grouse that live in Secwepemc country. After they bring him pitch and then go to sleep, he uses the pitch to glue their eyes shut. Their mothers find them, clean up their eyes and decide to give ***Sk̓elép*** a lesson. As he walks along the top of a cliff, each grouse, in turn flutters by to scare him. It is the male Blue Grouse's flying by suddenly that causes him to lose his balance and fall off the cliff.[14] He subsequently loses his own eyes after a group of unnamed animals induce him with the chant "***xelxelip xelxeléq!***" to pop his eyes out and stick them back in. As Coyote does this, Raven swoops by and snatches them. Blind and lost, Coyote bumps into trees whose species are not named, sticks last year's rosehips, and then kinnikinnick berries into his eyes, which allow him to see again, although barely, and then finds animals that are playing ball with his eyes. He retrieves his eyes by joining the game, and runs off with his recovered eyes.

Understanding Ida William's Version

As we have seen, all storytellers' versions of Coyote Juggles his Eyes mention specific animal and plant species, and weave knowledge about the physical characteristics and vocalizations, ecology, and habitat, as well as feeding behaviour into the story plot. In a minimal sense, the colour of rosehips or kinnikinnick berries reminds people of the colour of coyote's eyes. The four species of grouse found in the Interior figure in Ike Willard's and Lilly Harry's stories, and their encounters with coyote as he walks along a steep trail reflect the more passive behaviour of the fool hen and sharp-tailed grouse, to the fluttering of Willow Grouse and the louder ambush-like flutter-by of the Blue Grouse. Finally, trees as ecological indicator species play a central role in the story plot. In Ida William's and Ike Willard's versions Coyote's knowledge of tree species as indicators of elevation is the central component of the story, in that it allows him to return home safely and retrieve his eyes. In order to get a better understanding of the multi-dimensional and often illusive ways in which ecological messages, interwoven with social and moral messages, play a role in Secwepemc ***stsptékwll***, we will turn to Ida William's version in more detail.

Plot and Meaning of Ida William's Version

Ida William's version resembles Ike Willard's sub-plot about descending the mountain in search of water; however, it places emphasis on Coyote's descent *down* the mountain, and his knowledge of tree species and the elevations they are associated with. Moreover, her story conveys knowledge about the nature of power, although in an implicit manner. The story therefore needs some commentary as to its meaning, which derives from its embedded cultural context. Beyond merely disseminating biological knowledge, the narrative of ***stsptékwll*** represents artistry and poetry. As Hymes (1981:10) has reminded us, "Artistry comes into view only if the text can be seen as a texture within which particular means have been chosen and deployed." We will thus comment on the stylistic and literary devices used by the storyteller to communicate and reinforce the message of the story.

The beginning of the story has the Coyote gambling with the bird [people].[15] This takes place during the mythical age, when birds appeared in the shape of people and interacted with other animal-people (c.f. Teit 1909; Ignace 1998; Ignace 2008). We can presume that the game they play is ***sllekméw̓es,*** the bone-game, a favorite gambling game among Interior Salish peoples and other Aboriginal peoples throughout Northwestern North America.[16] ***Sllekméw̓es*** is a power contest, in which the players demonstrate and test their personal power acquired through ***étsxem*** or training, their ***seméc***, to outguess their opponents. Their vision, the ability to see, both in a natural and supernatural sense, is the key to power, and is an important part of winning. As the story has it, Coyote wins: "He beat the [bird]-people at everything. He won everything," leading his opponents to envy him, and to plot to get rid of his vision, as it is his eyes that give him his gambling power. Knowing Coyote, the audience also imagines that he is not the most tactful and humble of winners, and probably brags about his winning—an action not sanctioned in Secwepemc culture. If the birds, as Mrs. William later suggested, were indeed grouse (in particular Blue Grouse, Ruffed Grouse, and Spruce Grouse, which are residents of high mountain forests), there is a further allusion to the characteristics and behaviour of grouse here, likely involving the drum-roll of the Ruffed Grouse (here imagined as a game of ***sllekméw̓e*s**, where the players beat on a board with sticks!), the hooting of the Blue Grouse, and the whip-like cracks of Spruce Grouse. This is, of course, where on a social-moral level the story tells the listener what happens if (as it so often does to Coyote) one behaves against the norms of society (i.e., not acting humbly, being boastful and bragging, not being respectful). As Mrs. William herself commented when we were reviewing the story, "Coyote was getting too smart, that's why Raven wanted to take his eyes out." On another level, it conveys information about the physical behaviour and characteristics of particular animals, i.e., grouse species found in the environment that is referred to in the story. Much of this, of course, is left to the imagination of the listener. The allusion to Coyote using kinnikinnick berries (a.k.a. bearberries, ***elk***) as eyes is also significant, since these berries are known to be food of grouse (cf. Turner 1997), and, as well, male Spruce and Ruffed Grouse both have distinctive red patches over their eyes.

The Raven's Cry

Like Coyote, Raven is a trickster, and it is Raven who tells Coyote "***xelxlip, xelxléq!***", to "throw [your eyes] up high and stick [them] back in." [***xelip*** = "to throw up in the air"]. The saying "***xelxlíp, xelxléq***" at once imitates one of the natural sounds ravens make, and at the same time reads into it meaning in the Secwepemc language. It is a prime example of "fauna speech" (Egesdal 1992) which draws on both onomatopoeia and the "modification of actual speech" by involving "the selection of semantically appropriate items (given the narrative context in which the animal character speaks) that can be manipulated to echo or evoke the animal's cry, whistle, call or song" (Egesdal 1992:9; see also Hymes 1981:65ff). "***Xelxlíp xelxléq***" marks the "performative peak line" (Egesdal 1992:5) of character speech in this narrative: It dupes Coyote into throwing up his eyes up in the air and thus losing his eyesight, causing the plot to unfold. Egesdal (ibid.) asserts that the main function of fauna speech is to "amuse the audience," and moreover to remind the audience of the connection between the natural species and humans. As Egesdal has noted, "Their ability to speak exposes their human nature, while at the same time their faunal perversions and interjections betray the animal side of their personality" (ibid). More than this, however, such character speech involves lessons in biology, and in language, instilling in the audience (often children) the sounds which animals make. These onomatopoeia then become *mnemonic devices,* which connect the animals to humans, but which also help humans remember the animal cries, their habitat and natural characteristics. As "performative peaks" of stories, or sometimes told as distilled sayings, such "fauna speech" in stories have functions somewhat similar to European nursery rhymes.

Coyote's Lesson in Ecological Knowledge

When Raven steals Coyote's eyes by swooping down after the latter has thrown them up in the air (note that in Teit's version this is different), the blind Coyote is left behind. We now realize, without being told explicitly, that the story takes place on the mountain, as Coyote is trying to figure out how to descend. This portion of the story also has elements of the notion of ***étsxem***, or "practicing" (commonly referred to as "training for power" or "spirit guardian questing"—see Ignace 1999; Ignace 2008), as Coyote has to prove himself in solitude to be re-incorporated into his community, which is in the village in the valley below. He uses his botanical knowledge to do so. First, he finds replacement eyes in the pea-sized, spherical, opaque, bright-red berries of kinnikinnick (*Arctostaphylos uva-ursi*, ***elk***). These give him a bit of eye-sight, but not too much. By contrast, Teit's version has him use rose-hips (***sekwéw̓***), a larger fruit, but still opaque, and ends with him partially regaining his sight. Incidentally, Interior and Coastal First Nations widely used a decoction made of the bark, leaves, and sticks of rose-bush (*Rosa* spp.) as an eye-wash medicine. As we noted, in Lilly Harry's version (see above), he first tries rose-hips, which give him "a little bit of eye-sight", and then tries out kinnikinnick berries (a.k.a. bearberries), which give him much better sight, although in the end, he tricks the birds who took his eyes into releasing them. Mrs. William's Coyote, however, after he puts in kinnikinnick berries as eyes, continues his quest down the mountain, still half-blind, and orients himself according to tree species distribution by what we might call indicator trees of habitats and ecological zones: "He asks the trees their names, and, once told, knows what his relative position on the mountain must be." The mentioning of kinnikinnick berries is of further interest in that it allows the listener (at least the listener who is familiar with the wooded plateaus of Secwepemc territory) to visualize and imagine in what kind of environment coyote finds himself. Ecologists refer to kinnikinnick as "a good indicator of nutrient poor, dry to very dry soils" (Ringius and Sims 1997), associated with water-shedding rather than water-bearing sites.[17] Implied in this is that there are no other significant food supplies on the arid slopes associated with kinnikinnick. This information is not explicit in the story; however, for the audience that has experienced the kinnikinnick-bearing slopes of interior forests, the mere mentioning of kinnikinnick invokes the visual images of the environment and the consequences for food-gathering and survival associated with the occurrence of the species.

The sequence of upland trees he encounters as he ventures down the mountain includes: white pine, ***seléwllp***; spruce, ***t̓sellp***; subalpine, or balsam fir, ***melénllp*** (Figure 3); then a series of deciduous trees further down the mountain, including, in order of Coyote's descent, cottonwood, ***mulc*** (Figure 4); willow, ***q̓wlsellp***; poplar, or trembling aspen, ***meltéllp*** (Figure 5); and finally, saskatoon bush, ***speqpeqéllp*** (Figure 6).[18]

Figure 3. Subalpine, or balsam fir (***melénllp***; *Abies lasiocarpa*). Photo by Nancy Turner.

Figure 4. Black cottonwood (***mulc***; *Populus balsamifera*). Photo by Nancy Turner.

Figure 5. Trembling aspen (***meltéllp***; *Populus tremuloides*). Photo by Marianne Ignace.

Figure 6. ***Speqpeqéllp*** variety of Saskatoon (*Amelanchier alnifolia*). Photo by Marianne Ignace.

Ecological Zones and Significant Trees in the Homeland of the Simpcwemc

As has been noted elsewhere (Ignace 1998; Ignace 2008; Ignace and Ignace, this volume), Secwepemc territory as a whole is environmentally diverse, ranging over many different biogeoclimatic zones and encompassing a range of habitats and ecological communities. It ranges from the arid, treeless Bunchgrass Zone, through the dry wooded Ponderosa Pine and Interior Douglas-fir zones, to the wetter, colder Montane Spruce and Engelmann Spruce—Subalpine Fir zones, and eastward to the wet forests of the Columbia Mountains, in the Interior Cedar—Hemlock Zone. Northward, it encompasses the Plateaus between the Thompson and Fraser Rivers, the grasslands of the Cariboo, and, above the forested zones in the mountains, there is a gradation through subalpine parkland to the treeless Alpine Tundra Zone. The portion of the territory historically inhabited by the Símpcwemc varies from that inhabited by the Tk'emlúpsemc (Kamloops people). It includes the wetter mid-North Thompson region, but also notably the cool and wet northern part of the Columbia and Monashee Mountains and the eastern foothills of the Rocky Mountains in the Tete Jaune Cache to Jasper area.

Of the species Coyote encounters and names, the first, ***seléwll***[19] or white pine, occurs in the northern and eastern part of Secwepemc territory and is a notable element of the interior subalpine forest zone, characterized by and named after the second two species: Engelmann spruce and subalpine (balsam) fir. All of these species have cultural applications. They are used for their wood, for their medicinal pitch, and especially for ***selewll***, their bark is useful. White pine bark, and to a lesser extent, subalpine fir bark, was formerly stripped off the trees in sheets and used for covering canoes and making containers, as well as for other purposes.

Cottonwood and willow might be found at upper and middle elevations, but mainly in moist draws and along watercourses. Thus, implicit in the sequence of trees, and to be imagined by those in the audience who know the local habitats of trees, Coyote likely found and then followed a course of water away from the arid slope where he had found kinnikinnick. One can easily envision ***Sk̓elép*** stumbling around and finding a stream course to follow downward. The third deciduous tree, trembling aspen, does occur at relatively high elevations, but can also be expected in stands along gullies, moist hollows, and gentle slopes at middle and lower elevations. The last, saskatoon, is associated by the Secwepemc not only with lower elevations and valley bottoms (although they also grow on the sidehills at middle elevations), but with culture and food, since it is a staple among fruits. The berries of *Amelanchier alnifolia* are known in the Secwepemc language as ***speqpeq7úw̓i***, "real" or "ordinary" berries, and are thus seen as the "type" or "essence" of all berries, since they are both widespread and widely used.

The botanist may wonder why a species like lodgepole pine, ***qwli7t***, is missing from Ida William's story, especially since it is both frequently encountered in Secwepemc country and is a food species, whose edible cambium was harvested. Also missing from Mrs. William's version is the ubiquitous Douglas-fir, ***tsq̓ellp***. Perhaps the very "common-ness" of these trees, their wide elevational ranges and broad ecological tolerances, eliminate them as valid ecological indicators. Or perhaps, in another context of telling the story, or on another occasion, Mrs. William might have included them among the species the Coyote asked about to orient himself.[20] As her own spontaneous comments on the story show, the narrator was aware that this portion of the story involves a sequence of what the botanist might call ecological zones. While telling the story, and while mentally searching for the names of the trees, she would whisper to herself, "Oh, what is it that grows up there?" The concept of what amounts to ecological zones and their indicator species is also apparent in the verbal designations in Secwepemctsin for these. When describing their location along mountain slopes, speakers of Secwepemctsin would use terms like ***ne melénllp*** ("in the subalpine fir"), ***ne tsq̓ellp*** ("in the Douglas-fir trees") or **ne** ***qwli7t*** ("in the lodgepole pine") to describe the area of the mountain as per ecological zone (see Chapter 2).

In a narrative such as this, the ecological content is open to variation with context. This context, in turn, derives from the plants and animals the narrator is most familiar with, that is, usually those found within the portion of the territory he/she knows and where he/she has harvested resources and learned the knowledge about plants, animals, and all living things from his/her elders. Secondly, this context involves personal preferences and variation, both on the part of the storyteller and of his/her ancestors who handed down the story. Coyote's ecological knowledge in the story both reflects and is reflected by the knowledge of the storyteller, which is in turn determined and influenced by her own traditional education and her desire to pass on relevant teaching to the listeners of the story. While there are possibilities for selection of certain species over others for illustrative purposes, such selection is prescribed by the availability and cultural importance of these species.

Besides the different versions of the "Coyote Juggles his Eyes" theme listed above, a case in point for such "ecological variations on a theme" in traditional narratives are the "Star Husband Tales," of which more than 85 versions have been collected throughout the Pacific Northwest, and across aboriginal Canada and the United States. In the standard versions, one or two young women wishing to marry stars are transported to the sky country where they find that they are married to the stars at which they are they were looking. Eventually they find their way back to earth by digging a root vegetable growing in the ground of sky-land that created a passage through which the earth, far below, became visible. Invariably, the particular root vegetable the women dig is a staple food for the region in which the particular version of the story is set: These range from blue camas (*Camassia* spp.) in the Saanich (Straits Salish) versions, to fern roots (probably spiny wood fern, *Dryopteris expansa*) in a Snuqualmi version, to prairie turnip (*Pediomelum esculenta*) in a Peigan version. Furthermore, returning to earth is usually accomplished by means of a rope, which is made out of various materials, depending on the region in which the story is told: cedar-bark or stinging nettle twine for Northwest Coast, Indian hemp for the Interior Plateau, willow bark or buffalo hide rope for the Plains (see Brown 1873; Dundes 1965; Monroe and Williamson 1987).

