

# Compatible (or co-) management of forests for timber and non-timber values

by

**Brian D. Titus** (*Natural Resources Canada, Pacific Forestry Centre, 506 West Burnside Rd., Victoria, BC V8Z 1M5; corresponding author: btitus@nrcan.gc.ca*),  
**Becky K. Kerns** (*USDA Forest Service, Pacific Northwest Research Station, Corvallis, OR*),  
**Wendy Cocksedge** (*Centre for Non-Timber Resources, Royal Roads University, Victoria, BC*),  
**Richard Winder** (*Natural Resources Canada, Pacific Forestry Centre, Victoria, BC*),  
**Dave Pilz** (*Oregon State University, Corvallis, OR*),  
**Gary Kauffman** (*USDA Forest Service, Asheville, NC*),  
**Ron Smith** (*Natural Resources Canada, Atlantic Forestry Centre, Fredericton, NB*),  
**Stewart Cameron** (*Natural Resources Canada, Atlantic Forestry Centre, Fredericton, NB*),  
**Jim R. Freed** (*Washington State University, Olympia, WA*), and  
**Heidi L. Ballard** (*University of California, Berkeley, CA*)

**Abstract:** NTFPs can play an important role in contributing to the sustainability and stability of rural communities. They are also an important part of the practice – not just the theory – of sustainable forest management. There are opportunities to increase total forest values through compatible management to enhance both timber and non-timber values. A framework for thinking about compatible management strategies is given. Case studies from Canada and the US are then presented, with the objective of stimulating forest managers to consider options for compatible management in their local areas. Finally, suggestions are made for increasing the success of compatible management strategies.

**Keywords:** Non-timber forest products; NTFP; compatible management; co-management; silviculture

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### *Notes*

Since publication, evolving consensus on terminology in the Pacific Northwest suggests that, in the table on p. 7, “*Opportunistic*” should be replaced with “*Coincident*”

References to companies, institutes, organizations, trade names or web sites do not constitute endorsement by any of the government organizations or universities represented by the authors.

Direct quotations from publications or web pages are clearly cited and reproduced in *italics* throughout; accompanying comments are in regular font. Footnotes have been used to draw attention to further readings or to pertinent web pages. All literature cited in footnotes is included in the reference section.

The corresponding author takes all responsibility for any errors, and would be pleased to hear from any readers who have further examples or suggestions. All contributions will be acknowledged in future publications on this topic.

The PowerPoint presentation on which this paper is based is available from the corresponding author, on request.

## 1. Introduction to NTFPs

Many plants found in our forests, and parts of trees not associated with the traditional forestry sector, are of economic, social and/or cultural significance<sup>1</sup>. When harvested, these species and tree products are often referred to as *non-timber forest products* (NTFPs) or sometimes as *non-wood* or *special forest products*. While they have long been recognized as an integral component of forest management in developing countries, they have only recently begun to attract the attention of the forestry sector in Canada<sup>2</sup> and the US, at least at an institutional level.

The cultural, social and, in some instances, the financial importance of NTFPs should not be underestimated. NTFPs are one of the foundations of the culture of First Nations/Native Americans. They can play an important recreational role in society, with gathering being an opportunity for social outings to the forests. NTFPs can be important culturally, and include foods that are sought after as traditional seasonal delicacies (e.g., fiddlehead ferns, ramps or wild leeks, mushrooms, berries). They can be important for subsistence or sustenance gathering, especially in low-income rural areas, where they can also provide a source of seasonal employment. They can generate financial benefits to individuals and communities, from small-scale businesses through to major pharmaceutical industries (e.g., harvesting *Taxus* (yew) species for paclitaxel).

However, the financial worth of NTFPs is difficult to quantify, and few statistics are available<sup>3</sup>. It is tempting to directly compare the financial value of wages and products in the forestry and NTFP sectors, but it may be fairest to compare instead the number of workers or families that NTFPs allow to remain in rural communities, rather than amount of income alone<sup>4</sup>. Overall, NTFPs are generally of most importance where social safety nets do not exist, or are inadequate to sustain people. NTFPs are thus of importance to the forestry sector because they contribute to the social and economic stability and sustainability of rural communities, and healthy rural communities are needed to sustain a healthy forestry sector.

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<sup>1</sup> See species lists for Canada and the USA (<http://www.ifcae.org/cgi-bin/ntfp/db/dbsql/db.cgi?db=prod&uid=default>; >1343 records) compiled by the *Institute for Culture and Ecology* (<http://www.ifcae.org/ntfp/>). See bibliographies on NTFPs compiled by *Reforestation Scotland* (<http://rbg-web2.rbge.org.uk/ethnobotany/ntfp/home.htm>) at <http://193.62.154.38/ethnobotany/ntfp/database/biblio/biblio.php> and compiled by *Institute for Culture and Ecology* at <http://www.ifcae.org/cgi-bin/ntfp/db/dbsql/db.cgi?db=bib&uid=default> (the latter contains >2900 references).

