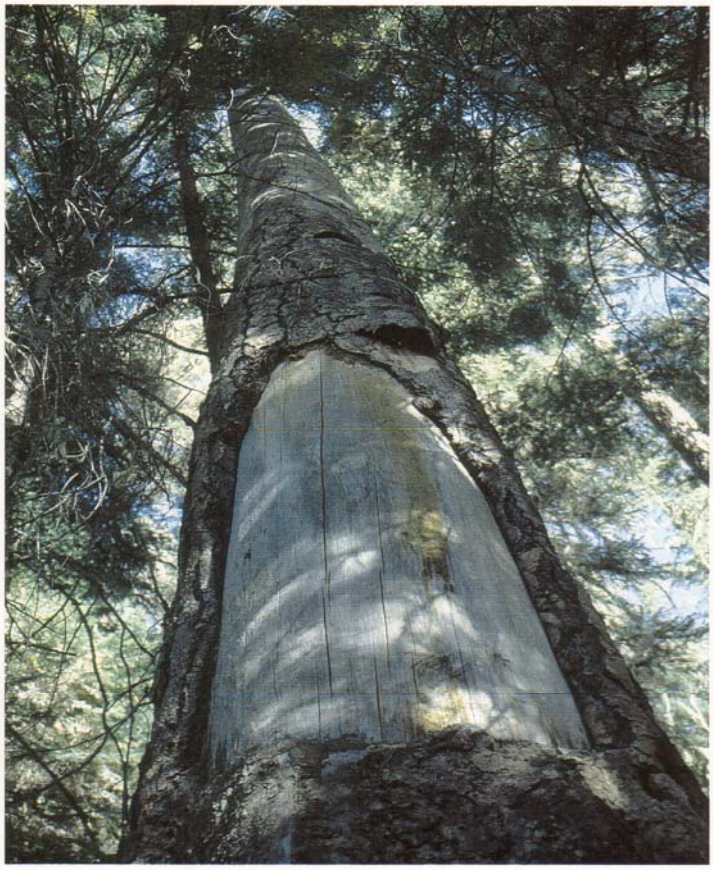
Institutionen för skoglig vegetationsekologi
SLU
901 83 UMEÅ

"How long does it take a ritual to build up, to take hold and become standard practice?"

- Bark peeling in Scandinavia and North America



Lisa Ahlberg

Examensarbete i skoglig vegetationsekologi, 20p.
Handledare: Olle Zackrisson och Lars Östlund
Mars 2001

Preface

During the summer of 1999, I studied literature about historical utilization of natural resources among Sami in Scandinavia and North American indigenous peoples to prepare myself for my coming trip to North America. The increased knowledge of similarities in the way of living and use of inner bark was inspiring! In September, I went to Missoula, Montana in the U.S.A to search for more material. Carolynne Merrell, archaeologist, guided me through parts of the Lolo- and Bitterroot National Forests, in western Montana, showing bark peeled lodgepole pine, (*Pinus contorta*) ponderosa pine (*Pinus ponderosa*), and Western red cedar (*Thuja plicata*). Carling Malouf, a retired archaeologist/ethnologist spent an entire day telling me about Native Americans and their conditions of living. I also spent several hours at the University library of Missoula, searching for literature about inner bark use. Next, I traveled to Vancouver Island, Canada, to meet Morley Eldridge, archaeologist at "Millennia Research Ltd.". Mr. Eldridge as well as his employees supplied me with lots of information for my work, as well as a house, a car and a bike! Mr. Eldridge also let me visit the Royal Museum of British Columbia to see tools used for bark peeling. At the University of Victoria, Vancouver Island, Sandra Peacock, archaeologist, provided me with literature and information about cooking pits. The great quantity of literature I have obtained, personal meetings, interviews and field studies of bark peeled trees in Sweden and North America have provided a general impression that has been very valuable for my work.

I would like to thank my supervisors, Olle Zackrisson and Lars Östlund, at the institution of Forest Vegetation Ecology, the University of Agricultural Science (SLU), Umeå, Sweden. Thanks to Olles contacts in North America I had a great benefit by the trip. Lars has devoted a lot of his time to proofreading and commenting the text. Thanks also to Terry Peterson and her family in Missoula, who let me stay in their house as a family member during my time in Montana. In addition, Terry kindly helped me editing my thesis. Carolynne Merrell let me stay at her place a weekend and devoted all her time to guiding me in Clearwater National Forest. Carolynne also had a narrative skill and that way I learnt a lot about the life of Native Americans. Other people interviewed in Montana were Tom Foor, Department of Anthropology, University of Missoula and Joanne Biterane, ethnobotanist at the Kootenai Cultural Committee. Morley Eldridge, Vancouver Island, was extremely helpful in many ways and apart from supplying me with material for my research work, he let me meet his own family and spend the Thanks Giving holiday in their company! Thanks also to my friends Annika Holmgren and Genaro Lopez who helped me proofreading the text.

Literature about bark use in Scandinavia is relatively sparse as compared to that in North America, especially concerning the specific areas of bark use. But, overall I'm satisfied having answered the main questions as well as found lots of detailed information I could never dream about!

Finally, I hope to increase the interest for research about inner bark use in the Northern Hemisphere.

Umeå, March 2001
Lisa Ahlberg

Table of contents

Abstract

Independently, the Sami people in northern Scandinavia and native people in the north temperate and boreal zone of North America have utilized the cambium layer of bark from both coniferous and deciduous trees as food, medicine, as well as material for other requirements; clothes, baskets and various kinds of wrapping. The sharp seasonal environments created food shortages in certain periods and inner bark thus became an important food component. Dating of bark scars indicates a slight difference between periods of bark use in Scandinavia and North America. The final cessation of inner bark use was dependent on an increased access to substitutive foodstuff as sugar and cereals, as well as authorities trying to prevent bark harvest. Cambium harvest was primarily a task for women, and sometimes children. Generally, bark was peeled in springtime, when the sap was "running", the proper time varying among tree species. During this period, the cambium had a comparatively high nutritional value and an appealing taste. Simultaneously, the supply of animal food/protein was generally low. Inner bark contains a relatively high amount of carbohydrates and healthy food fibers, as well as vitamins and essential minerals, making it a nutritional complement to protein rich food. Naturally, the tree species used for bark peeling differ in the areas described according to latitude and, consequently, bioclimatical zonation. The materials, as well as shaping of bark peeling tools were similar in northern Scandinavia and North America. In North America, there is an evident material transition from bones and antlers to metals, which occurred when trading with the white man began. The peoples described herein had a sacred relationship with nature, which meant that bark was not peeled all round the tree trunk. Therefore, avoiding girdling the tree and killing it. North and south were spiritually important directions to the Sami and consequently trees were primarily peeled to the north. Similar data is presented in survey material from Vancouver Island. However, indigenous people in North America likely had practical intentions when bark stripping a tree directionally. The shaded side had a better cambium taste as well as fewer branches. This side was often directed to the north. Occasionally, cambium was processed in cooking pits in both Scandinavia and North America, but it was an unusual phenomenon. In North America, these pits were primarily used for the processing of roots. Construction and function of cooking pits are similar. The heat generated in cooking pits breaks down large or complex carbohydrates into smaller, more digestible polymers, along with making food tissues less toxic. There is no clear distinction between food and emergency food. Due to some statements from Swedes as well as North Americans, bark cambium was emergency food. But, dating of scars reveals a regular use of bark. This fact points towards bark as a natural element of the diet. Although, bark use presumably increased during harsh periods when animal food was absent.

Keywords: bark peeled trees, CMTs, inner bark, Sami, native Americans, First Nations people, sharply seasonal environments, cooking pits

Introduction

Both the indigenous Sami in northern Scandinavia and many native groups in the north temperate and boreal zone of North America based their living upon animal foods. Also, they lived in similar climates with sharp seasonal changes. Such food in the diet resulted in a lack of important nutrients, such as carbohydrates and some vitamins and minerals. Consequently, both peoples gathered food plants and inner bark, cambium, as a food component. Recent research reveals essential vitamins and minerals in cambium. This is consistent with the fact that neither the Sami nor the North American indigenous people were stricken by vitamin shortage deficiency diseases. Furthermore, carbohydrate and fiber are good complements to protein rich food. Bark was also a preferred material used for other purposes, such as tanning agents for preserving, and certain fiber being durable and easy to handle.

Trees do not have internal mechanisms to naturally repair an area where wood has been removed. They cannot replace wood tissue, but can limit the damage by attempting to cover wounded areas with new layers of wood and bark, creating chemical defenses against attack by disease and insects (Shigo 1979). Sap continues to flow up the trunk on either side of the wound (Eldridge 1982:34) and the bark extends its annual growth laterally to cover the vertical margin of the injury (Hicks 1985:110-112). A scar remains, and these obviously have different shapes in different areas, due to the intended area of use, tree species, tools and by whom the bark peel was performed (Mobley and Eldridge 1992).

In Scandinavia, the Sami way of living and use of Scots pine inner bark was documented by priests in the 1600s. These authors mention Sami bark use and methods to process bark. Eidlitz (1969) discusses inner bark use and the attitudes towards it in "Food and emergency food". Swedish research about scarred trees was performed recently; Niklasson et al. 1994, wrote "A dendrochronological reconstruction of use by Sami of Scots Pine (*Pinus sylvestris L.*) inner bark over the last 350 years at Sädvajaure N. Sweden", where tree ring studies were performed, revealing Sami bark use between 1618 and 1870. In addition, Zackrisson et al. 2000 published an extended, multi-disciplinary study: "Ancient use of Scots pine inner bark by Sami in northern Sweden related to cultural and ecological factors". Continuous use of bark from 1450 and 1890 was discussed in a cultural and ecological context. The first literature reference about cambium use in western United States is the Louis and Clark Journals 1804-1806 (Thwaites 1905, in Swetnam 1984:177-178). North American ethnologists also noted the relationship between humans and trees at an early stage (Boas 1910), but systematic field observations were reserved for dendrochronological applications (Douglas 1929; Martorano 1981; Swetnam 1984). White (1954) used informants to develop an ethnographic context for Kutenai inner bark utilization in western Montana. Later, Hicks (1976) led investigations on Culturally Modified Trees, (CMTs) on Coastal British Columbia. Gradually, researchers in British Columbia have registered more CMT areas (Nicoll 1981a, 1981b; Mitchell and Eldridge 1982; A. Eldridge 1982; M. Eldridge 1982, Eldridge and Eldridge 1980; Provenance Research Inc. 1982; Ham and Howe 1983; Stryd 1982) and as a result, the provincial government has become interested in pilot studies of scarred trees. This inspired public and private parties to participate. Recent studies have stimulated more research interest in British Columbia (Arcas Consulting Archaeologists, Ltd. 1991; Eldridge 1988a, 1988b, 1991a, 1991b; Eldridge et al. 1988a, 1989b), proving bark stripped trees to be a valuable cultural

resource for anthropological study (Wilson and Eldridge 1988; Eldridge and Eldridge 1988). Parallel to the research, an enhanced public awareness of CMTs and their information value has developed.

The aim of this study is to describe and compare the use of inner bark by native groups in different regions; the Sami people in northern Scandinavia, native Americans in northwestern U.S.A. and First Nations people in British Columbia, Canada. Bark peeling is placed into a subsistence context to enable the understanding of bark use. To do this, I will discuss the temporal and spatial distribution of bark peeled trees, inner bark harvesting, tools used, the wide-ranging use of inner bark, the size, shape and directions of bark scars, inner bark contents as well as preparation techniques.

The specific questions I want to address are as follows: Are the apparent similarities in bark use based on similar climates and the resembling conditions of life that follow out of that? Secondly, was there a similar way of rendering and respecting nature among the Sami, native Americans and First Nations people? The comparison is based on a survey of literature, but also presents conclusions from interviews with American and Canadian researchers in anthropology and archaeology.

Bark peeling in Scandinavia and North America

According to several dendrochronological analyses, bark stripping of Scots pine (*Pinus sylvestris*) was common in the Sami culture from early 1450 to late 1890. Bark was mainly used as food and wrapping material. Bark peels for wrapping sinew are all recorded after 1750. After 1820, inner bark was seldom used (Zackrisson et al. 2000). Swedish authorities forcefully tried to stop the use of inner bark for food. From 1870 it was illegal to bark strip standing trees on crown land (anon. 1871).

Native people of northwestern America stripped most trees between the years 1850 and 1920. On the Flathead Reservation, inner bark use rapidly decreased after 1910, due to the increased availability of refined sugar. Also, Reservation officials were eager to restrain bark stripping, since it destroyed merchantable timber. During World War I, bark use was intensified due to sugar shortages, but after 1920 the practice completely ceased (Barrett 1990). White (1954) studied bark stripped pine trees near Flathead Lake in Montana and connected the high numbers of peeled trees during World War I to sugar shortages and sugar rationing. Since bark has a high sugar content, it was used as an alternate 'sweet'. On the Kootenai National Forest in northwest Montana, cored trees showed that peeling was done from 1756 to 1944 and most peels dated from the nineteenth century. Germination dates of scarred trees ranged from 1611 to 1821. 65% of germination dates were from the eighteenth century (Alldredge 1995). Although dating reveals some information about the frequency and extent of bark use, it is still impossible to tell the length of time that the bark peeling practice has been going on.

Alldredge (1995:69) explains that the Kootenai bark harvest ritual is an indicator of the antiquity of cambium acquirement:

> *"How long does it take a ritual to build up, to take hold and become standard practice? It is difficult to say, but probably centuries. As humans we are inherently opposed to change. Beginning some ritualistic practice and getting it accepted by a group or society is something that does not occur overnight. Although we will never know the antiquity of peeling trees to obtain the cambium for consumption, we can speculate that perhaps it has occurred for several hundred, if not thousand years".*

Fig. 1. Old bark peeling on snag. South White River Park, Bob Marshall Wilderness, Montana. Photo: Lars Östlund

Also, scarred trees are a relatively common phenomenon on the Lolo and Bitterroot National Forests (Montana and Idaho). Ponderosa pine is the most frequently scarred tree. Other trees used for bark harvest in western Montana are lodgepole pine (*Pinus contorta*), western larch (*Larix occidentalis*) and cottonwood (*Populus trichocarpa*). Dating of scars has been performed on some trees at sites close to the mentioned area. The scars originated from the late 1700´s to early 1800´s (McLeod and Melton 1986). Eldridge and Stryd (1993) performed an archaeological study of culturally modified trees, CMTs on Meares Island, western British Columbia. Dating of bark peeled trees (Western red- and yellow cedar) indicated that the practice had been going on for 350 years, from 1642 to 1984, with the majority of scars belonging to the nineteenth century. According to dating records, bark use has varied in intensity, but there has been continuous use for at least the last 270 years. A decline in the twentieth century is probably due to the recent downturn in traditional

Fig. 2. Multiple scars on a lodgepole pine. Lolo National Forest, Montana. Photo: Lisa Ahlberg

The majority of scarred lodgepole pine in northern British Columbia were peeled in the nineteenth century and the oldest scar was only 132 years old Eldridge (1982:39). The results also indicated a preference to peel young trees, and multiple scars on the same tree trunk were common. Moreover, dendrochronological analyses have allowed the dating of cedar tree bark scars older than 1467 A. D in the Newcastle block of Vancouver Island (Eldridge and Eldridge 1988:36).

CMT samples have been dated in many areas in the Pacific Northwest (Parker 1970, 1984). Although, the time span varies between different locations, peels have generally been performed more recently in British Columbia than in northwestern U.S.A. The most recent scar dates from 1984 (Meares Island).

Bark scarring has been a widespread event in North America. These trees have been located in Arizona, New Mexico and Colorado, as well as Idaho, eastern Washington and Oregon (McLeod and Melton 1986). Furthermore, following the natural distribution of two cedar types, there are scarred trees on the Olympic Peninsula in the west and north into Coastal British Columbia and southeast Alaska (Mack and Hollenbeck 1985:3). The northern limit for the distribution of Western red cedar is halfway up southeast Alaska (Hebda and Mathewes 1984). The Alaska yellow cedar continues further north and a relatively low number are present in Prince William Sound. Yet, there are no scarred trees registered at this location (Mobley et al. 1990). Bark stripped Sitka spruce (*Picea sitchensis*) and hemlock are recorded north into Prince William Sound and the outer Kenai Peninsula, while the northern limit for scarred spruce is the Kodiak Archipelago (Mobley et al. 1990; Betts et al. 1991). Peeled lodgepole pines continues north of latitude 60 in the Yukon territory (Morley Eldridge, personal observation).

In Sweden, bark peels are found between latitudes 65.00-68.50 N, and stripped trees are found within the natural distributional limits of Scots pine. The area is situated between the Caledonian Mountains in the west and the provincial boarder of Lapland in the east, within the northern and middle boreal zone.