Style and Message

Like other Salish narratives told in the original, Mrs. William's story is what others (Egsdal 1992; Jacobs 1959) have called "tersely delineated", with "expressions of content … limited to giving only a succinct descriptive of setting, movement in time or space and characters." Much of the underlying motives and actions of the protagonists of the story (the significance of gambling; Coyote's bragging; the connection between eyesight and bone-game), as we explained above, derive from the context, which of course at least in the past was taken for granted by the narrator and the audience. Other portions of the story, including the listener's imagination of the exact location of place of the story, the direction of Coyote's travel, the significance of particular animal and plant species to the plot of the story, or the consequences for the story they entail, are implicit rather than explicit. They invite the imagination by the listener of what the grouse and Coyote sound like, what the environment looks like due to the occurrence or absence of certain plants. Such implied messages are meaningful in the context of the listeners' shared knowledge about the fauna, flora, and physical landscape of particular parts of ***Secwepemcúl̓ecw***.

It is also noteworthy that the direct speech of the trees and animals who appear in the story is in short, almost stenographic style (c.f. Egesdal 1992). This holds true for the narrative peak line by the Raven, "***xelxlip, xelxléq***", as well as for the responses of the trees to his questions about what kind of tree he is facing. Coyote, by contrast, speaks to himself in short comments, his sentences being similar to those that would be used by humans.

As with other Secwepemc narratives (Boelscher (Ignace) 1989; Kuipers 1974, 1989) and Interior Salish narratives in general, this story makes extensive use of the passive voice as a focusing device. More than this, it presents the experiences of Coyote as the protagonist of the story from his perspective. In this context, lines 5), as well as 6) and 7), and the parallel lines 11) and 12) are worth pointing out, since they all make use of intricate passive voice constructions:

5) literally, “He was envied by the people (birds)”;
6) lit. “He was wanted by the birds to have his eyes stolen from him,”
7) lit. “And have them taken from him;”
8) lit. “Coyote had his eyes taken from him”
9) lit. “He was let go to return home.”

These are a function of this “terse” narrative style.[21]

The story, then, is told from the empathetic point of view of Coyote’s experience in the landscape, and his experience of interactions with fauna and flora.

The Pedagogical and Cultural Function of Disseminating Traditional Ecological Knowledge through Storytelling

This **stseptekwll** is one of many stories told on the Plateau that disseminate knowledge about land, flora, and fauna by way of the plot itself, sub-plots, or character speech and other stylistic devices used in the story. In an earlier article (Turner et al. 2000; see also Ignace, Turner, and Ignace, this volume), we examined the components of traditional ecological knowledge and wisdom in Northwestern North America. This diagram shows:

1. [culture-specific] “philosophy and worldview” at the core of traditional ecological knowledge;
2. “practices and strategies for sustainable living” as significant practical or lived components;
3. “communication and exchange of knowledge” as reflecting the social, political and pedagogical dimensions of lived and practiced ecological knowledge.

Our diagram moreover represents indigenous TEKW as a spiral, in that, from the perspective of particular Aboriginal Nations, such knowledge and practices involve the consciousness of history, of the connection of the past with the present. Specific elders know and acknowledge the sources of their stories, and thus provide “mental footnoting” (Wickwire 2007) of the sources and origins of their knowledge. The telling of oral histories not only gives credit to the ancestor they derive from, but connect the living storyteller to previous generations who lived on the land, and thus signifies the historical consciousness of the connection to land and environment.

Another aspect of TEKW, as we explained it, is the adaptability of knowledge and practices. Stories like the above Coyote story are adaptable to other environments and contexts, as these are called for: As we have seen, the sub-plot of Ike Willard’s “Coyote Juggles his Eyes” story includes a sequence of tree species more salient to the Kamloops environment, whereas Mrs. William’s story names tree species particular to, and significant within, the environment surrounding her own home community, Simpcw on the North Thompson. During storytelling training with learners of Sescwepemctsin, Ron Ignace has in recent years adapted this Coyote story to fit the sequence of indicator species trees descending from the spruce/subalpine fir zone, to lodgepole pine, Douglas fir, Ponderosa Pine, and saskatoon berries, as one would encounter in the Skeetchestn area, his home territory. Likewise, the message intended for stories can be adapted to reflect social and political needs of the present. Old stories can be deployed to give messages relevant for the present and the future (see Cruikshank 1998, 2005 for similar examples).

Why Stories?

It is important to realize that **stspetékwle** which explicitly or implicitly contain messages about the environment and species in it derive from a time when Secwepemc men, women, and children spent the vast part of their annual seasonal round traveling, camping, hunting, plant-gathering, and fishing in all parts of the plateaus of the Interior, migrating between highland areas and valley bottoms. In the context of this way of life, the knowledge of the behaviour of species, whether they were directly harvested or were ecological indicators of other species' life cycle events, was crucial to survival and success in pursuing and managing resources. It was also critically important for younger people to become trained in recognizing species in the landscape and understanding the ecological interconnections between species. In Secwepemc society, as in other indigenous societies—but each with its own culture-specific and linguistic ways—the explicit or encoded messages about environment contained in stories represent a way of disseminating and transmitting ecological knowledge needed for the successful harvesting of species, and for survival within the environment. Implicit messages about the connection between ecological indicator species and food sources not yet known to younger people or individuals who have no extensive knowledge of fauna, flora, and landscape, further invite the audience to re-examine the living landscape after hearing the story in the new light of what they have learned.[22]

As scholars of discourse and oral history have pointed out, storied narrative's function is "authorizing, founding and setting in place ways of experiencing the world" (Cruikshank 1998:1; see also Cruikshank 2005; Connerton 1984; de Certeau 1984; Tonkin 1998), to establish connections between people and places, present and past, and different groups of peoples. We may add to this that beyond connecting "people and places," narratives express the interactions of people, plants and animals in the intimately known and managed environments of the Indigenous homeland. Not only animals and plants, but the landscape itself is conceived of as animate and sentient. Stories have a crucial value in this context in that they allow storytellers to weave together themes, contexts, and elements, not merely as "bricolage" (Lévi-Strauss 1966) in the sense of pre-existing bits that carry affective, social, or logically significant meanings, but as elements deriving from a cumulative history of observation and experience in a particular environment.

Notes

1. The orthography used for Secwepemctsín (Shuswap language) in this essay is the practical alphabet originally developed by Dr. Aert Kuipers in collaboration with May Dixon and other speakers of Secwepemctsín. It uses the following symbols for consonants (IPA equivalents indicated): ll = voiceless lateral fricative; c = voiceless velar fricative); x = voiceless uvular

fricative); r = voiced velar fricative; g = voiced pharyngeal fricative. Glottalization is indicated through an apostrophe (') above the letter. A glottal stop is indicated by 7. Stressed vowels are indicated by an accent mark ´.

2. Scientific names, common English names and Secwepemc names of all animals and plants referred to in this chapter are provided in the Appendix.
3. ***Stsptékwll***, usually translated as "myth," "legend" or "story" are ancient narratives of powerful beings, the ***stspetékwle***, also called ***tellqel̓mucw*** or "shape-shifters", who could alternate between human and animal form. They traveled throughout the land vanquishing powerful beings that did harm to people, and thus made the land inhabitable by humans. Throughout the Interior Plateau, the trickster Coyote (***sk̓elép***) is the most ancient of these transformers (see Ignace 2008).
4. In Secwepemc usage, the terms for "grandfather," ***xpé7e*** and "grandmother," ***kyé7e*** apply to biological grandparents' collaterals, or in English usage, great-uncles, great-aunts, and so on. In the end, they apply to any known relative two generations up from ego, either male (***xpé7e***) or female (***kyé7e***).
5. For examples of environmental knowledge embedded in Hunn 1991; Nabhan 1985; see also Maffi 2001 for a compilation of essays that link language, knowledge, and environment.
6. As we will see, at least for the Secwepemctsin versions of the story, "juggles his eyes" is not an entirely correct translation, since Coyote does not "juggle" his eyes but throws them up and puts them back in their sockets. However, the stories that involve this theme are generally known in English as "Coyote Juggles his Eyes."
7. Northern communities where the western dialect of Secwepemctsin is spoken use the variation ***sek̓lép***.
8. Ron Ignace uses the political and social message behind this theme in a contemporary context, urging Secwepemc and other Aboriginal peoples to use their own ways and traditions to revive the languages, to educate younger generations, and create institutions, instead of copying the institutionalized ways of Euro-Canadian society.
9. Identified by Teit as "the name of a small dark-coloured bird which I was unable to identify" (Teit 1909:633 fn.2)
10. Much of the ethnobotanical information collected by Gary Palmer (with assistance from Nancy Turner, Randy Bouchard, and Dorothy Kennedy) during the late 1960s and published in Palmer 1975 and Turner 1995 [1975], 1998 [1979], derives from research with Ike Willard, his wife Adeline Willard, and Mrs. Willard's sister, Aimee August.
11. The tree species listed here are those that Ike Willard names in his Secwepemctsin narration of the story. In the English version edited by Bouchard and Kennedy (op. cit. 1979:16), white pine, maple, and alder are omitted. In Ike Willard's English rendition of the same story, his wife Adeline Willard interjects the names of the tree species, also adding "black pine [lodgepole pine]" and cedar.
12. Willow grouse or ruffed grouse, among all species of grouse, have a reputation to easily panic, get frightened, and then die. They are said to like the male catkins (***sqelelémcw*** ["male"], or ***sqelemcwéllp*** ("male plant") of aspen, hazelnut, and other trees near water sources. Hence Coyote asks if old woman Willow Grouse is scared of catkins but uses it as a double-entendre

that designates both male catkins and men. Willow Grouse replies, “No”. He then asks if she is afraid of ***swecwmémm̓llp*** (from ***wecw(p)*** “to sting” and the reduplicated lexical suffix –éllp, which is fairly similar in meaning to the English taxon vascular plant, but has a second meaning “animated being par excellence”). The word refers to stinging nettle (Urtica dioica), but very likely involves a pun or double-entendre here, in that he alludes to a “stinger par excellence,” most likely his male organ. She mentions that she’s deadly afraid of ***swecwmémm̓llp***. When he goes out to get some, she panics, and dies. Note also that willow grouse are said to live in burrows on the forest floor, and grind their food, in the story poetically alluded to by the old woman pounding her food, and living in a “teepee”.

13. Incidentally, pitch ointment, ***tsit̓***, made from Douglas fir, lodgepole pine or subalpine (balsam) fir pitch mixed with grease (animal fat or Vaseline) is an effective remedy for cracked heels in humans.
14. Another version of the story of Coyote and the Grouse Children was written down by Teit (1909) as a different episode of the Coyote cycle of stories. Tape-recordings also exist with Ike Willard (recorded by Bouchard and Kennedy 1972; see 1979), where this episode precedes the ***Xelxlíp Xelxléq*** Story; and with Bill Arnouse from Squilax (recorded by Dwight Gardiner and Brian Compton, 1992).
15. In a later commentary on the story and birds, Mrs. William and her brother, Eddie Fortier, mentioned grouse as being among the birds in the story plot, but did not recall details. This is significant with regards to the similarity to Ike Willard’s and Lilly Harry’s versions, and the overall role of the four local species of grouse in the story.
16. ***Sllekméw̓es*** or the bone-game, also called lehal, is a game where two teams of players have to out-guess one another as to the whereabouts of two unmarked bones hidden among two sets of two bones or small sticks which two of the players of one team handle. The team that handles the bones sings a ***sllekméw̓es*** song while beating on boards or a drum, in part to distract the opposite team. If the opposite team guesses wrongly, its players have to surrender a counting stick to the team that handles the bones.
17. While kinnikinnick berries are and were occasionally eaten by Interior Aboriginal peoples, they were not valued as a major food source, like huckleberries, soapberries, and the different species of blueberries that grow at similar elevations but on moister slopes and in richer soils. Nevertheless, kinnikinnick is valuable as a winter or famine food at times of shortage, since the berries remain on the plants over the winter and can even be dug out from under the snow. They are also widely known as a preferred food for bears, grouse, and other wildlife (Turner 1997; Turner and Davis 1993).
18. ***Speqpeqéllp***, the variety of saskatoon in Ida William’s story shown in Figure 6, is different from the ***sencweséllp*** and ***stséqwem*** varieties shown in Chapter 2 of this volume (Figures 8a and 8b). Secwepemc plant experts use several criteria, including habitat, sweetness, seediness, and shape of the shrub to determine each variety (Turner et al., forthcoming).
19. The name for white pine was previously translated as “two containers”, from ***sel***=two + lexical suffix –***ewll***, “container.” However, a more likely analysis is ***sel***=to peel, strip off + ***ewll***=container, also used in various compound words for “canoe,” and based on the use of white pine bark in the manufacture of canoes (Teit 1909:531–532).

20. According to Simpcw forest technician and Secwepemc language student, Harry Jules, who had puzzled over Ida William's story, her version of the story may well describe the forest ecology of a very particular area on the upper North Thompson River, which Harry Jules subsequently located (Harry Jules, pers. comm. to M. Ignace, 2007).
21. Much more could be said about narrative style, and about the intricacy of the message of this Secwepemc narrative. Following Hymes' (1981) analysis of the narrative structure of North American aboriginal "ethnopoetics", this story can be shown to consist of four scenes:
    1) Opening: Coyote at the gathering, beating all the birds at gambling;
    2) The Raven, who tricks Coyote into juggling his eyes and then steals them;
    3) Coyote alone on the mountain and descending (this can actually be subdivided into the episode with the kinnikinnick, and his descent, where he asks the trees for their names);
    4) Coyote arriving in the valley and having his eyes returned to him by the birds.
22. It should be pointed out here that Secwepemc people of all communities continue to carry out a significant and extremely culturally valued amount of hunting, fishing, and some plant gathering, and, indeed insist on the Aboriginal right to do so, and on Aboriginal title to their land. However, the knowledge of ***stsptekwll*** and specific environmental knowledge about the land embedded in such stories, along with the knowledge of the language, has been severely diminished due to the impact of Residential Schools, external hunting and fishing regulations, logging, mining, and urban and industrial development in their home country, Secwepemcúl̓ecw (see Ignace 2001). In this context, courses in ethnobiology—as those facilitated by Simon Fraser University—Kamloops with the participation of Secwepemc elders and younger generations, provide a contemporary forum to revive such knowledge, not only in an academic context, but also in a pedagogical and social context within the Secwepemc Nation.

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Appendix

Scientific Names and Secwepemc Names of Plant and Animal Species mentioned in this chapter (listed alphabetically by common name). Secwepemc Names are provided in Western Dialect.

