Coast Information Team

c/o Cortex Consultants Inc., 3A–1218 Langley St. Victoria, BC, V8W 1W2
Tel: 250-360-1492 / Fax: 250-360-1493 / Email: info@citbc.org

21 March 2004

Re: Economic Gain Spatial Analysis–Non-timber Forest Products Sector

The attached draft document, *CIT Economic Gain Spatial Analysis–Non-Timber Forest Products March 2004*, was commissioned by the Coast Information Team (CIT), a project established by the Provincial Government of British Columbia, First Nations, environmental groups, the forest industry, and communities. The CIT mandate is to provide independent information on the central and north coasts of British Columbia and Haida Gwaii/Queen Charlotte Islands using the best available scientific, technical, traditional and local knowledge.

The CIT is led by a management committee consisting of representatives of these bodies; and is funded by the Provincial Government, the environmental groups and forest products companies, and the Federal Government of Canada. The CIT technical team comprises nine project teams consisting of scientists, practitioners, and traditional and local experts. The CIT information and analyses, which include the EGSA–Non-timber Forest Products report, are intended to assist First Nations and the three subregional land use planning processes in making decisions that will achieve ecosystem-based management (as per the April 4th 2001 Coastal First Nations – Government Protocol and the CCLRMP Interim Agreement).

In keeping with the CIT's commitment to transparent and highly credible independent analysis, the EGSA–Non-Timber Forest Products report underwent an internal peer review and the CIT's independent peer review process chaired by University of Victoria Professor Emeritus Rod Dobell. Peer reviews of the report and the authors' response are found at http://www.citbc.org/abostru-comm.html

As of the date to bring CIT products to completion, this draft report did not satisfactorily address peer reviewer comments or meet the CIT Management Committee's expectations. The CIT is, therefore, issuing the EGSA–Non-Timber Forest Products report as a Working Paper. While CIT Working Papers contain useful information, readers should consider the analysis, results, and conclusions as provisional.

We encourage all stakeholders involved in land and resource management decision-making to consider CIT products as they seek to implement EBM and develop EBM Land Use Plans. We are confident that the suite of CIT products provides valuable information and guidance on the key tenets of EBM: maintaining ecosystem integrity and improving human wellbeing.

Sincerely,

Robert Prescott-Allen, Executive Director
on behalf of the CIT Management Committee:
Ken Baker, Art Sterritt, Dallas Smith, Jody Holmes, Corby Lamb
Graem Wells, Gary Reay, Hans Granander, Tom Green, Bill Beldessi

Economic Gain Spatial Analysis
RFP EGSA-1
(Non-Timber Forest Products)

Revised Final Report

by

Cognetics International Research Inc.
Box 184-579 Berry Road
Bowen Island, BC
V0N 1G0
tel. 604-9470271
rmw@direct.ca

March 2004

Contents

Executive Summary

We first have identified in excess of 130 floral species which comprise the main food plant species, medicinal plant species, food mushroom species, medicinal mushroom species and floral greenery species of BC's Central Coast, the North Coast, and of Haida Gwaii.

Given current and future short term market demands, we have then extracted from this master listing the best economic bets for commercial development within each of these five sub-categories –edible and medicinal plants, edible and medicinal/nutraceutical fungi, and floral greenery. Then we have further detailed the best bets for three regions – the Central Coast, Haida Gwaii, and Bella Coola. *These species are Devil's Club on Swindle and Cone Islands (near Klemtu); chanterelles and medicinal mushrooms on Haida Gwaii, and pine mushrooms in the Bella Coola Valley.*

Given these results, we have produced a simple economic gain spatial analysis which indicates within selected regions of the core CIT area, the approximate distribution of these economic best-bet species by map polygon on Forest Cover Maps (Appendix I.) and (2) economic gain scenarios for three sub-regions—in the Bella Coola Valley, and on parts of Haida Gwaii and the Central Coast. These scenarios discuss how First Nations and other local people can benefit from these non-timber forest resources through a variety of mechanisms –gathering and selling of dried raw materials, making products from cultivation forests, and activities such as botanical gardens and medicinal plant and fungi walks.

In the process of assigning an economic value to the areas, to the extent realistically possible we have estimated (1) the nature of potential economic gains in terms of jobs, annual revenues from specific activities, labour costs and profits associated with different types of commercializing the NTFPs such as gathering of raw materials, initiating cultivation forests, production of extract products, etc. (2) the profit distributions, (3) levels of the activities for both economic viability and species sustainability; (4) inputs, by activity, to realize these gains in terms of resource ownership and tenure, product and market development, and training needs.

With respect to revenue distribution, our scenarios are aimed at directing all profits from the development of the non-timber forest resources to First Peoples who inhabit the lands from which these resources are being taken.

Stand history files for specified sub-regions of the Central Coast and Haida Gwaii were examined along with forest cover maps and descriptions of ecosystems from the literature. The timber licensees cruise data has provided relevant information concerning populations for some of the medicinal fungi such as the *Ganodermas, Fomitopsis pinicola* and others. Wild edible mushroom populations were estimated using data from the literature and mushroom buyers. Populations of medicinal plant species such as *Oplopanax horridus* were estimated primarily from data collected by us in previous research. Where available, information from ground checking was assessed**.** In our analyses, we selected three sub-regions -- involving approximately 10,000 hectares of Kitasoo/Xaixais traditional territory, the Bella Coola Valley, and approximately 10,000 hectares on Haida Gwaii. Sites within these areas no smaller than 500 to 1,000 hectares were assessed. Accompanying maps have also been produced indicating the

concentrations of Devil's Club on Swindle and Cone Islands, hard medicinal mushroom species in regions of Haida Gwaii, and concentrations of Pine Mushrooms in and around the Bella Coola Valley.

Recommendations

(1) Haida Gwaii –The Council of the Haida Nation and Aveda are currently establishing the first cultivation forest for medicinal fungi on Haida Gwaii. Funding (approximately $150,000/year for four years) is needed to expand this project to include a second site on Graham Island.

(2) Central Coast – Klemtu –we recommend that the Kitasoo/Xaixais Nation set up the first coastal cultivation forest for Devil's Club. One hundred hectares of Devil's Club ecotype should be managed. This will cost approximately $150,000/year for three years.

(3) Bella Coola – we recommend a five year First Nations collaborative effort to study and implement the enhancement of pine mushrooms in a cultivation forest near Bella Coola. This will cost approximately $100,000/year for five years.

Non-Timber Forest Products in BC

background

A report by the authors (1999) described some of the most economically-valuable non-timber forest products and services emerging from BC wildlands and analyzed their associated industries, production technologies and markets. It then presented an economic strategy for rapid development of these industries.

The products and services highlighted were:

- X wild food mushrooms (mainly pines, chanterelles, boletes and morels)
- X nutraceutical and medicinal mushrooms (*mycomedicinals*) and fungi
- X nutraceuticals and pharmaceuticals from plants, bark, lichens, insects, soil organisms, and wood waste
- X biocides (non-toxic insecticides) from the same sources
- X anti-phytovirals (medicines *for* plants from forest substances)
- X floral greenery
- X ecotourism

The term *nutraceutical* broadly means a substance with both nutritional and therapeutic benefits, something one consumes when healthy to remain so or get healthier. Nutraceutical food products and herbal supplements have estimated global sales of between US $12-$18 billion in 2002, (Cognetics estimates) and a variety of popular nutraceuticals are found on BC's Central Coast and Haida Gwaii. Saskatchewan, Alberta and several US states are actively supporting their nutraceutical companies.

A major opportunity awaits any BC government that will act with determination to rebuild our forest industry on a new and more varied basis. Though dwarfed by the giant timber industry, the non-timber forest industries highlighted above employed almost 32,000 people in BC on a seasonal or full-time basis in 1997 and had direct corporate revenues of $280m and related provincial revenues in excess of Can. $630m (Wills and Lipsey, l999).

These figures do not include revenues from native plants taken for rehabilitation, restoration and ornamental purposes, revenues from BC's manufacturers of herbal medicines and food supplements (since they presently use so few indigenous ingredients), or sales of essential oils used in perfumery and aromatherapy Ball significant growth areas.

The annual corporate revenue growth of these NTFP industries over the past three years varies widely, ranging from yearly averages of around 10%-12% for some of the wild food mushrooms to over 30% for several nutraceutical manufacturers (Cognetics estimates).

It has become common wisdom that BC is overly dependent on resource-based industries (which generate in excess of three quarters of total merchandise exports), and that economic

diversification is needed urgently. *We are suggesting that BC become even more dependent on resources for export earnings,* through aggressively supporting these emerging industries.

These forest resources are not our Adependence" - they are our *comparative advantage.* Some of these industries use advanced technologies, some low-tech-- this does not matter, because most gather or manufacture *comparative advantage products* from BC and the Pacific Northwest which are found nowhere else. To date, the provincial government has noticed few of these emerging product areas.

Properly supported, these revenues could increase by a factor of 8-10 during the next decade to comprise in excess of a third of total forest-derived revenues (as computed at pre-recession prices), (Wills and Lipsey, l999).

Thus far we have developed a limited number of forest products, mainly timber and pulp. But judging from countries like Malaysia and Indonesia -- over the next decade there will be an explosion of new products from BC forests:

X medicinal and food mushrooms, and pharmaceuticals from plants for humans and animals;
X preventative healthcare products such as the tsunami of nutraceuticals coming onto the US market;
X resins, gums and camphors, essential oils and other cosmetic substances such as bases for face cream, perfumes, sunscreens and hair tonics;
X genetic material for foodstuffs, biocides, natural medicinal bases, new dental products, spermicides and non-toxic contraceptives;
X anti-viral agents for plant diseases such as infections of fruit orchards;
X crop protectors such as insect exudates which repel birds;
X chemical "detoxifiers" for both industrial processes and human tissue;
X new building materials modeled on naturally-occurring forms and structures.

People will always need to build wood houses and use paper for documents; but timber and pulp will be only two forest products among a myriad group of new forest industries based on chemical ingredients in under-story plants, lichens, insects, bark, soil organisms, fungi, wood waste, and other flora and fauna.

traditional plant knowledge

Since several of the NTFPs suggested for development in this work are based on traditional knowledge of First Nations, it is important to understand the First Nations perspective on the taking of their medicinal *plant* knowledge by outsiders.

Throughout history, BC first peoples have gathered and cultivated wild edible and medicinal plants. In BC there are rhizome remnants of ancient botanical gardens – as deeply resonant a marker as culturally modified trees (CMTs*). However some species cannot be gardened and must be cultivated in the forest. This is the essential notion of a cultivation forest. One sees many of these for food and medicinal mushrooms throughout Asia. In this report, we are*

recommending that the economically valuable food and medicinal mushrooms and plant species identified be propagated in cultivation forests –old and new forested areas set aside for the profuse cultivation of understory plants and fungi. Biodiversity is increased, and in such restricted areas it is possible to do some real ecosystem management. Besides it is a reasonable way to produce a continuous source of raw materials for the emerging natural medicine products.

Consumer products of commercial value are being made from the traditional plant knowledge of BC first peoples. For the most part, the people been exploited and have received nothing for this knowledge. Many First Peoples find any commercializations of traditional medicinal plants abhorrent. For example, Devil's Club (*Oplopanax horridus*) was universally used for upper respiratory infections and as a daily tonic, (Nancy Turner, personal communication), and is now entering a multitude of herbal formulae on the North American market. Unfortunately, none of these instances involves native-controlled companies.

There are two types of First Nations medicines – *individual species*, which are generally well known and which are already being sold by non-native companies, and medicinal *recipes* comprised of several plant species prepared in specific ways. Due to the inquiries of ethnobotanists, ethnolinguists and other scientists, the names and associated illnesses of most First Nations medicinal plant species are known and have passed into the "public domain" through publication. However, the combinations of plant ingredients used in medicinal recipes and their means of preparation are often not known. They should remain this way.

But it is the synergistic interactions of several chemicals prepared in specific ways that are responsible for therapeutic effects, not a single "active ingredient". *These "recipes" are highly proprietary and spiritual information, often held and promulgated by a single family. They should remain secret and not be commercially developed.*

However, it is appropriate that First Nations forest-cultivate and sell the individual medicinal and nutraceutical plant species that they discovered and developed, and which are *already being sold by non-native companies* on world markets. Such business ventures will assist first peoples in both reviving their traditional medicinal plant knowledge and using this knowledge for their own economic benefit.