Fig. 3. Bark peeled Scots pine in old pine forest. Bärgå, Arjeplog. Photo: Lisa Ahlberg

The majority (90%) of the peeled trees in Sweden are located 350-500 m above sea level (Zackrisson et al. 2000). According to archaeological research on Kootenai National Forest, northwest Montana, the majority of cambium peeled trees occur at a somewhat higher elevation, 3000-4000 feet (1000-1300 m) (Alldredge 1995). Alldredge theorizes that as cambium is gathered during spring time, and the locations of cambium harvest areas are based partly on the seasonal movements of camps, the majority of cambium peeled trees would be found where camps were located in the spring. According to data from the Middle Kootenai Valley, Thoms (1989) in turn

Fig. 4. Rectangular bark scars on cedar trees. Clearwater National Forest, Montana. Photo: Lisa Ahlberg

speculates that prehistoric camps located between 3000 and 4000 feet are mid-spring occupational sites. Also Eldridge (1982:33) states that cambium stripped trees are connected to habitation sites, temporary camps, camps for other resource exploitation, occasional hearths, rock-lined circular depressions (a possible processing sign) and sometimes trail corridors, indicating spring or summer use of inner bark.

Clustering of bark peeled trees is a common occurrence. In Prince William Sound, groups of as many as 200 scarred hemlock trees have been located (Mobley et al. 1990) and a higher number of spatially grouped scarred trees are recorded in other locations. Ponderosa pine on Lolo and Bitterroot National Forests are often located in groups of 2 to 25 scarred trees. Bark peeled trees in this area usually occur along major streams and rivers. However, the highest concentrations of these trees are found in open, south facing areas, with gentle topography, close to water, and in areas that probably were camp sites (McLeod and Melton 1986). Also Barrett (1990) states that peeled ponderosa pines are generally situated near logical campgrounds: near meadows, creeks and lakes, usually appearing in clusters.

However, certain distribution patterns might be based on skewed information. According to Alldredge (1995:4), culturally scarred trees are clustered within specific areas on the Kootenai National Forest, mainly along major river drainages on Forest Service managed property. However, this pattern is dependent upon logging and lack of geographical knowledge of private property. With no logging impact, the density of scarred trees would have been greater in areas where culturally scarred tree (CST) sites have been recorded, as well as in logging affected areas where no CST sites have been recorded. Also, CST sites have only been registered during Forest Service surveys, on property managed by the Forest Service. Due to lack of surveys on private property, distribution patterns are not known.

Arcas Associates (1984:62-73) examined spatial distribution of bark stripped trees at Meares Island. Accordingly, these trees were clustered close to the shore, logged trees were independent of the spread of scarred trees. And among bark scarred trees inland, the number of peeled Alaska yellow cedar were higher than western red cedar. Different results were found in other regions; at Merchantile creek, bark stripped trees were uniformly distributed regardless of the distance to water (Eldridge 1988b:iii). Also the dominant shape of the bark scars differed spatially. Eldridge (1988b:iii) states that there is a difference regionally. In coastal areas, bark scars are mainly triangular, whereas at interior locales, the rectangular scar feature dominates. On the other hand, Hicks (1985:13) reported that rectangular scarring belonged to northern British Columbia, while triangular scarring dominated the southern part.

> *"On the west coast of Vancouver Island, triangular, bark-stripped western red cedars are predominant. The scar type does not seem to have changed through time; First Nations people used the inner bark consistently and seemed to have hit upon an appropriate debarking process from the beginning. What may have changed is the way past Nuu-chah-nulth people (the overall name for the First Nations people who live on parts of Vancouver Island) used the landscape. It may be possible that through time people were forced to go farther and farther into the forest in order to obtain appropriate cedar trees. In terms of rectangular bark-stripped cedars, the rectangular scar results from when First Nations people cut a fairly large chunk of bark from a cedar tree. Rectangular bark strips were used in creating temporary dwellings or for trade. This type of scarred trees seems to be more common as you go north on the coast, but there are examples of this type on southern Vancouver Island" (Heather Pratt, pers. com. 2000).*

The area where Zackrisson et al. (2000) performed field studies in northern Sweden, carried a high number of bark peeled trees, but herbaceous vegetation was scarce. On the other hand, shrubs, mosses and lichen with a relatively low nutritional value, were common. Among Northwest Coastal peoples in Canada, carbohydrate sources, like inner bark, were important in areas where nutritious root foods, grains or sweetener sources were absent (Johnson 1997:96). In northern B. C., in areas with low plant food reserves and long distances between watercourses, a high number of scarred trees are registered. Alternately, in the southern part where watercourses are numerous and the supply of salmon, as well as nutritious plants are good, there are relatively few scarred trees (Morley Eldridge, personal observation).

Used tree species

In the Sami culture, Scots pine inner bark was used for food, either fresh, roasted or dried. When dried it was ground into flour and could be mixed with reindeer milk, fat, blood or certain food. Bark was also used as wrapping material, mostly for the wrapping of sinew (Zackrisson et al. 2000). The diet among Fishing Sami was mainly based on fish; fresh, dried or roasted. Some pounded the fish and mixed it with dried, pounded pine bark, to create gruel (Högström 1747:122). When Forest Sami ate pine bark, it was prepared underground and consumed as candy called *Sautopetzi* (Graan 1899). During the summer, the inner bark was pounded and mixed with reindeer milk and the dish was considered a delicacy (Lundii 1905:32). The cambium of spruce, pine,

pine, birch, poplar and willow has been used both as regular food and emergency food, and also as spice and medicine among arctic and sub arctic people (Eidlitz 1969:71). The cambium was dried either inside a shelter or outside. It was also soaked in water to get, rid of the bitter taste of pitch. After drying the bark, it was minced and sometimes ground. Then it could be used for oatmeal or bread. Sometimes it was consumed immediately by adding sour milk (Eidlitz 1969:80). Also, the Sami often used "shoe hay" in their shoes during summer time, but shredded willow bark was a good substitute. It kept the feet free from wounds and soreness, and also protected the shoes as a tanning agent (von Duben 1977:152).

In North America, Western Red cedar was extensively used. Inner bark could be used for slow matches, which enabled the carrying of fire from one camp to another.

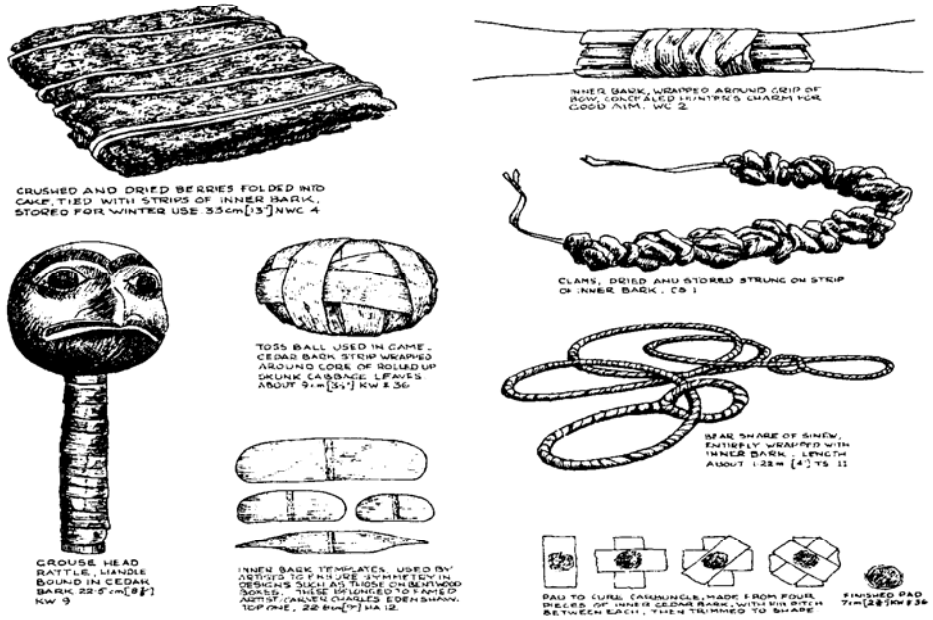


Fig. 5. The extensive use of cedar tree inner bark. In Stewart 1984.

Mats, baskets and head/neck rings were other cedar products (Smith 1997). The Thompson group, at times, made ponchos, cloaks, bodices and aprons using cedar inner bark. The bark was first rubbed and beaten in order to soften, then split into strips of desired length (Turner et al. 1990). Stewart (1984) mentions numerous applications:

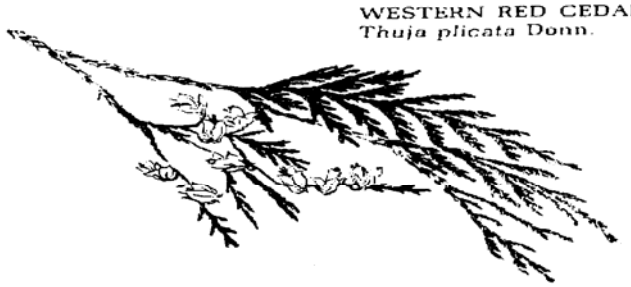


Fig. 6. Western red cedar twig.

Folded cedar bark baskets, mats, clothing, shelter, cooking and eating utensils, woven and coiled baskets, cordage, fishnets and line, sails, canoe bailers, diapers, blankets, personal and ceremonial ornaments, brushes, torches and bandages.

To make clear the extensive use of cedar bark, Drucker (1955:61) describes the life of an individual native in terms of cedar bark:

> *"As an infant he was swaddled in the bark, shredded and haggled to a cottony consistency; his pillow and head presser were pads of the same material; woven robes and rain capes of shredded bark protected him from rain and cold throughout his life; checker work mats of red cedar bark were his principal household furnishings, serving as tablecloths at mealtimes, as upholstery for seats, and as mattresses for his bed. With the beginning of European contacts he learned to use sails on his canoe and, when he was unable to acquire imported canvas, he made sails of heavily woven bark mats; old worn-out mats served to protect his canoe from the checking effects of the sun on bright days. On ceremonial and festive occasions he wore turbans and arm- and leg bands twisted and woven of shredded bark. He stowed his carpenting tools in a basket woven of the same bark. The Nootka whale hunter kept his precious harpoon heads in neatly made pouches of the same material. In historical times, our typical Northwest Coast native found shredded cedar bark to be an ideal gun wadding for the muzzle-loader he acquired from the white trader. And when he died, the chances were that unless he was a chief and entitled to special treatment, his body would be wrapped in a cedar bark mat for burial".*

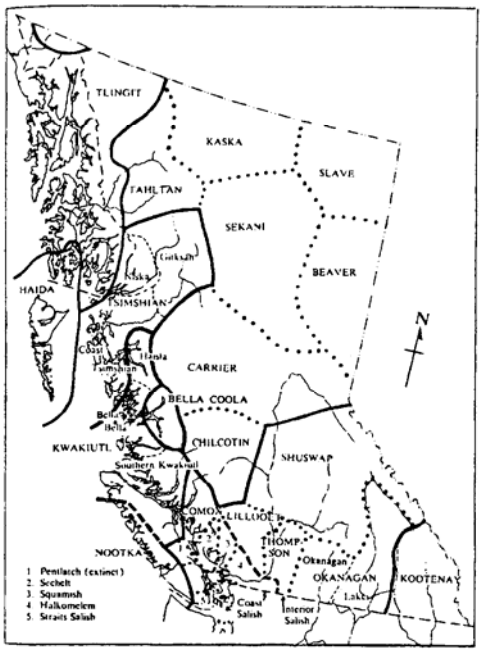


Fig. 7. First Nations groups in today´s southwestern Canada.

Some Northwest Coast groups used the cambium of Sitka spruce, *Picea sitchensis*. They ate it fresh or dried as cakes for the winter. Before drying the cambium, it was often mixed with Highbush Cranberries, (*Viburnum edule*). Some people still eat it today. The cambium could be eaten in the summer as a laxative (Turner 1995:33). The more Interior Gitskan people also ate Sitka spruce cambium, but they never dried it or made dry cakes (Smith 1997). The Thompson group used Sitka spruce inner bark for medicinal purposes. The inner bark was boiled and the concoction was drunk for various illnesses (Turner et al. 1990:101).

Western Hemlock cambium was popular among Coastal groups and some Vancouver Island Coast Salish. The Haida made cakes of a mixture of Hemlock cambium and Highbush Cranberries. These cakes were common as a feast food of supernatural beings in Haida myths. Hemlock cambium was consumed fresh or as cakes in the winter after the preserved salmon was consumed (Turner 1995:34). The Gitskan people ate the cambium with many kinds of grease (bear-, groundhog-) or salmon oil. The taste was said to be very good. As among other people, Gitskan made dry cakes to use during winter. The cambium was dried through simple kind pit cooking (Smith 1997). Hemlock cambium was said to be very was also believed to have medicinal qualities, and was an ingredient in wood medicine concoctions (Campbell et al. 1984:7). Eating the cambium was stated as good for the gall bladder (David Green 1987 in Johnson 1997).

Some groups ate Mountain hemlock, and Coast Salish groups consumed lodgepole pine cambium. The latter was, however, more commonly used by Central and Northern Interior groups as the Salish and Athapaskan (Turner 1997:35). Among the Gitskan people, lodgepole inner bark was both eaten and used as a blood purifier and purgative. The purging effect is said to start a half an hour to an hour after eating and to make one hungry (Turner 1997:35). Primarily, very young bark was eaten, while older bark was used medicinally (Johnson 1997:258). The bark and shoots of many species of pine are known to have antibacterial properties (Moskalenko 1986; McCutcheon et al. 1992). Flatheads and Kutenais in the interior of today's northern U.S.A. and southern Canada also ate lodgepole cambium. The latter suggested eating it for tuberculosis (Hart 1992:52).

Ponderosa pine was often bark stripped for its cambium layer. The Thompson ate it fresh or dried it for winter use (Turner et al. 1990). Kutenais and Flatheads ate ponderosa cambium as a sweet and delicious food. This was an ancient practice in the West. Rocky Mountain groups appreciated this "sweet" more than other groups. One sign of this is that ponderosa inner bark was peeled as late as the 1900´s on the Flathead Reservation. Since it dried out quickly, it was either immediately consumed or stored for only a few days. However, when preserving it for longer periods, the bark could be rolled into balls and stored to prevent drying (Hart 1992:50-51).

"Lodgepole seems to have been preferred before ponderosa. For example it has thinner bark, which is easier to remove, but seasons may have been of importance too. Lodgepole bark was possible to use later during the season (in September as horse food), while the ponderosa was harvested during the spring. Ponderosa was probably not used for horses. Lodgepole was a kind of secondary food. After fires on mountain ridges, lodgepole came back quickly. It was also found at higher altitudes and was simply more available. When native people used horses for traveling they didn't want to spend too much time to gather food and that's why lodgepole was a good alternative, having such thin bark. Maybe the taste of lodgepole was better too, because it grew at high elevation where the snow and ice melted later, meaning lodgepole experienced a later spring"
(Merrell 1999 pers. com.).

Fig. 8. Western larch
(Larix occidentalis)

Amabilis fir, *Abies amabilis*, cambium was used for food (Moerman 1998) or consumed to prevent constipation (Smith 1997). The cambium was either eaten fresh or dried for winter (Turner et al. 1990:102).

Inner bark of *Abies balsamea,* Balsam fir was a medicinal spice, and an infusion of inner bark was ingested for chest pain (Moerman 1998:34).

Inner bark from *Abies grandis,* Grand fir and *Abies lasiocarpa,* Subalpine fir, was typically eaten. Turner (1990) describes a medicinal experience using the bark: "*A Thompson woman tried inner bark from Subalpine fir as medicine for 'shadow of the chest', which was probably the same as beginning of tuberculosis. It made her very sick; "it was aching all over, just as if I had the flu..but after that I got better, went back for the x-ray, and no shadow".* Also the Gitskan people considered the bark of subalpine fur to be a strong medicine, curing respiratory ailments, dressing sores and wounds and working well in tonics (Johnson 1997:260). When eating the cambium in June it could cure constipation (Smith n.d.:66-67).

Cambium layers from Western larch, were peeled for food by native peoples in today's northern U.S.A.

Bark was not exclusively stripped from coniferous trees. Some Coast Salish groups ate the cambium layer from the inner bark of Red alder, *Alnus rubra*. They ate it fresh, with oil added, or dried in cakes to eat during the winter (Turner et al. 1995). Gitskan groups used *Alnus rubra-*, *Alnus incana-* and *Alnus crispa* bark for remedies to various conditions (Johnson 1997:267).