Animals

Chipmunk (*Eutamias minimus*) – qets’wéw̓ye
Coyote (*Canis latrans*) – sk̓elép, senxwéxwlecw
Foolhen (see Grouse, Franklin’s or Spruce)
Grizzly Bear (*Ursus arctos horribilis*) – skem̓cis
Grouse,
  Blue (*Dendragapus obscurus*) – sesúqw
  Ruffed (*Typanuchus phasianellus*) – sq̓úm̓qe
  willow (*Bonasa umbellus*) – sunéc
  spruce (*Dendragapus canadensis*) – sxó7xe
  Prairie chicken (see Grouse, ruffed or Grouse, willow)
  Raven (*Corvus corax*) – setsé7

Plants

Alder (green alder) (*Alnus crispa*) – kwle7éllp
Aspen, trembling (*Populus tremuloides*) – meltéllp
Bearberry (see Kinnikinnick)
Bullpine (see Pine, ponderosa) – s7étqwllp
Camas, blue (*Camassia* sp.) – n/a
Cedar (western red-) (*Thuja plicata*) – estqwllp; estqw
Cottonwood (*Populus balsamifera* ssp. *trichocarpa*) – mulc
Fern, spiny wood- (*Dryopteris expansa*) – pepesést̓ye7
Fir, Balsam (or Subalpine) (*Abies lasiocarpa*) – melánllp, melénllp
Fir, Douglas- (*Pseudotsuga menziesii*) – tsq̓ellp
Hazelnut (*Corylus cornuta*) – qe7p̓cw
Indian hemp (*Apocynum cannabinum*) – spéts’en
Jackpine (see Pine, lodgepole)
Kinnikinnick (*Arctostaphylos uva-ursi*) – elkéllp (berries: elk)
Maple, Douglas (Rocky Mountain maple) (*Acer glabrum*) – tswéllten
Red willow (red-osier dogwood) (*Cornus stolonifera*) – tseqwtseqwél̓qw
Rose (*Rosa* sp., probably Wood’s rose, *R. woodsii*) – sek̓lén̓llp
Pine, lodgepole (*Pinus contorta*) – qwli7t
  ponderosa (*Pinus ponderosa*) – s7etqwllp
  white (*Pinus monticola)* – seléwll
Poplar (see Aspen, trembling)
Prairie turnip (*Psoralea esculenta*) – n/a
Saskatoon (*Amelanchier alnifolia*) – speqpeq7úwi, stséqwem, sencweséllp

Spruce, [Engelmann] (*Picea engelmannii*) – t̓sellp
Stinging nettle (*Urtica dioica*) – secwmém̓llp
Willow (*Salix* sp.) – q'wlséllp
 Red (see Red willow)

Chapter 12. *Re tmicw te skukwstéls es tuwitentels*: Secwepemc Traditional Ecological Knowledge and Wisdom Now and in the Future[1]

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Abstract

In this chapter, we discuss the characteristics and applications of Traditional Ecological Knowledge and Wisdom (TEKW) for Secwepemc (Shuswap) Interior Salish peoples of British Columbia. We outline general characteristics of Traditional Knowledge systems and provide examples from Secwepemc history and culture. These features fall into major areas, as represented in a schematic diagram we provide, including Philosophy and Worldview, Practical Strategies for Sustainable Living, and Modes of Communication and Acquisition of TEKW. All of these features exist within an adaptive, cyclical, yet temporal context. The Secwepemc have existed for millennia within their ecologically diverse territory, learning and testing new knowledge and adapting their resource use patterns and lifeways to the environment in order to meet their physical and cultural needs from one generation to the next. The Traditional Knowledge systems of the Secwepemc people are an important part of their heritage, but they are also an essential element of their future. In order for the Secwepemc to continue managing their lands and resources effectively, applying their Traditional Ecological Knowledge and Wisdom, including its philosophical bases of respect and reciprocal accountability, must be acknowledged and supported by all.

Keywords: *Secwepemc; Traditional Ecological Knowledge and Wisdom; Indigenous Resource Management; contemporary applicatins of TEKW; Plateau ethnobiology.*

Introduction

> Long time ago, [Secwepemc] people looked after the land, and all the animals and plants, everything in it. That's why they always had plenty to fish. They had deer to hunt and plants to gather for food and medicine. But they had to

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> practice for it, and learn about everything on the land first for a long time. Then they knew how to look after it. It was also important for the elders to share each other's knowledge. That was how they learned and built up their understanding. What knowledge they shared had to be exact (the late Skeetchestn elder Nellie Taylor, 1992).

In 2000, we (N. Turner, M. Ignace, and R. Ignace) published a paper on systems of traditional ecological knowledge and wisdom (TEKW) of Aboriginal peoples of northwestern North America. We schematized indigenous TEKW in a diagram reflecting its different, interrelated components (Turner et al. 2000:1277). It included, at its core, the belief system and philosophies particular to an Indigenous group; surrounded by the complex of practical strategies and management regimes they developed, specific to their own territories, homelands and history, and connected to ways of communicating and transmitting ecological knowledge in everyday discourse, stories, ceremony, and other ways of verbal and non-verbal communication. We represented the interconnected and cyclical nature of philosophy, knowledge, and practices as an ellipsis. At the same time, in emphasizing TEKW systems as based on thousands of years of conscious historical growth and time depth, we added the dimension of a spiral. This was also to emphasize the dynamic, as opposed to static, nature of TEKW.

Our 2000 TEKW paper came on the heels of the academic and applied discourses of the 1980s and 1990s that began to validate and celebrate Indigenous knowledge. TEKW has become a major focus of attention in both academic and policy arenas since the early 1990s (see Berkes 2012; Berkes et al. 2000; Corsiglia and Snively 1995; Ford and Martinez 2000; Inglis 1993; Johnson 1992; Williams and Baines 1993), and our paper has been frequently cited. What we refer to as TEKW (Traditional Ecological Knowledge and Wisdom) has been variously referred to as TEK (without the wisdom factor), Indigenous Knowledge (IK), and TEKMS (traditional ecological knowledge and management systems—see Johannes 1993). Among others, Atleo (2011), Cajete and Little Bear (2000) and McGregor (2008) have further made the case that from an Indigenous viewpoint, "ecological" and "knowledge" are holistic, "encompassing all areas of human existence" (McGregor 2008:144). Moreover, "traditions" are not frozen in the past but connect to Indigenous peoples' continuing existence, rights, and interests in sustainable ecologies of their homelands; the narrative of traditions is seen as guiding the path for present and future action. As some Indigenous scholars have articulated it, cultural traditions expressed in narratives ("stories") not only provide a framework of Indigenous cultural values and practices, but of past and living Indigenous legal traditions (Borrows 2005, 2010a, 2010b; Ignace and Ignace in press). Moreover, along with (other) Indigenous scholars, we see TEK(W) as not a reified noun but as action and the ability to act, based on relationships, on experience, living and doing on the land. Lastly, we see it as inseparable from the particular people who hold it, including their history, livelihoods, and worldviews, but also their (our) land in its multiple dimensions. We continue to add the term "wisdom" since in our understanding the concept entails not only empirical knowledge, but good judgment based on lessons consciously learned from commemorated individual and collective experience. TEKW incorporates having learned "by doing" with the ability to act on the basis of cumulative knowledge. The Secwepemc term ***xexé7***, translated as "wise," "smart" and "powerful," circumscribes this state. Significantly, ***xexé7*** also engages not only empirical learning but moreover involves spiritual power acquired by training for it through ***étsxem***, or what in English has been called "guardian spirit questing."

For the past three decades, TEK(W) has been advocated as having fundamental importance in the management of local resources, in biodiversity conservation, and in providing locally valid and meaningful models for sustainable living. Internationally, the Brundtland Report, *Our Common Future*, noted, "… the larger society … could learn a great deal from their [Indigenous Peoples'] traditional skills in sustainably managing very complex ecological systems" (World Commission on Environment and Development 1987:115), and international agreements following from the UNCED '92 conference in Brazil specifically recognize the important knowledge of Indigenous and other long-resident peoples. These include the UN *Convention on Biological Diversity* (1992:Article 8j) and the *Declaration on the Rights of Indigenous Peoples*, adopted by the United Nations General Assembly in September 2007.

In terms of its relationship to land, and to resource management and conservation, ethnoecologists have favourably compared TEK(W) in effectiveness to scientific knowledge (Berkes 2000; Deur and Turner 2005; Hunn 1993). Thus, Berkes (2000), on the basis of a variety of examples of Indigenous adaptive management (e.g., resource rotation, selective harvesting, landscape management), has stipulated that localized TEK provides information to *complement* and *inform* scientific ecology. Notably, areas that are deemed sacred by Indigenous people play a significant ecological function as places of high biodiversity, buffer areas, and refugia (Berkes et al. 2000, 2012, 2013; see also Anderson 1996). Cuerrier et al. (2015) have recently used the term *cultural keystone places* to express the past and ongoing spiritual, cultural, and historical significance of particular locales, as connected to past and ongoing occupation and use, but also to conscious Indigenous knowledge and management regimes.

Despite the valuation of TEK(W) among ethnoecologists, in international declarations, in government policy statements and in school curricula,[2] in ecosystem-based management (Lertzman 2010) and even in indigenous tourism (Butler and Menzies 2007), practitioners who work in Indigenous communities and Indigenous ecologists who work in their communities alike are aware of how difficult it is to truly *integrate* Indigenous knowledge systems into western scientific discourse, let alone the environmental decision-making processes of the State that privilege non-Indigenous economic and social interests. Thus, Nadasdy (1999, 2004) showed how Yukon First Nation peoples' participation in land claim negotiations and co-management have forced them—at least in some contexts—to adopt Euro-Canadian perspectives toward the land and animals, as they have adapted to bureaucratic management structures. From this vantage point, the appropriation of TEK by western bureaucracies to date, along with its decontextualization and re-ification (see also Aikenhead 2002, 2007; Cruikshank 1998:50) have maintained the hegemony of western science, as opposed to treating explanatory and management alternatives presented by Indigenous TEK(W) on an equal footing. McGregor (2000, 2008) therefore stipulates to focus on *co-existence* of TEK(W) and western science, rather than purported *integration*.

It is essential, in the process of increasingly realizing the potential of traditional knowledge systems, that Indigenous peoples retain their Intellectual Property Rights and the decision-making authority for this knowledge and its applications, and that their knowledge is used in ways that do not compromise the integrity of either the knowledge and its central, grounding philosophies or of the original knowledge holders and their interests (International Society of Ethnobiology 2006). This aspect is of concern to many Secwepemc and other Indigenous people.

Although resource management at the government and industry levels, along with environmental impact assessments, continues to be dominated by western scientific knowledge and approaches—often superseded by economic interests of Nation-States as opposed to Indigenous stakeholders—TEKW has important potential in the trend towards implementation of ecosystem-based resource management, a management style that attempts to provide and use an integrated knowledge base for planning and decision-making (Lertzman 2010). In particular, holistic management of forestry, game, and fisheries in places like British Columbia is critical for the future of both people and environment, and this means that TEKW of Secwepemc and other Indigenous peoples will take on increasing meaning and significance to society at large. Furthermore, as Indigenous peoples' homelands are increasingly facing the lasting geographic and ecological impact of mining, principles and practices of TEKW may be able to inform restoration and reclamation projects.

Beyond mitigating or averting impacts from present and future resource extraction and resource management, the Secwepemc people, like the majority of Indigenous nations in British Columbia, have never ceded title to Secwepemcúl̓ecw, their Indigenous homeland in Interior British Columbia (see Map, Chapter 1), and some Secwepemc groups have legally asserted Aboriginal title to their territory. As we show near the end of this chapter, documenting Secwepemc TEKW will underscore the depth and detail of Secwepemc occupation and stewardship of the Indigenous homeland.[3]

In this chapter we re-examine some of the fundamental characteristics of Secwepemc TEKW as they pertain to the strategies for sustainable resource use of the Secwepemc, and as they derive from our insights as community insiders and ethnobotanists through our continuing engagement with Secwepemc elders' discourses and narratives of the epistemologies and ontologies that shape Secwepemc thinking about land, ecology, and human interactions. In particular, knowledge about plants and their cultural importance is exemplified as a major component and reflection of traditional ecological knowledge and wisdom. We provide an updated model for analysis of traditional ecological knowledge systems drawn from our earlier model (Turner et al. 2000), and provide examples of the various features and characteristics of this system as it pertains to the Secwepemc. Finally, we explore current and future applications of TEKW in resource management regimes and in documenting Secwepemc title and rights to Secwepemcúl̓ecw.

The Secwepemc and Secwepemcúl̓ecw through Times of Change and Colonization

Living in an ecologically and geographically diverse and vast territory that stretches from Jasper in the Rocky Mountains to the valley and mountains of the Upper Columbia, and including the rolling plateaus and valleys of the Fraser and Thompson rivers and a myriad of lakes at different elevations (see Map, Chapter 1 this volume), the Secwepemc have particularly rich environmental knowledge. In all, Secwepemcúl̓ecw (Shuswap territory) comprises some 156,000 square kilometres and encompasses nine major biogeoclimatic zones[4] and a wealth of local habitats, successional ecosystems, and topographical features. Secwepemc traditional ecological knowledge and wisdom has been shaped by some 10,000 years of continuous access to and experience with a tremendous array of biological diversity at a range of ecological scales. Like other Indigenous peoples with an ancient connection to place, having resided in their homeland through periods of dramatic climate and ecological change throughout this time (Hebda 1995; Mathewes 1985; Walker and Pellat 2001), the Secwepemc have had thousands of years of experience to fine-tune and communicate about their interactions with plants, animals, and the land. Throughout the relatively recent process of colonization, many Indigenous peoples have become marginalized within nation states, their economies, and their political and cultural lives, being embedded in globalized international markets. In the Interior Plateau of British Columbia, following a fur trade period that largely kept the Secwepemc and neighbouring Plateau peoples in control of their lands and resources (Thomson and Ignace 2005), the environments that are the homeland of the Secwepemc and neighbouring Indigenous peoples were initially affected by placer mining during the 1858 Gold Rush, and by the introduction of large cattle herds soon after. During the same time, smallpox and other infectious diseases decimated the Indigenous population by two-thirds. In the immediate aftermath of the devastating toll of diseases and continuing into the 1900s, settler land pre-emptions increasingly fenced Indigenous peoples out of their resource producing locations. Throughout the twentieth century, environmental changes and destruction were brought about by open cattle ranges, clear-cut timber harvesting, draining of wetlands, and railway and highway construction. More recently, the depletion of salmon runs, large scale mining projects, urban expansion, and increased logging operations following forest insect infestations, have continued to erode Secwepemc environments and the Secwepemcs' ability to harvest plants and animals, let alone have "quiet enjoyment" of Secwepemcúl̓ecw (see Chapter 10, this volume).

Beyond environmental degradation and deterioration, Canadian federal and provincial policies had a profound impact on the Secwepemcs' access to many of the most productive resources and places in their homeland. Notably, between 1866 and the 1950s, colonial and then provincial land laws in British Columbia specifically excluded Indigenous peoples from pre-emptions to obtain fee simple land, and from buying private property. Some 135 years of *Indian Act* rule and the policies flowing from it not only disparaged the Indigenous peoples' hunting, fishing, and plant harvesting way of life, but imposed legislation aimed at enforcing norms of private land ownership and peasant agriculture while confining Indigenous peoples to their tiny reserves which comprise only about 1% of Secwepemcúl̓ecw. Such policies also produced the cultural genocide brought on by enforced compulsory residential school attendance that distanced generations of Indigenous children from traditional land use practices and the associated traditional ecological knowledge systems (see Chapter 2 this volume; Ignace 2008; Ignace and Ignace 2013).[5] More recently, large-scale migration off reserves has taken a toll on the continuity of indigenous resource use and management practices and knowledge systems.

These forces of dispossession and cultural genocide have brought about not only loss of access to resource producing territory throughout Secwepemcúl̓ecw, but also loss of TEKW knowledge and a critical loss of the Secwepemc language as it expresses TEKW. As Mühlhaeusler (1995:155) aptly stated, "Life in a particular human environment is dependent on people's ability to talk about it." With Secwepemctsin, the Shuswap language, having become critically endangered as a result of the factors identified above, many Secwepemc have lost this powerful and detailed ability to speak about Secwepemcúl̓ecw in their Indigenous language—a language which embodies many types of ecological knowledge, from vocabulary and stories of habitats and botanical features of the species themselves, to ecological associations between different species. Given what we know about the connection between Indigenous language, land, cultural and biocultural biodiversity (Evans 2010; Hunn 2001; Maffi 2001, 2010; Nabhan 2001), this loss is all the more tragic and devastating.

Furthermore, it is important to emphasize that, as within all societies, Secwepemc knowledge is not homogeneous. Rather, while some types of knowledge are widely held within the society, others are more specialized and are held by sub-groups and individuals. Traditional division of labor by gender, for example, although by no means absolute, has brought about a differential knowledge among women and men in areas of plant and animal resource management. Finally, where cultural assimilation, language erosion, and environmental degradation have already taken their toll, within Secwepemc and related societies, with few exceptions, it is only members of the oldest generation that hold detailed knowledge of some time-honored environmental management techniques, such as the pruning of wild berry bushes and the use of periodic controlled burning to enhance production of certain root vegetables and berries (see Chapter 5, this volume). Thus, our descriptions here of Secwepemc TEKW are somewhat reconstructive and in some cases, to be realistic, their future application may be problematic, given the drastic environmental and social changes that have occurred. Nevertheless, many aspects of Secwepemc TEKW are vital and their continuance into the future is not only desirable, but essential for Secwepemc peoples' well-being and prosperity. Future TEKW regimes will need to be adaptive and resilient, using past knowledge to imagine or fashion new workable relationships for the present and the future.