<sup>2</sup> For example, amongst eight “[q]uestions and concerns regarding the standard hierarchy of forest management planning”, Tittler et al. (2001) ask “[w]hether non-timber values are really being considered when the level of harvest is set”.

<sup>3</sup> For some national statistics for Canada and the US see Duchesne et al. (2000), Alexander and McLain (2001), Alexander et al. (2002)

<sup>4</sup> See Atwood (1998): “It would be easy to dismiss the botanical industry because of its relatively low economic contribution. However, for those living a modest lifestyle the income generated from secondary forest products is sufficient to support them in their local communities. In today’s world, efforts to support small industry in rural communities may contribute to economic stability”

## 2. The forestry context

Within the current forestry context, NTFPs are important as a component of sustainable forest management (SFM)<sup>5</sup>. Over the years, the forestry sector has adapted to the increasing recognition of different ecological values, and has responded through improved management (e.g., riparian and watershed management to protect or enhance aquatic processes). In the three overlapping spheres of sustainable development (ecological, social and economic values), it is accepted that enhancing some ecological values (e.g., aquatic processes) can lead to enhanced social values (e.g., recreational fishing) and economic values (e.g., commercial fishing). By analogy, recognition of NTFPs in forest management can be used to enhance the social and economic values of an ecological value: biodiversity – and all of the ecological processes that it maintains (Davidson-Hunt and Berkes 2001).

In an increasingly competitive and market-demanding age, many forestry companies seek certification to retain or increase market share for their products. Consumers increasingly demand evidence of sustainable forest management practices, and these can be accounted for through the use of “criteria and indicators” (C&I). Two of the main C&I processes used in Canada and the US (Montreal Process and Canadian Council of Forest Ministers<sup>6</sup>) include measurements of NTFP sector activity as indicators of SFM, notably values and sustainability of harvest<sup>7</sup>.

While there are social benefits to consciously managing forests for NTFPs as well as timber, there are a number of problems that confront forest managers, especially on publicly owned land (e.g., crown, federal, state). These include a range of jurisdictional questions and issues that need to be addressed, from permits for limited access or harvesting, through to open access and the potential for “the tragedy of the commons” because of uncontrolled exploitation. Problems can also arise through trespassing, left garbage, increased fire risk, liability issues, and unauthorized travel on roads used for industrial extraction of timber.

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<sup>5</sup> See Davidson-Hunt and Berkes (2001): “*The linkages between ecosystem studies, traditional ecological knowledge, ecosystem-based forest management, livelihoods, and non-timber forest products provide a new direction for research and application that will lead us toward the vision of the Canadian Council of Forest Ministers to manage Canada’s forests as ecosystems.*”

<sup>6</sup> See (i) Montreal Process and C&I at [http://www.mpci.org/home\\_e.html](http://www.mpci.org/home_e.html), (ii) Canadian Council of Forest Ministers (CCFM) C&I (2003 up-date) at [http://www.ccfm.org/2000pdf/CI\\_Booklet\\_e.pdf](http://www.ccfm.org/2000pdf/CI_Booklet_e.pdf), and (iii) linkages between Montreal Process and CCFM C&I at [http://www.ccmf.org/pdf/pdf\\_docs/Technical%20Supplements/CI2003\\_tech\\_sup\\_2.pdf](http://www.ccmf.org/pdf/pdf_docs/Technical%20Supplements/CI2003_tech_sup_2.pdf).

<sup>7</sup> See list of Montreal Process C&I relevant to NTFPs at <http://iufro.boku.ac.at/iufro/iufro.net/d5/hp51100.htm> (IUFRO Research Group 5.11, Non-Wood Forest Products News Notes 1(1): 6-8, Dec. 2001, with list prepared by J.L. Chamberlain). No listing of CCFM C&I for NTFPs is available, but these include:

- (i) Indicator 5.1.4 *Contribution of non-timber forest products and forest-based services to the gross domestic product*
- (ii) Indicator 5.1.5 *Value of unmarketed non-timber forest products and forest-based services*
- (iii) Indicator 5.3.2 *Annual harvest of non-timber forest products relative to the level of harvest deemed to be sustainable*