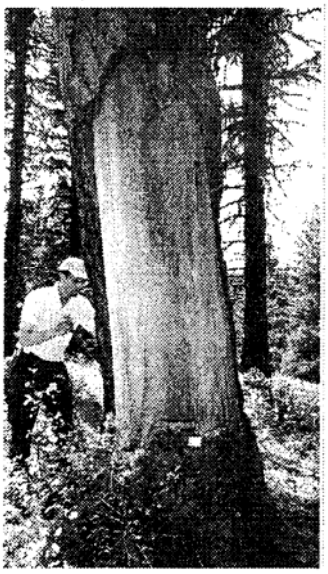


Fig. 9. Large bark-peeling on ponderosa pine, Brownstone Creek, Bob Marshall Wilderness. Photo: Lars Östlund

Several tribes within today's British Columbia ate Black Cottonwood, cambium. The cambium was consumed fresh or sun-dried with grease. Black cottonwood could not be stored, as it quickly sours and ferments (Turner et al. 1997). Flathead, Kutenai and Blackfeet appreciated its sweet bark, probably more than any other tree species. Not only humans, but also animals liked this bark. Some groups fed bark to their horses and also brought bark along to feed horses taken on war parties. When drinking black cottonwood bark tea, the Kutenais believed they could cure tuberculosis and whooping cough (Hart 1992:68-69).

Trembling Aspen, *Populus tremoluides,* was consumed by some groups (Chevallier 1996) and used in a cleansing, purgative decoction by the Gitskan (Smith n.d. 1997). Aspen cambium chewed in springtime worked as a stimulant (Mathews n.d. 1996).

The inner bark of another deciduous tree, Slippery Elm, *Ulmus rubra*, was collected by various groups and was used for many purposes. As food, it is nutritious, soothing and good even for infants. As a laxative, it works well against digestive disorders, but it also has a soothing effect on coughs and other respiratory conditions. When applied externally, it softened and protected the skin (Chevallier 1996). Another deciduous tree, Rocky Mountain maple, *Acer glabrum, w*as bark stripped for its cambium. This, in turn, was used to make baskets, woven packsacks and woven mats (Smith 1997). Also twine was made from Rocky Mountain maple inner bark.

Fibrous *Acer macrophyllum,* Broadleaved maple inner bark from young trees was made into whippers for soapberries (Turner et al. 1990).

Birch bark *Betula papyrifera* was used for baskets and dishes, as well as food wrap (People of ´Ksan 1980), and implements like moose calls, torches and fire starters. Corpses were sometimes wrapped in birch bark (Mathews n.d. 1996).

There are several accounts of cambium being used as a food source, but the question remains: "what was it really like to eat?" Gaertner (1970:69-70) experimented with flours extracted from *Pinus strobus* and *Abies balsamea* inner bark, and then concluded that the inner bark had a "*disagreeable and strong flavour.* According to Cushing (1920:223) and Standley (1912:448), inner bark was difficult to digest. After observing the Ute group, partly sustaining themselves on inner bark, W.A. Ferries (1940:269) declared: "*it has a sweet acid taste, not unlike acid syrup*". According to White (1954:np) tree species with more pleasant cambium tastes were ponderosa pine, lodgepole pine, white pine (*Pinus monticola)* and the quaking aspen (*Populus tremuloides*). Stump (nd) states that ponderosa pine was a favoured species "*perhaps because of the large quantities of cambium obtainable from a single tree*". However, Hart (1992) explains "*sweet inner bark of black cottonwood was relished by the upper Kutenai, who thought it sweeter than ponderosa cambium*". Other information states that quaking aspen was "bitter as quinine" (Peattie 1950:320) and black cottonwood was even less palatable (Peattie 1950:332). Along the coast of Washington state, Western hemlock and Mountain hemlock cambium were preferred. Nevertheless, species like Rocky Mountain maple, Sitka alder (*Alnus sinuata*) and Red alder were sometimes used. As mentioned, cambium was often mixed with oil or other food. The Coastal Salish experienced the inner bark as "*quite constipating when eaten alone*" (Barnett 1955:np, in Churchill 1979a:9). The taste seems to vary between tree species and different tree species were favoured in different areas!

In the past, trading of inner bark has occurred; cedar is mentioned (Eldridge and Stryd 1993), and Gitskan people traded hemlock bark to the Wet´suwet´en (Johnson 1997). Pine inner bark was commonly traded between Forest and Mountain Sami families (Drake 1918). The Forest Sami sold pine bark, prepared underground, to the Mountain Sami, who liked its taste (Lundii 1905). Trading provided the Fraser River Lilloet with certain foods and material that otherwise would not have been available. Bitterroots, hazelnuts, cedar bark and wood from some tree species were imported from people living in nearby areas (Turner, in Hayden 1992).

The annual bark harvest

Forest Sami groups who had their dwelling places in pine forests generally peeled bark around midsummer, when the bark was easy to remove from the tree trunk. The bark

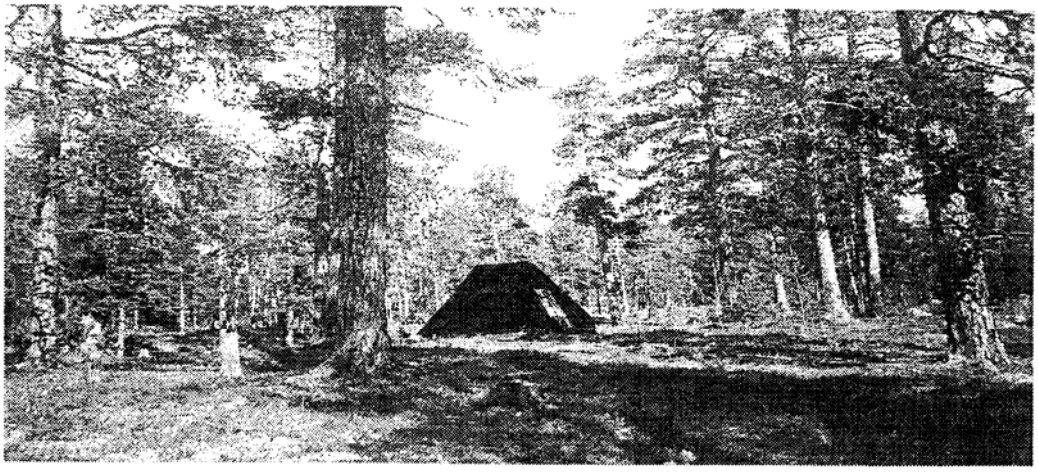


Fig. 10. Sami hut surrounded by bark peeled pine trees in a former dwelling place. Bärgå, Arjeplog. Photo: Lisa Ahlberg

pieces were approximately two ells (about 90 inches), and the inner bark was separated from the outer bark with a knife (Lundii 1905:32). The peeling was typically performed during spring, when the sap was rising, and the bark easily removed. Moreover, the nutritient value of the bark flour was higher at this time of the year (Eidlitz 1969). Meat and fish dominated the diet among arctic and sub arctic people. In addition, wild plants were a delicacy as well as a regular food, emergency food and a medicine, with species use varying in different locales. Women and children routinely harvested and accordingly, they consumed more vegetables. The use of certain species was bound by tradition. The most important vegetables for the Sami were some *Umbelliferae* species, for example *Angelica archangelica,* some from the families *Liliace* and *Polygonaceae*, and also algae, lichen, sap, pitch, berries, and the cambium from certain trees (Eidlitz 1969). Pine, birch and, in some areas, spruce, were bark stripped, and most often among rich Sami families who had lots of milk. The pine bark harvest sometimes began earlier than Easter. The pine inner bark was hung over a rope in the hut to dry. When dried and ready, it was rubbed into coarse flour that was often eaten mixed with reindeer milk. The mix became porridge-like, and was very rich in fiber. Graan (1899) has described the methods that Sami people used preparing pine bark:

> *"They take the pine bark from large and thick pine trees, preferably as close to the ground as possible. They hang it on racks a day or two to dry, and then they rip it into small slices and put it in a big, well-wrapped bushel made of birch bark. They place the bushel into a pit in the ground, cover it with soil and peat, over which they make a huge fire of logs. The fire burns for a day, then they unearth the bushel again, and the bark is red and sweet".*

Grain of pine bark was also used to thicken meat or fish soup (Fjellström 1985). Gruel made from pine bark held a prominent place in the diet.

Hundreds of old dwelling sites have been found in openings in the forest, with decayed tree trunks piled nearby. When the edible layer under the bark had been consumed, the trunk was discarded. When all the trees around the dwelling had been used up, the family packed its hut or tent and moved on to a new site (Nickul 1977).

Stripping bark was also primarily a task for women and children among the Kootenai and Flathead groups. It was a spring ritual, combined with the harvest of bitterroots. A small test hole was cut in the bark to try the inner bark flavour; the sweeter the sap, the better (Barrett 1990). Likewise, Hart (1992) states that women performed the debarking of ponderosa trees, although the bark is relatively thick. According to Turner and Efrat (1982), the harvest of bark was a task for either families or entire villages having the sole right to harvest certain areas. The annual bark-peeling event was obviously of great importance.

Fig. 11. Bitterroot (Lewisia redviva)

Fig. 12. Mary Ann Combs with wooden-handled, iron digging stick and rawhide collecting bag, Montana.

Stewart (1984:113) explains that red and yellow cedar bark were collected during the spring and summer months, but the harvest times varied among different cultural groups, due to their geographic location. When the sap was running, women and men went together to cedar stands. The men were needed to help because pulling bark was strenuous. Bark thickness and quality depended on the size and growth of the tree. Young cedars, twenty to thirty-five years old, and about two hand-spans wide were chosen first.

Eldridge and Stryd (1993) stated that women generally performed bark stripping of western red cedar and yellow cedar. Young cedars with little or no lower branches were primarily chosen. The Thompson group bark stripped lodgepole pine (*Pinus contorta*) in May

or June, depending on elevation. Trees having a stem of about 30cm in diameter were preferred. When harvested too late in season, the inner bark apparently gets to dry to come off (Turner et al. 1990:102).

The Okanagan-Colville group harvested several different plants, seeds, nuts, lichen and roots as well as cambium from ponderosa and lodgepole pine. These food plants were so important to the people that each spring before harvest, ceremonies were held in Okanagan-Colville territory to celebrate the arrival of the crops. Other indigenous groups held similar ceremonies. The food-gathering process was typically the women's job. At times, families worked together harvesting crops. People usually moved campgrounds seasonally, and in early spring, they moved their winter villages, to areas for digging roots. The gathering process could start as early as March; seeking the shots of balsamroots (*Balsamorhiza sagittate*). In April, May and June, bitterroots (*Lewisia redviva*), onions (*Allium sp.*) and other "roots" were harvested and trees were bark stripped to extract the cambium. In summer and fall various fruits and berries along with lichens and mushrooms were gathered (Turner et al. 1990). An unusual way of harvesting hemlock cambium is described by Curtis (1915):

> "*A man would climb a tree via a cedar with a rope and a yew block. When he reached a desired height (sometimes as high as 45 feet) an incision was slashed through the bark. Then the climber would begin his decent. While doing so, strips of bark were lacerated from the tree. As the strips fell to the ground, a woman would gather the bark and scrape off the cambium. Later, in the village the peeled inner bark was cooked and rolled into balls. The balls were then kept until the winter dances began. At that time the inner bark was eaten with oulachen oil (Thaleichthys pacificus)*".

Furthermore, White (1954:2-3) references an unnamed source, when describing the ceremonies around harvest of certain crops:

> *"When old timers used to do this peeling they did it in the spring, usually on and after the first Sunday in May. They held a celebration in which all the Kutenai in the old days used to participate. Now the ceremony is nearly died out. Usually the day before Sunday they held a gathering of the people. They prepared for the Sunday morning when it was necessary for them to pray to the digging sticks that were used for digging bitterroot. After the head woman, (who serves a lifetime) discovered that the bitterroot was ready to dig, the others in the group peeled trees for a noonday feast (the bitterroot ceremony must precede all the harvesting of roots, greens, nuts and berries during the year). Of course, if she, the headwoman found out that the bitterroot was not yet ready to dig, then the whole affair was postponed. In the old days if any person peeled trees before the bitterroots were ready, it was believed it would bring bad luck. The offender was not punished by the people, but the spirits would somehow do that. Those actually involved in debarking trees were strong women, who could peel off the trees, some expert bark splitters with special tools designed for their craft, and children who helped their elders as best they could".*

Several statements imply that the bark harvest was of such importance that camps were erected in connection with the peeling:

> *"They make a camp near water and make an evergreen shelter and stay there until they have enough hemlock sapwood"* (People of ´Ksan 1980:83). *"They all went into the valleys to gather hemlock bark and camped there while they worked"* (Turner 1975:62). *"Harvest areas could be located a day hike from the camp site and they were often known for the presence of bitterroot and camas. They could establish a camp and stay some week and harvest bitterroot and camas and then peel bark"* (Merrell 1999 pers. com.).

Fig.13. Bark peel on ponderosa taken twice within a few years. Bitterroot Mountains, Montana. Photo: Gerd Aurell

In People of ´Ksan (1980:80), a woman describes the harvest of Jack pine (*Pinus banksiana*) "noodles" (thin strips of inner bark), emphasizing that the noodles are immediately eaten, as they quickly discolour, sour, and cannot be eaten the next day. The noodles are sweet, tender and delicious, a good source of sugar. Also, she explains that the bark must be peeled at daybreak, when it is "milky" and easily handled. Later, when the sun has warmed the bark, the noodles are too sticky and syrupy for her taste.

According to Turner (1978:58-59), lodgepole cambium was "*sweet and succulent*" and had to be harvested at precisely the correct time in the spring.

Further, Turner (1978:60) suggests that ponderosa pine cambium was at its best when "*obtained from young trees, before they began to bear cones. It older trees. It was usually ready to harvest two or three weeks before lodgepole pine cambium*". Likewise, Churchill (1979b:np) citing Malouf (1974) states that lodgepole pine cambium was peeled a bit later in the spring than ponderosa pine. "*In other words, when one source of cambium dried up, another seemed to become available*".

> *"Different ponderosa had different degrees of sweetness, so very often they tasted a sample of the sap. If it didn't taste satisfactory, they would simply try another tree. I'm not sure why the taste differs, maybe because of different sun exposure. The sap is best during spring time"* (Merrell 1999 pers. com.).

Cambial activity is gently dependent upon temperature, but also moisture (Helmers 1962:276). The "right" time for cambium harvest varies by a few weeks annually. The Coeur d´Alene people from the southern Plateau called May the "*bark loose on tree month*" (Teit 1930:95). Cambial activity also differs among species. Before bud break, harvest of spruce cambium is ideal, while pine cambium is preferable slightly after bud break (Busgen 1929:99). When waiting too long, the cambium turns into wood during

the lignification process and becomes inedible (Busgen 1929:106). However, the ability to peel conifers is longer than for hardwood. The stem direction is also important. Trees growing in well drained, south-facing slopes have a longer peeling season as compared to trees in other environments (Wilcox 1962:64). After the point in the growing season when the bark is "sweet and tender", it matures and accumulates secondary compounds. Then, conifer barks are no longer digestible, but good for medicine (Johnson 1997:317).

There were several different methods to determine whether or not a tree was ready to be peeled. Among Swedish farmers, pines chosen to provide bark were often based on bark thickness (Levander 1914; Pettersson 1941) presumably a consequence of thin bark being easier to carry (Niklasson et al. 1994). Art Matthews Jr 1994 (in Johnson 1997:126) explains that the bark was penetrated on the northern side of the stem when determining whether the cambium of a tree was harvestable or not.

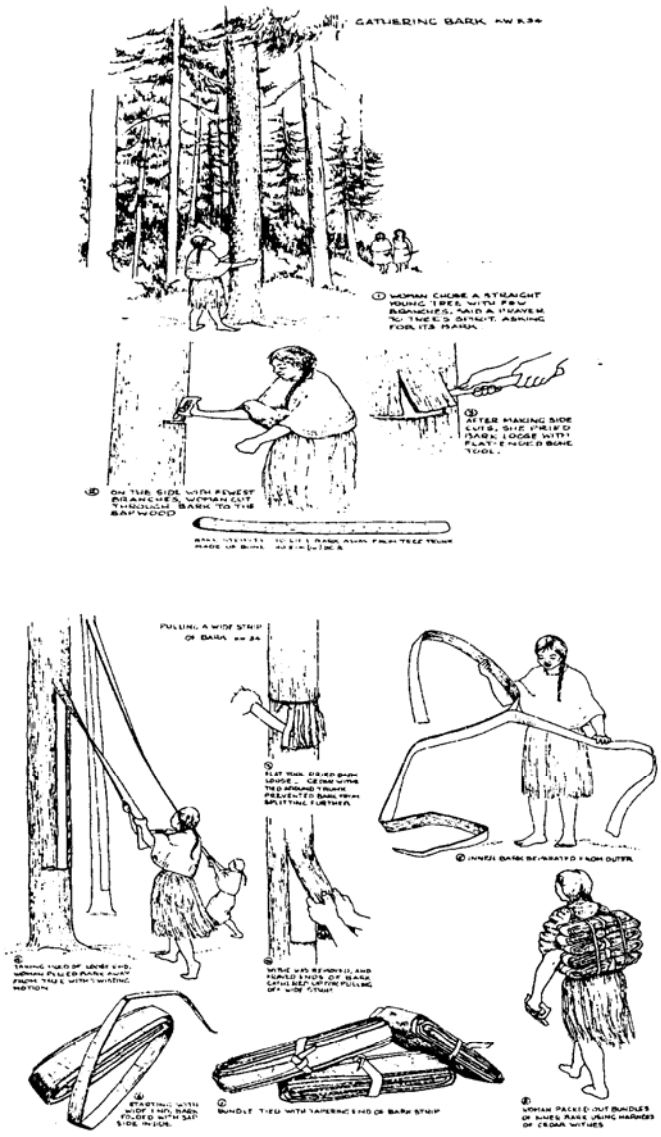


Fig. 14. Cedar inner bark harvest.