Principles of Secwepemc Land Use and Access

It is important to emphasize that the Secwepemc concept of guardianship or stewardship over land generally means that their homeland and its resources are not disposable property, but have to be carefully managed and preserved by the present generation for the benefit of future generations. The sense of respect for and stewardship of land (see Chapter 5) involves not a generalized "mother earth," but particular territories—what Secwepemc call Secwepemcúl̓ecw, their ancestral homeland.

According to ethnographic evidence from the late eighteen hundreds to early nineteen hundreds (Teit 1909), the Secwepemc had a *collective* system of land tenure, whereby all Secwépemc, by virtue of birth and membership in a Secwepemc community, had joint rights of access to reside and travel throughout Secwepemcúl̓ecw and harvest its resources. For example, Secwepemc fishing, hunting, and plant gathering areas in particular parts of Secwepemcúl̓ecw were open to Secwepemc from any part of the territory. Individuals who had ties of kinship or affines (in-laws) within the nation, were welcome to harvest Secwepemc resources with and for the benefit of their Secwepemc kin. In the early part of the twentieth century, Secwepemc chiefs referred to the joint "ranch" held in common by each tribe or Nation (Memorial to Sir Wilfrid Laurier 1910), and throughout the twentieth century, despite external pressures, elders maintained this sense of joint land tenure of Secwepemcúl̓ecw. Thus, Secwépemc elder Dr. Mary Thomas of Neskonlith also unequivocally referred to the same idea when she stated,

> We traveled a lot. There was no such thing as private property. All the Secwépemc dialect people shared the whole territory of the Secwépemc Nation. Nothing was private property: we always shared (Thomas 2001).

Since, however, throughout Secwepemcúl̓ecw, the caretakership of land and resources rested on those communities and groups of communities who were resident in a particular area and whose members most frequently harvested its resources and were in the best position to monitor them and protect them, the principle of Secwepemc collective ownership of and access to territory was accompanied by the principle of caretakership (***yecwmin̓men***) on the part communities and "divisions" (Ignace and Ignace in press; Teit 1909) within the nation. Anastasio (1972) recognized the way in which this collective system of access and caretakership, along with secondary access through intermarriage and resulting kinship, regulated resource use and access throughout the Interior Plateau and created a mechanism for addressing local shortages.

Secwepemc Traditional Ecological Knowledge and Wisdom

The general characteristics of TEKW as reflected in traditional cultures of northwestern North America are categorized within three general themes: practices and strategies for resource use and sustainability; philosophy or worldview; and communication and exchange of knowledge and information. These are portrayed schematically in Figure 1, which depicts the knowledge system within the context of time as a cyclical, repetitive, and yet temporal progressive dimension. These themes are complex and not subject to simple characterization, but each is developed as a general concept, and Secwepemc examples are provided. In this paper, we focus on the Secwepemc people's approaches to and attitudes about resources, as well as the techniques and strategies applied to their harvesting, production, and perpetuation. We also discuss some of the ways in

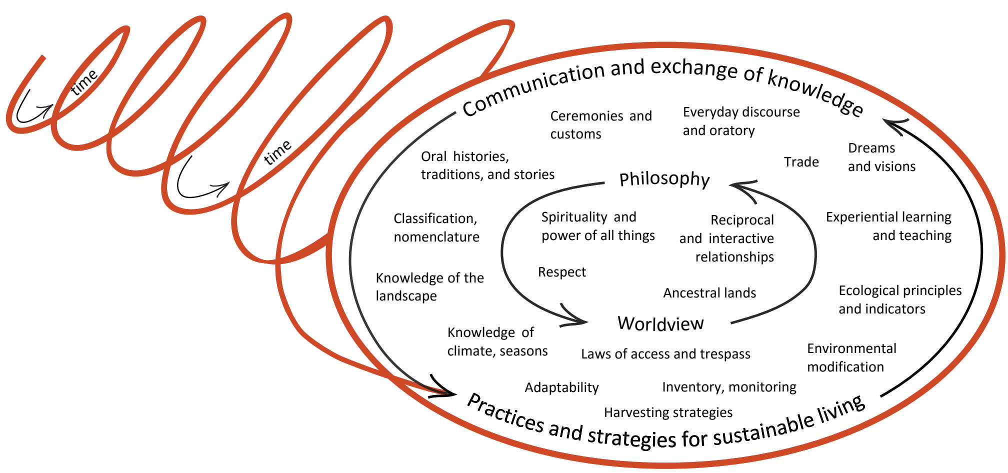

Figure 1. A Schematic Representation of Secwepemc Traditional Ecological Knowledge and Wisdom (adapted from Turner et al. 2000).

which understandings about resource use and environmental management are communicated and learned within the context of cultural traditions.

As noted in Chapter 5 (this volume), the Secwepemc and other Aboriginal peoples of northwestern North America have usually been classified as hunter-gatherers or foragers, although increasingly in some circles their status as active managers and cultivators of their resources is being recognized (Anderson 2005; Deur and Turner 2005; Kimmerer 2013; Minnis and Elisens 2000; Turner et al. 2013). The widely held anthropological dichotomy between opportunistic food gatherers ("foragers") on the one hand, and food producers (pastoralists, agriculturalists, horticulturalists) on the other, has resulted in the creation of an artificial gap in the understanding of complex resource management techniques between the former and the latter (Smith 2005). As accumulating data on sustainable plant management techniques among the Secwepemc and other First Peoples from western North America shows (Anderson 2005; Loewen 1998; Peacock 1998; Peacock and Turner 2000; Turner 2014; Turner and Peacock 2005; Turner et al. 2013; see also Chapters 2 and 5, this volume), even those peoples characterized as "hunter-gatherers" actually practiced a variety of sophisticated cultivation techniques including plant propagation and translocation, habitat management and enhancement, soil fertilization, and enhanced productivity of plant foods, which blur and confound the perceived division between foragers and horticulturalists. Furthermore, much of the knowledge of these activities is held, and was formerly practiced by women.

Information in this study is drawn from our (ongoing) work with Secwepemc elders and plant specialists, supplemented by published ethnobotanical and ethnohistorical writings, ethnographies, and accounts from neighbouring peoples, such as the Nlaka'pamux (Turner et al. 1990) and Okanagan (Turner et al. 1980).

Secwepemc Worldview and Philosophies

For the Secwepemc, as for other land-based long-resident peoples, the environment is seen as a whole; all the elements of the environment, seen and unseen, tangible and spiritual, are interconnected in a seamless web inextricably linked to human behaviors, actions, and attitudes. People and other animals, plants and fungi, water, mountains, celestial bodies, and supernatural entities, spirits and forces are not regarded as separate and distinct. Rather, they are bound to each other and to the place where they reside through cultural traditions and interactive, reciprocal relationships (Anderson 1996; Atleo 2011; Ignace 2008; Nazarea 1998). In the Secwepemc culture, people have a sense of spiritual and practical respect for their total environment and all its components, based on an unspoken and automatic integration of the secular with the spiritual, of the past with the present, and of all parts of the living universe. The spirituality of the elements—the wind, water, mountains, and all life-forms—and their power to influence the success and well-being of humans, is an integral part of Secwepemc and other cultures with deep connections to specific homelands (Kimmerer 2013; Turner 2005; Turner and Atleo 1998). Ancient relationships tie all beings together in communities. They are reflected in the traditional narratives and discourses that are a part of the Secwepemc ways of knowing.

> The basis of Shuswap [Secwepemc] spirituality was nature and the interconnection of all beings. The earth was seen as an animate being; the lands, animals,

> plants, and fish were seen as gifts from the Old One, which must be respected, used properly, and kept from becoming angry (Teit 1909:596).

The interconnectedness of humans, plant, and animal species and the land itself is explained in Secwepemc ***stsptekwll***, ancient narratives that take us back to the ***Tellqel̓mucw***, the time of the ancient transformers on the land.[6] In one of the recollections of the Secwepemcs' ancestors beginning of time on their land, Coyote (***Sk̓elép***) was alone on the land, and without human company and a wife. He thus took a tree for a wife, symbolizing an ancient symbiotic relationship between people and trees as life-givers, as protecting the land, and who deserve protection by humans. Just as trees are considered to be in a kinship relation with people, kincentric (Salmón 2000) concepts exist for many other relations among humans, plants, and animals. Thus, Laura Harry noted, "***Re sqlélten ri7 re xetéqs re stsmémelt***" ("the salmon are our first children"), pointing to the interrelationship between humans and salmon, but also involving the ecology of salmon and salmon migration, and the caretakership role of humans within it. Relationships among humans, plants, animals and the land are further expressed in the saying, "***xwexwéyt ren k̓wséseltkten***"—"All my relations."

At the core of human relationships with the land is also the notion of *respect* for all lifeforms and for the land itself. This notion of respect is central to North American Indigenous belief systems (Atleo 2011; Ignace 2008), and the Secwepemc are no exception. Their use and management of the land and its resources have been practiced within the underlying culturally reinforced principle that life, including other humans, be treated with consideration, deference, and gratitude. In the Secwepemc belief system, the concept of respect—invariably a verb rather than a noun—is rooted in the notion of ***eyemstéc***, "you respect, pay back the honour someone or something granted you." Having and showing respect is an act of reciprocity that derives from the very way in which the resource (animal or plant) showed pity (***qweqwenstés***) to humans long ago who needed to survive on the land, and thus gave itself (***kecmentsut***) to them out of compassion. This relationship continues in that each time an animal is killed by a hunter or fisher, each time a plant is harvested, they continue to *give themselves* to the people gathering it, as opposed to the volatility of making a kill or successful harvest resting with the hunter-fisher-plant gatherer alone. This is the source of the respect that is owed to the plant or animal species. In order to show this respect and to reciprocate, individuals must use their resources fully and without waste or overindulgence. Children were taught this respect from the earliest age, as attested to by the recollections of many Secwepemc elders.

Thus, elders recall being taught never to "play with" (i.e., playfully waste) animals or plants, who are perceived as giving themselves to humans for their benefit (see also Chapter 5, this volume). As one Secwepemc elder, Ida Matthew from Simpcw, recalled,

> It was pitiful enough that we had to kill [animals]. [My mother] instilled in us that we were not to waste the food, that we had to kill the poor animal. With any kinds of animal that we would hunt and eat, you have to respect them …. ***Ta7 me7 skests re kenkeknem w7ecs re ts7eyemstécwes***. [They won't do anything to you if you respect them.] …. ***Ta7 k s7eyemstés, ta7k s7eyemstes, e exw7axwte-***

> ***men t'ucw me7 k̓estwilcwes***. [They throw it around and it gets spoiled.] Like often times down the Fraser, you know, they would, I think when … a lot of the people started to go from different reserves or different tribes, they went down to the Fraser, they kind of just would get a lot of fish and they … would leave it laying around, you know, and let it spoil …. I just could hear my mom said something about wasting, wasting (pers. comm. to MBI and Mona Jules, June 1987).[7]

Ida Matthew also recounted an incident from her childhood when one of the children was playing with the severed foot of a grouse their mother was cleaning. The child was pulling on the tendon of the leg and making the foot move, to scare the other children. She recalled,

> … My mom can't put up with that because you're making fun of something that you're going to eat and … if you do that then it would be harder for us to kill another, you know, like for food. It seems like you would get punished or something, it would be ***E seykstmincwes, tsukw k seykstmînc me7 qwenqwént-k*** …, ("If you play with them, if you only play with them, you will be pitiful") she would say, '***qwenqwént-k*** ("you will be pitiful"), like either the deer meat or the birds and that. '***Ta7 cwú7tsem me7 re sticwts̓e-k!*** ("You will not be able to make a kill"). They used to use even the feathers and everything for cushions. … Or berries, that went for berries, too.[8]

Nellie Taylor concurred, emphasizing that people just did not waste their resources:

> Boy, in those days [when she was a child] we don't even waste. Watch our grandparents when they did it here. We used the [deer] brain to tan the hides and they skin the head boiled it for soup. The tongue they cooked it. But there's no waste, we used the whole thing. Just the guts. Maybe white man might go hungry. Maybe young generation go hungry. But no [not in] old times. Dry our berries; same with the salmon, we dry the heads. Dry the salmon eggs. Cooked them for all sorts of things … (pers. comm. to Gordon Mohs, August 1985).

Wasteful behaviour (***ta7 me7 re stustéc***—"don't waste it") or "playing with" (***seykstminc***) animals and plants could entail spiritual sanctions, in that the animal or plant will refuse to give itself to the wasteful person. As Turner has noted (1997, 2005), such spiritual connections among humans, animals, plants, and nature in general were embodied within and integral to all other forms of knowledge. Spiritual considerations and beliefs determined and shaped peoples' actions and practices regarding resource use and management as they did with all other aspects of life. Those who acted unsuitably, without showing proper appreciation or courtesy towards those in their family or their broader community, including all other life and environmental features, would face the consequences in that they would be unable to catch fish, unable to bag game ("get skunked"—***te7óy̓e***), and the land would become dried up and used up (***q̓wempúl̓ecw***). In other instances, seeing that animals and plants are imbued with spiritual essence, if insulted, they will refuse to give themselves. Verbal and physical insults to animals can trigger such spiritual sanctions, as the story of Coyote and the Salmon (below, p. 33) teaches us.

The essence of this attitude, or what is appropriate behaviour, is revealed in many aspects of Secwepemc culture, from the words of *Thanks* pronounced before one ate berries, to the appreciation and gifts of tobacco or even a copper penny returned to the soil to acknowledge foods and medicines that were harvested. It also includes the thanking ritual to bagged ungulates, and the mourning song the hunter sang to a bear upon hunting it (Ignace and Ignace in press; Teit 1909). It also includes the ritual of returning salmon bones and entrails to the river to serve as nourishment for future generations of salmon and to return them back downstream. Secwepemc elder Dr. Mary Thomas recalled that her mother, even as a very elderly woman, when she was given berries to eat, would always hold them up towards the sky and say, "***Kukwstsámc***, ***kukwstsámc***, ***kukwstsámc***, ***kukwstsámc!***" before she ate them. This was a practice going way back in her family's traditions (Turner 2008). It is no coincidence that the Secwepemc term ***kukwstsamc*** (Eastern Dialect, ***kukwstsétsemc*** in Western Dialect), usually translated as "thank you" literally means "you saved me," thus replying to the pity the animal or plant showed to the human being.

Humans, animals, and plants thus exist in a state of *reciprocal accountability* (***eyemstwécw***), whereby animals and plants feed humans out of pity, giving themselves to them. Humans, in turn, through their behaviour, must be accountable to these living beings by respecting them, showing them thanks, thus acknowledging them and humbling themselves, and by giving back in deeds, gifts, and words.