Non-Timber Species of BC's Central Coast, the North Coast and Haida Gwaii

In this section, we first have identified in excess of 130 floral species which comprise the main food plant species, medicinal plant species, food mushroom species, medicinal mushroom species and floral greenery species of BC's Central Coast, the Bella Coola Valley, and of Haida Gwaii.

Given current and future short term market demands, we have then extracted from this master listing the best economic bets for commercial development within each of these five sub-categories –edible and medicinal plants, edible and medicinal/nutraceutical fungi, and floral greenery. Then we have scrutinized these best bid species for three regions – the Central Coast,

Haida Gwaii, and Bella Coola. *These NTFPs are Devil's Club on Swindle and Cone Islands (near Klemtu); chanterelles and medicinal mushrooms on Haida Gwaii, and pine mushrooms in the Bella Coola Valley.*

methodology

Given these results, we have produced a simple economic gain spatial analysis which clearly indicates within selected regions of the core CIT area, the approximate distribution of these economic best-bet species, and estimates of amounts which naturally grow there in good years, by sub-regions, and (2) economic gain scenarios for three sub-regions—in the Bella Coola Valley, and on parts of Haida Gwaii and the Central Coast. These scenarios detail in specific terms how First Nations and other local people can maximally benefit from these non-timber forest resources through a variety of mechanisms –gathering and selling of dried raw materials, and making products from cultivation forests, medicinal plant and fungi walks and other forms of integration of plants and fungi into First Nations ecotourism efforts.

In the process of assigning an economic value to the areas, to the extent realistically possible we have estimated (1) the nature of potential economic gains in terms of jobs, annual revenues from specific activities, labour costs and profits associated with different types of commercializing the NTFPs such as gathering of raw materials, initiating cultivation forests, production of extract products, etc. (2) the profit distributions, (3) minimal and maximal levels of the activities for both economic viability and species sustainability; (4) we are also prescribing requisite inputs, by activity, to realize these gains in terms of resource ownership and tenure, product and market development, and training needs.

With respect to profit distribution, our scenarios are aimed at directing all profits from the development of the non-timber forest resources to First Nations which inhabit the respective lands from which these resources are being taken.

(1) economic gain spatial analysis

Wildstocks of selected NTFPs were estimated using:

- Ministry of Forest Stand History Files
- Forest Cover Maps
- Ecosystem Descriptions
- Timber Cruise Data from Weyerhaeuser, etc.
- Mushroom Buyers' Information
- Existing NTFP Data from Previous Research

Stand history files for specified sub-regions of the Central Coast and Haida Gwaii were examined along with forest cover maps and descriptions of ecosystems from the literature. The timber licensees cruise data has provided relevant information concerning populations for some of the medicinal fungi such as the *Ganodermas, Fomitopsis pinicola* and others. Wild edible mushroom populations were estimated using data from the literature and mushroom buyers. Populations of medicinal plant species such as *Oplopanax horridus* were estimated

primarily from ecosystem description data provided by the Ministry of Forests, timber licensees, and data from previous research. Where available, information from ground checking was also assessed.

(2) economic gain scenarios for three sub-regions

Firstly we have selected three sub-regions for analysis -- involving approximately 10,000 hectares of Kitasoo/Xaixais traditional territory, the Bella Coola Valley, and approximately 10,000 hectares on Haida Gwaii. Sites within these areas no smaller than 500 to 1,000 hectares were assessed. Accompanying maps have also been produced indicating the concentrations of Devil's Club on Swindle and Cone Islands, hard medicinal mushroom species in regions of Haida Gwaii, and concentrations of Pine Mushrooms in and around the Bella Coola Valley.

edible plants

With the exception of wild edible berries that can be gathered and sold, markets for edible plants from the three regions are extremely limited at present. The demand for wild edible plants involves only a few species (such as fiddleheads) which are seasonably consumed at some restaurants in the Greater Vancouver Area and sold at a few other specialty stores such as Capers or Granville Island Market.

medicinal plants

There are opportunities to forest grow and harvest several species of nutraceutical plants and to market these initially in the forms of immune-stimulating teas and later as whole spectrum extracts. These can be sold first to BC Ferry visitors and other tourists and later to consumers worldwide over the website. Easy to grow, light to transport, and uniquely First Nations, this is a major opportunity area and it involves selling simple products, not raw materials. T*he medicinal and nutraceutical plant species we are recommending for economic development are already being sold on world markets--mainly by non-native companies—and are thus already in the public domain. The traditional recipes for medicines (i.e. several plant species prepared in specific manners) should remain in the domain of First Nations families where they are held, and never be sold.*

We estimate that the world market for herbal medicines (both crude extracts and refined, so-called phytopharmaceuticals) was approximately US $22 billion in 2001 and is increasing at around l0% annually. The most developed markets are those of Germany, France, and Italy.

nutraceuticals

Nutraceuticals are plant-based extracts which one eats when healthy to remain so. Plant-based nutraceuticals accounted for around $4.2 billion in North American sales during 2001 (Cognetics estimates), and most concoctions (of several plant extracts) are still based on the traditional European pharmacopoeia of species used there for several hundred years. However some First

Nations medicinal plant species are rapidly entering this yuppie nutraceutical market. Devil's Club was universally used by coastal BC first peoples for a range of illnesses and as a daily health tonic. In l999 there were only two or three companies on the Internet selling Devil's Club. By mid-2002, there were hundreds. A 50ml bottle of Devil's Club extract retails for around US $25-$55.

The following Table presents some other indigenous BC medicinal and nutraceutical plant species and their current dried wholesale bulk prices in Canadian dollars.

Table 1. Select BC Indigenous Medicinal Plants and 2002 Wholesale Prices

Name	Wholesale Price ($Can/lb.), dried
Alder bark	$ 2.80-$5.00
Alum root	$11.45
Avens	$11.00
Arnica	$ 7.95
Baneberry	$12.00
Bittercherry bark	$11.00
Bittersweet	$11.00
Bleeding Heart root	$11.00
Bloodroot	$ 10.00
Burdock	$ 7.45-$14.30
Bunchberry	$12.00
Cattail pollen	$70.00
Cascara segrada	$11.95
Cedar Oil	$5.00-$60.00
Chickweed	$ 8.75
Chokecherry	$25.00
Club Moss	$10.00
Colt's Foot	$20.00
Dandelion	$6.00-$12.00
Devil's Club	$20.00-$85.00
Dogbane root	$25.50
Elder flowers	$11.00
Feverfew	$15.00
Fireweed root	$22.00
Giant Horsetail	$19.00
Goldenrod	$ 7.00
Hawthorn leaves	$ 7.00
Heal all	$ 8.95
Horsetail	$ 7.00
Indian Hemp	$12.00
Kinnikinnik	$ 5.00

Name	Wholesale Price ($Can/lb.), dried
Lady Slipper root	$90.00
Licorice Fern	$16.00
Madrone leaf	$12.00
Male Fern	$12.00
Mullein	$ 6.00
Nettle Leaf, organic	$18.75
Oakmoss	$ 7.75
Oregon Grape root	$4.00-$l5.00
Pearly Everlasting	$13.00
Pipsissewa	$11.00
Pleurisy Root	$ l6.00
Rasberry Leaf	$ 2.95--$14.95
Reed Root	$18.00
Scullcap	$20.00
Sheep Sorrel	$7.50
St. John's Wort	*$ 7.55*
Strawberry Leaf	$ 7.55
Tansy	$ 4.95
Valeria	$2.00-$18.00
Willow flowers	$12.00
Yarrow	$ 8.00

Source: internet searches

food mushrooms

pines

The most valuable BC wild food mushroom export (almost entirely to Tokyo and Osaka) is our species of pine mushroom, *Tricholoma magnivelare.* To date artificial laboratory cultivation of the BC pine mushroom has not been possible, but as the demand increases, pine mushrooms will be enhanced in dedicated cultivation forests. The harvest and sales of this valuable crop are analyzed on page 39-40.

Other wild food mushrooms harvested in BC include: chanterelles (around 750,000 kgs. in a good year), boletes (l00,000 kgs.), morels (around 225,000 kgs.) and other species such as lobster, secondary boletes, cauliflower, hedgehog, and such (about 50,000 kgs. together). These other wild food mushrooms are generally sold in Europe, the US and other parts of Canada (Wills and Lipsey, l999).

chanterelles

Pickers receive on average between Can. $2.00-$4.00/lb for chanterelles and an average selling price of Canadian exporters is in the range of US$l0.00-$l5.00/kg fresh and landed in the US or Europe. In 2000, 220,000 kgs. of fresh chanterelles were imported from Canada to France at an average landed price of US $9/kg.

boletes

In a good fruiting year, approximately l00,000 kgs. of fresh boletes are harvested in BC. In a bad year there may be virtually no harvest at all. These mushrooms are so weather dependent that it is not possible to rank order their source areas. Again boletes grow in many places on the Mid-Coast and around Bella Coola, where they are not currently harvested.

Pickers on average are paid Can. $2.50/lb for boletes (there are four grades), and exporters receive US $8-12.00/lb fresh, around US$75.00/kg. dried, and around US$5.00-6.00/kg frozen. Approximately 90% of all harvested boletes are exported dried or frozen and only around l0% of the harvest is exported fresh. Boletes are one of the first wild food mushrooms to be attacked by pests and can change grades in three hours.

morels

In a good year approximately 225,000 kgs. of morels are harvested in BC and the Yukon but in a bad year this figure may fall to the range of l0,000-20,000 kgs. (It is generally BC pickers who perform the Yukon harvest). Seventy five to eighty percent of all morels exported from BC come from the Yukon (because BC does such a good job in suppressing forest fires), with the remainder arising from the Pemberton area, the southern Okanagan and the Smithers area (in decreasing order of importance). There are two grades of morels and pickers receive, on average, Can. $3.00/lb for fresh morels, with exporters receiving US $l8.00-$22.00/lb fresh, or in the range of US $l00.00-$125.00/kg dried in the US or Europe.

In order of importance, the consuming countries for BC chanterelles, boletes and morels collectively are France, Germany, Italy, Switzerland and the Netherlands. France serves as the major redistribution centre for Europe.

medicinal mushrooms

Ninety nine percent of all production and sales of medicinal mushrooms and extracts occur in Asia and are derived from Asian species, with less than 0.01 percent of current world sales in North America.

The rate of incorporation of indigenous mushroom extracts into North American nutraceutical formulae is slow at present, and most of the Asian sales occur in the form of refined extracts or pharmaceutical level injections, or crude whole spectrum extracts.

The following table presents some typical prices from BC and US companies for dried nutraceutical and medicinal mushrooms from Asia, mushroom extracts, and mycelia extracts. The market for BC wild medicinal mushrooms is so important that it is elaborated in a detailed manner in the section dealing with Haida Gwaii.

Table 2. Typical Retail Prices for Selected Dried Medicinal and Nutraceutical Mushrooms and Mycelia Extracts

Mushroom or Extract	**Qty.**	**US$ (retail)**	**US$ (wholesale)**
Ganoderma lucidum (Reishi)	1 lb.	$102.00	$22.25
Cordyceps sinense –fruit body and caterpillar (Dong Chong Xia Cao)	1 oz.	$89.00	
Auricularia polytricha	1 lb.	$16.00	
Grifola frondosa (Maitake)	1 lb. 1 oz.	$129.95 $14.95	$25.00
Grifola frondosa water Extract, fine powder, 4:l concentration	1 lb.		$120.50
Trametes versicolor alcohol extract	1 kg.		$102.25

Sources: internet searches

floral greenery

This sector has two main parts in BC--six companies that sell directly to European buyers, and twelve smaller firms that sell to US buyers who in turn sell into European markets. Direct sellers get better prices for quality products.

The main products in terms of weight are salal, ferns, cedar boughs, huckleberry, and boxwood. Other floral greenery is regularly harvested in BC and sold to Europe, the US, Japan and the distribution centre of Hong Kong. Some floral greenery companies also harvest wild food mushrooms, but they do not take medicinal botanicals, which is a separate industry. The BC firms in this sector have annual collective gross revenues of between Can. $55m -$65m. The total number of part-time commercial pickers is around l5,000 (Wills and Lipsey, l999).