This way one could consider the thickness of the new tissue layer between the bark and wood. A satisfying cambium layer on the north side implied that the whole tree was good. The Gitskan people used a bone gauge tool to try out the swelling of hemlock bark. If the tip of the tool easily pierced the bark, then it was harvest-time (G. MacDonald pers. com. in Eldridge 1982). Further, a vertical strip could be removed, and sap was sampled to test the flow and sweetness (Hart 1992; People of ´Ksan 1980:83; Turner 1978:206).

Other tribes analyzed the taste of branch tips, and the look of new growth colour in pine, birch and cottonwood (R. McDonell pers. com. in Eldridge 1982). Another way to decide about the peeling was to check the blooming of certain plants and the ripening of conifer pollen cones, which indicates that lodgepole and ponderosa pine are ready to harvest (Turner et al. 1980). Generally, young trees with as few lower branches as possible were chosen first (Anderson 1925:136; People of ´Ksan 1980:80); Spier 1930:165; Turner and Bell 1973:270). Nowadays, other criteria are applied for hemlock, where quite large trees are chosen (G. MacDonald pers. com. in Eldridge, 1982). Good areas for bark stripping were often known in advance and during harvest, the camp was established for a week or more (People of ´Ksan 1980).

There are numerous recommendations connected to the harvest. According to some people, a sunny day is preferable for harvest, while others believe in better inner bark quality on a mild and overcast day, or during rain. Hart (1992) claims that a harvest day should be cloudy and cool, which makes the sap run well. Also, trees close to the camp were often peeled first. After having pulled off the huge bark pieces, the separation of inner- and outer bark was performed at the harvest site, since the pieces were too heavy to carry back to the campsite. Art Matthews Jr. (7/24/94) suggests that a tree growing by itself rather than in a group of trees has better cambium. A sun-exposed tree is ready to be peeled earlier than a tree growing in a shady gully. To get as "good" and clean a product as possible, a tree with smooth bark should be chosen.

Trees were approached with respect

The Sami people always left some undamaged cambium to secure the survival of the tree. Disobedience to this tradition would lead to illness (Drake 1918). Before being cut, the spirit of the tree had to be informed to be able to safely leave the tree (Louise Bäckman pers. com., in Zackrisson et al. 2000). Apparently, some native groups in North America had similar customs. According to Stewart (1984:113), before the bark was pulled off a cedar tree, the spirit of the tree was addressed in a prayer of respect, thanking it for being a good

Fig. 15. Very large bark peel which almost killed the tree. Brownstone Creek. Bob Marshall Wilderness, Montana.
Photo: Lars Östlund

provider and asking for its "dress" (the bark), and explaining why it was needed. People expressed gratitude to all natural resources; plants, animals, birds or fish, understanding that the resources gave of themselves. To show respect was to ensure a good supply in future years.

According to old Kootenai people, their ancestors never stripped a tree completely around the trunk. They knew that girdling would kill the tree (Barrett 1990). Peels for bark were, however, made almost all around the stem. Sometimes as much as three quarters of the circumference was taken. Still, the trees survives this, and often look as vigorous as "unpeeled" trees. A pitch layer develops over the scar shortly after the bark has been stripped. The pitch protects the tree against insects and fungi.

Heather Pratt is of the same "protective" opinion:

> *"Sometimes on the Northwest Coast a cedar tree would be stripped more than once, but it would be extremely unusual for the tree to be stripped completely of bark. First Nations people knew that to do so would kill the tree"* (pers. com. Dec. 14, 1999).

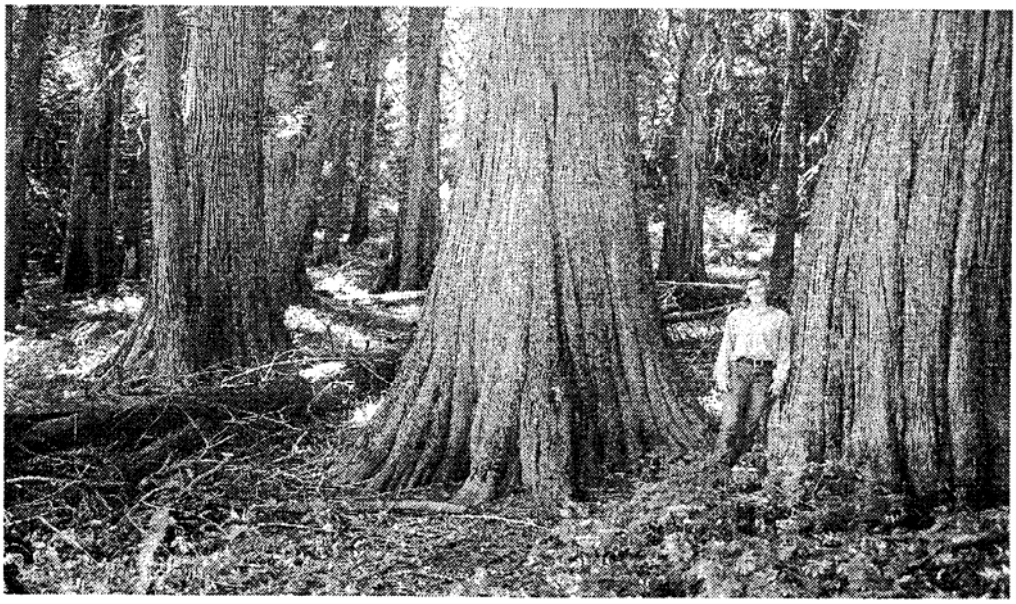


Fig. 16. The little author between the souls of two cedar trees. Clearwater National Forest, Montana. Photo: Carolynne Merrell

On the other hand, Tlingit elders have reported that whole young hemlock trees were cut down *"to obtain the confection made from the inner bark"* (Newton and Moss 1984:24-25). Johnson (1997:96) is of the same opinion, explaining that either the whole bark was cut from a standing hemlock or the tree was cut down and then the bark was peeled off. In 1985, Mack and Hollenbeck surveyed bark peeled trees in the Gifford Pinchot National Forest in Washington, and found four characteristic scars: rectangular with cut marks at the top and the bottom, triangular with cut marks at the bottom, combinations of the rectangular and triangular forms, and scars that *entirely girdled* the tree (Mobley and Eldridge 1992:94). The question of how much bark to

pull off seems to differ between the groups. If it was a good tree, most west coast basket makers pulled it all; the Coast Salish took about two thirds, and the Kwakiutl on the west coast left a strip of four finger widths on the tree. The Haida said that if you removed all the bark and killed the other cedars nearby would curse you. Generally, one side of a tree had more branches than the other, making it less desirable for pulling bark. This left enough bark for the sap to carry nutrients to the roots, providing for the trees` continued growth (Stewart 1984:116). Overall in native religious traditions, plants and animals were generally believed to have "souls" capable of thought and feeling just as people are today. The need to utilize and exploit natural objects was recognized, but usually the object was approached with reverence and respect and never used wastefully or without due appreciation (Anon). This belief was reflected in the harvesting of plant materials, as can be seen in the following "prayer" (Boas 1930), by a First Nations woman on the West Coast, to a young cedar tree from which she is about to harvest the bark:

Look at me, friend, I come to ask for your dress,
For you have come to take pity on us;
For there is nothing for which you cannot be used...
For you are really willing to give us your dress,
I come to beg you for this, Long-life maker,
For I am going to make a basket for lily-roots out of you.
I pray, friend, do not feel angry
On account of what I am going to do to you;
And I beg you friend, to tell our friends about what I ask of you!
Take care friend! Keep sickness away from me,
So that I may not be killed by sickness or in war,
O friend!

Bark peeling tools and technical aspects

Forest Sami people used long and thin knives made of steel or bone to cut the bark off the stem, and the cambium was removed with broad bladed scrapers with handles (Lundii 1905; Itkonen 1948). Antler scrapers and knives, associated with collection and preparation of bark for food, have been revealed during excavations at a dwelling site in northern Finland (Carpelan 1975 and Carpelan unpublished).

In North America, before metals were obtainable through trading with the white man, the women used sharpened horns from mountain sheep to cut through bark.

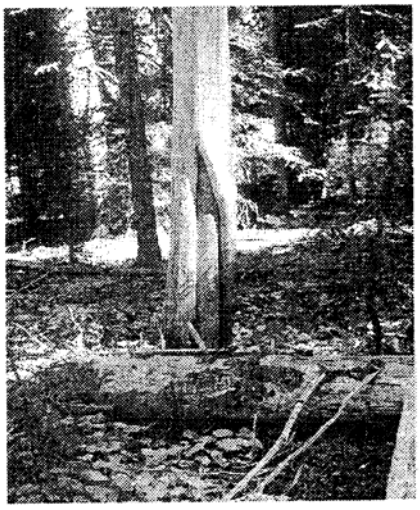


Fig. 17. Scarred lodgepole pine. Lolo National Forest, Montana.
Photo: Lisa Ahlberg

Then, large wooden pry sticks simplified the work by making the bark come off the stem and, finally, the inner bark was scraped (Barrett 1990). Among the Kutenais, deer rib scrapers were used to remove cambium layers from White pine and Red pine (Schaeffer 1940). According to Joanne Biterane (pers. com. Sept 23, 1999), trading with the white man started in the late 1700´s. Before, buffalo ribs were used to get underneath the bark and "push" it up, and after, knives and hatchets made of iron were preferred.

> *To peel the bark off they used a long stick, probably ten feet. That way they could detach the bark over their heads, then twist it and pull it off. The tool they used to cut it off was usually obsidian with. In the 1800´s they got metals from the white man, and the tools changed. Then they used to put the top of a tin can on a stick. The long stick was perhaps not used for lodgepole, only ponderosa, because the* ponderosa scar is a lot bigger" *(Merrell 1999 pers. com.).*

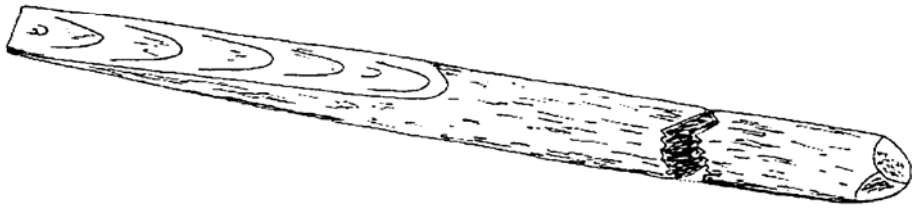


Fig. 18. Large wooden stick used to peel bark off a tree trunk. It was typically ten feet in length.

In "Native plants and early peoples" (1992) Jeff Hart describes the way a ponderosa was peeled. Like Merrell, he explains that a wooden stick, (most often made of juniper), was used to separate the bark piece from the tree trunk. The stick was flattened as a chisel in one end. Even though the tool was somewhat large, it was still flexible enough to follow the shape of the trunk. Rib bones from elk or bison were also used for debarking. Another tool was needed to part inner- and outer bark. In prehistoric times, native Americans made scrapers out of mountain sheep horns, but more recently, by the 1890´s, baking powder cans came into the region. Spade-like instruments were created out of the cans, which were superior to the horn knife (Hart 1992:50).

Bark from different tree species doesn't "behave" the same way when being pried off. When bark is peeled from lodgepole and ponderosa, lodgepole cambium sticks to the stem, while ponderosa cambium comes off with the outer bark. Accordingly, different tools are needed to detach the cambium (Teit 1930:92; Turner et al. 1980:32). Teit 1930, (in Churchill 1979b:np) states that

Fig. 19. Significant scar on a lodgepole pine. Lolo National Forest, Montana. Photo: Lisa Ahlberg

when removing the bark from a ponderosa tree, tools made of wood or various kinds of animal antlers, were used. The cambium was detached by using a knife-shaped rib bone scraper.

Likewise, Ray (1933:103) Turner et al. (1980:33) mention that a straight knife made of deer rib or ulna was used to separate the inner- and outer bark. Lodgepole scrapers had concave ends, in order to follow the shape of the stem (Anderson 1925:136). Animal scapulae had the correct shape and were exclusively used (Teit 1930:92). Many tribes also used a double-ended bone or antler scraper, which they thoroughly decorated (Eldridge 1982:12). When stripping the outer bark of a lodgepole, a first cut was made and then bark removal was performed by hand (Alldredge 1995:29-31). According to Turner et al. (1990:102), a piece of horn or wood was used. The cambium was pried off the trunk by scraping with the shoulder blade of an animal. The harvested cambium had the shape of narrow strips (Alldredge 1995:29-31). Turner explains that based on the maturity of the tree, the edible tissue was scraped from either the wood or the bark. And, like Alldredge, she states that this scraping was often accomplished by using a sharp bone or horn implement, often obtained from the shoulder blade of some large animal (Turner et al. 1990:102). Similar to ponderosa, hemlock inner bark came off together with the outer bark. A special knife was used to scrape it off. The blade of the knife had a semicircular shape and was made from a piece of saw blade, ground down until it was razor sharp (Johnson 1997:96-97). After hemlock bark had been harvested, the inner bark was scraped off with a copper knife and historically a mussel shell scraper was used (Boas 1909:405). Other "scrapers" used were double-ended and made of bone (G. MacDonald pers. com. in Eldridge 1982:9).

Results of a survey in northern Sweden show three distinct scar lengths on Scots pine. Peels for food had an average length of about 96 cm, while scars for wrapping of sinew appeared in two sizes. When bark was intended for rolled up cases, the remaining scars had a mean length of approximately 34 cm, and bark for double folded packages produced scars of about 57 cm (Zackrisson et al. 2000). By cutting two scars with a knife at the top and bottom of the ends respectively, the bark was peeled off from part of the tree.

When ponderosa and contorta were peeled, rectangular pieces of bark were cut out (Johnson 1969:74; Turner et al. (1980:32). The size ranged from 50 cm (Ray 1933:103) to 125 cm in length (Palmer 1975:51). Palmer (1975:51) stated that the Shuswap made horizontal cuts of 225 cm and 125 cm in height. A vertical cut split the bark and then it could be pried off (Cline 1938:28; Medsger 1939:93). Harlan I. Smith (1919) describes that Sitka spruce (*Picea sitchensis*) bark was cut in horizontal bands, inner- and outer bark was removed together, and the cambium was then separated on the ground. (This kind of stripping is believed to have killed the tree). As mentioned, lodgepole bark was infrequently pulled off by hand, after the first horizontal cuts (Teit 1930:92). Some tribes, nowadays, initially make vertical cuts, 3 to 5 cm apart at the top. The outer bark is then pulled down and only a small piece of bark is left at the bottom of the scar (People of ´Ksan 1980:81). Arcas Associates (1984:8-9) described how the Nootka people harvested cedar bark: *To start a bark strip, a cut was made near the base of the tree with a knife, chisel or D-adze* (Drucker 1951:93, Turner and Efrat 1982:42). *The height of the cut is described as "at the base", "near the base" and "three feet up"* (Drucker n.d.:65, Turner et al. 1983:70, Koppert 1930:48). In some cases, parallel vertical cuts were made with a specialized "digging stick" as far up as

one could reach (Drucker n.d.:65), before the strip was grasped by hand and pulled away from the trunk and up the tree. The width of the strip varied from four inches (10 cm) to one foot (30 cm), tapering to a point at the top of the scar (Drucker n.d.:65, Koppert 1930:48). The length of the strip was described as 3-5 m (Turner et al. 1983:70), 15-20 ft (5-7 m) (Koppert 1930:48) and 9 m or more (Turner 1979:88).