The concept of respect and spiritual sanctions for those who fail to show respect also extend into the social realm of humans interacting with one another. People must not be stingy (***xwexwiyélesem***), but in Secwepemc society, as in other Indigenous societies, there is a fundamental obligation to "share" (***c7il̓cmen***), "to help one another" (***knucwentwécw***). Hunters, fishers, and plant-gatherers thus must be generous and considerate towards others by sharing the plants and animals who gave themselves to them with kin and community members; people who were wasteful or "stingy" were spiritually sanctioned in that the plant or animal resource would fail to give itself to them. In addition, they received social sanctions, in that memories about their "stingy" behavior kept circulating, and, in Keith Basso's (1995) words, they were "stalked" with stories—or even teased—about their inappropriate actions as a mechanism of social control. More than that, in Secwepemc culture there exists a fine balance between the need and importance of helping one another and the principle of self-sufficiency required of individuals so they were not a burden or "nuisance" (***yéwyut***) on society. Again, many ***stsptekwll*** (Ignace 2008; Ignace and Ignace in press) show the consequences of laziness in resource procurement, and the "nuisance" this produces among relatives, leading to those who are ***yéwyut***, being rejected by their relatives and starving to death or being ostracized. Thus, Secwépemc people practised looking after themselves and not being a nuisance to others, and not begging or freeloading (***q̓en7élt***) through everyday tasks and work, particularly in their ***étsxem***, or spirit guardian quest. At the same time, there was a strong ethic not to be stingy, especially with food obtained from nature, to share it out, and to be generous.

Nellie Taylor (Ignace and Ignace 2013) talked about the importance of respecting community members, especially elders, and of sharing any kind of resources with others. In one instance, two young men failed to share their catch of trout with Nellie and another elder who was nearby and, as a consequence, they did not catch any more fish; this was the trout spirit's sanction for their neglectful behaviour. Not only would paying respect, sharing, and not wasting protect one from repercussions; if due respect is rendered, a person might be given special powers and luck by a supernatural helper, as is demonstrated in many Secwepemc ***stsptekwll***.

The power of Nature to "strike back" at those who do not treat her with respect is reflected in many traditional stories of the Secwepemc and neighbouring peoples. For example, ethnographer James Teit recorded in his notes that the Nlaka'pamux people hold the concept that "flowers, plants, and grass especially the latter are the covering of blanket of the earth. If too much plucked or ruthlessly destroyed earth sorry and weeps[.] It rains or is angry & makes rain, fog & bad weather" (Turner 2005). Mary Thomas tells another story (pers. comm. to NT 1997), one that she was told by her own grandmother when she was a child, and was used to teach children the concept of respect:

> When Mother Nature had finished all her creations, the trees and the flowers and the animals, she made an appearance among them. All of the beings she had created bowed down to her: all, that is, except the aspen. The aspen was disrespectful, and disobedient, and for that reason, Mother Nature caused her to tremble and shake all the time, even if there was no wind. That is why the trembling aspen trembles to this day.

This story, Mary explained, was told to children so that they would learn to respect their elders and their Creator.

The First Foods ceremonies (see Chapter 5, this volume), rites of passage, especially ***étsxem*** (spirit guardian quest) of girls and boys at puberty, and purification rituals of hunters, healers, and others seeking and striving for difficult achievements are all evidence of the spiritual and philosophical aspects of peoples' knowledge and belief systems. These general philosophies of sacredness of all things, and respect and gratitude for the gifts provided to people by Nature or the Creator to enable them to live, have a definite influence on the way people use their resources.

Another concept that expresses the relationship of *reciprocal accountability* between humans and the land is the notion of ***x7ensq̓t***, which Secwepemctsin elders translate as "the land (and sky) will turn on you." In his ethnographies of the Secwepemc and the neighbouring Nlaka'pamux, James Teit alerted to certain "mystery" places in the mountains where

> people painted their faces and asked for good luck or good weather when approaching certain lakes and other parts of the higher plateaus and mountains. They also made offerings to peaks and to the genii of certain places (Teit 1909:601).

In his ethnography of the Thompson Indians (Nlaka'pamux), Teit further noted,

> Certain parts of the high mountains, especially peaks or hills, were considered sacred, being the residence of land mysteries. Some of these places, when trodden upon by human foot, were always visited by snow or rain. In other places, snow or rain fell only when they were trodden upon or visited by a stranger for the first time. Indians, therefore, when hunting in the vicinity of these places, visited them, and appeased the spirits by making an offering to them, thus insuring good weather during their stay, and good luck while hunting. These offerings generally consisted of a lock of hair, a rag from the clothing, a little powder, a few shot, a piece of tobacco, a stone, and so on. The women, when picking berries or digging roots on certain mountains, always painted their faces red. In general, they paint their faces wholly red before coming in sight of certain lakes, that they may be favored with good weather and good fishing. The paint is considered as an offering to the spirits. Sometimes, when they came in sight of these lakes, they made the sign of good will or blessing, and prayed to them to give them good weather and plenty of fish. They also did this to some of the mountain-peaks near their hunting-grounds (Teit 1900:344).

As Skeetchestn elders think of it, ***x7ensq̓t*** expresses the respect for places on the land imbued with spiritual power that derives from past events and experiences of ancestors. Such respect, they remembered, is shown by blackening one's face, and making offerings that express the respect and gratitude to the powers inherent in this place. Several such places, including the area around ***Pípsell*** or Jacko Lake near Kamloops—at the time of writing the site of a proposed large open pit mine—are remembered for such powers. Another such place is ***Pelúkwes*** or Deadman Creek Falls at the headwaters of Deadman Creek, a tributary to the main Thompson River, and there are many others.[9] The notion of powers that rest in nature thus extends to special "marked" places (***stsq̓ey̓úlecw***) in the landscape permeated with spiritual powers that derive from past deeds (actions) of ancestors, plants, and animals, who in the process *deeded* these lands in the sense of conferring the rightful possession of present Secwepemc generations lest they neglect their responsibility to look after these lands. These places and the powers within them continue to be *medicines* that can act on people, and they can harm people if one shows disrespect or carelessness. All parts of the Secwépemc land and environment are thus thought of as a "sentient landscape" (Cruikshank 2004; see also Anderson 2000). The land communicates with people, and people communicate with it in song, prayer, story, and thought. In ecological and spiritual-moral terms, the relationship of Secwepemc people with these places on the land is a further instance of *reciprocal accountability*, where causing harm to such places violates the responsibility that present and past Secwepemc have to protect them. The knowledge about such places and the *deeds* that past ancestors left and told about in stories create the responsibility of caretakership (***yecwmín̓men***) for present and future generations.

Ignace and Ignace (in press) have articulated the philosophical principles and sanctions explained above as Secwepemc Indigenous laws (***stsq̓ey̓***) that connect the Indigenous concept of collective ownership of traditional lands with the responsibility of caretakership. We will return to this point at the end of this essay.

Practical Strategies and Applications for Sustainable Living

Practices of Indigenous Peoples like the Secwepemc applied to maintaining and enhancing their lands, waters, and living resources are derived not only from generations of experimentation and observation, and an understanding of complex ecological and physical principles, but are in fact reiterations of peoples' belief systems, as discussed in the previous section. Hence, the concept and philosophy of respect and guarding against waste resulted in a culturally constrained general strategy against excessive harvest, since people took only what they needed and did not waste what they took. The result was resource conservation. It has been shown elsewhere (e.g., Berkes 2013; Swezey and Heizer 1993; Turner 2005; Turner and Berkes 2006) that the ceremonial aspects of food use, such as the First Salmon Ceremony, also promote conservation, since before general, broad-scale harvesting is allowed, a special ceremony has to take place. In many cases, wise and knowledgeable leaders and their designates are requested to make decisions about when general harvesting can begin. These people would use their observations, experience, and judgment to make such determination. As they travelled throughout the seasonal round, hunters and fishers were harvesting the state of fish runs, game, and the frequency and health of plants. For game, hunters would report on, and share their observations of game frequency and distribution. Hunters who lived or camped on their traplines had further long-term observations about not only fur bearing animals, but also the general state of animals in the area of their traplines. For salmon, this would mean watching the fish coming up the tributaries to the main stem rivers to spawn, and ensuring that enough had passed by before fish were allowed to be caught. It also entailed selective harvesting techniques like those involved in large-scale fish weir operations that existed in various locations (Chapter 2 and 3 this volume). Monitoring fish also entailed keeping track of water levels in creeks and rivers, and monitoring the health of spawning grounds and rearing habitat.

As noted in Chapter 5 (this volume) management of plant and animal resources is manifested in at least three levels:

- populations, as in harvesting and maintaining individual stands or patches of a plant species, or herds of deer, or specific runs of fish,
- habitats, as with the use of fire to create and maintain particular successional stages conducive to the productivity of a complex of plant species, and
- landscapes, in which a host of strategies, including seasonal rounds leading to variable harvesting regimes, conventions relating to ownership and authority over resources, and culturally mediated prescriptions for humans' relationships to plants and animals influence landscape development (see Peacock and Turner 2000).

Many of the techniques used by people to sustain the productivity of their plant resources relate to the fact that virtually all resource plant species in northwestern North America are perennials (Turner and Peacock 2005). Therefore, unless an entire tree is required for construction or canoe making, individual plants could be harvested from, without destroying them, since they have the capacity to regenerate vegetatively. Thus, the bark of paper birch (*Betula papyrifera*) was, and still is, harvested in quantity by Secwepemc and other Interior peoples for use in basketry and other arts. So is the bark of pin cherry and bitter cherry (*Prunus pensylvanica, P. emarginata*), used in basket decoration and for other purposes. However, for birch and cherry, only the outer layer of bark is removed, leaving the inner bark intact. The inner bark will harden up and continue to protect the growing cambium cells and the flow of sap needed to keep the tree alive (Figure 2) (Turner 2008). When it was necessary to remove the bark, such as in gathering cambial and inner bark tissues of lodgepole pine (*Pinus contorta*) and other species for food, or the gathering of bark of various trees and shrubs for medicines, people normally removed only a vertical section of the bark or pruned off branches, being careful not to girdle the tree or shrub and cause its death. Such living Culturally Modified Trees (CMTs), either having the outer bark removed in the case of birch and cherry, or having a section of the whole bark removed in the case of western red cedar (*Thuja plicata*) and various medicinal tree species, are a common sight in British Columbia's forests (Eldridge 1997; Turner et al. 2009).

In the case of harvesting root vegetables, entire bulbs, tubers, roots, or corms might be removed, but the harvesting was highly selective by size and other characteristics. In many cases, selective harvesting can lead to enhanced capacity for propagation. Even when large quantities of plants were harvested, the productivity of the plant populations like yellow glacier lily, or avalanche lily (*Erythronium grandiflorum*) (see Chapter 7, this volume), mountain potato (*Claytonia lanceolata*), bitterroot (*Lewisia rediviva*), and wild onions (*Allium cernuum*) was maintained.

The efficacy and sustainability of these harvesting methods was borne out in the quantities of resources people consistently harvested over many, many generations. For example, yellow glacier

Figure 2. A paper birch (***qwllin***, *Betula papyrifera*) culturally modified tree which shows the scar from bark having been stripped without damage to the tree. Photo by Nancy J. Turner.

lily bulbs are estimated to have been taken by generations of Secwepemc people at the rate of about 225 kg per family per year (Palmer 1975). Other root vegetables were harvested in similar quantities (Turner et al. 1990). Even a conservative accounting of these harvests would point to severe depletion of culturally important resources unless they were in some way managed and enhanced as they were harvested.

Even when entire plants were taken, as in cutting trees, it was done in the context of ecological understanding. Trees were almost always harvested selectively, with standing forest cover being maintained. Secwepemc elder Mary Thomas was told as a young woman that her people usually waiting until trees had died or were blown down in winter storms before they were taken for use in house construction (pers. comm. to NT, 1995).

Plant resource use was, and is, imbued with ecological knowledge and wisdom, which takes many forms. Understanding concurrent life cycles of different species, seasonal indicators such as position and size of snow patches on the mountains, the arrival of the first snow in the fall, the relative numbers of particular birds in a given location, the flowering of certain plants, and the productivity of certain berries or cones: all of these provided signals for people to know when to expect a salmon run, when roots are ready to be dug at a given elevation, or when various types of berries are ready for harvesting (Lantz and Turner 2003; Turner 1997, 2005). Knowledge and use of alternative resources in times of temporary scarcity was also an important strategy (Turner and Davis 1993), as was access to alternate resource-producing locations based on Plateau protocols of access (see above).

Ecological succession is well recognized by the Secwepemc and their neighbours, as demonstrated by their detailed knowledge of landscape burning and the resultant enhancement of successional species (Kimmerer and Lake 2001; Turner 1999). Interior Salish Elders who have recalled landscape burning cite the enhanced growth and productivity of several different plant food resources after fire, particularly wild root vegetables like tiger lily (*Lilium columbianum*) and wild onion (*Allium cernuum*) and berries like saskatoons (serviceberries) (*Amelanchier alnifolia*) and huckleberries (*Vaccinium* spp.) (Turner 1999; Turner et al. 1990, 2013; see Chapter 5, this volume for more complete description of burning by Secwepemc and neighbouring peoples).

Secwepemc people also had an intimate understanding of the optimal habitats for various culturally important species, the conditions under which they were most productive, and the best methods for processing and storing them for the most efficient and sustainable utilization. Similar strategies were applied to the monitoring, management, and harvesting of salmon, shellfish, and game such as deer and mountain goat, where seasonal and age and gender selection and use of ecological indicators for population health was paramount (Turner 1997). Monitoring and control of specific resources was often undertaken by individual chiefs and families within a given territory. Thus, these people had the direct responsibility and authority to look after specific fish, plants, or shellfish beds, and if they noted populations in jeopardy, they could pronounce a harvesting moratorium until the situation improved (see Chapter 5, this volume).

The European newcomers did not follow the Secwepemc practices of respect and conservation. As early as 1877, elders from the Secwepemc area gave testimony to the Joint Reserve Commission illustrating their concern for traditional resources:

> They know, and say, that if the younger fish are destroyed, and the shoals returning from the sea will be proportionately diminished. That the Indians, with this fact in view, are careful not to destroy, wantonly or wastefully the mature fish, or to impede their passage to the spawning beds. That the barriers they construct in rivers are only to retard the passage of the fish, to enable the Indians to obtain their necessary winter supply, and that these temporary obstructions are thrown open, as necessary, to give passage to the ascending fish (Ware 1983:53).

Culturally Appropriate Ways of Learning and Teaching

Modes of acquisition and communication of Traditional Ecological Knowledge and Wisdom take many forms, and understanding them is essential to understanding the other elements of TEKW. Knowledge and wisdom is embodied in traditional narratives or ***stsptekwll*** that teach all generations, as they successively understand nuances of narratives based on their experiences. Other formal and informal discourse that name and classify land forms, movement in the landscape, plant and animal habitats, sources of water, and what amounts to biogeoclimatic zones (see Chapter 2, this volume) contribute to such ways of teaching and learning, as do place names and the names and classifications of the plants and animals themselves (Hunn 1996; Ignace and Ignace in press).

The social institutions and interactions of the Secwepemc and other First Peoples facilitate the learning of knowledge and philosophies by younger members of the communities. The extended family unit was particularly important in this regard. Children and youth traditionally participated with their parents, grandparents, uncles, and aunts in the day-to-day activities of harvesting and processing foods and materials, "learning by doing"—on the land (Ignace 2008). They listened, as well, to instructions and lessons from their elders in proper behaviour towards other people and all other lifeforms and natural entities. Witnessing and taking part in the First Salmon and other thanksgiving ceremonies also instilled respect and appreciation in children and youth that would carry through an entire lifetime.

Even before they were born, babies were treated with great care, through the gentle, special treatment of expectant mothers. Mary Thomas (2001) recalled that pregnant women bathed in special solutions with wintergreen-scented creeping snowberry (*Chiogenes hispidula*), and were prevented from viewing anything unpleasant such as a slain animal. This was to protect them from any bad thoughts that might harm their children. New babies were trained for strength and independence right from the outset. Being tied into a cradle for long periods of time and carried around on its mother's back, the baby learned patience and the skill of observation. A twisted saskatoon withe was placed in the grip of baby boys, and as their hands clutched the stick, they were lifted up from the lying position and encouraged to hang on and flex their tiny muscles. This was to teach them strength.