The following wholesale price listings, unless otherwise noted, are taken from *Seeing the Forest Beneath the Trees,"* (draft), Mitchell Consulting Associates. These listings contain prices for a variety of floral greenery species from the Burnaby Flower Auction.

Product	**CAN$**
Evergreen boughs (cedar, pine, fir)- per bunch (24-36 inches long)	2.00- 2.40
Salal – per bunch	2.00
Japanese Boxwood – per bunch	1.80
Willow (including *salix contorta*) – per stem	2.40
Sword Fern – per bunch	0.80
Mosses per pillow-sized bundle (all kinds – drier preferred)	4.00
Pinecones (4 inches long, 2-3 inch diameter) – per cone	0.20
Baby's Breath (largest demand in February) – per bunch	3.00
Live Christmas trees (5 foot including pot) – per tree	12.00

Extract from **Lost Coast** website (URL) (US$ converted to Canadian at rate of 1.40). (25 per bundle)

Ferns		
Sword fern	*Polystichum munitum*	CAN$ 4.90/bundle
Maidenhair	*Adiantum pedantum*	$ 5.60/bundle
Deerfern	*Blechnum spicant*	$ 4.90/bundle
Brackenfern	*Pteridium aquilinum*	$ 4.90/bundle
Ladyfern	*Athyrium alpestre*	$ 5.25/bundle
Miscellaneous Greens		
Salal (Lemon Leaf)	*Gaultheria shallon*	$ 7.84/bundle*
Huckleberry (red and green)	*Vaccinium ovatum*	$ 3.85/bundle
Oregon-Grape	*Mahonia nervosa*	$ 4.90/bundle
Beargrass	*Xerophyllum tenax*	$ 3.15/bundle
Scotch Broom	*Cytisus scoparius*	$ 3.50/bundle
Boxwood	*Pachistima myrsinites*	$ 4.90/bundle
Horsetail (Rush)	*Equisetum arvense*	$ 3.85/bundle
Manzanita	*Arctostaphylos pungens*	$ 3.85/bundle
Chinquapin	*Castonopsis chrysophylla*	$ 4.90/bundle

Evergreen Boughs

Douglas Fir	*Pseudotsuga menziesii*	$ 4.90/bundle
Western Red Cedar	*Thuja plicata*	$ 4.90/bundle
California Myrtle	*Umbelluria californica*	$ 5.60/bundle
California Eucalyptus	*Eucalyptus globulus*	$ 4.90/bundle
Silver Dollar Eucalyptus	*Eucalyptus cinerea*	$ 7.70/bundle

Extract from **Wildwoods Evergreens** website (prices converted to Canadian at 1.40 exchange rate).

Balsam Wreaths	24"@ $16.80 / 60" @ $64.33
Cedar Wreaths	24" @ $23.75

Extract from Oregon Mountain Forest Products Packaging Company.

Green Moss	Large Bale (approx. 25lbs) sells for C$ 42 - $46 depending on volume
Spanish Moss	Large Bale (approx. 25lbs) sells for C$ 52 - $61 depending on volume

There may be opportunities in the three regions to gather greenery species from the wild in a sustainable way and sell these directly to exporters. Mitchell Associates has estimated that: " a 'good' salal area can produce approximately 10,000 bundles (five stems each) per 100 acres per annum on a sustainable basis. At current market prices of $1.50 per bundle paid to the picker, a 1,000-acre salal-rich area, would generate pickers' wages of between $100,000 to $150,000 per annum." Unfortunately, most of the salal on the Central Coast and Haida Gwaii is of little market appeal – its leaves are the wrong size and the leaf spacing is not appealing to the greenery buyers.

Some mosses are also quite valuable. Small bags of moss sell for up to Can. $10.00 in the Vancouver retail market. One or two species could be selected and test sold to a floral wholesaler or at an auction like the United Flower Growers Co-Op in Burnaby. This would allow one to determine the profit margin given the high transportation (and other) costs from Klemtu or from Haida Gwaii. Basic drying and packaging facilities will have to be built locally if this product area is eventually chosen for development.

Best Bets for Economic Diversification

Given market conditions, the following species are the best candidates for economic diversification on the North and Central Coast and Haida Gwaii,. Some of these species grow in such profusion that they may be harvested sustainably from wild stocks. However we recommend that any other species selected for development be *forest-grown* in selected areas designated as *cultivation forests,* and that only these forest-farmed plants and fungi be used. In this way the wild plants and mushrooms on traditional territory and crown land will continue to flourish.

I. Medicinal Plants

Devil's Club (*Oplopanax horridus)*

II. Edible Fungi

Chanterelle (*Cantharellus cibarius*)

Pine Mushroom (*Tricholoma magniverlare*)

III. Medicinal Fungi

Artist's Conk *(Ganoderma applanatum)*

Hemlock Varnish Shelf *(Ganoderma tsugae)*

Red Belt *(Fomitopsis pinicola)*

Split Gill *(Schizophyllum commune)*

Turkey Tail *(Trametes versicolor)*

With this general discussion, we now focus in on our three areas of analysis -- The Central Coast area of Swindle and Cone Islands, the Spirit Lake Region of Haida Gwaii, and the Bella Coola Valley.

Medicinal Plants on Swindle and Cone Islands

introduction

The Kitasoo/Xaixais live on BC's central coast on Swindle Island. . This First Nation has a membership of around 460 people and is roughly doubling in population each two decades. The Kitasoo, originally from Kitasu Bay and the Xaixais of Kynoc Inlet, are the only first peoples within these traditional territories. Commercial and food fishing (the mainstay of the economy) has been devastated, and the Kitasoo/Xaixais are making major efforts to diversify their economy through forestry, aquaculture and ecotourism. This diversification is based on an attempt to balance ecological values with the needs of economic survival and the creation of sustainable employment and income.

The traditional territories of the Kitasoo/Xaixais encompass the southern three quarters of Princess Royal Island, the mainland inlets of Khutze, Green, Altanash, Muswse and Kynoc;

Dowager, Pooley, Aristazabal , and Roderick islands; and the surrounding waters and islands out to the centre of Hecate Straight.

We are focusing our Central Coast economic gain scenario in Swindle and Cone Islands (near Klemtu), and here we are concentrating exclusively on Devil's Club (*Opplopanax horridus).* Of all the "economic best-bet" species growing on and around Swindle Island, Devil's Club is the most promising and grows in healthy profusion almost everywhere. We have found in various field trips to this region conducted over the past two years, that most of the other medicinal and food plants and fungi do not thrive in this region since they are hammered during the winter by sea spray and inundated year round by acidic runoffs from marshy bogs which comprise a good portion of this region (almost l5% of total land areas).

The Kitasoo Land Use Plan of June 2000 sets aside forty percent of their traditional territory as protected areas. These areas, collectively known as "Nakami Weld", will be defended against timber cutting, mining and other forms of resource extraction, and are being used for food and medicine gathering, and ecotourism.

The other sixty-percent of traditional territory has been designated as Integrated Use Areas, to be sustainably used to create economic development opportunities and jobs. This biologically diverse, isolated and protected area encompassed in the Land Use Plan holds considerable opportunity for non-timber forest product development and the revitalization of traditional Kitasoo plant knowledge.

Propagation Techniques for Devil's Club

Harvesting of wildstocks entails whole plant removal or excision of the bark in situ. On the other hand, forest cultivation involves the in situ propagation of wild strains. These are the main techniques for propagating Devil's Club.

-seed germination

-stem cuttings

-root cuttings

-layering

We estimate that the sustainable management of approximately one million Devils Club plants could involve the yearly harvest of 25% of wildstocks or 50% of the cultivated crop.

Table 1 – Devil's Club on the Central Coast

	Wildstocks	Cultivated

Products	**raw bark, whole spectrum extracts, tinctures, etc.**	**same products**
Sustainable Yield	**25% per annum**	**50% per annum**
Yield Estimate	**2,500kg of dry bark Per one million plants**	**5,000kg of dry bark per one million plants**
Costs	**$150,000**	**$450,000**
Price	**$120/kg.**	**$120/kg.**
Returns	**$300,000 gross**	**$600,000 gross**
Sales Breakdown		
employment income	**$100,000**	**$300,000**
non-employment income	**0**	**0**
revenues to crown profit	**0**	**0**
Jobs Breakdown	**7 technical**	**7 technical**
Viability	**poor**	**good**

Devils Club economic estimates

With each of the medicinal plants and fungi we are recommending for development, we have estimated their in place value (1) gathered and sold as raw material on the open market, and (2) forest cultivated or gathered and sold as an ingredient in a nutraceutical extract product. Forest cultivation involves growing the species in the forest, and extracts may be taken from either cultivated or foraged sources. With cultivation (in either a forest or laboratory setting), both the quantities and strengths of constituent phytochemicals may be more rigorously controlled, and one is also not dependent on nature's harvest times. However, given the middle class's penchant for natural products, gathered produce from forest sources now qualifies for a premium and exerts consumer appeal.

method 1.

If we assume a harvest area of 10,000 hectares near Klemtu, BC, with around 1 percent cover of Devil's Club, in this harvest area on the accompanying maps, there will be l00 hectares of a Devil's Club Management Zone. If we assume approximately one Devil's Club plant per square metre ,in this smaller zone, one has a total of one million plants to manage. Small (one and two gallon) live plants sell on the web for $4.50 and $9.75 respectively.

Conservatively, one plant should yield approximately ten grams of dried Devil's Club bark and root (the commercial parts of this plant). Therefore there are approximately 10,000 kilograms of dried Devil's Club bark in the stand. Bulk dried bark sells on the web for around US $147/lb. or US $ $241/kilo.

Labour costs for picking, drying and shipment are 25%-50% of total gross revenues. Exploitation and sale of the raw resource can thus be profitable. But in addition to raw plant and bark sales, the Kitasoo should aim toward production of a simple Devil's Club extract product for final consumers and should locate now, the optimal area for Devil"s Club management close to Klemtu.

method 2. Table 1 outlines approximate costs (including labour) associated with each phase of a three year pilot cultivation forest of 100 hectares. During the three year period, we have estimated that a cultivation forest of 100 hectares will create two to three forest technician jobs and a laboratory technician position plus five planters. The greater job creation effects will be seen with the harvesting of wild Devil's Club, and the production and sales of extract products. These job effects are anticipated to include: a managerial position, 10 to 12 gatherers, two plant propagation technicians, additional forest/material handling technicians, plus other positions involved in website creation and maintenance, product preparation, packaging and distribution, etc.

Production costs of 50ml bottles of full spectrum Devil's Club extract are approximately thirty percent of price; thus if one sells slightly over 10,000 50ml bottles at an average price of Can. $23.00 during the first year of sales, we have forecast revenues of $230,000 during the first year on production and distribution expenses of around $70,000. If this product sales keeps up with the US average for the nutraceutical sector (30% annual growth), then by the third year of sales, gross revenues will exceed $350,000.00.

Medicinal Mushrooms on Haida Gwaii

Haida Gwaii (the Queen Charlottes Islands) comprises an archipelago made up of 150 islands covering an area of around one million hectares. Located about 70 kms off the mid-coast of British Columbia, the Islands are home to the Haida First Nation. Inland areas of Haida Gwaii lie within the Coastal Western Hemlock (CWH) Biogeoclimatic Zone.

Most of the seven cultivation forest sites we have examined on Haida traditional territory are located in productive portions of the Submontane Wet Hypermaritime Coastal Western Hemlock Variant (CWHwh1). The CWHwh1 is restricted to Haida Gwaii where it occurs at lower

elevations on the leeward side of the Queen Charlotte Ranges. Elevation ranges from sea level to approximately 350m. The CWHwh1 has mild, wet winters with minimal snowfall, and cool, moist summers. The occasional dry spell during summer reflects the rain shadow effect of the Queen Charlotte Ranges. Mild temperatures are attributable to the moderating effect of the Pacific Ocean. Though precipitation varies widely in this biogeoclimatic unit, cloud, drizzle and fog are common throughout the year. Forests on zonal sites are dominated by western hemlock (*Tsuga heterophylla*), western red cedar (*Thuja plicata*) and sitka spruce (*Picea sitchensis*). Mosses dominate the understorey with *Hylocomium splendens*, *Rhytidiadelphus loreus* and *Rhyzomnium glabrescens* occurring most commonly. The herb and shrub layers are sparse due primarily to heavy deer browsing.