Trees used for cambium had oval, "tear-drop", or rectangular shaped scars (Alldredge 1995). Obviously, bark scars occur in a variety of sizes and shapes. Western red cedar and yellow cedar have long and narrow scars, tapering to a point, which makes them triangular. A survey from Meares Island on the west coast of Vancouver Island (Eldridge and Stryd 1993) reveals that a majority (>98%) of the nearly 2000 scars were triangular. Most of them were western red cedar. The "typical" scar was slightly over 7 m in length, although scar lengths greatly varied. The triangular scars may be remnants from traditional cedar bark collection, from which clothes, mats, hats and a large number of other items were made. One third of the trees had more than one scar, which indicates that revisiting of favorite stands occurred. Some rectangular scars were found as well, belonging to western red cedar, cascara, red alder, hemlock and yew. More than half of the scars were less than 50 cm in length and 10 cm in width and this bark was likely used for traditional medicines and, in some cases dyes and food. In other areas, such as the interior of Washington State, berry baskets were made from such rectangular bark pieces (Eldridge and Stryd 1993).

Scar directions - a religious matter?

Swedish studies imply that Scots pines were primarily peeled on the northern side of the stem. North and south were both important directions to the Sami and influenced cultural and religious phenomena (Schlachter 1958; Manker 1938, 1950; Louise Bäckman pers. com. in Zackrisson et al. 2000).

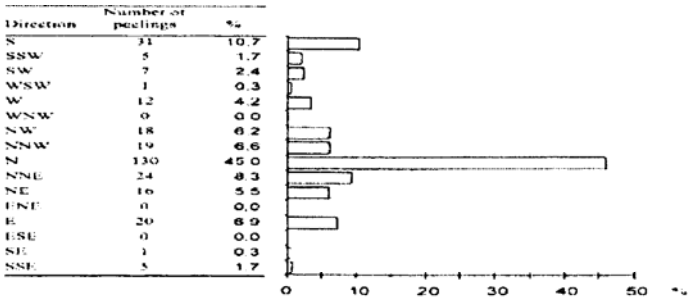


Fig. 20. Directions of registered bark peelings in Zackrisson et al. 2000.

The Sami had a special relationship with trees, which is likely to have affected the way of peeling the trees. As mentioned, the tree had to be told before the peel was done, to ensure that the spirit of the tree had time to safely leave it (Louise Bäckman pers. com.). Also, living trees that provided bark for food became sacred and were not used for firewood (Itkonen 1948). A similar respect for nature was prevalent in North America; the Okanagan-Colville people deeply respected plants, and especially those which were used for food and medicine. They had faith in both animals and plants having "spirits" and in their mythology plants/animals were given human features.

(The status of different plants today appears to be a consequence of such early mythology) (Turner et al. 1990:152).

> *"Scars from peeled trees are most often found on the northern side of a tree, depending of the taste. Bark peeled trees are generally found in south- or southwest exposured stands. First Nations people had total awareness of directions, but as opposed to the Sami, north and south did probably not have any spiritual or traditional meaning. Yet, dawn of day was spiritually important*" (Stafford pers. com. 1999).

Turner et al.(1990) connect the scar direction to dawn, explaining that the Thompson tribe gathered bark, for instance from hemlock and Western Yew (*Taxus brevifolia*), from the sunrise side of the tree. The same is mentioned for Vine Maple (*Acer circinatum*): *"The wood and bark was always taken early in the morning and from the sunrise side"*. Arcas Associates (1984:73-78) connects bark peeled trees with the direction and steepness of slope. Bark scars are frequently found on the upslope side, turned away from the reflecting light from the sea and as a result have fewer branches (Mobley and Eldridge 1992). Millennia Research Ltd., having surveyed upland areas west of the Thompson River, also recognized a north-facing trend among scars on cambium stripped pine trees. Within a certain site, located at the edge of a southwest-facing mountain, 50% (35 of 69), faced north or northeast. 68% were directed towards north, northeast or east (Stafford 1999:36). *"Peels doesn't seem to have been performed in a certain direction (at least not on the ponderosa)"* (Merrell 1999 pers. com.).

Nutritive substances of inner bark

Scots pine inner bark contains a relatively high amount of Fe and C-vitamin. Furthermore, the content of healthy food fiber is high (unpublished analyses, in Zackrisson et al. 2000). Carbohydrates, vitamin C and fiber were the most important nutritional constituants in pine cambium since they helped balance the protein and fat in meat, fish and reindeer milk, from which the main part of the calories in the diet was obtained. According to data, Scots pine inner bark peeled during springtime is highly nutritious (Airaksinen et al. 1986; Hanson 1996). Inner bark use was also thought to have prevented scurvy among the Sami people. At that time, scurvy was a widespread illness among Swedish and Norwegian farmers living at the coast, as opposed to the Sami in the Interior (Fellman 1906; Urbye 1937).

A Norwegian researcher examining bark bread- and flour (1937) showed that there was C-vitamin left, even during wintertime. However, the fact that bark was most often peeled during springtime, when the sap was flowing, would also affect the nutritious value of the flour (Eidlitz 1969).

According to chemical analyses (Keeley 1980:37) of hemlock cambium, it is composed of 26% carbohydrates (starch and edible sugars), 2% usable protein and 0.6% lipids. The energy value is 103.2 calories per 100 g of fresh cambium. Also the mineral content is worth mentioning; especially calcium (201.7 mg/100 g) and magnesium (11.57 mg/100 g). Iron and zinc is present as well. At the present, there is no standardized research technique to measure the nutritional value of cambium.

Another tree strongly preferred for its cambium is the ponderosa pine. Martorano (1981) describes the nutritional value of the inner bark: One pound (454 g) of ponderosa pine consists of 224 g of moisture (49%), 138.5 g of carbohydrates (31%), 55.8 g of crude fiber (12%) (dietary fiber 25 g), 8.2 g of ash (1.8%), 4.5 g of protein (1.0%), 2.7 g of fat (0.6%) and 595 calories (131 kcal/100 g). Spectral analyses also revealed 2740 mg of calcium, 173 mg of magnesium, 112 mg of phosphorous, 34 mg of sodium, 9 mg of zinc, 4.5 mg of iron, 0.5 mg of boron and 0.1 mg of chromium.

Fig. 21. Bark peeling on ponderosa pine. Indian Campground, Bitterroot Mountains, Montana. Photo: Lars Östlund

Analyzed lodgepole pine cambium contained 9.9 g of carbohydrates and 1.1 g of fiber per 100 g portion. Nutrient contents of spruce cambium (*Picea x lutzii*) are likely to be similar to pine cambium, whereas hemlock cambium is more nutrient rich. Cottonwood (*Populus balsamifiera ssp. trichocarpa*) is similar to pine, apart from containing a higher percentage of moisture. Cottonwood cambium is also rich in folate (Kuhnlein 1990) as is the cambium of aspen, *Populus tremoluides* (Johnson 1997).

Accordingly, hemlock and ponderosa cambium contain a quite similar amount of energy, yet the ponderosa is somewhat more nutrient rich, while the cambium of both species contain more energy than the lodgepole pine cambium.

Tannins are secondary metabolites in many plant orders (Cronquist 1981). They occur to a large extent in bark of temperate zone dicotyledonous trees and shrubs. Tannins and other polyphenolics can interfere with the absorption of nutrients when present in large amounts in foods (Griffiths 1989). At high concentrations, tannins inhibit enzyme activity, while at low concentrations they stimulate enzyme activity (Okuda et al. 1991). The inner cortex of Scots pine contains secondary metabolites such as lignans and tannins, and also resins, terpenes, waxes and steroids (Airaksinen et al. 1986). Lodgepole pine contains various flavonoids (Vercruysse et al. 1985). P. engelmannii bark (from the Washington state) contains benzenoids (Pearson et al. 1979) and P. glauca contains tannins (Arnasson et al. 1981). Two other species containing tannins are balsam fir, *Abies balsamea.*

Cambium was collected during a certain period in the spring when cambial activity was at its maximum and there was a relatively thick layer of new, active phloem, the tissue eaten. The outer part of the inner bark contains more inedible elements like tannins and polyphenols of various types (Airaksinen et al. 1986). The nutrient rich sap of the new phloem contains high levels of translocated sugars, being transported downwards to the roots. There is also a high percentage of moisture (Johnson-Gottesfeld 1995).

Reasons for heat treatment

There are several reasons to prepare food in cooking pits. Yet, depending on nutritional composition, the reactions during heat treatment vary between different kinds of tissues. Overall, heat treatment makes food tissues less toxic, more digestible and durable. Increased digestibility means that more energy and nutrients can be gained from the food. The heat can also remove possible toxins, bacteria or parasites, as well as enhancing the flavour. Also, cooking reduces the water content and consequently bacteria as well.

Food tissue is a mixture of proteins, lipids and carbohydrates, minerals, enzymes and water. The tissue polymers of proteins, carbohydrates, and lipids in food vary in complexity and in nature and strength of the links between constituent units. Only small polymers are absorbed by the small intestine. Consequently, it is important to break down large or complex carbohydrates into smaller, more digestible, polymers, by chemical or physical processes. Native peoples seem to have pit cooked food with high contents of lipids or complex carbohydrates (Wandsnider 1997). The length of the cooking time depended on the chemistry of the carbohydrates (polymer size and structure) (Konlande and Robson 1972).

Processing of plants is a natural element among peoples everywhere and includes activities such as grinding, pounding; soaking, leaching; heat treatment, drying; and fermentation, all being aimed towards increased edibility of foods (Stahl 1989). This occured either through physical changes, adjusting the size of the food particles, or through chemical changes, adjusting the form of the nutrients. Processing of some kinds could result in nutrient losses, but according to Stahl (1989:183-184), processing for the most part creates substantial gains in nutritional value:

- Reduction of particle size can enhance digestibility and improve the effectiveness of the following detoxification.
- Removal of fiber increases the availability of digestible carbohydrates, amino acids and minerals.
- Fermentation can enhance digestibility, provide better access to nutrients (e.g. amino acids), and raise the vitamin content of foods as well as allowing storage.
- Heat treatment makes the digestible carbohydrates more available and can contribute to detoxification.
- Detoxification, which may involve one or a number of processing techniques, enhances nutrient availability and may allow uptake of greater quantities of a given foodstuff.

Food processing underground

In the interior of northern Sweden, remains of cooking pits dating from the Mesolithic to the 18th century have been found (Mulk 1994; Bergman 1995). Forest Sami dug a large pit in the ground where they placed the peeled inner bark from pine trees together with other bark. The pit was covered with soil and large logs. The logs were set on fire and kept burning for one, three or four days. When the bark turned red it was removed from the pit and then dried (Lundii 1905). According to Eidlitz (1969:73) some of the Sami made a sweet and tasty delicacy of the inner bark;

> *"it was dried and shred into small pieces, then put into big birch bark bushels. The bushels were dug down and covered with sand. During one day they let a fire burn over the place where the bushel was buried, and when uncovering the bark it was red and sweet and eaten as candy".*

The Okanagan-Colville people steam cooked both plant and animal food. A large pit was lined with round rocks, which were heated, before a layer of dirt was added to the rocks. Various kinds of vegetation were put above the dirt, for instance fern fronds (*Athyrium filix-foemina, Dryopteris expansa* and possibly *Matteuccia struthiopteris*), skunk cabbage leaves (*Lysichiton americanum*) and damp pine needles. The food was placed on the vegetation layer and then covered by more vegetation and dirt. One or more sticks were placed in the pit, then it was filled and the sticks removed to create water passages. Water was poured down until the passages were covered. In this way steam cooking was created. A fire was often lit on top of the dirt and then the cooking process continued overnight or longer. Men were forbidden close to the pit during the cooking and the same rule was followed by women during their menstrual cycle. If the rules were not followed, the cooking results could be negatively affected (Malouf 1979).

The Gitskan cooked hemlock bark, or wrapped food in hemlock or birch bark. *"The birch bark wrapper keeps the food clean and seals it so that the baking food is self basted and the good juices that seep out are saved"*. One way to check the cooking (concerning plant foods) was to leave a few inches of plant stem above ground. At the point when the fire had destroyed the stem completely, the plant was properly cooked. Another logical test was to simply scooping the earth away in one corner and looking at the meat, fish or roots (People of 'Ksan 1980).

The digging of cooking pits was done with digging sticks among some tribes and flat rocks and wide pieces of wood among others (Malouf 1979). Pit size was determined from what and how much was to be cooked. Both round, squared and rectangular pits are described. Yet there is a wide-ranging cooking capacity among the same kinds of pits. The stones put in the pit are described as small river boulders, flat stones or rocks, or smooth stones, about five inches in diameter. The pit was preferably heated by firewood from the cottonwood tree. Firewood (charcoal) from ponderosa has also been found in excavations.

Fig. 22. Sunflower (Helianthus annuus)

However, there is uncertainty about whether the stones were placed on the firewood, or the opposite. Another point is that the stones could be heated outside the pit and then added to the bottom. The combinations of plants put on top of the hot rocks were many. Although grass was most common, other plants used were ferns, pine needles, alder leaves (Alnus sp.), willow leaves/branches (*Salix sp.*), sunflower (*Helianthus annuus L.*) stalks or leaves (Malouf 1979). Sometimes a layer of bark was added as well. The Flatheads used fir bark (Ray 1942:102), while the Kutenais used either fir or spruce bark (Schaeffer 1940). Information about the fire is scarce, as for example the intensity and size and whether it was burning the full cooking time or not. In any case, the cooking time seems to have ranged between twelve and seventy hours, possibly dependent upon the quantity of food to be cooked (Grinell 1962).

Gitskan people pit cooked hemlock inner bark as a first step when making dry cakes for winter use. Inner bark was placed on heated rocks in the bottom of a pit and was "baked" until dawn. Further, the bark was pounded in a mortar for hours and then shaped inte thin cakes, which were dried on a rack in the sun. After soaking in water, the cakes were eaten with grease (Smith 1997). Spruce inner bark was prepared the same way as hemlock (Jones 1914:10; Knapp and Childe 1896:94). Other groups pit cooked inner bark from lodgepole pine, ponderosa pine and cottonwood (Peacock 1998).

Peacock describes earth ovens as "large, circular, rimmed depressions, varying between 3 to 6 m in diameter and 0,5 to 0,75 m in depth". Peacock (pers. com. 1999) further points out that older pits are usually larger than younger. Paleo-Indian roasting pits found in the northwestern plains of North America had the arrangement of two to four pits placed around a central hearth (Wandsnider 1997). Within many groups there was a tendency to reuse the same cooking pit anually (Malouf 1979; Turner in Hayden 1992; People of ´Ksan 1980; Peacock 1999 pers. com).

The use of earth ovens to pit cook food is a widespread and presumably ancient food processing technology. Construction and use of earth ovens are confirmed in Australia (Gott 1983, 1984; Lourandos 1985), Polynesia (Gill 1880), Mexico (Flannery 1986b; Parsons and Parson 1990) and throughout much of North America, including the Great Basin (Fowler et al. 1998), the Southeast (Fish et al. 1986; Fish 1997), the Pacific Northwest (Norton 1979; Turner 1995; Turner et al. 1983), the Columbian and Canadian Plateau (Dawson 1891; Teit 1900, 1909; Ray 1932; Turner 1997; Turner 1990; Thoms 1989; Peacock 1996, 1998) and the Northwestern Plains (Peacock 1992).

Earth ovens as well as base camps have been located in upland areas (Peacock 1998). They were mainly used for processing of roots, and there was a high abundance of important roots, as well as materials for construction and use of earth ovens in the uplands (Peacock 1998:177). Roasting pits were often at campsites. The sites were generally located along river terraces, near the union of drainages and near water in relatively flat, open terrain (McLeod and Melton 1986). Root pits were said to be numerous along the lakeshores and could still be seen until recently (Schaeffer 1940). Pits are often located in meadows with access to fuel and water (Peacock pers. com. 1999).

Discussion

Bark peeling is documented as a 400-year-old tradition in Scandinavia. The reason for a cessation in the end of the 1800s was primarily access to substitutive foodstuffs such as cereals and sugar (Petterson 1979; Eidlitz 1969). Bark use in North America appears to be a more recent phenomenon. This relatively current bark peeling could be due to a recent tool change from horns and skeletal bones to metal tools, naturally simplifying the peeling. However in British Columbia there are some registrations as old as in Scandinavia. The tradition seems to be longer in B.C than in today´s northwestern U.S.A. Overall, inner bark use is likely to have decreased in periods when food, such as sugar, was easily obtained. Also, authorities in both continents tried to prevent the bark harvest.

Scarred trees have been registered in many parts of North America; from Arizona in the southwest to Washington in the northwest (McLeod and Melton 1986), Coastal British Columbia and southeast Alaska (Mack and Hollenbeck 1985:3). Bark peeled trees in Sweden are registered between the Caledonian Mountains in the west and the provincial boarder of Lapland in the east, within the northern and middle boreal zone.