Apart from wider social benefits<sup>8</sup>, are there direct financial benefits to managing forests for both timber and non-timber values? Unfortunately, it is probably difficult for forest companies to obtain enough financial benefits from the NTFP sector to fully pay for silviculture. However, some companies are able to partially recover costs through issuing permits or leases. Permits may be for the day, week, or month, and may be a flat rate per harvester, per party of harvesters, or a rate per amount of material removed (e.g., per pick-up or truck load). Other permits or leases can be for a proportion of the amount of NTFP harvested (e.g., salal at 5-8% of value of salal removed in the PNW<sup>9</sup>, *Taxus canadensis* at 5-10 cents/pound to land owner in NB, balsam fir boughs as a proportion of total value (Mickman Bros.) to landowner in MN). Regardless of the commodity, forest managers must bear in mind that the income of most harvesters is small and they cannot afford to pay much for permits or leases, regardless of the fact that some of the products they pick – once they have moved through buyers, value-added steps, and distributors – appear expensive at the retail level. Although no systematic survey has been completed, it would appear that many NTFP harvesters make ~\$100-150/day (\$CDN or \$US) before expenses, regardless of species harvested. This probably reflects the minimum daily amount that a person is willing to work in the forest for, rather than the retail value of products.

While it may be tempting for a forest company to try and maximize the financial returns from NTFPs on their land, it is important to balance access for commercial harvesting with access for subsistence and recreational harvesting. Being a “good neighbour” may sometimes be worth more than the dollar value of income from charging for NTFP access for subsistence and recreational harvesting. On the other hand, it may be possible to charge recreational harvesters more than commercial harvesters for some NTFPs, as dollar returns are often better if the product is harvested closer to the ultimate consumer. (For example, “u-cut” Christmas trees can earn the land owner more net income than if the owner cuts and markets the trees themselves.)

Although it may be difficult to recoup silvicultural costs through leases and permits, some NTFP harvesting itself is a form of silvicultural treatment, and may therefore be free. For example, in one long-term lease arrangement with salal pickers in the PNW, the local forester taught the pickers how to prune, and the pickers now do this at no charge, to increase their access to salal. Pruning is also done for boughs for essential oil extraction (e.g., western redcedar in the PNW), and boughs (often pines) for swags and greenery. Pre-commercial thinning is less common, and includes removal of small diameter trees for rustic furniture and other items.

Forest companies may also benefit from NTFPs if the land they manage is private, if they reserve at least portions of it for the exclusive use of their staff, and if their staff are trained in NTFP harvesting. There is then the possibility that staff can use this resource as alternate income if their forestry work is seasonal. This kind of arrangement may allow workers to remain in the community during downturns in the forestry sector or economy, thereby helping ensure workforce stability for the company, rather than have under-employed staff move to new employment elsewhere. In this case, carrying out silvicultural treatments to enhance NTFP

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<sup>8</sup> See also Emery and Zasada (2001): “Including NTFPs in silvicultural systems today can provide benefits that are largely overlooked by contemporary forest management. These include:

- Community good will, support for forest management
- Additional forest resources (i.e., keeping land forest, instead of other uses)
- Potential income (but authors warns that claims for NTFP income are often overstated)
- Appreciation of forested landscapes” (by NTFP harvesters, both recreational and commercial)

<sup>9</sup> The Pacific Northwest (PNW) will be taken to include BC, as well as the PNW states

values may benefit the company directly, but not financially. For example, a good salal site in the PNW can have a value of ~\$1000/ha/year, but is commonly leased at 5 to 8% of its value, or \$50 to \$80/ha/year. The lease revenue to the company is minimal, but the total value is not insignificant if the company's workers can benefit from it. Company control for the company workforce is equivalent to an NTFP worker holding a long-term lease on managed land, and is incentive for good stewardship of NTFP resources and perhaps for increased applications of silviculture to enhance NTFP values.

Perhaps the ideal situation for compatible management of timber and non-timber resources arises with private woodlands when the owner is also the NTFP harvester. Here, the owner can benefit from compatibly managing their entire forest resource to optimize both timber and non-timber values. In one particular case, forest owners and bough harvesters are coming together at a state level in Minnesota to maximize both timber and non-timber values through the Balsam Bough Partnership by developing relevant policies and coordinating opportunities for bough harvesters to work with forest companies for timely access to boughs<sup>10</sup>. Cooperative initiatives like this may be a model for moving policy ahead in other jurisdictions.

### 3. What is compatible management?<sup>11</sup>

Although *co-management* is sometimes used to describe managing forests for both timber and non-timber values, the term is increasingly used in the context of joint management of forest land by partners (e.g., forest company and local community, forest company and First Nation/Native Americans, etc.) We therefore prefer the term *compatible management* (after Monserud et al. 2003), which suggests management regimes that are compatible with both timber and non-timber values. (Other terms also exist in the literature. For example, Weigard (1998) uses *multiproduct management* in the sense that we use *compatible management*.)