The 2001 population of Haida Gwaii was around 6,000 people. Most residents live in several communities located on Graham Island to the north and Moresby Island to the south. Masset and Old Masset, situated next to each other on the north end of Graham Island have a population of around 2,300. The smaller towns of Port Clements and Tlell are situated near the middle of Graham Island. Skidegate and Queen Charlotte City are located next to each other at the south end of Graham Island and ave a combined population of around 2,100. The community of Sandspit is situated on the northeast end of Moresby Island and has a population of around 700. In Haida Gwaii we have concentrated exclusively on medicinal mushrooms and chanterelles generally in the region of Spirit Lake. Since the world medicinal mushroom market is complex, we begin with an analysis of this growing market.

Due to it's unique ecosystem Haida Gwaii is well suited for the enhanced forest production of medicinal and nutraceutical fungi, and the Haida Nation will benefit from the manufacture of new lightweight, valuable, nutraceutical products. Such an enterprise will accelerate Haida-controlled economic diversification, especially if forest cultivation of medicinal fungi becomes a theme of the emerging Haida tourism effort. A pilot cultivation forest is being established, with our assistance, in ancient forests on Haida traditional territory near to cultivate several species of hard wood mushrooms called conks. This project is supported by Aveda.

markets for medicinal mushrooms

Of the 10,000-12,000 species of mushrooms in the world, around 300 have known medicinal properties. Of these 300, around 50 are indigenous to the forests and wildlands of Haida Gwaii (Fig. 1). Among the most prominent and best-selling species in the world (mainly in Asia) are the wood conks or polypores –*Ganoderma lucidum* (Reishi), *Schizophyllum commune* (Split Gill) and *Trametes versicolor,* (Turkey tail). (Throughout this section, indigenous BC species are indicated in blue.)

The undersides of these hard wood conks growing on trees and decaying logs have pores rather than gills. However many common gilled mushrooms, such as *Lentinus edodes* (Shiitake) and *Flammulina velutipes* also have significant medicinal properties.

We do not have *Ganoderma lucidum* in Haida Gwaii, but we have related species with similar chemical compositions in profusion –such as *G. applanatum and G. tsugae.* In a Cognetics study supported by Weyerhaeuser Company Ltd., a research team headed by Fidel Fogarty at the

UBC laboratory of Neil Towers scrutinized the bioactive chemical composition of selected BC indigenous medicinal mushrooms, with a concentration on our wood conks, looking specifically for Reishi-like compounds (Fogarty et. al., 2001).

There are generally four types of mushroom products on the US market:

-capsules and tablets of naturally grown dried mushroom fruit bodies
-extracts from fruit bodies which were artificially cultivated
-dried preparations of the crushed combined substrate, mycelium and primordia (young mushrooms)
-extracts from mycelia which were harvested from submerged liquid cultures grown in fermentation tanks.

The mushroom nutraceuticals are generally sold as single extract products or as cocktails containing extracts from several plant or mushroom species -- valarian, feverfew, oregon grape, yarrow, and such. Mushroom extracts are also being added to health and sports drinks in China, Singapore, and Korea.

Both mushrooms and their root-like structures (called mycelium) produce several medicinal or nutraceutical (general immune enhancing) compounds, central of which are triterpenes, the polysaccharides –high molecular weight polymers of sugars -- and "immunomodulatory" proteins. Although all mushrooms and many foods have polysaccharides in their cell walls, certain mushroom species have been found to contain polysaccharides and terpenes which are particularly effective in retarding the progress of various cancers and other diseases (through immune stimulation rather than direct cytocidal effects), and in alleviating the side effects of chemotherapy and radiation treatment. There are now many studies in Asia, and particularly in Japan, documenting life span increases of cancer patients undergoing conventional cancer treatment plus mushroom extract consumption or injection. Mizuno *et al.* (l995) and Hobbs (l995) have summarized these studies.

The fact that some of these immune-enhancing mushroom extracts can be consumed in very high dosages with no known adverse effects has led to their appearance in the North American yuppie *nutraceutical* market since the early nineties –both as a single and mixed mushroom product line and as included in formulae together with medicinal plants. Maitake Products, Inc., of New Jersey, for example, introduced the main Maitake extract –called Maitake D-fraction, into retail markets in l992 and sold it to vitamin and health food stores, and directly to health care professionals. By l997 they were producing this specific extract in the form of capsules, pills, and teas, plus a blend of six medicinal mushroom extracts, and a formulae based on D-extract plus Saw Palmetto (the most widely selling herbal for prevention and treatment of prostate hyperplasia) (Maitake Products, Inc. website).

Another emerging market for indigenous BC plant and fungal species involves cosmetics. A wide variety of anti-aging and firming skin creams, hair care and massage products, soaps and shampoos, cleansing scrubs, and deodorants contain a panoply of plants from the European pharmacopoeia. For example, TENNE LTD. makes natural skin-care products based on healing plants such as: Aloe Vera, Chamomile, Rosemary, Bearberry, and wheat germ oil as well as vitamins and beewax for skin nourishment and cells regeneration. They produce about 40 products based on vascular plants -- body care lotions, facial care products, men's products and

complementary products, all based on plants and vitamins and special enzymes extracted from fungi, which are essential for the skin, nourish it and preserve its young and healthy look (Tenne website).

At the same time, mushroom ingredients in moisturizers and skin creams are widely prevalent throughout Asia, particularly in Japan and Korea. SongYi mushroom, *Tricholoma matsutake*, and its relatives, for example, are widely used in natural products and emit a pine musk odour. (The mushrooms are important dietary items for the musk deer, whose range of habitat stretches from the Korean- Siberia high mountain steppes to the Himalayan mountain chain). Since this musk is similar in structure and chemistry to the pheromones secreted by the human male and is a well-recognized sexual attractant, such mushroom extracts have been incorporated in a variety of men's skin and hair care products.

Throughout the Far East, a holistic approach prevails, integrating both health and beauty, and a Shiitake mushroom tea is but one herbal means used widely used to strengthen, vitalize, energize and tone the body. In BC, a large natural products cosmetic company has teamed up with the Council of the Haida Nation and the Global Forest Society to explore and research new cosmetic and nutraceutical products based on fungi from Haida Gwaii.

BC's fifty or so wild nutraceutical and medicinal mushrooms then, include (1) relatives of Asian species used for centuries for the treatment of specific illnesses and immune stimulation, such as *Ganoderma applanatum;* (2) some presently used in conventional Japanese cancer treatments, such as extracts from *Trametes versicolor,* (also called *Coriolus versicolor*) and (3) a diversity of species being increasingly consumed as nutraceuticals by an aging North American boomer population to maintain good health (such as *Inonotus obliquus* or Chaga).

Nutraceuticals, or dietary supplements, are extracts from plant or fungal species, not used as a regular food, which boost the immune system or otherwise maintain health**. Our estimated 2002 US sales of products containing extracted nutraceuticals (of both plant and mushroom origin) is approximately US $13 billion.** Presently these are largely of plant origin but mushroom extracts are now entering nutraceutical cocktails and these are being sold as in the US as dietary supplements.

Mushroom dietary supplements are sold as dried fungal parts and consumed in tablets, capsules and tea, or as extracts from either the mycelium (root-like structure) or mushroom itself. A mushroom extract may contain hundreds of chemical compounds, and to reemphasize, it is thought that the synergistic effects of several components in an extract are responsible for the therapeutic or prophylactic properties, rather than a single active chemical ingredient. However mushroom extracts are also sold in the form of specific, refined chemicals, such as PSK which is derived from *Trametes versicolor*.

There are many mushrooms consumed mainly as foods, but which have documented medicinal properties. Enokitake (*Flammulina velutipes),* for example, is widely consumed in Japanese restaurants throughout the world but has shown significant tumor inhibition in mice (Jianhe *et al.* l987) and when regularly eaten, may prevent some liver diseases. Other mushrooms are used solely as medicines or as nutraceuticals, for example most of the wood conks.

Many of our "economic best-bet" BC indigenous medicinal fungi identified here are all of the second type –they have medicinal or nutraceutical effects but cannot be ordinarily consumed as food – the *Ganoderma* species (*G. applanatum, G. tsugae* and G. *oregonense*), or *Trametes versicolor* -- all of which are wood conks.

In 2001, the world value of mushroom production (10,32 million metric tons of food plus medicinal mushrooms) was estimated at US $21 billion, with China capturing approximately 65% of this total (Cognetics estimate).

China is still the world's number one producer of both cultivated food and medicinal mushrooms With respect to medicinal mushrooms alone, in l999 China produced an estimated l3,000 tonnes of *Poria cocos*, 4,800 tonnes of *Ganoderma lucidum*, and approximately l2,000 tonnes of *Agaricus blazei* (Chang l998).

In l994, medicinal mushrooms, extracts, and products based on these constituted US $2 billion in sales worldwide, and by l997, this figure rose to US $3.2 billion. (S.T. Chang, personal estimate**). Present estimated figures are between US$ 3.0 billion-US$3.8 billion, if one includes sales of the main food species with significant medicinal properties such as Shiitake.**

Ninety nine percent of all sales of medicinal mushrooms and extracts occurred in Asia and Europe with less than 0.1 percent in North America. The 2001 US market for products based mainly on medicinal mushrooms or their extracts was an estimated US $92 million (Chang, personal communication).

The best selling medicinal species in the US in 2001, in order of sales volume, were: *Ganoderma lucidum* (Reishi,. *Grifola frondosa* (Maitake), and the *Cordyceps* species. *Trametes versicolor* is also a serious contender at present in this market, and together with Reishi and Shiitake, tops sales in Japan due to the mainstream use in cancer treatment of a *Trametes* extract called PSK.

World sales of products associated with a single species, *Ganoderma lucidum*, were an estimated US$2.1 billion in 2000 (Cognetics estimate).

opportunity areas

Although consumption of mushroom-based medicines and nutraceuticals is generally concentrated in China, Korea, Japan and other Asian countries, the North American demand is increasing between 40%-150% annually, depending on species, and the main opportunity in North America involves the bulk extraction of compounds for use in nutraceutical products plus sports drinks.

At the same time we anticipate increased penetration by "mycomedicinal" extracts into the North American direct-to-home market for medicines to treat specific illnesses through the internet, as awareness of the medicinal and tonic benefits of mushrooms increases and patients order supplementary medicines and general immune boosters directly from websites with no prescription.

Mushroom extracts are not yet being sold by big pharmaceutical companies here for several reasons, one of which is that they cannot be patented, and clinical testing requirements necessitate examining the effects of several hundred ingredients which may be in a single extract. Such stringent testing requirements are not prevalent in Japan, where there is wide use of several mycomedicinal extracts as adjunct pharmaceuticals in the treatment of cancer.

Presently a polysaccharide extract from *Trametes versicolor* (a common BC wood conk), called PSK or Krestin commercially, accounted for approximately US $310m in Japanese sales during 2000 (Kureha website figures) , and *T. versicolor* is known to have anti-tumor, anti-viral, anti-bacterial, anti-oxidant and immune-boosting properties In another example, Sloan Kettering has for several years widely used extracts from another Asian fungus, *Ganoderma lucidum*, in the treatment of terminal cancer patients and claims to significantly increase survival time.

To summarize, medical research in Japan, China, Korea, and the Russian Far East has shown that the polysaccharides, terpenes, steroids and other ingredients found in certain indigenous BC mushrooms (Figure l.) have immune-stimulating, antibiotic, anti-tumour and antiviral properties. The most promising short term economic bet species of Figure 1 are indicated with an asterisk.