In North America, scarred trees are often clustered (Barrett 1990; Mobley et al. 1990), located close to water, near campgrounds (McLeod and Melton 1986; Barrett 1990), in open and south-facing areas. When studying temporal and spatial distribution of peeled trees in different areas it is important to consider the historical divergences in research, logging and fire dynamics, and also the different life cycles of tree species. Moreover, the distribution pattern of bark-scarred trees might to some extent be a function of the supply of animal foods as well as the nutritional value of the vegetation. In both Scandinavia and North America, trees were possibly bark peeled in areas with a bad supply of animal foods and vegetation with a rather low nutritional value.

Rectangular bark scars dominate some areas of North America and a triangular shape dominates in others. In Sweden, the scar length varies more than the shape of scars. Bark peeling for food caused rather long scars, while peels for wrapping material resulted in shorter ones. Spatial distribution of scarred trees as well as scar shapes reveals various patterns, presumably due to what purpose the bark was peeled for, temporal and spatial differences in use of tools and techniques, and also variations in terrain and tree types (Eldridge and Eldridge 1988:24). It is understandable that the scar shapes vary locally, since the shape of bark scars is due to specific technology applied to certain tree species for a certain function (Mobley and Eldridge 1992).

Scots pine was the most frequently scarred tree species in northern Scandinavia. The inner bark was used as food, wrapping material, medicine, spice and shoe hay. As food it was eaten fresh, roasted or dried (Zackrisson et al. 2000; von Duben 1977). Also spruce, birch, poplar and willow were used to a certain extent (Eidlitz 1969:71). In North America, inner bark was gathered from many tree species. Cedar inner bark was primarily peeled in British Columbia, while ponderosa pine and lodgepole pine bark was used most often in northwestern U.S.A.

Cedar inner bark had many areas of use, for instance baskets, mats, clothing, shelter, cordage, fishnets and line, sails, diapers, blankets, personal and ceremonial ornaments. Cambium from other tree species was often used for food and medicine. As food it was eaten either fresh, dried or roasted.

The taste of inner bark varies among species. Ponderosa pine and hemlock were often favoured. Taste differences between tree species may also be a result of the date that the cambium is obtained, and how old the tree was when the cambium was removed (Alldredge 1995). Merrell (pers com. 1999) speculates on different sun exposure affecting the taste.

Women and children often performed the bark harvest among both the Sami and North American native people. In North America, men sometimes participated, especially during cedar bark harvest, which was strenous work (Stewart 1984:113). In North America, camps were moved seasonally. During spring, they moved to places favourable for root-digging and bark harvesting (Turner et al. 1990). Also the Sami stripped bark around spring. When the sap is rising, inner bark is highly nutritious (Eidlitz 1969). The tissues become saturated with organic compounds (proteins and carbohydrates). Accordingly, this is the best period to use cambium for food, as well as removing the inner- and outer barks from the trunk (Hawankorn in White 1954:1-2). When waiting too long, the cambium turns into wood during the lignification process and becomes inedible (Busgen 1929:106). When all favourable trees around a certain campsite were bark stripped, the Sami moved from one area to another, (Nickul 1977). Above all, rich Sami families gathered inner bark.

Swedish farmers peeled thin bark first (Levander 1914; Pettersson 1941), probably because of the lower weight (Niklasson et al. 1994). In North America, young trees with as few branches as possible were preferred. They used tools to poke through the bark and measured the thickness of the cambium layer. Another way to test a tree was to remove a bark-strip and check the sweetness and flow of the sap (Hart 1992; People of ´Ksan 1980:83; Turner 1978:206). Further, the taste of branch tips and blooming of certain plants could determine whether the inner bark was ready to be peeled (R. McDonell pers com. in Eldridge, 1982; Turner et al. 1980).

To ensure the survival of a tree, Sami never peeled bark all round the stem (Drake 1918). In addition, the tree spirit was told before the cutting was done. That way it could leave the tree in time (Louise Bäckman pers com. in Zackrisson 2000). Similar phenomena are reported in North America. Apparently it is common in native religious traditions, to render plants, trees and animals as living creatures having souls. Accordingly, natural resources were deeply respected and used with care (Anon). Some indigenous groups still girdled the trees, but to leave some bark appears to have been most common.

The Sami generally used long and thin knives made of steel or bone to peel the outer bark. The cambium was removed with broad-bladed scrapers (Lundii 1905; Itkonen 1948). Before metals were available, native Americans used horns and ribs from different animals to cut through the outer bark. Next, long wooden sticks helped loosen the bark from the stem (Barrett 1990). When trading with the white man started, iron knives and hatchets were favoured during the bark harvest (Joanne Biterane pers. com. Sept 23, 1999). Depending on the tree species, different tools were used to remove the

inner bark. For instance, ponderosa cambium was loosened by scrapers (Teit 1930, in Churchill 1979b:np) or knives made of deer rib or ulna (Ray 1933:103;Turner et al. 1980:33). Unlike ponderosa cambium, lodgepole cambium sticks to the stem after the outer bark is cut off. Concave scrapers like animal scapulae worked well to remove lodgepole inner bark (Anderson 1925:136; Teit 1930:92).

Three scar lengths are particularly common in northern Sweden. Cambium intended for food produced scars of about 96 cm, cambium scars for rolled-up cases and double-folded packages were some decimetres shorter (Zackrisson et al. 2000).
In North America, cambium scars are often oval, "tear-drop", or rectangular shaped (Alldredge 1995). Cedar tree scars are generally long (about 7m) and triangular (Eldridge and Stryd 1993). It is understandable that the scar shapes vary locally, since the shape of bark scars is due to a specific technology applied to certain tree species for a certain function (Mobley and Eldridge 1992).

Since multiple scars are often found on a single tree, it is known that stands were revisited in Scandinavia as well as in North America.

The Sami generally peeled trees on the northern side (Schlachter 1958; Manker 1938, 1950; Louise Bäckman pers. com. in Zackrisson et al. 2000). Due to cultural and religious tradition north and south were important directions. The taste of bark is most likely different on the sun exposed south side, as compared to the shaded north side. Since bark peels to get wrapping material for sinew, were exclusively done on the north side as well, the cultural and religious tradition, not the taste, seems to be of vital importance (Zackrisson et al. 2000). Scar registrations from North America imply that bark was most often peeled on the shaded side (Phil Grinder pers. com. 1997, in Stafford 1999) or upslope side (Mobley and Eldridge 1992), which is generally directed to the north. The direction probably had no religious connections. The shaded side usually had fewer branches and the inner bark was jucier and more tasty. Heather Pratt (pers com. Dec. 14 1999) is of the same opinion:

> *"On the shaded side there are fewer branches and therefore fewer knots, which serve to lessen the quality and size of the bark strip. In my own experience, bark has been peeled on certain sides for practical reasons".*

Scots pine inner bark contains carbohydrates, vitamin C and fiber. These substances functioned as a good complement to the protein and fat from meat, fish and reindeer milk, which principally made up the Sami diet (Airaksinen et al. 1986 and Hanson 1996). The vitamin C content of inner bark appears to have prevented scurvy among the Sami (Fellman 1906; Urbye 1937). Bark cambium evidently provides energy in the form of sugar in a fiber matrix. As a result, the absorption rate is slowed down and a relatively steady blood-sugar level is maintained. Therefore, bark cambium is a preferable food during high-energy activities, such as traveling. The calcium content had an important role for bone development among children and pregnant women. Bark also reduced physical effects during spring famine (Ann Eldridge 1982:24). Moreover, when comparing the FDA´s (the current Food and Drug Administration) suggested daily values for a healthy diet (based on a 2000 calorie diet), to one pound of ponderosa inner bark, cambium is obviously nutritious. Cambium contains twice the suggested daily value of dietary fiber and only 4% of the recommended maximum daily amount of fat (Alldredge 1995:24).

Many tree species contain secondary metabolites such as tannins (Wandsnider 1997; Cronquist 1981). High concentrations of secondary metabolites complicate nutrient absorption and enzyme activity, which should have been problematic to the people consuming bark. Heat treatment simplified cambium consumption. Benefits from heat treatment are removal of toxins, bacteria, and parasites as well as creating a more digestible, durable and appetizing food. Accordingly more energy and nutrients can be gained from the food (Wandsnider 1997).

Earth oven pit cooking appears to be an ancient occurence in Scandinavia as well as in North America. Fragments of cooking pits have been found in the interior of northern Sweden (Mulk 1994; Bergman 1995) and throughout a large part of North America. Cooking pits appear to have been built and used similar ways in different cultures. The pit was basin-shaped and heated rocks, placed in the bottom, kept the heat. Vegetation layers brought about moist, food protection and flavour enhancement. Generally, there was also a layer of dirt and a fire lit on top. The fire burned for one to three or four days (Lundii 1905; Grinell 1962), and the more food to be cooked, the larger pit size (Malouf 1979). In addition, the pit cooking procedure involved certain rules, to ensure a good outcome. Men, as well as menstruating women, should keep away from the cooking. According to Malouf, many groups in North America anually reused cooking pits. Earth ovens were mainly used for processing roots. Consequently, the pits were generally located in upland areas (Peacock 1998), since there was a high abundance of nutritionally important roots located near, as well as materials for construction and use of earth ovens (Peacock 1998:177). Further, pits are often located near campsites (Peacock 1998; McLeod and Melton 1986), with water close by, in open terrain and along river terraces, based on the importance of accessable to fuel and water (Peacock pers. com. 1999).

Many sources describe cambium use among the Sami as a regular staple food resource (Schefferus 1674; Leem 1767; Rheen 1897; Graan 1899; Lundius 1905; Drake 1918), not an emergency food used during starvation periods only. Finnish "Skolt"- Sami people, for instance, used bark as late as to World War II (Vorren in Eidlitz 1969). In a study by Zackrisson et al. (2000), there is no indication that bark peeling increased during periods of famine in northern Sweden. On the contrary, it is stated that wealthy Sami families gathered more cambium than others (Drake 1918). Swedish farmers often used bark as a flour substitute (Eidlitz 1969:72-73). During years of famine, bark was mixed in bread as a substitute for grain. At these times, a large quantity of bark was used as an emergency food (Eidlitz 1993:32). However, there was no clear difference between regular food and emergency food. The fact that some food was considered emergency rations was mostly based upon cultural tradition, the general condition of the group, and how much of that certain food they had to eat. Even during periods of food scarcity, all food types that were possible to utilize, were not. The attitude towards a specific food varied widely between groups. When consumed in a large quantity, rich people could consider some foodstuff emergency food, but the same provision could be looked upon as a delicacy in small amounts. To poor people, it might well be a regular staple food (Eidlitz 1969:153-154).

To some North American indigenous groups, inner bark was a delicacy, but tree cambium was likely not of major nutritional importance in the diet. It appears to have functioned as an energy source during travel and a delicacy that provided variety. In

People of `Ksan (1980:83) inner bark was described as "*good, but you couldn't survive on it if you were starving*". However, hemlock cake served as starvation food among some coastal groups. Churchill (1979b:np), citing Malouf (1974) declares that lodgepole pine cambium *"was especially relied upon as a food source during times of scarcity"*. Cambium was often served at winter feasts and potlatches as well as for guests in legends (Eldridge 1982:20). Clark (1805) stated that cambium use was a seasonal occurrence, while his friend Lewis (1806) pointed out that cambium was only used during periods of starvation. Lewis´ suggestion is widely supported (Newberry 1887; Brown 1868; Spinden 1908; Cushing 1920; Castetter 1935; Castetter and Opler 1936; Opler 1941; Haines 1939; Chalfaut 1974). Others are of the opposite opinion (Ferries 1940; Hrdlicka 1908; Curtis 1915; Jones 1914; Teit 1930; Schaeffer 1940; Drucker 1950; White 1954; Barnett 1955; Eidlitz 1969; Harbringer 1964; Malouf 1974). Despite different opinions, cambium obviously supplemented the diet of Sami as well as indigenous people of North America. The former apparently used cambium as regular food and even a delicacy, while the latter perhaps used it as both regular- and emergency food, dependent upon the supply of food.

Energy is the most essential nutritional need and. Digestible carbohydrates that can be transformed into glucose or other simple sugars, are important sources of energy (Johns 1990). Carbohydrates have been an integral part of hunter-gatherer diets for a long time. In regions with a sufficient supply of protein, carbohydrates should be the first resource given priority in the food production system (Flanerry 1986b). Speth and Spielman (1983) are of the same opinion, suggesting hunter-gatherers in "*sharply seasonal environments*" to build supplies of storable carbohydrates during fall. Further, they point out that hunter-gatherer populations in temperate regions periodically experienced food stress, usually in late winter and early spring. During such periods, protein was relied upon as the primary calorie source, but *"such reliance could lead to marginal or inadequate energy intake and other nutritional deficiences in the diet*" (Speth and Spielmann 1983:2). The problem with protein reliance originates from the specific dynamic action, (SDA) of protein ingestion connected to starvation periods (Speth and Spielman 1983:63). SDA is described as the metabolism increase or heat production, which results from food ingestion. Protein ingestion is followed by a relatively high SDA (up to 30%), compared to fat (6 to 14%) or carbohydrates (6%). Consequently, "*for every 100 calories of protein ingested, up to 30 calories are needed to compensate for the increase in metabolism*" (Speth and Spielman 1983:6). Without fat or carbohydrates in the diet, the body starts using protein for energy, thus converting the amino acids and non-nitrogenous residues to glucose or fat to meet the body's energy needs (Speth and Spielmann 1983:13). Accordingly, the supply of body protein will not be refilled and, if the problem is serious, skeletal muscle is reduced. Fats and carbohydrates, though, have a protein-saving effect, meaning they provide energy for the metabolism, and avoid loss of body protein. According to Speth and Spielmann (1983:20), carbohydrates have a greater protein-saving effect than fat and "*higher quantities of carbohydrate will be included in hunter-gatherer diets than would be expected given the relative availability of carbohydrate and protein in these environments*".

Inner bark use is undoubtedly an old phenomenon in Scandinavia as well as in North America. According to the literature, bark peeling started in the 15th century among the Sami, about 300 years earlier than in North America. However, earlier sites have been located on both continents (Eldridge pers com. 1999; Zackrisson pers com. 2000).

Until the late 1900s, peeling and inner bark use continued in North America. This is almost 100 years longer than any recorded site in Scandinavia.

The bark harvest occured in the spring when the sap was rising and the sugar content was high. Sami, native Americans, and First Nations, harvested bark during the same time. In North America this point of time differs some weeks among the various tree species. Women and children most often peeled the bark. Among First Nations people, men helped with the harvest because bark pieces from some tree species were very heavy. The Sami peeled bark from the northern side of the stem first, and some bark was always left for the tree to survive. There is no directional preference in North America. The north and northeast side prevails in some areas, but the peeling direction differs among groups. However, the shaded side, which generally has fewer branches, was often bark peeled. Further, some groups girdled trees, while others did not. Tools used by all groups for harvesting are similar. However, there is a greater variety of tools used in North America. On both continents, knives were commonly used for cutting away the outer bark. In North America, people also used hatchets, horns, animal ribs and wooden pry sticks. All three groups used animal shoulder blades to scrape off the cambium. In North America, scrapers were made from mussel shells, double-ended bone or antler, horns and ribs, as well as tin cans.

In northern Scandinavia, Scots pine was primarily peeled, but bark from deciduous trees (willow, poplar and birch) was also used. In North America, many different tree species were peeled. Coniferous trees such as cedar, hemlock, and larch, along with spruce and pine species as well as deciduous trees (cottonwood, alder, aspen, elm, maple and birch) were used. All three groups used the inner bark for food, medicine and various kinds of wrapper. Furthermore, First Nations people used inner bark to make mats, baskets clothing, fish line, and fishnets. Sami people used inner bark as a regular staple food, whereas North American indigenous people ate it both as staple- and "starvation" food.

Currently, there are no surveys to locate cooking pits in Scandinavia, but pits have been registered in the interior of northern Sweden. Cooking pit remnants, found in North America, are primarily located close to campsites, water and in open areas. On both continents, pit cooking is similar: Either the food was placed in the bottom of the pit or on top of heated rocks in the pit bottom. Next there were layers of vegetation, soil or sand, sometimes logs, and fire was ignited on the top.

Conclusion

The study deals with native people in the northern hemisphere that lived under similar circumstances, with sharp seasonal changes and a diet based primarily on animal foods. Their way of "solving" nutrient supply and general health problems corresponds, through the use of carbohydrate supplements from plants and bark. What created these similarities in natural resource utilization among isolated peoples? In these climates, there appears to be substances in cambium that cannot be obtained to a satisfying extent from other plants and animals. Obviously, bark is often peeled in areas with insufficient supplies of animal and plant foods during certain time periods. Could this be the main reason for bark use or were the seasonal changes the greatest problem in keeping up a steady food supply?

In northern Scandinavia as well as in North America people looked at plants and animals as living creatures having souls and consequently respected the natural resources. Still, some groups in North America cut down trees or peeled bark all round the stem, which does not correspond to the idea of respecting nature. These groups probably did not "waste" trees, but only used the trees and inner bark they needed.