As soon as they were able to walk, Secwepemc children were taken out to begin learning about harvesting and food preparation, as well as other important life skills. They were taught the names of plants and how they were used, and were instructed in the proper use of a ***pats'a/ péts'e*** or root-digging stick, and other implements like bows and spears. Sometimes they incorporated the work of gathering into their play. Mary Thomas recalled that she and her brother and sister, commissioned by their grandmother to transport bundles of Indian-hemp stalks back to the processing area down at the mouth of the Salmon River, would hold the bundles over their head and allow them to trail down over their backs, then gallop along with them, pretending they were horses. Mary and her siblings also participated in picking out and cleaning the roots their grandmothers dug: wapato tubers (*Sagittaria latifolia*) and water-parsnip (*Sium suave*) roots from the wetlands, and glacier lily (*Erythronium grandiflorum*) and riceroot (*Fritillaria affinis*) bulbs and mountain potato, or spring beauty (*Claytonia lanceolata*) corms (Figure 3) and others from the meadows and sidehills. When the children had placed the roots into the baskets, their grandmother would go through them, pick out any she thought were too small, and return them to the ground (pers. comm. to NT 1994–1998, 2000). Likewise, Sarah Deneault remembered being told to pick off the appendages of glacier lilies her mother and aunts had harvested and to return them to the digging plots. Leslie Williams remembered how groups of families from the Chase area would combine their efforts to dig long trenches to harvest glacier lilies and mountain potatoes, with children replanting the young ones. These are only some of the ways that past Secwepemc plant gatherers learned about sustainable harvest of the root vegetables, a practice they remembered their whole life (pers. comm. to MI 1997–1998).

Figure 3. Spring beauty (***skwenkwinem***, *Claytonia lanceolata*), one of the Secwepemc root plants associated with TEKW management regimes. Photo by Nancy J. Turner.

One example of a ***stsptekwll*** or narrative that teaches important ecological and cultural lessons is Ida William's *Coyote Juggles His Eyes* (see Chapter 11, this volume). Another oral narrative that teaches us about what happens when one does NOT show respect to animals that one relies on for food is the story about *Coyote and the Salmon*:

> Coyote built an underground house on the Upper North Thompson River, at a place now called Coyote's House. It was afterwards turned into rock, and may be seen there at the present day. He spent several winters at this place. One fall, salmon came up the river in great numbers, and he made up his mind to catch a large supply, saying, 'I will dry very many, and then will invite all the people to a great feast.' By the time the salmon ceased running, he had filled many sticks, and was delighted when he viewed the large amount of fish he had on hand. One day as he was passing underneath the sticks where salmon was hanging, his hair caught in one of them, and this made him angry. Four times this happened, and each time he became angrier. The last time he became very angry, saying, 'Why can't I pass underneath these fish without their catching in my hair?' He tore down the offending salmon and threw it into the river. At once it came to life and swam away. Then all the salmon came down from the sticks and plunged into the river. In vain Coyote tried to stop them by catching them and clubbing them. In a short time they had all disappeared, and he was left without supplies for the winter, and had to give up the project of giving a feast. Now he gathered up all the slabs of wood which he had used for splitting salmon on, and all the poles on which they had been hanging. He took them up to his house, and said, 'I will boil them in the winter-time and have fish soup.' (Teit 1909:743; told by George Sisyulecw from Simpcw).

Many other Secwepemc narratives allude to consequences of harming animals or treating them inappropriately, and harming the spirit power of animals (see, for example, Teit 1909:718ff). In addition, Secwepemc songs like the "Berrypicking Song" and the "Kukwstamc (thank you) Song," often through ellipsis and allusion, celebrate the interconnections of the land, animals, plants, and humans, as they invoke and celebrate the *reciprocal accountability* of all life-forms as mutual relations.

TEKW Now and in the Future

In reflecting on the critically endangered role of the Secwepemc language vis-à-vis the philosophical principles underlying Secwepemc TEKW, and its connection to the continuing ability of Secwepemc people to harvest and share the resources of Secwepemcúl̓ecw, the Skeetchestn elders group[10] composed the following statement, connecting the Secwepemc language to the land, to the responsibility to protect the land and its real and potential consequences:

Yeri7 re tmicw-kt re skectéls te xqweltén-kt.
Our land gave us our language.

E ta7es es westém re tmicw-kt me7 llegwentém re xqweltén-kt.
If we don't have our land, we will lose our language.

E xilmet yeri7 me7 re sqwenqwentwilc-kt.
If we let that happen, we will become poor.

Me7 k̓wiyusem-kt, we7 kénmes k stem, ta7ews k sllépentem.
We will suffer, whatever happens, let's not forget that.

Re tmicw te skukwstéls es tuwitentels.
We thank the land for raising and sustaining us.

Above, we pointed to the central role that particular Indigenous languages like Secwepemctsin have in that they express and refract the intricate ancient connections to and knowledge of place, animals, and plants. Such knowledge manifests itself in the classification systems of plants and animals, but also in the ways grammatical categories of the language express and encode relationships between people and living entities, and thus afford unique and different perspectives on the world. For example, as we noted above, in Secwepemctsin like in many other Indigenous languages, the many complex categories that express the philosophical foundations of TEKW are expressed relationally as verbs rather than as nouns, as they tend to be in English. Given the fact that there are only some 100 fluent speakers of Secwepemctsin remaining, among some 8,000 Secwepemc, many of whom now live in cities, the intricate ways of expressing TEKW will invariably be impoverished if the language is silenced. Through the work of the past twenty-five years, we have documented this knowledge with elders; however, unless we find ways to breathe new life into Secwepemctsin as a spoken language, only archiving this knowledge will result in it becoming "pickled" (Hinton and Hale 2001) as opposed to being part of living practice. While this imposes a new and fundamental challenge to the future of Secwepemc TEKW, throughout our years of teaching and instilling Secwepemctsin in younger generations, we have found that the intricate categories of Secwepemc TEKW in philosophy, in practice and modes of transmission through story, song, and "doing" on the land have generated interest and commitment among younger generations to learn this difficult language. Perhaps the ongoing and future use of Traditional Ecological Knowledge and Wisdom regimes will help revitalize the use of the language as connected to the land.

Practising TEKW in Community-based Resource Management Regimes

While the decline of Secwepemctsin represents one important challenge but also an opportunity for the future of Secwepemc TEKW discourse, institutionalized resource management regimes as they have grown in Secwepemc communities afford additional challenges and opportunities. On a positive note, our collaborative community research since the early 1990s (see Chapter 1, this volume) included research training among Secwepemc community members and community-based course offerings in ethnobotany and ethnoecology.[11] Thus, hundreds of adults have re-engaged with the TEKW knowledge of their elders, at times directly and at times with the authors of this chapter as interlocutors. Many of these students of ethnobotany and TEKW are now productively engaged in the monitoring of plants and animals throughout Secwepemcúl̓ecw, often as part of impact assessments regarding Crown logging permits and other resource developments. However, a challenge to this work is the fact that much of it entails bureaucracy-driven responses ("referrals") to industrial and Crown-sanctioned resource extraction. As D. A. Lertzman has noted,

> ecosystem-based management entails a paradigm shift for industrial society in the perception of humanity's place within ecosystems. Its implementation requires new theory and practice for planning and management, legislation and policy, education, political process, and public consultation with collaborative interdisciplinary research in the natural and social sciences. Significant changes in our economic activities will be required… (Lertzman 2010:120; see also Blackstock 2002).

In light of the fact that forestry practices continue to be driven by industry and state interests, First Nations resource management regimes in the Secwepemc nation, like those elsewhere, continue to have to respond to provincial licensing, permitting, and forestry practices, as opposed to proactively being able to focus on encouraging the re-introduction and revitalization of many of the TEKW plant management practices we detailed in this chapter (see also Chapters 2 and 5). However, there are some small victories: Mary Thomas' family has made a successful effort to restore ***ckwalkwalúl̓s*** (wapato, *Sagittata latifolia*) habitat in the Salmon Arm estuary, although in the end, this may still be threatened by proposed industrial development in the area. Other communities are considering protecting areas that still feature good growth of native plants used by Secwepemc, but much more could be done here.

One exception, to a small degree, has been the reintroduction of landscape burning in a few areas within Secwepemcúl̓ecw: Following decades of aggressive fire suppression and the criminalization of Indigenous burning on the part of the BC Ministry of Forests, Interior British Columbia has experienced severe wildfires in the North Thompson and Kelowna areas in 2003 and intermittently since. One consequence of these wildfires was the BC Ministry of Forests and BC Wildfire Service reintroduction of

> … managed, low-intensity ground fires [to grasslands in the Cariboo area] intended to restore and maintain the traditional grassland plant communities that are native to these areas. These managed fires also reduce fuel loads, leading to a decreased risk of catastrophic wildfires (http://bcwildfire.ca/hprscripts/wildfirenews/ – retrieved Oct. 30, 2015).

These controlled burns—at this point mainly in grasslands as opposed to forested areas—are administered through local Ecosystem Restoration Committees which include representation from "provincial and federal government, as well as local First Nations, B.C. Cattlemen's Associations, various conservation societies and other forestry professionals" (ibid.).

Figure 4. Wapato (***ckwalkwalúl̓s***, *Sagittaria latifolia*), which has been successfully restored to the Salmon River estuary near Salmon Arm, based on the knowledge of Dr. Mary Thomas. Photo by Nancy J. Turner.

Ron Ignace and Marianne Ignace, the co-authors here, have revitalized landscape burning on grassy hillsides and plains on the Skeetchestn Indian Reserve since the late 1990s with the specific objective of monitoring and enhancing the growth of Secwepemc food plants, specifically ***ts̓wéw̓ye*** (*Fritillaria pudica*—Figure 5) and ***qweq̓wile*** (*Lomatium macrocarpum*—Figure 6). The fire management techniques practiced by Ron Ignace have been based on what he learned from his great-grandfather, Edward Eneas, and other elders regarding season, wind direction and other factors (see Ignace and Ignace 2010). The results to date are promising, in that biennial burning in spring has resulted in an exponential increase in *Fritillaria*, which has been monitored through annual counts, and also visible increases in *Lomatium*. Given that "indigenous resource management systems are not mere traditions but adaptive responses that have evolved over time" (Johannes 1998; Turner and Berkes 2006), in the face of changing climate and environments, a renewal of Secwepemc resource management practices guided by TEKW can inform future resource management strategies. To drive this process, Secwepemc community institutions and processes can play an important role in applying TEKW to enhance and restore environments.

TEKW in Documenting Land Title

As we showed in the introduction to this chapter, Indigenous TEKW is inseparable from the Indigenous homelands—in our case Secwepemcúl̓ecw—where it is rooted in thousands of years of practice, adaptation, and cumulative knowledge. Indeed, our TEKW diagram (Figure 1) would best be three-dimensional rather than two-dimensional in order to accommodate the concept of

Figure 5. Large fruited desert parsley (***qweq̓wile***, *Lomatium macrocarpum*). a culturally important root plant whose habitat has been restored by fire management on the Ignaces' land at Skeetchestn. Photo by Nancy J. Turner.

Figure 6. Yellowbell (***tś̓wéw̓ye***, *Fritillaria pudica*), a culturally and spiritually important early spring bulb. Regular landscape burning on the Ignaces' land on Skeetchestn Reserve has dramatically increased a plant community here. Photo by Marianne Ignace.

Figure 7. Large scale burning of grasslands and vegetation on Skeetchestn Reserve, March 2015. Photo by Marianne Ignace.

the land to which it is inextricably connected. Throughout the past two decades and supported by the Supreme Court of Canada's increasing recognition of Aboriginal Title (see note 6), Secwepemc communities have launched court actions in defence of their claim to unextinguished title and rights over areas that have been traditionally occupied by Secwepemc people engaged in dwelling and resource harvesting throughout the Indigenous seasonal round, even while they were literally being fenced out of those areas (see Chapter 2, this volume). In this context, the detailed documentation of the principles and practices associated with Secwepemc Traditional Ecological Knowledge and Wisdom is important, in that it not only shows species harvested and locations where traditional resource harvesting took place and often continues to take place, but instead shows the principles, practices, and transmission of TEKW (for examples, see Ignace 2000; Ignace and Ignace 2014; Turner 2004; Turner and Peacock 2005). As such, it represents what the Supreme Court of Canada termed the "Aboriginal perspective [that] focuses on laws, practices, customs and traditions of the group" (Tsilhqot'in v. R., 2014, at para. 35), and its documentation potentially shows "a strong presence on or over the land claimed, manifesting itself in acts of occupation that could reasonably be interpreted as demonstrating that the land in question belonged to, was controlled by, or was under the exclusive stewardship of the claimant group." Borrows (2005, 2010a, 2010b) has termed such culturally embedded protocols *Indigenous legal traditions,* which do not exist in a vacuum but are connected to specific indigenous lands and environments (2005:197). Viewed in this light, Secwepemc TEKW embodies and integrates Secwepemc Indigenous law (***stsq̓ey̓***) in its connection to Secwepemcúl̓ecw as a whole, and to precious parts within it.[12] Now and in the future, thus, the detailed accounting of Secwepemc TEKW as embodying Secwepemc Indigenous legal traditions and practices of resource use and environmental stewardship connected to specific areas can thus help to underscore historic Secwepemc land use and occupancy as compatible with legal parameters of Aboriginal title as set out in the Tsilhqot'in decision. Beyond that, in articulating the principles and practices of Secwepemc traditional knowledge and wisdom with its enactments in specific Secwepemc harvesting areas and spiritual sites, we stipulate that Secwepemc TEKW will be of relevance in creating and protecting future "cultural keystone places" (Cuerrier et al. 2015) as environmentally, culturally, historically, and spiritually significant areas of harvest and ceremony that can be protected from industrial development. This is where Secwepemc principles of caretakership and reciprocal accountability with the environment can be continued and revitalized. In such places, future generations will be able to revitalize the principles and practices of TEKW and breathe new light into the Secwepemc connection with land in a holistic sense.

Conclusions

Worldwide, the knowledge base for Indigenous Knowledge systems is threatened, and so are the possibilities for continued expression and reproduction of this knowledge and the modes of production it engenders (Carlson and Maffi 2004; Maffi and Woodley 2010). Although the Secwepemc people have their own unique economic, spiritual, political, and historical relation to their homeland, their struggles to maintain their cultural and territorial integrity and their own Traditional Ecological Knowledge and Wisdom, are in many ways representative of those faced by Indigenous and long-resident peoples around the world. On the basis of a detailed description of Secwepemc TEKW as intrinsically connected to Secwepemc ancestral lands or traditional territory, we thus stipulate that TEKW has present and future relevance in not only re-creating traditional resource management regimes, but also in articulating Secwepemc use and occupancy as compatible with the Canadian Supreme Court's parameters of title, thus hopefully enabling, long term, the constitution of important places in Secwepemcúl̓ecw where the harvesting and management of Secwepemc food plants informed by principles and practices of TEKW will find continuing use and expression. While not a focus of this article, we can also see Secwepemc TEKW guiding mining reclamation practices in areas of Secwepemcúl̓ecw that have been affected by mining, like the Mount Polley Mine near Williams Lake, the Highland Valley mine, and the New Gold mine near Kamloops, where the Stk̓emlupsemc te Secwepemc (comprising Skeetchestn and Kamloops Bands) are embedded in the mining permits and will have the opportunity to play a significant role in mining reclamation and habitat restoration. Beyond merely "greening" past mine sites and removing contaminants, mining reclamation that deploys Secwepemc TEKW will be in a unique position to restore ecosystems. Bringing back practices, places, and Secwepemc Indigenous laws of interacting with everything on the land will enable the continuation of Secwepemc Indigenous legal traditions on the land, and will be important Secwepemc manifestation of the overall role of Indigenous ecological knowledge systems in biocultural conservation (Berkes 2012; Maffi and Woodley 2010; Lepofsky 2009).