Figure 1. Potentially Nutraceutical and Medicinal BC Wild Mushroom Species

(not exhaustive)

Genus/Species	Common Name
Amanita muscaria	Fly Agaric
Armillaria mellea	Honey Mushroom
*Auricularia auricula**	Wood Ear
Boletopsis leucomelaena	Kurotake
Boletus edulis	King Bolete
Boletus mirabilis	Velvet Top
Boletus zelleri	Zeller's Bolete
Cantharellus spp.	Chanterelle
*Cordyceps spp.**	Insect Fungi
*Flammulina velutipes**	Velvet Stem
Fomes fomentarius	Tinder Polypore
Fomitopsis officinalis	Quinine Conk
*Fomitopsis pinicola **	Red Belt
*Ganoderma applanatum**	Artist's Conk
*Ganoderma oregonense**	Varnish Shelf
*Ganoderma tsugae**	Hemlock Varnish Shelf
Gloeophyllum separium	Gilled Polypore
Hericium spp.	
*Hericium abietus**	Coral Hydnum
*Inonotus obliquus**	Chaga
Laetiporus sulphureus	Sulfur Shelf
Lenzites betulina	Gilled Polypore
Morchella esculenta	Morel
Phellinus igniarius	Flecked-Flesh Polypore
*Pleurotus ostreatus**	Oyster Mushroom
Polyporus spp.*	Polypores
*Schizophyllum commune**	Split Gill
*Trametes versicolor**	Turkey Tail
Tremella spp.	Witches Butter
Tricholoma magnivelare	Pine Mushroom

Source: Fogarty (2001)

Some of these mushroom species have also been shown to have anti-inflammatory effects, reduce lipids in blood, inhibit the synthesis of prostaglandins (hormones which regulate blood vessel size), decrease cholesterol levels, extend the survival rates of patients with Hodgkins disease, lymphosarcoma and pancreatic cancer, and alleviate side effects of chemotherapy (Hobbs l995, Wills and Lipsey l999).

product sources

Between 80%-85% of all medicinal mushroom products are derived from the fruit bodies (caps), which have been either commercially farmed or collected from the wild. Only about l5% of all products are based on extracts from mycelia (roots) or consist of the actual powdered mycelia plus the substrate used for growing. However, due to increased quality control and year round production, mycelial-based products are the wave of the future.

Product quality from foraged fungi is unpredictable and inconsistent, since the chemical composition of the fruiting bodies depends on substrate composition, which changes depending on what is available –straw, manure, wood waste, etc. Nevertheless there is a growing market demand in North America for nutraceuticals which are naturally grown in the forest. Thus mycomedicinals are being inoculated in these areas of Haida Gwaii – in a pristine old forest, on the stumps and residual logs in clearcuts, and in partially harvested stands where predictability and consistency of mushroom-derived chemical extracts can be better controlled.

Another benefit of cultivation in remote, clean sites lies in the fact that mushrooms absorb heavy metals and pesticides from surrounding agriculture areas, and mushroom exports from China (the main Canadian competitor , are often found to be contaminated with *E-coli* and pesticide residues plus lead strips.

---

species information

Ganoderma lucidum (Ling Zhi or Reishi)

Called Ling Zhi in China and Reishi in Japan, this is the most famous and ancient medicinal mushroom in the world and has been used in Asia since prehistoric times. Differing varieties of Reishi are described in the *Compendium of Materia Medica* – the most comprehensive work of ancient Chinese medicine. Considered an elixir of life throughout Asia which could maintain good health and longevity, *G. lucidum* is presently used both as a general tonic and as a remedy to treat in excess of twenty illnesses, including hypertension, arthritis, asthma, anorexia, gastritis, bronchitis, high cholesterol, hepatitis, cardiovascular problems and many other conditions (Mizuno *et al.* l998). *G. lucidum* does not grow naturally in BC but several sister species do.

Reishi is one of the first mushroom species which is entering North American nutraceutical formulae, and is of particular interest since three other indigenous BC Ganoderma species (*G. applanatum, G. tsugae and G.oregonense*) contain some of the same therapeutic and

prophylactic chemicals. If properly developed, products based on this species can capture a significant percentage of the *G. lucidum nutraceutical and cosmetic* markets of the US, Europe, and Asia.

G. lucidum is now being cultivated artificially in more than fifteen countries with an estimated annual total production of around 8,000-15,000 tonnes, as compared with around 200 tonnes fifteen years ago, and China is the main producer (approximately 8,000 tonnes per year) (Chang, personal communication). *G. lucidum* continues to be studied medically worldwide and the beta D glucans are thought to be responsible for its immune-stimulating properties, and the ganoderic acids for cholesterol and cardiovascular effects. Summaries of contemporary research on the cardiovascular effects of *G. lucidum* are given in (Mizuno l997). Most of the chemical constituents of *G. lucidum* with pharmacological properties belong to either the triterpene or polysaccharide groups. But a group of fungal immune stimulating proteins have also been isolated from the caps of *G. lucidum,* and from two indigenous BC species, *Ganoderma tsugae and Ganoderma applanatum*. Polysaccharides in *G. lucidum* are generally extracted through hot water methods and triterpenes through alcohol extraction.

indigenous BC *Ganodermas – G. applanatum* and *G. tsugae*

G. lucidum is not native to BC, but we have other ganodermas with the same, or similar, chemical constituents. *Ganoderma applanatum* –also called Artist's Conk or Kofukitake in Japan – grows throughout Haida Gwaii and much of the province.

G. applanatum has shown immune-stimulating and anti-tumor activities in a variety of studies, and RNA from *G. applanatum* has caused the production of an interferon-like substance in mice spleen and has also been found to confer protection against tick-borne encephalitis in mice (Hobbs l995). The polysaccharides in *G. applanatum* have also been found to stimulate antitumor activity against sarcoma 180 in mice (Gao and Yang l991).

Chemically similar to *G. lucidum, G. applanatum* contains steroid compounds such as ergosterol, ergosta 7,22-dien-3b-ol, fungisterol, alnusenone, friedelin plus other triterpenes. In addition, ganoderenic acid, ganoderic acid derivatives, and furanoganoderic acid been derived from *G. applanatum* (Gao and Yang, l991).

This species is used throughout Asia for esophageal cancer and tuberculosis and as a general antibiotic. Often *G. applanatum* is deceptively sold as the main ingredient in Reishi mixtures and is available throughout Asia from Chinese bulk herbal dealers. This species is gradually creeping into North American nutraceutical formulae and currently retails over the web for around US $130/lb in dried tea form.

There is less *G. tsugae* in BC than the profuse *G. applanatum*, but this second indigenous Ganoderma, we found in our UBC chemical analyses, (Fogarty et. al. 2001) contains three of the identical triterpenoids, ganoderic acid B, lucidone A and ganoderic acid C2, which are found in *G. lucidum*. More recently, Mizuno et. al. (l998) extracted seven glycans with strong antitumor activities from both the fruit bodies and mycelia of *G. tsugae* and other researchers have found

that ganderic acid B from *G. tsugae* provides protection from carbon tetrachloride-induced liver poisoning and that the mushroom also contains several polysaccharides which has shown strong antitumor activity against sarcoma 180 in mice (Hobbes 1995).*G. tsugae* is widely cultivated throughout China and Taiwan, and this species retails over the web for around US $30-$50/oz. in dried tea form. We have not been able to accurately estimate world or Asian sale volumes of *G. tsugae* or of *G. applanatum.*

Fomitopsis pinicola (Red Belt)

Growing throughout Haida Gwaii and much of BC, this wood conk contains ergosterol, polyporenic acid C, ergosta-7,22-dien-3b-ol, fungisterol, lanosterol, inotodiol, and other chemicals and triterpene mixtures detailed by Hobbs (l995).

Compared to the pharmacological effects of the other indigenous conks, *F. pinocola* shows only slight tumor-inhibiting effects against sarcoma l80 in mice, but nevertheless is one of the more expensive BC wood conks on the internet -- retailing at US$310/lb in dried tea form or US$50/oz.

Judging from market appeal, the initial BC species which should be grown in a cultivation forest on Haida Gwaii are *Ganoderma applanatum, Ganoderma tsugae, Schizophyllum commune,* and and *Fomitopsis pinicola* .At the same time concentrations of specimens in "infected" areas should be collected by the Haida prior to timber harvesting, identified, and tissue cultures and spore-prints isolated from candidate species for both laboratory and field cultivation.

Techniques for Forest Cultivation of Medicinal Fungi on Haida Gwaii

Commercial harvesting of wildstocks of medicinal mushrooms on Haida Gwaii is virtually non-existent. Sustainable harvesting of these species involves locating and gathering of conks on old growth forest. Too little data regarding populations of wildstocks exists to promote commercial harvesting projects. We are currently assessing medicinal fungi on Haida Gwaii. Methods of propagation involve:

-isolation of mycelium

-expansion of mycelium in culture

-inoculation of bulk substrates

-forest inoculation (logs, stumps, etc.)

Table 2 – Medicinal Mushrooms on Haida Gwaii

Wildstocks	Cultivated

Products	**raw, dried, whole extracts tinctures, capsules etc.**	**same products plus mycelial extracts**
Sustainable Yield	**2% per annum**	**10% per annum**
Estimate	**20,000kgs. dried Per l0,000 ha**	**30,000kgs. dried**
Costs of setup	**$250,000**	**$1,000,000**
Price	**$10/kg.**	**$10/kg.**
Returns	**$200,000 gross**	**$210,000 gross**
Sales Breakdown		
employment income	**$100,000**	**$150,000**
non-employment income	**0**	**0**
revenues to crown profit	**0**	**0**
Jobs Breakdown	**4 technical**	**5 technical**
Viability	**good**	**good**

medicinal mushrooms eonomic valuation – method 1.

The authors examined and researched seven sites on Haida Gwaii for the presence of these species. Though *Fomitopsis pinicola* seems most prevalent, *Ganoderma applanatum* is the species of choice for initial development. *Ganoderma tsugae*, though much rarer than *Ganoderma applanatum*, is the second priority species.

Since the market value of *Fomitopsis pinicola* varies widely, and since it is widely prevalent, it should be taken by foraging rather than cultivation, *as should all the medicinal mushrooms which grow in areas which are about to be clearcut according to forestry plans*. Most of these will die anyway. Haida trainees should accompany the forestry companies' timber crews to areas of "fungal infestation" to determine wild stocks of these species in pre timber harvest regions. *This crop should be harvested prior to timber cutting for pilot production research*.

Medicinal mushrooms (of all species growing on Haida Gwaii) may yield up to 100 kilograms per hectare of marketable dried produce in the seven sites. Assuming l00 kgs/ha of medicinal mushrooms, with a average price of only $5 per kilogram, the gross value of produce in a cultivation forest of 10,000 hectares is approximately Can. $5,000,000.

However if a full Spectrum *applanatum* extract is sold as a natural medicinal product, a different picture emerges: To produce this extract, approximately one kg. of dried mushroom is cooked with five litres of a 60% alcohol and 40% water mix. This produces around 4 litres of extract which can be bottled and sold at an average retail price of Can. $25.00 – Can. $40.00 per 50ml bottle. This means that one kilogram of dried *Ganoderma applanatum* can be processed and sold for $2,000.00 minimum at the lower retail price.

Some of the medicinal mushroom extracts, in fact, sell in the range of US$40.00-$65.00/50ml bottle.

These are conservative estimates, and obtaining accurate data regarding the biomass of even a single species in our 10,000 hectare study areas would require line intercept surveys on a tight grid of 50 metres. Also existing timber cruise data and Ministry of Forest history files provided limited information regarding the biomass of these three conk species.

method 2. –cultivation forests

The knowledge of the use of medicinal fungi has for the most part been lost among the Haida. In addition to providing raw materials for nutraceutical products, the cultivation forest can serve as a cultural/educational tool to help revitalize Haida traditional medicinal mushroom knowledge. (The Haida, unlike many First Nations in BC, continue to use dozens of species of vascular plants in their medicinal recipes and have continued and deepened this knowledge base.)

Cultivation forests involve an imaginative way of extracting economic benefits in an environmentally sustainable manner from the remaining fragmented coastal forests that everyone from conservationists to band elders wants preserved. The plan adds value to an existing ecosystem using a traditional knowledge base plus a more scientifically oriented approach in order to create jobs and economic development for First Nations.

costs of setting up cultivation forests

The following are activities involved in initiating and running a single cultivation forest of ten to one hundred hectares.

- Formulation of Business Plan
- Personnel Hiring and Technical Training
- Pilot Forest Site Selection
- Site Mapping
- Inventory of Select Medicinal Fungi and Plants on Site
- Examination of Foraging Opportunities
- Economic and Market Analyses

- Species Research and Selection
- Collection of Source Material
- Establishment of Facilities: Laboratory/ Plant Nursery
- Propagation and Growing of Plants and Fungi
- Planting and Inoculation of Site
- Monitoring and Assessment of Growth
- Data Collection and Analysis
- Harvesting
- Drying
- Chemical Extractions
- Product Testing and Chemical Analyses
- Product Development
- Packaging and Labeling Extracts
- Test Marketing of Products

Table 1 outlines approximate costs associated with each phase of the first year of a pilot cultivation forest of 100 hectares.