One interesting future line of research would be to study the use of inner bark in Siberia, which is geographically between Scandinavia and North America. Possibly there are yet unknown links between the latter areas in this respect. Inner bark use has a long tradition, yet its` extent is difficult to determine due to the inconstancy of wood material. Is the tradition of bark utilization even older than documented?

References

Personal communication

Biterane, Joanne. Interviewed September 23, 1999. Ethnobotanist at the Kootenai Cultural Committee, Montana, U.S.A.

Eldridge, Morley. Interviewed October 4, 1999. Archaeologist at Millennia Research Ltd., Vancouver Island, Canada.

Merrell, Carolynne. Interviewed September 18, 1999. Archaeologist. Montana, U.S.A.

Peacock, Sandra. Interviewed October 8, 1999. Archaeologist. University of Victoria, B.C., Canada.

Pratt, Heather. Interviewed December 14, 1999. Archaeologist at Arcas Associates, Coquitlam, B.C., Canada.

Unpublished sources

Drucker, Philip. n.d. Unpublished field notes on file with the B.C. Indian Language Project, Victoria, B.C.

Keeley, Pat B. 1980. *Nutrient Composition of Selected Important Plant Foods of the Pre-Contact Diet of the Northwest Native American Peoples*. Unpublished MSc. Thesis. University of Washington, Seattle.

Mathews, Art. n.d. *Plants for Review*, manuscript, February 1996. Prepared for the Gitskan Dictionary Committee.

Smith, Harlan I. 1919. Photograph and notes dated July 5. Department of Mines Geological Survey Photographic Division Catalogue # 46663, now on file with National Museum of Man.

Smith, H. I. n.d. 1997. *Ethnobotany of the Gitskan Indians of British Columbia*. 2nd copy. 1192.4A.B90 F1. Unpublished manuscript on file at the Canadian Museum of Civilization, Hull, Quebec (1926).

Stafford, Jim. 1999. *Murray and Twaal Creek watersheds: Final report for 1998 Field Season - Js Jones Forestry Developments Archeological Reconnaissance and Impact Assessment of 12 blocks & Associated roads*. Millenia Research Ltd. B.C., Canada.

Stump, Sheila A. (nd). *On the track of the wild ponderosa and other game trees of the Northwest*. Unpublished class paper, Washington State University, Pullman, Washington.

Literature

Airaksinen, M.M., P. Peura, L. Ala-Fossi-Salokangas, S. Antere, J. Lukkarainen, M. Saikkonen, and F. Stenback. 1986. *Toxicity of plant material used as emergency food during famines in Finland.* Journal of Ethnopharmacology 18:273-296.

Alldredge, Ken. 1995. *The phenomenon of cambium peeled scarring on the Kootenai National Forest, Northwest Montana: Mitigation efforts of 24 LN 14444.* Kootenai National Forest, Montana.

Anderson, James, A. 1925. *Trees and Shrubs; Food Medicinal, and Poisonous Plants of British Columbia.* King's Printer, Victoria, B.C.

Anonymus. 1871. *Underdånigt betänkande och förslag angående skogsförhållandena i Norrland och åtgärder för åstadkommande af en bättre skogshushållning derstädes.* Iwar Haeggströms Boktryckeri, Stockholm.

Arcas Associates. 1984. *Meares Island aboriginal tree utilization study.* Prepared by Arcas Associates for MacMillan Bloedel Ltd., Nanaimo, B.C. Report on file with the Heritage Conservation Branch Library, Victoria, B.C.

Arcas Consulting Archaeologists, Ltd. 1991. *Archaeological Impact Assessment Bligh Island Development Plan.* Report prepared for B.C. Forest Service, Campbell River, on file with the Archaeology Branch, Victoria, B.C.

Arnason, Thor., Richard J. Hebda, and Timothy Johns. 1981. *Use of Plants for food and medicine by Native peoples of eastern Canada.* Canadian Journal of Botany 59: 2189-2325.

Barnett, Homer G. 1955. *The Coast Salish of British Columbia.* University of Oregon Monographs, Studies in Anthropology, No. 4, University of Oregon Press, Eugene, Oregon.

Barrett, Stephen W. 1990. *Indian trees are living history. A springtime Indian tradition created an archaeological heritage that you can find.* Vol 3, No 1. Glacier Valley Publishing, a division of Designsmith Graphics. U.S.A.

Bergman, I. 1995. *Från Döudden till Varghalsen.* Studia Arhaeologica Universitatis Umensis 7. Umeå.

Betts, Robert C., Christopher B. Wooley, Charles M. Mobley, James C. Haggarty, and Aron Crowell. 1991. *Site Protection and Oil Spill Treatment at SEL-188: An Archaeological Site in Kenai Fjords National Park, Alaska.* Exxon Shipping Company and Exxon Company, U.S.A., Anchorage.

Boas, Franz. 1909. *The Kwakiutl of Vancouver Island.* Memoir of American Museum of Natural History, Vol. 5, Pt. 2.

Boas, F. 1910. *Methods in Indian woodwork.* Southern Workman 337-343.

Brown. 1868. Paper presented to the Edinburgh Botanical Society. No other information. As it appears in Sturtevant 1919 which appears in Swetnam 1984.

Busgen, Moutz. 1929. *The structure and life of Forest Trees.* 3rd edition, English Translation by Thomas Thomson. Chapman and Hall, Ltd. London.

Campbell, Ruth, Marsden Debbie., and Good Roddy. 1984. *Gitanyow Summer Student Research Program 1984.* Gitanyow Band Gitanyow, B.C.

Carpelan, C. 1975. Sompio. Kemijoki 8000-laxälv i norr In: Erä-Esko A (ed) *Forntiden i Kemiälvområdet under åtta årtusenden i arkeologisk belysning.* pp 63-69.

Castetter, Edward F. 1935. *Uncultivated Native Plants Used a Sources of Food.* University of New Mexico Bulletin No. 266, Biological Services Vol. 4, No. 5, Ethnobiological Studies in the American Southwest No. 1.

Castetter, E.F., and Morris R. Opler. 1936. *The Ethnobiology of the Chiricahua and Mescalero Apache.* University of New Mexico Bulletin No. 297, Biological Services Vol. 4, No. 5, Ethnobiological Studies in the American Southwest No. 3.

Chalfaut, Stuart A. 1974. *Aboriginal Territory of the Nez Perce Indians.* Garland Publishing Inc., New York, New York.

Chamberlain, Alexander F. 1906. *The Kootenay Indians.* Annual Archaeological report. Toronto.

Chandler, R. Frank and Shirley N. Hooper. 1982. *Herbal remedies of the Maritime Indians: a preliminary screening.* Part III. Journal of Ethnopharmacology.

Chevallier, Andrew. 1996. *The Encyclopedia of medicinal plants.* London.

Churchill, Thomas, E. 1979a. *Subregional Variations in the Utilization of Tree Inner Bark Within the Pacific Northwest Coast Region.* Department of Anthropology, Oregon State University, Corvallis, Oregon.

Churchill, T, E. 1979b. *Cambium Peeled Trees Located in the Wallowa-Whitman National Forest, Eastern Oregon.* Paper submitted for the Wallowa-Whitman National Forest Symposium, Northwest Anthropological Conference.

Cline, Walter B., R.S. Commons, M. Mandelbaum, R.H. Post, and L.V.W. Walters. 1938. *The Sinkaietk or Southern Okanagon of Washington*, ed. L. Spier. General Series in Anthropology VI:1-262.

Cornpton, Brian, Douglas. 1993. *Upper north Wakashan and southern Tsimshian ethnobotany: The knowledge and use of plants and fungi among the Oweekeno, Hanaksiala (Kitlope and Kemano), Haisla (Kitamaat) and Kitasoo peoples of the central and north Coasts of British Columbia.* Dept. of Botany. University of British Columbia.

Cronquist, Arthur. 1981. *An Integrated System of Classification of Flowering Plants.* New York: Columbia University Press.

Curtis, Edward S. 1913-1916. *The North American Indian*, Vols 9, 10, 11. Johnson Reprint Corporation. New York, New York.

Cushing, Frank H. 1920. *Zuni Breadstuff.* Indian Notes and Monographs, Vol. 8, New York Museum of the American Indian.

Dawson, G.M. 1891. *Notes of the Shuswap People of British Columbia*, Transactions of the Royal Society of Canada, Section II, 3-46.

Douglas, A.E. 1929. *The Secret of the Southwest Solved by Talkative Treerings.* National Geographic Magazine 5(6):736-770.

Drake, S. 1918. *Västerbottenslapparna under förra hälften av 1800-talet.* Wahlström och Widstrand. Uppsala.

Drucker, Phillip. 1950. *Culture Element Distributions: 26 Northwest Coast.* University of California Anthropological Records, Vol. 9, No. 3, Berkley, California.

Drucker, P. 1951. *The Northern and Central Nootkan Tribes.* Bureau of American Ethnology Bulletin 144.

Drucker, P. 1955. *Indians of the Northwest Coast.* American Museum science books; published for the American Museum of Natural History. New York.

Eidlitz Kuoljok, Kerstin. 1969. *Föda och nödföda.* Studia Ethnographica Upsalensia 32.

Eidlitz Kuoljok, K. 1993. *Bark och ripa.* Ájtte förlag, Jokkmokk.

Eldridge, Morley and Ann Eldridge. 1980. *An Evaluation of the Heritage Resource Potential of the Dean River Valley: Final Report on the Cariboo Planning Study.* Report on file, Heritage Conservation Branch.

Eldridge, Ann. 1982. *Cambium resources of the Pacific Northwest: An ethnographic and archaeological study.* Dept. of Archaeology, Simon Fraser University.

Eldridge, Morley. 1982. *Report on the Initial Phase of Stage II, Detailed Inventory of the Skeena-Rupert 500 kV Transmission Line.* Report Prepared by Provenance Research Inc., for B.C. Hydro; on file, Heritage Conservation Branch, Victoria, B.C.

Eldridge, M., and A. Eldridge. 1988. *The Newcastle Block Culturally Modified Trees.* Report prepared by Eldridge Heritage Consulting for Heritage Conservation Branch, Victoria. B.C.

Eldridge, M. 1988a. *Heritage Impact Assessment of Crown Lands near Chimdemash Creek, Terrace,* B.C. Report prepared under permit 1988-2 by Millennia Research for

B.C. Lands, Skeena Region, on file with Archaeology and Outdoor Branch, Victoria, B.C.

Eldridge, M., Sandra Zacharias, Randy Bouchard, and Dorothy Kennedy. 1988a. *Robson Bight Archaeological Resource Inventory*. Report prepared under permit 1988-85 by Millennia Research for Archaeology Branch, Victoria, B.C.

Eldridge, M. 1988b. *Mercantile Creek, Ucluelet Inlet, Heritage Impact Assessment*. Report prepared by Millennia Research for MacMillan Bloedel Ltd. Report on file with the Heritage Conservation Branch Library, Victoria, B.C.

Eldridge, M., Dorothy Kennedy, and Randy Bouchard. 1989b. *Bawden Bay Archaeological Resource Impact Assessment*. Report prepared for MacMillan Bloedel Ltd., Woodlands Services Division, Nanaimo, on file with the Archaeology Branch, Victoria, B.C.

Eldridge, M. 1991a. *An Inventory of Culturally Modified Trees in the Lower Tsitika Valley*. Report prepared for the MacMillan Bloedel Ltd., Eve River Division by Millennia Research, on file with the Archaeology Branch, Victoria, B.C.

Eldridge, M. 1991b. *Culturally Modified Trees in the Hotel Block Kelsey Bay, B.C.* Report prepared for the MacMillan Bloedel Ltd., Kelsey Bay Division by Millennia Research.

Eldridge, Morley. 1992. Personal observation. In Arctic Anthropology Vol. 29, No. 2, pp. 91-110.

Eldridge, M and Stryd, A. *CMT Archaeology in British Columbia: The Meares Island*. B.C. studies: A Quarterly Journal of the Humanities and Social Sciences. No. 99, Autumn 1993.

Fellman, J. 1906. *Anteckningar under min vistelse i Lappmarken*. Finska litteratursällskapets tryckeri. Helsingfors.

Ferries, W.A. 1940. *Life in the Rocky Mountains*. Paul C. Phillips, editor. The Old West Publishing Company.

Fish, S., P. Fish, C. Miksicek and J. Madsen. 1986. *Prehistoric Agave cultivation in southern Arizona*. Desert Plants 7:2:107-120, 100.

Fish, S.K. 1997. *North American aboriginal farming and field systems: A southwestern perspective*. Paper presented at the Annual Meeting and Science Innovation Exposition, American Association for the Advancement of Science, Seattle, Washington, February 16.

Fjellström, Phebe. 1985. *Samernas samhälle i tradition och nutid*. Värnamo.

Flannery, K. V. 1986b. *The Research Problem*. In Quila Naquitz: Archaic foraging and early agriculture in Oaxaca, Mexico, edited by K.V Flannery, pp. 3-18. New York: Academic press.

Fowler, C., L. Housley, W.J. Cannon, S. Eiselt and K. Gupta. 1998. *Pit roasting Valeriana edulis, a root food of the Surprise Valley Paiute*. Paper presented at the 21st Annual Conference, Society of Ethnobiology, University of Nevada, Reno, April 1998.

Gaertner, Erika. 1970. "*Breadstuff from Firs (Abies balsamea)*". Economic Botany, 24(1):69-72.

Gill, William, Wyett. 1880. *Savage life in Polynesia*. George Didsbury, Wellington.

Gott, W.W. 1983. *Murnong - A Victorian staple food: Some nutritional implications*. In *Archaeology at Anzaas*, edited by Graeme K. Ward, pp. 111-115. Canberra: Australian Institute of Aboriginal Studies.

Gott, W.W. 1984. Murnong - *Microseris scapigera*: *A study of a staple food of Victorian Aborigines*. Australian Aboriginal Studies No. 2:2-18.

Graan, Olao. 1899. *Relation, Eller En Fulkomblig Beskrifning om Lapparnas Ursprung så wähl som om heela dheras Lefwernes Förehållande*. I: Berättelser om samerna i 1600-talets Sverige. Kungliga Skytteanska Samfundets handlingar nr 27, 1983. Nyheternas tryckeri AB, Umeå.

Griffiths, D.W. 1989. *Polyphenolics and their possible effect on nutritive value*. In D´Mello, J.P.F., C.M. Duffus, and J.H. Duffus (eds.) *Antinutritional Factors, Potentially Toxic Substances in Plants*. Aspects of Applied Biology 19. Wellesbourne, Warwick: Association of Applied Biologists.

Grinell, George Bird. 1962. *Blackfoot Lodge Tales: The Story of a Prairie People*. The University of Nebraska Press, Lincoln.

Haines, Francis. 1939. *Red Eagles of the Northwest*. The Scholastic Press, Portland, Oregon.

Ham, Leonard C. and Geordia Howe. 1983. *Report of the 1981 Archaeological Survey of the Nimpkish River Valley and Adjacent Offshore Islands*. Report by Provenance Research Inc., to the Heritage Conservation Branch, Victoria, B.C.

Hanson, A-M. 1996. *The Ljunga Bread - Prehistoric Bark Bread?* In: Robertsson A-M, Hackens T, Hicks S, Risberg J, Åkerlund A (eds) Landcapes and Life. PACT 50. Journal of the European Network of Science and Technical Cooperation for the Cultural Heritage, pp. 385-398.

Harbringer, Lucy Jayne. 1964. *The Importance of Food Plants in the Maintenance of Nez Perce Cultural Identity*. Masters Thesis, Washington State University, Pullman, Washington.

Hart, Jeff. 1992. *Native plants and early peoples*. Montana historical society press.

Hayden, Brian. 1992. *A complex culture of the B.C. plateau*. UBC Press, Vancouver.

Hebda, R. and R. Mathewes. 1984. *Holocene History of Cedar and Native Indian Cultures of the North American Pacific Coast.* Science 225 (4663):711-713.

Helmers, Henry. 1962. *Temperature and Tree Growth Near the Northern Timber Line.* In: Koslowski pp. 265-274.

Hicks, Russell. 1976. *Culturally Inflicted Injuries to Cedar Trees on the Northwest Coast.* Report on file, Archaeology and Outdoor Branch, Victoria, B.C.

Hicks, Russell. 1985. *Culturally Altered Trees: A Data Source.* Northwest Anthropological Research Notes 19(1):100-118.

Hrdlicka, Ales. 1908. *Physiological and Medical Observations Among the Indians of the Southwestern United States and Northern Mexico.* Smithsonian Institution, Bureau of American Ethnology Bulletin No. 34.