Notes

1. Translation: "We Thank the Land for Raising and Sustaining Us."
2. Canadian provincial curriculum guides and frameworks for the Canadian K-12 education system mention the curricula should include examples of Aboriginal TEKW as part of what is taught, especially in the K-7 education system [see British Columbia, Ministry of Education *Grades K-7 Science Integrated Resource Package,* p. 13 (bced.gov.bc.ca)], without, however, including much by way of tools and resources. Aikenhead (2002, 2007) provides discussion on western science education and Indigenous knowledge.
3. Section 35 of the Canadian Constitution affirms the "existing and treaty rights" of Canadian Aboriginal peoples, without, however, defining the nature and content Aboriginal rights. Since the mid-1980s, the Supreme Court of Canada has handed down several landmark decisions defining Aboriginal title and rights. In Delgamuukw v. R. (1997), the SCC identified Aboriginal title as a collective, pre-existing title *sui generis,* which, however, upon *consultation* with the Aboriginal titleholder group, can be infringed upon by the Canadian government upon consultation with the Aboriginal group. *Haida v. R.* (Canada, Supreme Court 2004a) and *Taku River Tlingit v. R.* (Canada, Supreme Court 2004b) further defined the requirement of such consultation even if title has not yet been proven in court. In the 2014 *William v. R.* SCC decision, the Tsilhqot'in (Chilcotin Nation) won the Supreme Court's declaration of Aboriginal title to a core 5% of their territory, with the court acknowledging that Aboriginal title is not restricted to Aboriginal village sites but also applies to the larger territory for which there is evidence of use throughout the seasonal round. Furthermore, the SCC raised the bar on the accommodation and reconciliation of Aboriginal interests: rather than requiring "consultation" as Delgamuukw had, it requires the "consent" of the Aboriginal Nation.
4. These include: Bunchgrass, Ponderosa Pine, Interior Douglas-fir, Montane Spruce, Engelmann Spruce-Subalpine Fir, Interior Cedar-Hemlock, Sub-boreal Spruce, and Alpine Tundra.
5. The term *cultural genocide* was used in the 2015 Report of the Canadian Truth and Reconciliation Commission to describe the impacts of compulsory Residential School attendance. (See http://www.trc.ca).
6. For an exegesis of Secwepemc ***stsptekwll*** as moral and educational narratives, but also as fundamentally, connected to geological, climatic, ecological, and human events in Secwepemc history, see Ignace (2008), and Ignace and Ignace (in press).
7. June 18, 1987; Tape #86 Side A.
8. June 18, 1987; Tape #86 Side A.
9. Secwepemc elders and knowledge keepers are reluctant to disclose the location of such places, since in past experience they have been defaced and destroyed, sometimes in the process of road construction, logging, or mining, sometimes through graffiti. As Secwepemc communities face increased pressures on industrial development, however, it may sometimes be necessary to disclose the location and meaning of such places to ensure a measure of their integrity, rather than their desecration and destruction (Ron Ignace).
10. This group comprises fluent speakers of Secwepemctsin who have worked with Ron and Marianne Ignace for several years in language documentation, including ethnoecological and

ethnobiological concepts as expressed in the language. They include: Christine Simon, Amy Slater, Daniel Calhoun, Leona Calhoun, Garlene Dodson, Cecilia Peters, Doris Gage and Julie Antoine. Other members who are deceased and sorely missed were Hilda Jules and James Peters.

11. SFU's Ethnobotany of British Columbia First Nations, with emphasis on Secwepemc ethnobotany, has been taught over the past 18 years in Kamloops at Stk'emlupsemc te Secwepemc (Kamloops Band) and the Shuswap Nation Tribal Council, at Adams Lake Band, Skeetchestn Band, and at Williams Lake and Xats'ull (Soda Creek), involving participation of elders and learners throughout the Nation. Courses in ethnoecology and landscape ecology were offered in Kamloops (2010) and Williams Lake (2013). Unfortunately, SFU's First Nations satellite program on the Kamloops reserve was closed down at the end of 2010, which has resulted in fewer community courses and programming.
12. Jeannette Armstrong (2009) has also articulated Syilx (Okanagan) cultural and environmental knowledge as representing an indigenous environmental ethic.

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Chapter 13. Conclusions: Secwepemc Ethnobotany into the Future

Marianne B. Ignace, Nancy J. Turner, and Sandra L. Peacock

This book represents an unusual and productive collaboration, bringing together different approaches to knowledge and understanding not only from a range of different academic disciplines but, most of all, from the environmental knowledge and wisdom of a people who have a prolonged and deeply personal relationship with their homeland.

In traditional Indigenous societies, including Secwepemc, knowledge is wide-ranging and holistic. It is not parceled out into disciplines or departments as it often is in academic institutions. There are no stand-alone sectors of archaeology, anthropology, botany, or ecology in Indigenous knowledge systems. There are, of course, many specialists in any Indigenous society—accomplished herbalists, artists, or berry experts, people who know how to predict the weather accurately, or who know the habits of particular animals, birds or fish—but even such specialized knowledge and skills transcend disciplinary boundaries. Nor can such expertise be learned within the confines of lecture halls or laboratories. It must be acquired from spending long periods of time outdoors, from mentoring, and from guided experiential learning and observation, sometimes over generations. It includes technologies, practices, methods, and underlying philosophies, as well as information.

Much of this knowledge is place-specific, and often it originates beginning in very early childhood. Elders like Ida William, Lilly Harry, and Dr. Mary Thomas featured in this volume experienced this kind of learning from the experts of their day—their mothers and grandmothers, among others. They learned well the stories of their ancestors, the names of all the plants and animals, how to administer medicines, and prepare nutritious food. Yet, this pleasurable and important learning changed abruptly at a tender age, and these women and many others were subjected to a particularly insidious brand of new and alien western-style learning. Mary Thomas, who was taken away from her family at the age of six, recalled:

> …out of the blue we were taken away from our homes, off to the Kamloops Residential School. There we were not allowed to speak. We were never allowed to talk unless we were spoken to. And we were never allowed to ask questions.

She told of hunger and harsh punishment, and described how her self-esteem and her interest in her own culture were stifled for many years. It was not until she was in her 50s that she began to reconnect with elders and to appreciate the richness and importance of her own Secwepemc culture again.

Her experiences were not unusual for her generation, and even for succeeding generations. Because of the residential schools, combined with loss of access to traditional lands and resources, and a whole series of other cascading impacts on people's rich land-based knowledge and wisdom, the language and the detailed knowledge of place held by ancestral Secwepemc began to erode significantly. Over this time, people's diets changed away from local indigenous food, their traditional medicinal and ceremonial practices diminished, and cultural assimilation to the "western" European based lifestyles accelerated—a situation that was occurring more generally across British Columbia and around the world (Harris 1997; Ignace and Ignace 2013; Kuhnlein et al. 2009; Maffi and Woodley 2010; Turner 2014; Turner and Turner 2008).

It was under these circumstances that our collaboration—the Secwepemc Ethnobotany project—was born. The elders and the Secwepemc people in general did not want to lose their critically important knowledge of plants and environments, and all of us in the partnership were determined to do what we could to support the documentation, and most importantly, the continuation and renewal of this vital cultural knowledge, for the sake of future generations of Secwepemc and for all those recognizing its significance as a key component of our humanity's heritage.

As noted earlier, the authors of these various chapters have been working together with Secwepemc communities for many years, in a quest to record and understand as much as we can about the history, environmental relationships, and issues facing contemporary Secwepemc people. The fabric of this book is thus woven with strands of both academic knowledge and Traditional Ecological Knowledge and Wisdom.

What We Have Accomplished

As we discussed in the introductory chapter, the methods we have followed in the Secwepemc Ethnobotany Project are, we believe, situated at the forefront of "decolonizing" research approaches. We have sought to serve, first and foremost, the Secwepemc community, in a mutually supportive effort to record, communicate, and provide learning opportunities for maintaining this knowledge in ways that are effective and respectful. We have followed the directions and advice of Secwepemc leadership and our Secwepemc collaborators, and have taken care to ensure that our findings are reviewed and approved before they are presented more widely. From time to time, our research has been applied in the legal arena, helping to determine Secwepemc legal rights and title to lands and resources (Ignace 2000; Ignace et al. 2009; Ignace et al. 2014; Turner and Peacock 1995; see Chapter 12, this volume). In all, our work fits well with the research goals and trends of the Society of Ethnobiology members overall, as described in various chapters of the textbook produced recently by the Society (Anderson et al. 2012).

As early as March 1994, we presented information on the project at the Society's annual conference in Victoria, together with elders Nellie Taylor, Mary Thomas, and Christine Simon, who travelled to the meetings with Marianne and Ron Ignace. In March 1996 we presented an entire symposium on the Secwepemc Ethnobotany Project ("Documenting Plant Knowledge of the Secwepemc of British Columbia: A Collaborative Research Project") at the Society's meetings in Santa Barbara, California, and we presented an additional symposium at the 1997 Society of Ethnobiology meetings in Athens, Georgia. Since that time, we have presented, collectively, an immense range of papers and posters on various aspects of our work, from the importance of

Figure 1. Roadside ethnobotany at Dog Creek Reserve, Summer 1991. Left to right: Anne (last name unknown), Brian Compton, Alison Davis, Mary Palmantier, Lilly Harry, Marianne Ignace, Julienne Ignace, and Ron Ignace. Photo by Nancy J. Turner.

narrative, to archaeological aspects, to cooking techniques and nutrition, to traditional management methods. This present volume, published through the Society, is not only a culmination of our Secwepemc research, but also expresses our relationship and alignment with this dynamic and supportive organization.

Our work has also contributed to the development and presentation of many different courses in ethnobotany and ethnoecology, especially through the Secwepemc Cultural Education Society/Simon Fraser University (SCES/SFU, subsequently SFU Kamloops) post-secondary institution at Kamloops[1], but also at the University of Victoria, Simon Fraser University's Burnaby campus and elsewhere. This means that students from many different backgrounds and areas of interest have been exposed to Secwepemc Traditional Ecological Knowledge and Wisdom in various forms, including the practical hands-on arts of pit-cooking and basketry, as well as to the archaeological and linguistic aspects of plant use, traditional narratives incorporating plants, and issues of ethics and intellectual property, particularly around medicinal plant knowledge.

When in 1995 the British Columbia Ministry of Forests and Lone Pine Publishing Company published the Southern Interior Plant Guide, subsequently re-titled *Plants of Southern Interior British Columbia and the Inland Northwest* (Parish et al. 1999), Marianne Ignace was asked to write an introduction about Aboriginal Knowledge and Use of Plants in the Interior. In addition, assisted by First Nations research assistants Arnie Baptiste and Lenora Fletcher, we were able to include descriptions of Indigenous plant use for many of the 675 trees, shrubs, and herbaceous plants presented in the volume. These were based on Turner's earlier work with the Syilx/Okanagan (Turner et al. 1980), the Nlaka'pamux (Turner et al. 1990), the St'at'imc (Turner et al. ms.) and data from our ongoing Secwepemc ethnobotany research. This book has become a seminal field guide widely used among foresters, botanists, resource managers, and field technicians, and it is also extensively used by natural and cultural resource management staff, field workers in First Nations communities, and organizations throughout the Interior, including the seventeen Secwepemc communities. It is also used by many elders and community members at large.

The work on pit-cooking—just one example of the project's contributions to the continuation of applied knowledge—has shown the tremendous sophistication of the Secwepemc elders and ancestors. To achieve the best taste and highest nutritional qualities to foods like ***wila*** (black tree lichen), balsamroot, and yellow glacier lily bulbs, the cooking has to be exact, balancing moisture, food combinations and quantities, quality of fuel and rocks used in the pit with the amount of water added in cooking, the vegetation used to line the pit, cooking time, and temperature regime. Without the right balance, the food will not cook properly, and, for the ancestors, this could mean the difference between survival and starvation, especially in the lean winter months. Knowing the correct life cycle stage, optimal harvesting times and how to dry the food properly for winter storage are other key aspects. Through bringing together the teachings of elders, the evidence from archaeology and the experimental work of the researchers, we have been able to renew and perpetuate this culturally important technology. At the beginning of the project, some of the elders we collaborated with had not witnessed this cooking method since their childhood. Today, not only elders, but also many other adults, youth, and children have had a chance not only to see pit-cooking, but to participate in the process: harvesting and preparing the food, digging the pit, heating the rocks, and tasting the finished product. They, in turn, have taken this knowledge back into their communities, so that pit-cooking is a better known practice now than it has been for several generations.

Another outcome of our work was to support the development of the Secwepemc Ethnobotanical Gardens at the Secwepemc Heritage Park, representing the ecosystems found within the Secwepemc Territory (see SCES 2007), and to support the propagation and planting of native plants in various parts of Secwepemc territory for purposes of both education and ecological restoration.

A better and more complete understanding of the methods, techniques, and cultural approaches to management of plant resources has also been a major contribution of this research, as outlined in Chapters 5, 12, and elsewhere in this volume. This work is particularly notable, because it has been part of a growing realization amongst anthropologists, archaeologists, land managers, and others that the so-called "Hunter-Gatherer" Indigenous Peoples of the Interior Plateau and Northwest Coast, as well as other regions of North America such as California, are, in fact, active participants in the production of their plant and animal resources, using a wide range of practices to maintain and enhance the foods and other materials on which they rely (Peacock and Turner 2000; Turner et al. 2013). Their approaches are underlain by a belief system or philosophy that values the lives of other species, including trees, and therefore favours methods of harvesting that are least destructive to these species and populations. Knowing how to harvest birch bark sustainably, without killing the tree, for example, is not only a practical technique, it is part of a "kincentric" worldview in which the birch tree itself, as a living being and a relative of people, is recognized and respected (Turner 2008, 2014). This "new way" of understanding

Figure 2. American Sweet-flag [*Acorus americanus* (Raf.) Raf.] was found by Nancy Turner and Ann Garibaldi growing in a widely dispersed patch in the Salmon River estuary in 2012. An important medicinal plant, sometimes called "rat-root," it is a rare, red-listed species in British Columbia. Its thick aromatic rhizomes are valued as a stimulant by Cree and other First Nations of northern Canada, as well as by Hudson's Bay Company trappers. This isolated population was quite likely introduced into Secwepemcúlecw many decades ago from east of the Rockies by Cree or Sekani traders. Photo by Nancy J. Turner.

Figure 3. Celebrating the successful restoration of wapato in the Salmon River estuary. Left to right: Bonnie Thomas (Mary's daughter), Nancy Turner, and Ann Garibaldi. Photo by Val Janzen.

people's relationships with plants and animals is highly significant. It points to a different type of land occupancy and resource use, in which humans have taken an active and conserving role, and are not just passive users of available resources, in contrast with and of an earlier stage of human development compared with agriculturalists, as has often been implied (cf. Anderson 2005; Deur and Turner 2005; Minnis and Elisens 2000). The complexity and sophistication of Secwepemc land and resource management therefore warrant special and ongoing attention.

From all available evidence, the diversity of plants and animals and their habitats observed by the first Europeans in Secwepemc territory and elsewhere in British Columbia was the result of generations of careful use and management. We do not know the antiquity of these practices, but we can assume that their beginnings extend back many centuries, perhaps two or three millennia or more. Earth ovens, which appeared in the region over 3,000 years ago, and have continued in use right up to the early 1900s, may reflect focused management of root foods, such as balsamroot, yellow glacier lily, mountain potato or spring beauty, and tiger lily, through a variety of approaches, from landscape burning to selective harvesting technologies (Chapters 5 and 12).