Table 1. Summary of Cultivation Forest Activities and Labour/Infrastructure Costs

Timeframe	Activity	Cost
	Meetings of the Council outline project scale and scope, finalize site selection and plant species to be collected and grown, and identify and select technical personnel.	$10,000
	Prepare detailed business plan	$30,000
	Assessment of potential and mapping of project site.	$10,000
	Interview, hire and train technicians.	$10,000
	Inventory wild stocks of selected medicinal plants and fungi on site.	$20,000
	Species research and selection of best-bets candidates for the site.	$10,000
	Laboratory, plant nursery and/or greenhouse set-up.	$40,000

	Collection of plants and fungi for source material.	$15,000
	Isolation and cultivation of plants and mycelium.	$15,000
	Further economic and market analyses.	$20,000
	Planting and inoculating site.	$25,000
	Monitoring and assessment of growth.	$25,000
	Harvesting, drying, extracting and packaging for test marketing.	$30,000
	Product testing and chemical analysis.	$20,000
	Test marketing of products (raw/extracts)	$20,000

Source: Wills and Fogarty, 2002

sales projections and investment

Sales Projections- $210,000 year one growing to $400,000 by year three.
This projection assumes that slightly over 9,000 50ml bottles are sold through all outlets during the first year of sales (the second year of the cultivation forest). We have forecast revenues of $210,000 during the first year, growing to approximately $400,00 by the end of the third year of sales. These are on production and distribution expenses of $69,000 in year one, and approximately $140,000 in year three. These forecasts do not include annual tour revenues to the Haida, estimated at approximately $20,000-$25,000 annually. The profit margin in the nutraceutical sector has recently ranged from l2%-35%.

Investment - $1.2 million
Setting up and rendering a cultivation forest of approximately 100 hectares operational during the first two years will require approximately $600,000. A $1.2 million first-round financing will allow one to set up and operationalize the cultivation forest, complete product development, begin an aggressive and focused marketing and sales effort, build product awareness, secure partnerships, and continue research and development.

technical training and job creation

Training sessions should be ongoing and occur throughout each phase of these projects involving economic feasible species –Devil's Club, Medicinal Mushrooms or Food Mushrooms. Some projects will survive only with external funding for the set up and early operational phases. First Nations technicians must learn to identify and inventory candidate medicinal species. Current populations of wild stocks of selected species must be estimated in the cultivation forest site

prior to initiating any harvesting of wild stocks or forest cultivation. Seeds, cuttings, rootstock and tissue cultures of pertinent plants and fungi must be collected and propagated from traditional territory.

A sterile culture lab, plant nursery and/or green house should also be established and staffed with trained personnel. Here selected fungal and plant species will be grown and their populations expanded for out-planting into the cultivation forest site.

All of these tasks will necessitate training, and during the first two years, we have estimated that a cultivation forest of 100 hectares will create two forest technician jobs and a laboratory technician position plus five planters. The real employment effects will be seen when the harvesting of wild stocks and the production of raw materials from the cultivation forest begins toward the end of the second year and extracts are being produced and sold. These job effects are anticipated to include: a managerial position, a second lab/plant propagation technician, additional forest/material handling technicians, and a guide to conduct site/facility tours, plus other positions involved in website creation and maintenance, product preparation, packaging and distribution, etc.

The training programs should include:
1. Identification of selected medicinal plants and fungi
2. Inventory and field assessment of wild stocks (line surveys, transects)
3. Estimating biomass and growth rates of wild stocks
4. Determining sustainable harvesting rates
5. Propagation methods (seeds, rhizomes, cuttings) and transplanting techniques
6. Micro-site selection: *in situ* cultivation of plants and fungi
7. Growth and yield assessments: data collection and analyses
8. Harvesting methods
9. Drying and packaging raw materials
10. Extraction methodology for creating products
11. Product development
12. Bottling and labeling extract products
13. Marketing (locally, regionally and globally online)
14. Economics: market analyses and business development

product development on Haida Gwaii

Today there is a wide variety of water and alcohol-based extraction technologies being used for plant and mushroom extracts. For example, water-based techniques include decoctions, tinctures, infusions, percolation, counter current extraction, steam distillation, and extraction with water plus solvents. The Haida-Aveda project will be utilizing processes that yield *full spectrum extracts (all of the ingredients)* The competitive differentiation of this product line involves these factors: (a) premier BC First Nations nutraceutical mushroom products; (b) advanced extraction process; (c) higher profit margins and (d) source material is forest cultivated or harvested from existing wild stocks (equivalent to organic certification). Initially, at least, all product extraction and bottling done will be done locally.

The vast majority of commercial plant and mushroom extracts available on the market are based on simple water or ethanol extraction processes and produce a whole concentrate of all the constituent ingredients. This "*full-spectrum*" extract is precisely what we are interested in, since the synergistic interactions of a number of chemicals in a given species can be responsible for its therapeutic effects, not a single "*active ingredient"*. In fact only a few companies further refine their product to purified active chemicals. Highly refined extracts are usually sold to pharmaceutical companies. Pharmaceuticals have to undergo clinical testing, but nutraceuticals are sold as nutritional supplements and do not have to be subjected to such expensive testing. Initial extraction can be accomplished with comparatively simple equipment and can be done locally

Judging from market appeal, the initial BC species which should be grown in the cultivation forest are *Ganoderma applanatum* (Artist's conk), *Ganoderma tsugae* (Hemlock varnish shelf), *Fomitopsis pinicola* (Red Belt), and *Schizophyllum commune* (Split gill). The initial products should be 50ml bottles of cold-pressed, full spectrum extracts of *G. applanatum* plus a blend of *G. applanatum* and a popular immune-boosting plant extract. Several new product lines involving extracts of these other fungi should be developed during the second year. But they should all involve *G. applanatum* as ingredient.

A private, Haida-controlled company may be set up to commercialize these fungal extract products. These will be sold directly to consumers worldwide over the Web, with a Japanese version of the site, and will also be made available through distributors at BC supermarkets, organic specialty food shops such as Capers, and through the alternative pharmacies emerging in the US. These extract products will also be bundled, at every opportunity, into the Haida ecotourism effort, as will the cultivation forest itself, which should be presented as an ecological attraction with appropriate Haida-conducted tours.

tourism revenues

Until now, most of the tourism revenues in Haida Gwaii has gone to white-controlled fishing companies, but the Haida Nation is looking beyond the direct economic benefits into secondary opportunities that such developments will create. Ecotourists like to be edified rather than entertained. They are seeking education and meaning rather than relaxation. Western ecotourists are deeply interested in traditional fungal and plant knowledge and will pay for the privilege of touring and even working briefly in a forest dedicated to the cultivation of medicinal botanicals- as the experience of Belize and Costa Rica illustrates. The cultivation forest, and the reintroduction of traditional medicinal botanical and fungal knowledge, will become one of the main themes of the Haida ecotourism effort and will have a special appeal to Europeans. Revenues are modest but ongoing. The tourism component of the cultivation forests is still unknown.

Across BC there is currently a renewed interest by First Nations in their rapidly disappearing medicinal botanical knowledge. Cultivation forests will help to revive such knowledge through the day-to-day activities in running it. Haida people, for example, are learning to undertake species identification, mapping, inventory, collection, cultivation, drying and storage of the species grown or collected from wild stocks. Performing these research and practical activities is

necessarily deepening and revitalizing traditional plant and mushroom knowledge among the people.

Food Mushrooms on Haida Gwaii

introduction

The main food mushroom on Haida Gwaii is the chanterelle. This is an established market with significant room for growth. This section is entirely based on work in Haida Gwaii by Mitchell Associates.

The main mushroom export from Haida Gwaii is the Pacific Golden chanterelle (*Cantharellus formosus*), with lower volumes of the Blue Chanterelle (*Polyozellus multiplex*). though these are harvested at a much lower volumes.

In a normal year, the QCI/HG produces approximately 250,000 pounds of mushrooms and as much as 350,000 pounds in an exceptional year. In a poor year, however, that volume could be less than half. Nineteen ninety-nine was considered an extremely poor year for chanterelles and less than 100,000 pounds were harvested and shipped off the islands. The volume of king boletes harvested, however, was said to be the best in five years. The average price for paid to pickers for chanterelles was $4.50 per pound, and for king boletes $8.00 per pound, making the total harvest worth approximately $450,000 – 500,000 (Mitchell Associates l999).

According to Mitchell Associates, "The future of the mushroom industry on the QCI/Haida Gwaii will depend on distributors' ability to continue receiving a premium price in Europe. Also important is the expansion into U.S. and other markets, and on the accessibility to and continued productivity of current and future mushroom growing areas. The current comparative advantage from the perceived quality difference between mushrooms from the Island's and elsewhere may lessen in the long run. This advantage may be further impacted by less costly product from other North American sources such as Vancouver Island, and greater volumes of cheaper higher quality product coming from Eastern Europe and Turkey. The higher price needed to make the QCI/Haida Gwaii chanterelle industry profitable is becoming more difficult to obtain.In most years, at least 90% of the mushrooms harvested are Pacific Golden chanterelles (*Cantharellus formosus*). Other species harvested less frequently and in smaller volumes are king boletes (*Boletus edulis*), blue chanterelles (*Polyozellus multiplex*), and chicken of the woods (*Polyporus sulphureus)*, and in rare cases pines mushrooms (T*richoloma magnivelare*)"

.

We have estimated that the yearly volume of mushrooms (of all species) harvested on Haida Gwaii ranges from about 100,000 to 350,000 pounds in a good year.

price trends for chanterelles

Darcy Mitchell and her colleagues tracked chanterelle prices during the fall of l999 and found that although chanterelles were slow to fruit in 1999, "By mid-September (they) had overtaken the daily volume of boletes purchased. In September, pickers averaged approximately 4.50 to

$5.00 per pound for chanterelles. Prices peaked at the end of September reaching $7.50 per pound on September 30 before falling to $4.50 per pound two days later. By the middle of October prices had fallen to $3.00 per pound. Prices in Europe ranged from approximately CAN$15.00/kilogram ($6.80/lb) to $22.00/kilogram ($10.00/lb) by the end of November, after supplies from Poland declined. The most significant characteristic of the 1999 chanterelle season was not only the low volumes in North America, but also the unusually long season in Poland. In a normal year, the Polish season would end no later than the middle of September. In 1999, however, weather conditions were such that Poland supplied chanterelle mushrooms to the European market up to the middle of November, which had the effect of depressing prices for North American supplies. Thus in 1999, low prices were coupled with low volumes, in an industry where profit is volume driven. " (Mitchell Associates, l999).

In 2001 there were seven companies that use gatherers to search for mushroms in Haida Gwaii. These seven companies had 66 field buyers and each company had a buying station at Skidegate Lake and some had agents on Graham Island.