Högström, P. 1747. Beskrifning Öfver de til Sweriges Krona lydande Lapmarker År 1747 (description of the Swedish part of Lapland in the year 1747). Stockholm.

Itkonen, T. 1948. *Suomen lappalaiset vuoteen 1945.* Werner Söderström, Helsinki.

Johns, T. 1990. *With bitter herbs they shall eat it: Chemical ecology and the origins of human diet and medicine.* Tucson: University of Arizona Press.

Johnson, Olga Weydemeyer. 1969. *Flathead and Kootenay.* Arthur H. Clark Company, California.

Johnson-Gottesfeld, Leslie M.1995. *The role of plant foods in traditional Wet'suwetén nutrition.* Ecology of Food and Nutrition. 34:149-169.

Johnson, Leslie M. 1997. *Health, wholeness and the Land: Gitskan traditional plant use and healing.* Dept. of Anthropology, University of Alberta, Edmonton.

Jones, Livingston French. 1914. *A study of the Thlingets of Alaska.* Revell, New York.

Knapp, Frances and Rheta. Louise Childe. 1896. *The Thlinkets of Southeastern Alaska.* Stone and Kimball, Chicago.

Konlande, J.E. and J.R.K. Robson. 1972. *The nutritive value of cooked camas as consumed by Flathead Indians.* In: Ecology of food and nutrition, Volume 2, pp. 193-195. Philadelphia: Gordon Breach Science Publishers, Ltd.

Koppert, Vincent. 1930. *Contributions to Clayoquot Ethnography.* Catholic University of America Anthropological Series 1.

Kuhnlein, H.V. 1990. *Nutrient values in indigenous wild plant greens and roots used by the Nuxalk People of Bella Coola, British Columbia.* Journal of Food Composition and Analysis 3:38-46.

Leem, K. 1767. *Beskrivelse over Finnmarkens Lapper*. Rosenkilde og bagger, Kobenhavn.

Levander, L. 1914. *Livet i en Älvdalsby före 1870-talet*. Nordstedts, Stockholm.

Lourandos, H. 1985. *Intensification and Australian prehistory*. In Prehistoric Hunter-Gatherers: The Emergence of cultural complexity, edited by T.D. Price and J.A. Brown, pp. 427-435. Toronto: Academic Press.

Lundii, Lappi, Nicolai. 1905. *Descriptio Lapponiae*. I: Kungliga Skytteanska Samfundets handlingar: Nr 27, 1983. *Berättelser om samerna i 1600-talets Sverige*. Nyheternas tryckeri AB, Umeå.

Mack, Cheryl, A. and Hollenbeck, Barbara, J. 1985. *Peeled Cedar Management Plan*. Manuscript on file, Gifford Pinchot National Forest, Pacific Northwest Region, USDA Forest Service.

Malouf, Carling, I. 1974. *Economy and Land Use by the Indians of Western Montana, USA*. Interior Salish and Eastern Washington Indians II. Garland Publishing Inc., New York, New York.

Malouf, Richard T. 1979. *Camas and the Flathead Indians of Montana*. Contributions to Anthropology, No 7. Dept. of Anthropology, University of Missoula, Montana.

Manker, Ernst. 1938. *Die Lappishe Zaubertrommel*. Eine ethnologische monographie. I. Die Trommel als denkmal materieller kultur. Acta Lapponica I. Aktiebolaget Thule, Stockholm.

Manker, E. 1950. *Die Lappische Zaubertrommel*. Eine ethnologische Monographie. II. Die Trommel als urkunde geistige lebens. Acta Lapponica VI. Hugo Gebers förlag, Stockholm.

Martorano, Marilyn A. 1981. *Scarred Ponderosa Pine Trees Reflecting Cultural Utilization of Bark*. M.A. thesis, Department of Anthropology, Colorado State University, Fort Collins.

McCutcheon, A.R., S.M. Ellis, R.E.W. Hancock, and G.H.N. Towers. 1992. *Antibiotic screening of medicinal plants of the British Columbia native peoples*. Journal of Ethnopharmacology 37:213-223.

Mc Leod, C.M., and Melton, Douglas. 1986. *The prehistory of the Lolo and Bitterroot National Forests*. USDA Forest Service, Northern region, Lolo and Bitterroot National Forests.

Medsger, Oliver Perry. 1939. *Edible Wild Plants*. Collier MacMillan, London, New York.

Mitchell, Donald and Morley Eldridge. 1982. *A Heritage Resource Survey in the Liard River Valley*. Report prepared for B.C. Hydro and Power Authority, on file with Archaeology Branch, Victoria, B.C.

Mobley, Charles, M., James C. Haggarty, Charles J. Uthermole, Morley Eldrige, Richard E. Renier, Aron Crowell, Bruce A. Ream, David R. Yesner, Jon M. Erlandsson, and Paul E. Buck. 1990. *The 1989 Exxon Valdez Cultural Resource Program*. Exxon Shipping Company and Exxon Company, U.S.A, Anchorage.

Mobley, Charles M. and Eldridge M.1992. Arctic Anthropology Vol 29, No. 2, pp. 91-10. Wisconsin Press, U.S.A.

Moerman, Daniel E. 1998. *Native American Ethnobotany*. Portland, Oregon.

Moskalenko, S.A. 1986. *Preliminary screening of Far-Eastern ethnomedicinal plants for antibacterial activity*. Journal of Ethnopharmacology 15:321-259.

Mulk, I-M. 1994. *Sirkas - ett samiskt fångstsamhälle i förändring Kr.f. - 1600 e.Kr.* Studia Archaeologica Universitatis Umensis 6. Umeå.

Newberry, John S. 1887. *Food and Fiber Plants of the North American Indians*. Popular Science Monthly, 32:31-46.

Newton, Richard and Madonna Moss. 1984. *The Subsistence Lifeway of the Tlingit People: Excerpts of Oral Interviews*. USDA Forest Service, Alasaka Region, Juneau.

Nickul, Karl. 1977. *The Lappish nation. Citizens of four countries*. Volume 122. Indiana University publications, Bloomington.

Nicoll, T. Michael. 1981a. *Report on a Survey of Haida Forest Utilization, Massett Inlet, Queen Charlotte Islands, B.C.* Report prepared by MacMillan Bloedel Ltd., on file with Heritage Conservation Branch, Victoria, B.C.

Nicoll, T.M. 1981b. *Haida Forest Utilization Study*. Datum 6(4):11.

Niklasson, Mats., Zackrisson, Olle., and Östlund, Lars. 1994. *A dendrochronological reconstruction of use by Saami of Scots pine (Pinus sylvestris L.) inner bark over the last 350 years at Sädvajaure N. Sweden*. Dept of Forest Vegetation Ecology, Swedish University of Agricultural Sciences, Umeå. Vegetation History and Archaeobotany 3:183-190. Springer-Verlag.

Norton, H. 1979. *The association between anthropogenic praires and important food plants in western Washington*. Northwest Anthropological Research Notes 13: 175-200.

Okuda, T., T. Yoshida, and T. Hatano. 1991. *Chemistry and biological activity of Tannins in medicinal plants*. In Farnsworth, N. and H. Wagner, Eds. Economic and Medicinal Plant Research Volume 5, pp.130-165. London: Academic Press.

Opler, Morris E. 1941. *An Apache Lifeway: The Economic Social and Religious Institutions of the Chiricahua Indians*. The University of Chicago Press, Chicago, Illinois.

Palmer, Gary. 1975. *Shuswap Indian Ethnobotany*. Syesis 8:29-81.

Pan, H., and Lundgren, L.N. 1996. *Phenolics from inner bark of Pinus sylvestris*. Phytochemistry 42: 1185-1189.

Parker, M.L. 1970. *Dendrochronological Technics Used by the Geological Survey of Canada*. In: Tree Ring Analysis with Special Reference to Northwest America, edited by J. Harry, G. Smith and John Worrall, pp. 55-66. University of British Columbia Faculty of Forestry Bulletin 7.

Parker, M.L. 1984. *Tree-ring Dating of the Cabin behind Hat Creek House*. Report on file, British Columbia Heritage Trust.

Parsons and Parsons, J. R. and M. H. Parson. 1990. *Maguey utilization in highland Mexico: An archaeological ethnography*. Anthropological Papers, Museum of Anthropology, University of Michigan, No. 82. Ann Arbor, Michigan.

Peacock, Sandra, L. 1992. *Piikáni ethnobotany: Traditional plant knowledge of the Piikáni Peoples of the northwestern Plains*. Master of Arts thesis, Department of Archaeology, University of Calgary, Alberta.

Peacock, S.L. 1996. *Taproots, taboos and transformations: The mystery of Balsamorhiza sagittata, a former root food staple on the Canadian Plateau*. Paper presented at the Annual Conference, Society of Ethnobiology, Santa Barbara, California, March 1995.

Peacock, S.L. 1998. *The emergence of wild plant food production on the Canadian Plateau*. University of Victoria, Canada.

Pearson, T.W., J.R. Kritz Jr. and R.J. Taylor. 1979. *Absolute identification of hydroxystilbenes, chemical markers in Engelmann spruce*. Wood science 10:93-98.

Peattie, Donald C. 1950. *A Natural History of Western Trees*. Riverside Press, Massachusetts.

People of `Ksan. 1980. *Gathering what the great nature provided. Food traditions of the Gitskan*. Published in Canada by Douglas & McIntyre Ltd, Vancouver, B. C. Simultaneously published in the U. S. A by the University of Washington Press, Seattle.

Pettersson, O.P. 1941. *Gamla byar i Vilhelmina*, I-IV. Kungliga Skytteanska Samfundets handlingar, Umeå.

Petterson, O.P. 1979. *Kristoffer Sjulssons minnen*. Nordiska Museet. Acta Lapponica 20. Stockholm.

Provenance Research Inc. 1982. *The Potential Impact of Logging Upon the Heritage Resources of Hanson Island*. Report prepared by Provenance Research Inc., for the U´mista Cultural Society, Alert Bay, B.C.

Ray, Verne F. 1933. *The Sanpoil and Nespelem: Salishan peoples of northeastern Washington*. University of Washington Publications in Anthropology 5:1-237.

Ray, V. 1942. *Culture Element Distributions: XXII. Plateau*. Anthropological Records, 8(2): 98-262.

Rheen, S. 1897. *En kortt Relation om Lapparnes Lefwerne och Sedher, wijdSkiepellsser sampt i många Stycken Grofwe wildfarellser*. Svenska Landsmål 17:1. Uppsala.

Schaeffer, Claude E. 1940. *The subsistence quest of the Kootenai: A Study of the Interaction of Culture and Environment*. Ph.D dissertation, University of Pennsylvania, Philadelphia, Pennsylvania.

Schefferus, J. 1674. *The history of Lapland wherein are shewed the original, manners, habits, merriages, conjurations of that people*. George Best and Co. Oxford.

Schlachter, W. 1958. Wörterbuch des Waldlappendialekts von Malå und Texte zur Ethnographie. Suomalais-ugrilainen seura, Helsinki.

Shigo, Alex L. 1979. *Compartmentalization of decay in trees*. Scientific American 252(4):96-103.

Smith, H. I. 1997. *Ethnobotany of the Gitskan Indians of British Columbia*. Canadian Museum of Civilizaton, Quebec, Canada.

Speth, J.D. and K.A. Spielmann. 1983. *Energy source, protein metabolism, and hunter-gatherer strategies*. Journal of Anthropological Archaeology 2(1):1-31.

Spier, Leslie. 1930. *Klamath Ethnography*. University of California Press, Berkley.

Spinden, Herbert J. 1908. *The Nez Perce Indians*. Memoirs of A.A.A. 2:3. University of Washington State Museum, Seattle, Washington.

Stahl, A.B. 1989. *Plant-food processing: Implications for dietary quality*. In Foraging and Farming: The evolution of plant exploitation, edited by D.R. Harris and G.C. Hillman, pp. 171-194. London, U.K: Unwin Hyman.

Standley, P.C. 1912. *Some Useful Native Plants of New Mexico*. Smithsonian Institution Annual Report, 1911:447-462.
Stewart, Hilary. 1984. *Cedar: Tree of life to Northwest Coast Indians*. University of Washington Press, Seattle and London.

Stryd, Arnoud, H. 1982. *Monkman Project, Ancillary Developments: Stages I and II Heritage Impact Assessment*. Report on file, Heritage Conservation Branch, Victoria, B.C.

Swetnam, Thomas W. 1984. *Peeled Ponderosa Pine Trees: A Record of Inner Bark Utilization by Native Americans*. Journal of Ethnobiology 4(2): 177-190.

Teit, James, Alexander. 1900. *The Thompson Indians of British Columbia*. Memoir of the American Museum of National History, Vol i, Part IV, 163-192. New York: G. E. Stechert and Co.

Teit, J., A. 1909. *The Shuswap*. Memoir of the American Museum of Natural History, Vol. II, Part VII, pp. 443-789. New York: G. E. Stechert and Co.

Teit, J., A. 1930. *Salishan Tribes of the Western Plateus*. 45th Annual Report of the Bureau of American Ethnology, Washington D.C.

Thoms, A. 1989. *The northern roots of hunter-gatherer intensification: Camas and the Pacific Northwest*. Ph.D. dissertation, Department of Anthropology, Washington State University, Pullman, Washington.

Thwaites, R.G. 1905. *Original Journals of the Louis and Clark Expedition*, 1804-1806. Vol. 3 and 5., Dodd, Mead and Company, New York.

Turner, Nancy, J., and Marcus A.M. Bell. 1973. *The Ethnobotany of the Southern Kwakiutl Indians of British Columbia*. Economic Botany 27:257-310.

Turner. N.J. 1975. *Food plants of British Columbia Indians*, Part 1. Coastal Peoples. B. C. Provincial Museum Handbook No. 34.

Turner, N.J. 1978. *Food plants of British Columbia Indians*. Part II: Interior Peoples. British Columbia Provincial Museum, Handbook No. 36, Victoria, British Columbia.

Turner, N.J. 1979. *Plants in British Columbia Indian Technology*. British Columbia Provincial Museum Handbook 38.

Turner, N.J., Bouchard, Randy, Kennedy, Dorothy I.D. 1980. *Ethnobotany of the Okanagan-Colville Indians of British Columbia and Washington*. British Columbia Provincial Museum. No 21, Occasional Paper Series.

Turner, N.J. and Barbara S. Efrat. 1982. *Ethnobotany of the Hesquiat Indians of Vancouver Island*. British Columbia Provincial Museum Cultural Recovery Paper No 2.

Turner, N.J., J. Thomas, B. Carlson and R.T. Ogilvie. 1983. *Ethnobotany of the Nitinaht Indians of Vancouver Island*. Occasional Paper No. 24. Victoria: British Columbia Provincial Museum.

Turner, N.J., Thompson, Laurence C., Thompson, Terry M., and York, Annie Z. 1990. *Thompson Ethnobotany*. Royal British Museum memoir No. 3.

Turner, N.J. 1995. *Food plants of Coastal First Peoples*. Revised edition. Victoria: Royal British Columbia Museum and Vancouver: University of British Columbia Press.

Turner, N.J. 1997. *Food plants of Interior First Peoples*. Revised edition. Victoria: Royal British Columbia Museum and Vancouver: University of British Columbia Press.

Turney-High, Harry Holbert. 1937. *The Flathead Indians of Montana*. American Anthropological Association, Menaska, Wisconsin. U.S.A.

Urbye, J.G. 1937. *Barkemel som antiscorbuticum*. Tidsskrift for den Norske Laegeforening 57: 975-979.

Vercruysse, S.A.R., J.A. Delcour, and P. Dondeyne. 1985. *Isolation of quercetin, myricetin, and their respective dihydro-compounds by sephadex LH-20 chromatography*. Journal of Cromathography 324: 495-497.

Von Duben, Gustaf. 1977. *Om Lappland och lapperne*. Tofters tryckeri AB, Östervåla.

Wandsnider, LuAnn. 1997. *The roasted and the boiled: Food composition and heat treatment with special emphasis on pit-hearth cooking*. Journal of Anthropological Archaeology 16, 1-48.

White, Thain. 1954. *Scarred Trees in Western Montana*. Montana State University Anthropological and Sociological Paper 17.

Wilcox, Hugh. 1962. *Cambium growth charachteristics*. In: Koslowski. pp 57-88.

Wilson, I. R., and Morley Eldridge. 1988. *Stein River Haulroad Route Refinements: Heritage Resources Inventory and Impact Assessment*. Report prepared by I. R. Wilson Consultants for British Columbia Forest Products Ltd., on file with Archaeology and Outdoor Recreation Branch, Victoria, B.C.

Zackrisson, O., Bergman, I., Korhonen, O. and Östlund, L. 2000. *Ancient use of Scots pine innerbark by Sami in N. Sweden related to cultural and ecological factors*. Dept. of Forest Vegetation Ecology. Umeå, Sweden.