Unfortunately, many circumstances have changed since traditional plant resource management methods were developed and practiced widely. Indigenous peoples throughout British Columbia, including the Secwepemc, have lost access to major portions of their homelands and today they struggle to maintain the traditions of their ancestors against the pressures of the social and economic changes accompanying the rapid industrialization of the Plateau landscape. The net result has been a loss of productivity and biodiversity in traditional harvesting locales as management techniques such as periodic controlled burning are no longer practiced and as introduced species, intensive agriculture, industrial forestry, and the resulting soil erosion and contamination impact almost every part of the territory. Resources that used to be abundant—old-growth cedars, birches, productive patches of avalanche lilies and mountain potatoes, wapato and Indian-hemp, and special medicines like Canby's lovage—are now difficult to access at all, let alone to maintain in traditional ways. In Mary Thomas' words, "Everything is deteriorating" (Chapter 10). However, as the homeland of the Secwepemc in the South-Central Interior of British Columbia is facing the unprecedented onslaught of present and planned industrial resource extraction, ethnobotanical knowledge and the Traditional Ecological Knowledge and Wisdom that sustains it also gives us hope: As we discuss at the end of Chapter 12, documenting this knowledge provides important evidence towards Secwepemc Aboriginal title and rights to Secwepemcúl̓ecw, the Secwepemc homeland, and ecologically and culturally significant "keystone places" (Cuerrier et al. 2015). There is hope that documenting and putting forth this knowledge can result in the protection of areas that will be important for the future ability of Secwepemc people to harvest plants for food, medicinal, spiritual and technological purposes, and to continue practicing and transmitting the knowledge of their ancestors on the land.

Future Directions for Secwepemc Ethnobotany

In addition to this volume, focusing on various research projects relating to Secwepemc ethnobotanical knowledge, a second volume is well underway—the actual *Secwepemc Ethnobotany*, which will be a reference book with photographs, Secwepemc names, and associated information on all of the plants having cultural significance in any part of Secwepemc territory. We anticipate that this book will be published through Sono Nis Press, Winlaw, BC, and will be similar to the book on Haida ethnobotany first published by this press in 2004 (Turner 2004).

We believe that, together, these two volumes focusing on Secwepemc people and plants not only represent a chronicling of past Secwepemc plant knowledge, but also provide a pathway into the future, suggesting important venues by which this knowledge and associated practices and worldviews can be woven and rewoven into contemporary lifeways of Secwepemc people. Obviously, there will be adjustments and adaptations—these are the norm with any Indigenous knowledge system. However, the enfolding of the rich knowledge and traditions of the past into the education and practices of current generations can only strengthen a people's identity and confidence, and support them as they continue to take their place in the world as planners, decision-makers, educators, and restoration practitioners. And, in terms of sustaining the habitats and plant and animal species of the Secwepemc world, this knowledge is paramount.

Concluding Thoughts

The "ethnosphere," encompassing the sum total of human imagination, creativity, language, and knowledge, is a tightly linked counterpart to the "biosphere," comprised of the earth's life in all its forms (Davis 2001). The ethnosphere and the biosphere cannot be separated, and both are in imminent danger. The erosion of languages—a reflection of cultural knowledge and diversity—through acculturation and globalization, in fact exceeds the rate of species extinctions in the world—the loss of biological diversity (Carlson and Maffi 2004). This trend is made even more critical by the looming peril of global climate change—which is already underway, and which threatens the productivity of the very ecosystems on which we all depend. The knowledge and practices of Indigenous Peoples in relation to their own homelands are important in helping them, and all humanity, to understand how people have accommodated and adapted to change in the past while retaining the essence of their culture (Salick and Ross 2009; Turner and Clifton 2009).

Perhaps even more importantly, place-based cultural wisdom can point the way to a deeper understanding of humans' impacts on other species, and provide guidance for necessary changes in our priorities—including a multi-generational view of planning and decision-making—to reverse our destructive practices and, instead of continuously challenging natural processes, to work with them in culturally appropriate ways to restore and enhance our ecosystems and the species they support, including ourselves.

We have, together, taken the first steps in a journey that is ongoing. Bringing the Secwepemc and other Indigenous peoples as full partners in land management and governance is imperative if the productivity and biodiversity of the landscape is to be restored. Western scientific knowledge, short-term economics, and top-down governance have not been adequate to face today's environmental challenges, especially in view of cumulative and indirect effects that are not well accommodated under current regimes. Without balancing these predominant approaches with

Figure 4. New generations harvesting Secwepemc plants: Skeetchestn elder Christine Simon with her grandchildren Tyson Simon, Candice Camille, and with Katie Ignace beating soapberries off the branches. Photo by Marianne Ignace.

the knowledge, practices, and wisdom of those who are most familiar with the landbase, through generations of occupation, observation, and experience, the trends of cultural and environmental erosion will continue. With this collaboration, we hope that the stage is set for such a new relationship.

Note

1. Unfortunately, SFU's Kamloops site was closed down at the end of 2010. Courses in ethnobotany (SFU's FNST 332, Ethnobotany of British Columbia First Nations), however, have continued on in various First Nations community locations since 2010, including at Williams Lake, Soda Creek, Kamloops, Lillooet, and in Burnaby.

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Gladys Baptiste is a member of the Simpcw community in the Secwepemc Nation. She completed her B.A. with a joint Major in Archaeology and Anthropology in 1994. Throughout the 1990s, she worked as a research assistant in the archaeology lab at Kamloops partnership program between the Secwepemc Cultural Education Society and Simon Fraser University.

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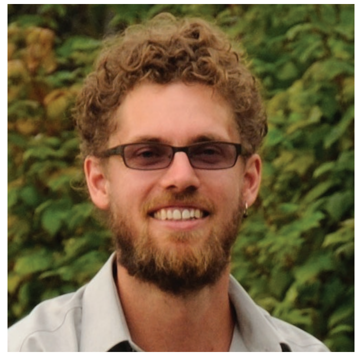

Stuart Crawford completed an M.Sc. in Interdisciplinary Studies at the University of Victoria in 2007. Stu lives on Haida Gwaii where he works as an environmental consultant and educator, and spends his spare time foraging. His research interests focus on lichens and other culturally marginalized taxa, as well as anything edible.

Ann Garibaldi is an ethnoecologist and ethnobotanist with more than 15 years of research experience and applied experience related to social-ecological issues in changing environmental systems. Ann's work explores process to support respectful and meaningful dialogue between indigenous communities, government, and the private sector. Ann has brought her expertise and training in botany (1993, B.Sc., Ohio University) and ethnobotany (2003, M.Sc., University of Victoria) to bear on issues related to: Traditional Ecological Knowledge (TEK) studies and Traditional Land Use (TLU) studies; Cultural Impact Assessments; forest management practices that involve traditional land users; biodiversity and wildlife habitat reclamation; and, land management strategies. Ann has worked in British Columbia, Alberta, and Alaska.

Marianne Ignace is Professor in the departments of Linguistics and First Nations Studies at Simon Fraser University in Burnaby, British Columbia, Canada. She is also the Director of SFU's First Nations Language Centre. She has carried out research in and with First Nations communities for more than 30 years, and her publications include *The Curtain Within: Haida Social and Symbolic Discourse* (1989), A practical grammar of Ts'msyen Sm'algyax co-authored with Margaret Anderson, a *Handbook on Aboriginal Language Program Planning in British Columbia*, and various articles and book chapters on Secwepemc and Haida language and culture, comprising such diverse topics as ethnobotany and ethnoecology, language revitalization, ethnography, oratory and stories, ethnohistory, and youth hip-hop culture. As a resident of the Skeetchestn community in the Secwepemc Nation, she has researched and taught Secwepemc ethnobotany for the past twenty years in many communities in the nation. She presently directs a SSHRC partnership grant (2013–2020) focused on First Nations language documentation and revitalization.

Chief Ronald E. Ignace (Stsmél̓qen) is a member of the Secwepemc (Shuswap) Nation. He has been the elected Chief of the Skeetchestn Band for more than 26 years since the early 1980s, and also served as Chairman of the Shuswap Nation Tribal Council and president of the Secwepemc Cultural Education Society during the 1990s. For many years, he was the co-chair of the Aboriginal university partnership between the Secwepemc and Simon Fraser University in Kamloops, B.C., and he continues to teach courses in Secwepemc Language and First Nations Studies through SFU. He holds B.A. and M.A. Degrees in Sociology from the University of British Columbia, and completed his Ph.D. in Anthropology at Simon Fraser University in 2008 with a dissertation titled, *Our Oral Histories are Our Iron Posts: Secwepemc Stories and Historical Consciousness*. He has published and co-published with Marianne Ignace, several articles and book chapters on Secwepemc history, ethnobotany, language, and culture. Ron has more than sixty years of practical experience in Secwepemc traditional food gathering, having learned these skills from his own elders, who shared their stories and teachings in the Secwepemc language with him.

Harriet V. Kuhnlein, Ph.D., FASN, FIUNS, LL.D. (Hon.) is a nutritionist, Emerita Professor of Human Nutrition, and Founding Director of the Centre for Indigenous Peoples' Nutrition and Environment (CINE) at McGill University. She was a professor at the University of British Columbia before joining McGill as Director of the School of Dietetics and Human Nutrition. Dr. Kuhnlein's research uses a participatory approach with Indigenous Peoples and spans more than 40 years, during which she has worked with Indigenous Peoples in many parts of the world on topics related to documentation of Indigenous Peoples' food systems, particularly for nutrient components, and health promotion using local foods for food security and good health.

Donna Leggee was senior laboratory manager at the Centre for Indigenous Peoples' Nutrition and Environment (CINE) at the time this research was conducted. Donna coordinated the nutrient analyses after the samples were received in the lab.

Dawn Loewen studied the ecology, ethnobotany, and carbohydrate chemistry of the yellow glacier lily for her M.Sc. thesis in Biology and Environmental Studies at the University of Victoria. She was privileged to work with Mary Thomas and other Secwepemc elders and teachers during her studies. She is currently living in Saskatoon, on the Canadian Prairies, mothering three children, and working as a freelance editor of books and academic journal articles.

George Nicholas is a professor of Archaeology at Simon Fraser University (SFU), in Burnaby, British Columbia, adjunct faculty at Flinders University, South Australia, and director of the Intellectual Property Issues in Cultural Heritage (IPinCH) project, an 8-year international initiative funded by the Social Sciences and Humanities Research Council. He developed and directed SFU's Indigenous Archaeology Program in Kamloops (1991–2005), and has worked closely with the Secwepemc and other First Nations in British Columbia, and Indigenous groups worldwide. His research focuses on Indigenous peoples and archaeology, intellectual property issues relating to archaeology, the archaeology and human ecology of wetlands, and archaeological theory, all of which he has published extensively on. In 2013, Nicholas received the inaugural "Partnership Impact Award" from the Social Sciences and Humanities Research Council.

Sandra Peacock is an ethnobotanist and archaeologist interested in the ways in which people—both past and present—use, classify, and manage plants. She has worked collaboratively with First Nations communities in Alberta, Montana, and British Columbia for more than 20 years to document traditional plant knowledge and the archaeological evidence of ancient plant use. Her research explores the archaeological evidence for wild root food collecting and processing in northwestern North America. When she's not in the field, Sandra can be found teaching at The University of British Columbia - Okanagan where she is an Associate Professor of Anthropology in the Department of Community, Culture and Global Studies. For the last several years, she has been leading a summer field studies program in Tanzania on community-engaged research and local food systems.

Nancy Turner is an ethnobotanist, Distinguished Professor, and Hakai Professor in Ethnoecology in the School of Environmental Studies, University of Victoria. She has worked with First Nations' elders and cultural specialists in northwestern North America for over 40 years documenting and promoting their traditional knowledge of plants and habitats. She has authored or co-authored over 20 books and over 125 book chapters and papers. Her awards include membership in the Order of British Columbia (1999) and the Order of Canada (2009), membership in the Royal Society of Canada, and Killam and Pierre Elliott Trudeau fellowships. Her recent book, *Ancient Pathways, Ancestral Knowledge: Ethnobotany and Ecological Wisdom of Indigenous Peoples of Northwestern North America* (McGill-Queens University Press, 2014) has received the Prose Award from the Association of American Publishers, and the James A. Duke Excellence in Botanical Literature Award from American Botanical Council.

Leisl Westfall graduated from Simon Fraser University in 2000 with a B.A., joint major Archaeology and Anthropology, and a certificate in Native Studies Research. She has subsequently gone on to work in both the public and private sectors, including Mackin House Museum (Coquitlam), Port Metro Vancouver, BC Hydro, and SFU's IPinCH, consulting on various information management projects.

Michèle Wollstonecroft is an archaeologist, who received her M.A. from Simon Fraser University and her Ph.D. from the University College London (UCL) Institute, UK. She is currently Degree Coordinator and Teaching Fellow in Environmental Archaeology at the UCL Institute and holds dual Canadian and British citizenship. Her research interests include archaeobotany of hunter-gatherers, dietary ecology and the evolution of the human diet, smallholder farmers, ethnobotany, and Near Eastern Epipalaeolithic, Iberian mesolithic, mesolithic-neolithic transition.

Mary Thomas. Revered and cherished, the late Dr. Mary Thomas was a wise and tireless teacher of Secwepemc culture. Her deep knowledge of Secwepemc plants, language, and traditional ways was taught to her by her grandparents, particularly her paternal grandmother "Macreet" (Marguerite Pierrish), from the Salmon Arm Indian Reserve No. 3. Mary was born in 1918 and into her mid-eighties, she worked alongside her children to teach university students, community members, and others the rich history of the Secwepemc people. Growing up listening to her elders, Mary was acutely aware of the changes happening to both the Secwepemc land and culture, and committed herself to using traditional ways to support people of interior British Columbia. As Mary said, "Young people are so important to me … I'd go through Hell just as long as I know it's helping" (M. Thomas pers. comm. 2002). Mary received an honorary doctorate from the University of Victoria in 2000.

Secwepemc People and Plants: Research Papers in Shuswap Ethnobotany

The Secwepemc (Shuswap) people of the Plateau of northwestern North America developed and practice(d) intricate relationships with plants that reflect the biodiversity of their environment and thousands of years of experience of living in Secwepemcúl̓ecw, their homeland. This collection of essays derives from more than twenty years of collaborative research on ethnobotany and ethnoecology with Secwepemc plant specialists and elders. It begins with an in-depth introduction to botanical and indigenous perspectives on Secwepemc plants, environment and landscape, and then goes on to address such diverse topics as archaeobotany, plant resource management and stewardship, edible root vegetables and edible lichen harvesting and processing, the role of cultural knowledge in understanding Secwepemc medicines, and the nutritional qualities of edible plants. Additional chapters in this volume speak to the fascinating ways in which plant and environmental knowledge is articulated in oral narratives, and how Secwepemc Traditional Ecological Knowledge and Wisdom is constituted. In light of the escalating nature of environmental degradation in Secwepemcúl̓ecw, the volume addresses the crucial relevance, now and in the future, of Secwepemc TEKW and environmental stewardship.

Marianne B. Ignace is Professor in the Departments of Linguistics and First Nations Studies at Simon Fraser University. Her ongoing ethnographic and linguistic research in the Secwepemc Nation began in 1984 and led to the collaborative research on Secwepemc ethnobotany and ethnoecology featured in this volume.

Nancy J. Turner is an ethnobotanist and ethnoecologist, now Professor Emeritus with the School of Environmental Studies, University of Victoria. Along with Ron and Marianne Ignace, she helped to initiate the Secwepemc Ethnobotany Project over 25 years ago and has been part of the team ever since.

Sandra L. Peacock is an Associate Professor at The University of British Columbia where she teaches archaeology and ethnobotany. Her research exploring the archaeological evidence for wild root food collecting and processing in northwestern North America began with the Secwepemc Ethnobotany Project nearly 20 years ago.

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