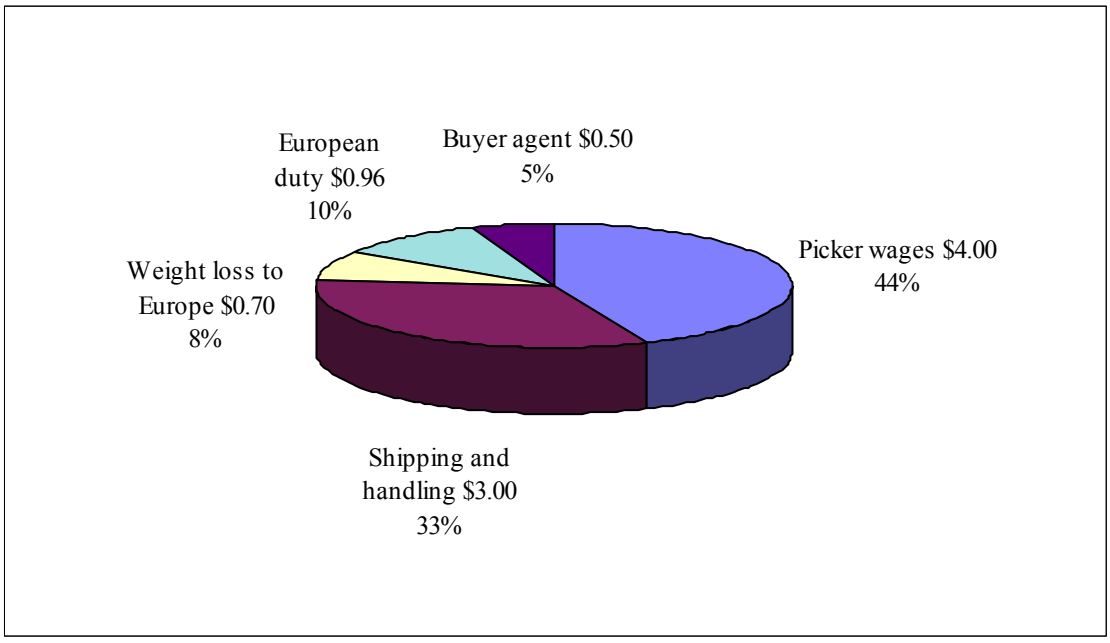
Mitchell Associates also tracked the path of the chanterelles from Haida Gwaii to final consumers and found that they "are shipped from the Haida Gwaii to Vancouver either by air or land. The maximum shipping time from the Islands to Vancouver is three days and the mushrooms lose anywhere from five to 10 percent of their weight due to moisture loss. Once the mushrooms reach Vancouver they are kept in cold storage, sorted, and then shipped to their final destination within three to five days. Moisture loss from Vancouver to Europe is anywhere from three to seven percent, depending on the original moisture content. The exporter's margins must be adjusted by the moisture loss factor to reflect actual returns to their initial cash outlay.Prices vary widely in this industry and the average price based on European import data suggests that North American wild mushrooms receive a premium over European mushrooms. Newer entrants to the European market, such as the Baltic states and other former Soviet bloc states can provide mushrooms at a far lower cost, due to lower transportation and labour costs. As a result, buyers in Europe may become less willing to pay the higher price for QCI/Haida Gwaii mushrooms."

Mitchell Associates also found that "the price paid in France for Polish chanterelles in July, 1999, was 40 French francs per kilogram, or CAN$ 9.25 per kilogram and North American mushrooms averaged approximately CAN$15 to $22 per kilogram from September to November. North American chanterelles, especially from the Haida Gwaii, must earn a premium over the European product because of the labour, shipping and handling costs. The cost of bringing the product to market includes the following: shipping charges of approximately $3.50 to $4.00 per kilogram from the Islands to Europe, plus freight fowarding and handling charges, harvesting costs averaging $5 to $10 per kilogram, an average weight loss of 10 to 20%, and European import duties of 12%."

Given these averages costs, Mitchell Associates have estimated that to break even, an exporter must sell the chanterelles in Europe for no less than approximately $9.16 per pound, or $20.19 per kilogram. Figure 1 shows the average costs per pound associated with the chanterelle's journey to Europe, including some of the factors, such as moisture loss and import duties.

Thus in Haida Gwaii, chanterelle buyers cannot make a profit without earning a significant price in Europe. This condition is exacerbated by the labour costs on the Haida Gwaii. During the 1999 season, the authors noted, "The price paid to pickers ranged from $4.00 to $5.00 per pound ($8.8-0 - $11.00 per kilogram) and went as high as $7.50 per pound, while prices on Vancouver Island ranged from $2.00 - 2.50 per pound ($4.40 - $5.50 per kilogram). As a result of these cost pressures and supply concerns, some exporters are shifting their operations away from the Haida Gwaii."

Figure 1: Average per pound costs of shipping one pound of chanterelles to Europe. (source: Mitchell Associates)



Source: Mitchell Associates

The high price for Haida Gwaii chanterelles is a function of the timing of the harvest and not mushroom quality. Again Mitchell Associates have noted that "The premium price received for QCI/Haida Gwaii chanterelles is highly dependent on the productivity and timing of the European harvest and the supply from other North American regions. Chanterelle harvesting begins in Bulgaria in May and progresses through Eastern Europe through August and periodically into September, although this is not always the case as illustrated by the 1999 Polish season which lasted well into November. The chanterelle harvest in North America begins in August or September on the QCI/Haida Gwaii, and progresses south through Vancouver Island and into Washington and Oregon."

Expanding the economic return of the chanterelle harvest on Haida Gwaii involves a number of simultaneous actions: welcoming pickers and providing camping facilities for them; improving the poor distribution channels for this project by helping set up backhauls to lower transportation costs and do this through freight pooling between several exporters, creating new chanterelle based products and services such as a chanterelle festival, guided mushroom discovery searches, more dried chanterelle exports through a better drying and freezing capacity in Haida Gwaii.

Food Mushrooms in the Bella Coola Valley

introduction

In the Bella Coola region, we have subcontracted with Peter Rhem, who has provided the following research and information and wrote these sections on the pine mushroom.

1.Informed estimates of the value of the pine mushroom harvest in the Bella Coola Valley in an average year.

2. Production of a topographical map of the Bella Coola Valley and Surrounding Areas of pine mushroom concentrations and distributions. These sites are categorized as "high, medium, and low" production.

3. Obtained forest cover maps from the MOF (1:20,000) of the high and medium production areas as possible candidates for cultivation forests.

4. Examined a variety of ways to enhance economic development of pine mushrooms.

There is a variety of wild food mushrooms in the Bella Coola Region; these include

Wrinkled thimble Caps
Morels
Yellow chanterelles
Lobster Mushrooms
Yellow Foot Chanterelles
Chicken of the Woods
Honey Mushrooms
Boletes
Hedgehogs
Oyster mushrooms
Bears tooth
Pine Mushrooms

Currently the only species of significant economic importance is the pine mushroom. However it is possible that markets for other NTFP's in the area could be developed.

gathering in the Bella Coola region

Gathering activities in the Central Coast area can be divided into the following categories

Personal Non-Commercial Harvesting
Traditional Native Uses
Commercial Harvesting

Personal non commercial harvesting is restricted mostly to areas accessible by road and is conducted by a great variety of local individuals. Activities include but are not limited to: Berry and Mushroom picking and the gathering of herbs.

Traditional native uses are widespread and include the harvesting of many local wild plants for cultural, medicinal, ceremonial, and spiritual purposes.

Commercial harvesting of NTFP's in the central coast area is almost entirely limited to the Pine mushroom harvest.

Viable marketing devices need to be developed for other products. Marketing possibilities for less valuable NTFP'S are often complicated by the need to ship fresh, with profits being marginal due to shipping costs.

economic development

The key to economic development of lower value NTFP"S in the Bella Coola Region will be to first conduct an inventory of the resources and educate locals as to the value of different products. Workshops can be sponsored to stimulate picker initiatives concerning floral greenery and other mushroom species besides pines.

The creation of value added products should be promoted, such as dried mushrooms, dried berries, dried herbs, ornamental wreaths etc.

Currently there is a local initiative to activate the fish plant on the Nuxulk reservation, complete with a retort canner, which could also be utilized to can wild fruit and other products which could be harvested in the area.

Over the past decade research on the ecology and production of pine mushrooms has led to the realization that it should be possible to operate a cultivation forest, with the goal of augmenting pine mushroom volume, and that such may result in up to 200% improvement in production amounts.

As well as having the potential of greatly enhancing the most productive mushroom areas, the concept of a cultivation forest facilitates a dependable, predictable crop , that would

lend itself better to management, accountability and regulation to sustain environmental integrity.

industry overview

Wills and Lipsey (l999) have shown that:

- In an average-to-good" year, around 350 tonnes of pine mushrooms are harvested in BC, but in a less-than-average year such as 1995, this figure falls to around 200 tonnes. In the Bella Coola Region these figures are respectively 30 to 15 tons.

- The Pacific Northwest (BC, Washington and Oregon) supplies around 15% to 20% of the annual Japanese consumption of around 5,000 tonnes of pine mushrooms, which represent a luxury market (and a fall from the mid-1800s when the smaller Japanese population consumed around 12,000 tonnes annually).

- In the foreseeable future Japanese and Korean consumers will absorb all the pine mushrooms which BC can export; therefore, the limits to export become the limits of sustainable harvesting plus cultivation. These general market prognoses point toward intensive forest-based cultivation of pine mushroom areas to increase the export volume and the targeting of forest types best suited to enhanced commercial yields.

- A three tier market has arisen in Japan: Japanese pine mushrooms command the highest price; Korean pines fetch a half to a third of this price; and BC pines average a third to a half of the price of the South Korean imports. In 2000, a lower-than-normal year for prices, BC buyers surveyed selling to Japan reported prices of US $30/kg. on average for all grades, although at times prices spiked to US $95/kg. for the best grade. Although over the past decade the BC pine harvest has approximately doubled, the average price paid to exporters has remained static - US $30.00/kg to US $67.00/kg. In 2002, the average price was around $23/kg for all grades.

  Pine mushroom harvesting in the Bella Coola Region has been occurring for approximately 25 years. In that time it has developed into a seasonal activity which contributes a much needed boost to the local economy. The price paid to the picker varies depending on the grade of mushroom, and the supply plus other factors. Price to picker varies from $5.00/kg for the lower grades to $150.00/kg for the best.

  From Bella Coola the harvesting area stretches east as far as Anaheim Lake and includes areas in all the contributory watersheds of the Atnarko, Telchacko, Noosegultch ,Nusatsum, and Saloompt rivers; as well, harvesting operations occur in North and South Bentink Arms, and in the Dean Channel and the Dean Valley watershed.

  It is also likely that there are more areas where Pine mushroom crops occur which have not been found yet

Not all these areas produce mushrooms every year; in fact the advent of crop production is unreliable, and varies between different areas on different years. For example, on a given year the Dean may start producing a week or two earlier or later than the Bella Coola Valley, and crop occurrence within the Bella Coola Valley can vary greatly from sub area to sub area, and from year to year.

A large percentage of the local population participates in the harvest , some as a recreational activity and others as a serious way to make some money. The area also accommodates picking activities by many people from the Anaheim lake area, as well as an increasing number of *transient professional pickers* (on a good year).

There are several issues concerning pine mushroom harvest in the Central Coast area, mostly about picking activities within the boundaries of Tweedsmuir Park where the issues are littering, ground disturbance, and bear -human contact. The parks department is now too under funded and understaffed to deal with these issues. But if proper harvesting methods are used, ground disturbance is minimized and crop sustainability is achievable.

One solution may be for the Regional Board to apply to the Lieutenant Governor in Council to grant jurisdiction over NTFP'S within its boundaries and to include a park resource use permit, to be granted on the condition that locals will police the situation in the park.

This could be done by creating a limited permit system, with a condition that to obtain a permit, a harvester must attend a workshop designed to promote good picking habits and address the other issues of concern. Funds raised from the licensing program could be used to hire and train mushroom rangers who could patrol the park area and hand out fines for raking, littering ,or picking without a permit, and revenues from the fines could go directly back into the park policing program.

A local harvesters association could be formed to promote sustainable harvest methods and to promote solidarity among local pickers, also to provide pickers with a consolidated voice. An alliance of local harvesters could produce sufficient volumes of mushrooms to justify forming our own local marketing board, if locals can market directly to Japan, returns would increase enormously.

the economic importance of pine mushrooms to the local community

Results from information correlated on the 2002 production of pine mushrooms for the central coast area, along with data and information gathered from some local buyers and some of the more aware and experienced local pickers, leads to the conclusion that an estimated average mushroom season will generate between $400,000 and $800,000 dollars and 15 to 30 tonnes.

For 2002 the gross value was approximately $2 million . There were 142,597 pounds shipped by air and another estimated 8,000 pounds trucked out at an average price of $11.79/lb, totaling $1.78 million, and an estimated commission to buyers of $ 289,580.00 (averages of buyer estimates).

The economic well being of the Bella Coola area has become more dependent on mushroom harvesting as Interfor has closed their office here, and government cutbacks have resulted in very limited availability of income producing activities.

Income information for pickers is very difficult to obtain, but it should suffice to say that very few pickers realize any real amounts of income. Another aspect that sustains the picker initiative is that the income is not taxed, and in many cases forced accountability and income taxation for mushroom harvesting would be discouraging and lead many pickers to stop. As far as the concept of taxation is concerned, it is probably unanimously rejected by all industry participants, and would prove a detrimental and counter productive imposition on the current status quo.

cultivation forests for pine mushrooms

The economic benefits of managing pine mushroom harvest areas through the implementation of cultivation and enhancement techniques, opens the door to the eventual development of a portion of the industry that will be fully accountable as well as predictable. Managing the pine mushroom resource in this manner will create a more controlled and environmentally responsible component of the industry.

Establishing dependable, predictable volumes of pine mushrooms will validate the development of a local processing facility and the creation of a local marketing system direct to Japan

crop enhancement

Mushroom quality and quantity can be enhanced in a controlled cultivation forest by the application of insect proof enclosures positioned over the beds where the mushrooms will develop. It is estimated that export values deteriorate as much as 75% by the time the product reaches the market, due to worm infestations from fly larvae There are several procedures invented for inoculation and transplantation, and these are ways of potentially increasing crop certainty and volumes within a productive habitat.

Forest cultivated pine mushrooms should sell for the same price as commercially-harvested wildstocks becauses the quality will be as good or better under moderately controlled conditions. The price difference between BC, Japanese, and Korean pine mushrooms could be reduced by decreased fly infestation under controlled conditions. These are the mainly ways of increasing crop volume.

-Transplanting portions of existing shiros into new locations.

-Placing spore laden mushroom caps directly on exposed roots

-Planting spore prints taken from older mushrooms

Other procedures can be experimented with to enhance production, for example: it is found that a pine mushroom will be in the #1 stage (the most valuable) until it has pushed its way upwards enough that the pressure on the cap begins to lessen, and the cap will begin to expand and form gills. Most pines begin 2-4 inches below the surface and thereby average around 2-4 inches tall and weigh about 2 oz. Mushrooms growing from deeper areas are larger and taller, and some specimens found growing from 10 to l4 inches below the surface have weighed in at 24 -30 oz.

Thus in a cultivation forest, after shiros are exactly located and marked, the surface over the active area can be artificially made denser by applying a layer of filter cloth, then adding 6 - 10 inches of clean sand on top. This may be a way to produce much larger fruit. Other methods of field inoculation and productivity increases involve

1) Spores isolated from pine mushrooms and directly applied to specific candidate trees in Douglas fir/ western hemlock stands.
2) Sporocarps (whole mushrooms) ground up and incorporated as a slurry to soil.
3) Vegetative mycelium-tissue cultures isolated from young #1 mushrooms (buttons or primordia) applied both in the field and laboratory inoculation trials.
4) Spawn-increased mycelial biomass (both on solid and liquid media) applied as above.
5) Seedling transplants - select species of tree seedlings planted into the colony or shiro in the field and resulting colonized seedlings transplanted to new sites in both first and second growth stands.
6) Shiro transplants- prior to timber harvest pine mushroom colonies are located, and removed (literally dug up) and relocated to adjacent stands.)

In some locations it will be also be possible to create an irrigation system which could help increase crop volumes by weight, but may also be used to activate the fruiting stage. It has been found that increasing moisture levels during fruiting will create larger, heavier mushrooms. This difference can be as much as 500% compared to a dry area

As pine mushroom production occurs in nature, it is unpredictable, unreliable, difficult to quantify, difficult to regulate and has led to a scenario of extreme competition, where everybody is picking everywhere, and there is no organization or control. These factors have resulted in many issues being raised, like ground cover disturbance (raking) and the impact raking may have on future crops, littering in parkland, bear confrontations, lost pickers, forest fire hazards, confrontations between pickers, etc. All these issues could be more easily addressed and managed in a cultivation forest where control is achieved through approved tenure.

Table 3 – Pine Mushrooms in the Bella Coola Valley

	Wildstocks	**Cultivated**
Products	**fresh**	**same products plus mycelial**

Sustainable Yield	**50% per annum**	**100% per annum**
Estimate	**200,000kg. in Bella Coola Region**	**10,000 kg. per annum**
Costs of setup	**-**	**$1,000,000**
Price to Picker	**$22/kg.**	**$22/kg.**
Returns	**$4.4 million**	**$220,000**
Sales Breakdown		
employment income	**$4.4 million**	**$120,000**
non-employment income	**0**	**0**
revenues to crown profit	**0**	**0**
Jobs Breakdown	**1200 part time**	**3**
Viability	**good**	**good**

Recommendations

(1) Haida Gwaii –the Council of the Haida Nation and Aveda are currently establishing the first cultivation forest for medicinal fungi on Haida Gwaii. Funding (approximately $150,000/year for four years) is needed to expand this project to include sites on the North part of Graham Island.

(2) Central Coast – Klemtu –we recommend that the Kitasoo/Xaixais Nation set up the first coastal medicinal plant cultivation forest for Devil's Club. One hundred hectares of Devil's Club ecotype should be managed. This will cost approximately $150,000/year for three years.

(3 Bella Coola – we recommend a five year First Nations collaborative effort to study and implement the enhancement of pine mushrooms in a cultivation forest near Bella Coola. This will cost approximately $100,000/year for five years.

References

Chang, S. T. (l998) World Production of Cultivated Mushrooms in l997 With Emphasis on *Lentinula Edodes* in China.Mimeo.

Chang, S. T. and J. A. Buswell (l999) Ganoderma lucidum (Curt.: Fr.) P. Karst. (*Aphyllophoromycesideae)* – a mushrooming medicinal mushroom. *International Journal of Medicinal Mushrooms,* 1, 139-146.

Fogarty, Fidel (2000). Non-Timber Forest Products: Inventory and Management Strategies for the Sunshine Coast Forest District. FRBC 2000 Final Report.

Fogarty, Fidel et.al., (2001) Chemical Analyses of Selected BC Medicinal Mushrooms, Cognetics International Research, Inc., submitted to Weyerhaeuser Company.

Fogarty, Fidel and Russel M. Wills, (2002) "Non-Timber Forest Species on Kitasoo/Xaixais Traditional Territory," Cognetics International Research Inc., submitted to the Kitasoo Chief and Council, (private and confidential).

Fogarty, Fidel and Russel M. Wills, (2002) "The Development of Non-Timber Forest Species by the Kitasoo/Xaixais Nation-Final Report of Stage One," Cognetics International Research Inc., supported by the Council of the Kitasoo/Xaixais, and Rainforest Solutions Project.

Gao, B. and G. Yang (l991) Effects of *Ganoderma applanatum* polysaccharide on cellular and humoral immunity in normal and sarcoma 180 transplanted mice. *Phythother. Res.* 5:134-138.

Hobbs, C. (l995) Medicinal Mushrooms, Botanica Press, Santa Cruz.

Jianzhe, Y. *et al.* (l987) Icons of Medicinal Fungi From China, Science Press, Beijing.

Mitchell Associates (l999) Seeing the Forest Beneath the Trees: Strategies to Maximize Social and Economic Potential of Non-Timber Forest Products and Services in the Queen Charlotte Islands/Haida Gwaii

Mizuno, T. *et al.* (l995) Health foods and medicinal usages of mushrooms. *Food Reviews International.* 11(1): 69-81.

Mizuno, T. *et al.* (l998) "REISHI, GANODERMA LUCIDUM AND GANODERMA TSUAGE; BIOACTIVE SUBSTANCES AND MEDICINAL EFFECTS," (revised version) at http://www.mikei.com/REISHI1997-6.htm.

Wills, Russel and Richard G. Lipsey, (l999) "Economic Strategy to Development Non-Timber Forest Products and Services in BC," FRBC report PA97538-ORE.

Wills, Russel and Fidel Fogarty, (2000) "World and Regional Markets for BC Indigenous Medicinal/Nutraceutical Mushrooms and Extracts," Cognetics International Research Inc., supported by Weyerhaeuser Company.

Wills, Russel and Fidel Fogarty, (2002)"Haida Cultivation Forest for Medicinal and Nutraceutical Fungi –A Feasibility Study," Cognetics International Research Inc., submitted to the Haida Tribal Society and the Council of the Haida Nation (CHN).

Appendix: Forest Cover Map Concentrations of Pine Mushrooms, Chanterelles, Medicinal Mushrooms and Devil's Club in the Study Areas

Bella Coola – Pine Mushroom Concentrations

Forest Cover Map #	Polygon #	Priority
93D.050	28, 29, 31, 32, 92, 87,35, 43,42,38, 40, 41,39,59, 56,54,55/V, 46/V, 53/V,47/V,39/V 33,41,40,21,17,15/V,16 10,8,4/V,28/V,27	HIGH
93D.040	Tweedsmuir Park Area south of Atnarko River (no poylgon #, see Map)	HIGH
	45, E2s/V, 83, E2s/V,89,108, 110, 52, 112E2s, ll4,ll5,ll6	MEDIUM
93D.048	176/I, 177, 261/V,	HIGH
	43, 126,127,156,164	MEDIUM
93D.049	303,161E2s,17,16/s,107Es	HIGH
	151,152,153/I,154,106Es,107Es, 160Es,162E2s,164Es,209/V,229,229/V 230/V	MEDIUM
93D.07	131/V,120,130,106,101,102,88E,263	MEDIUM
93D.017	129E,133E,132E,180E,177E	MEDIUM

93D.037	22E2s,35E,162	MEDIUM
93D.087	78E2s,59E,62E,51E,60E,64E,64E2s 147E,155E,166E,167E,182E,284E (three potential Cult. Forest sites here)	HIGH
	65,69,86E,82E,71E,57,53E,48E,44E, 248E,147E,156E,158E,175E,174E,183E 275,187,183E,177E,178E,179E,285E,287E	MEDIUM
93D.085	83,95,93,82,81,29/s,80,98,78,79,73,72,77 97,99,76,75,107,103,112,105,114,111,108, 109,110,117 (high priority Cult. Forest site)	HIGH
93D.086	99,98,88,97,85,87,105,100,103,101,102,96	HIGH
	195,196,74E,73E,72E,69E,70E,202/V,75E, 67E,68E,236E,63E,62E,64E,51E,56E,83,84 80,81,82,204,205,112E,113E,114E,126E	MEDIUM
93D.077	31E,35E,	MEDIUM
93D.078	102E,100,316,315,172E,173E,175E,183E, 73E,51E,62,204	MEDIUM
93D.079	81E,79,82E,83E,87E,96E,95E,88E,89,93E 92,99	MEDIUM

The Central Coast—High Priority Sites for Development of Devil's Club in and Around Klemtu/Cone Island

Forest Cover Map #	Polygon #
103A.058	6,7,8,9,11,31,25,22,13,12,21,23,26,24,25, 31,49,47,48,28,27,19,52, 53,
103A.068	241,239,324,322,329,323,321,319,315,314, 308,312,307,313,320**,**333,334,335, 349,353,352,350,392,391,385
103A.48	14,12,204,16,17,27,30,29,26,28,24

Medium Priority Areas (accessible coastal watersheds/creeks) with Potential for Future Devils's Club Development

103A.067

103A.057
103A.047

Haida Gwaii Medicinal Fungi

Seven sites have been examined in the south portion of Graham Island. Optimal areas for establishing cultivation forests for fungi exist near Skidegate (Spirit Lake), QueenCharlotte City and Massett (White Creek). Estimates of biomass for sustainable harvesting of wildstocks have been done. The actual site(s) selected for the cultivation forest will be determined by the Council of the Haida Nation. Larger scale harvesting of medicinal fungi should be done prior to logging in areas designated for timber harvesting. Specimens have been collected for isolation of tissue cultures. A chanterelle enhancement project should be located near Skidegate Lake on Morsby Island.

High Priority Sites for the Establishment of a Cultivation Forest

Forest Cover Map #	**Polygon #**
103F.030	177, 178, 179, 175, 176, 257, 270, 443, 174, 420, 421, 418,419, 442, 444, 271, 273, 275, 276, 146, 148, 149, 416, 289, 279, 154, 415, 140, 135, 133, 128, 132, 290, 291, 285, 286,289,295,294, 298.
103G.011/021	Chanterelle enhancement near Skidegate Lake.
103F.039	Area around Yakoun Lake. (In TFL 39- no polygon #s)
103F.040	Tlell—Reconnaissance surveys need to be done.

103G.031	191, 248, 209, 211, 212
103G.041	138, 148, 146, 142, 139, 141, 68, 71, 72
103F.070/061	Naikoon Park—ground check for conks for isolation of tissue cultures.