We see compatible management opportunities as existing along a continuum<sup>12</sup> from *inactive* compatibility (i.e., taking advantage of existing forest management tools to increase NTFP values) to *active* compatibility (i.e., applying forest management with the explicit objective of increasing both timber and non-timber values). In between are *opportunistic* management scenarios, where management for one value happens to benefit the other, even though this is not a stated objective:

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<sup>10</sup> See [http://www.blandinfoundation.org/documents/GFTW\\_Policy\\_Update\\_Report\\_051304.pdf](http://www.blandinfoundation.org/documents/GFTW_Policy_Update_Report_051304.pdf)

<sup>11</sup> For other discussions of the interactions between timber and non-timber management, see Molina et al. (1997), Emery and Zasada (2001), Gautman and Watanabe (2002), and Chamberlain et al. (2002). Duchesne et al. (2001) also discuss acquisition of silvicultural knowledge of NTFP species through traditional knowledge, scientific research, or both. However, few case examples are included in the above references, although they provide good background information and philosophical overviews of compatible management for timber and non-timber values, and some general examples.

<sup>12</sup> Duchesne and Wetzel (2002) take a slightly different approach and, rather than using a spectrum of choices, comprehensively discuss four discrete categories of “modes of interaction between the NTFP and timber industries”, which they identify as *independent*, *competitive*, *symbiotic* and *complementary resource use*.



and life-history of the organism) and the interaction with forest management, natural disturbance, and succession at stand to landscape scales. Many factors and processes influence NTFP species distribution, and abundance. Forest management practices that can affect non-timber species include the initial effects of disturbance associated with logging and site preparation, and subsequent activities that directly or indirectly alter rates or patterns of succession (Halpern and Spies 1995). These can include the catastrophic disturbance from which the stand originated, the degree of biotic legacies retained following the disturbance, and the rapidity with which trees established on the site and form a dense canopy. For example, light availability and shade tolerance of understory plant species are important factors because light is considered a major limiting resource for most photosynthetic understory species in coniferous forests, particularly in wet, mild, low elevation locations (Alaback 1982). On the other hand, the responses of fungi are largely determined by their mode of nutrition. For these species, carbohydrates and other nutrients are usually gained from live trees or coarse woody debris rather than photosynthesis. Thus, nutritional substrate alterations, rather than light, are key. For many NTFP species, limited understanding of individual species' ecology (i.e., autecology) often hampers compatible management.

While many forest managers may be familiar with the general distribution of a species and its biological abundance across a stand or landscape using existing forest inventory or plant association information, harvesters of NTFPs are seeking specific product characteristics that may not be directly related to biological abundance (e.g., plant cover). For example, many fresh foliage products such as salal and bear-grass require shade to develop dark green foliage, a requirement for commercial value. For some products, such as berries and leaves of certain medicinals, commercial product abundance and biological abundance may be more closely linked. Most understory plant species require some light to flower and fruit, and significant fruit production is usually needed in an area to be realistically harvestable. (See Kerns et al. (2003) for a fuller discussion of the ecological implications of compatible management for PNW species.)

## **5. Compatible management case studies: Inactive management**

Forest managers already have tools that can be of great benefit to NTFP harvesters. One of the best “value-added” efforts a forest manager can make is to install secure, locked gates and grant exclusive access. Security of access – especially long-term access – is and will increasingly become perhaps the commodity most sought after by NTFP harvesters, and makes leasing a possibility. Other tools for increasing the value of land for NTFPs that are already in place include forest road networks and, perhaps more importantly, relevant maps (e.g., forest cover, inventory, ecological zones, topography) and aerial photographs. (In some cases, routine forest management planning process may actually identify locations of NTFP species when these species compete with crop trees.) While some NTFP harvesters are well prepared for finding their species of interest, many have little mapping knowledge. In one of the few accounts available (Cocksedge 2000), one novice NTFP researcher was able to pick more mushrooms than experienced professionals simply by applying knowledge of mushroom habitat to topographic maps and aerial photos obtained through a local forestry office, and using a map and altimeter so that they knew where they were in the landscape (Cocksedge, pers. comm.) Using presently available maps of ecological parameters can provide a “first approximation” for locating

**mushrooms** (SK<sup>18</sup>), **ground hemlock** (or **Canada yew**; *Taxus canadensis*; eastern Canada) and **American ginseng** (*Panax quinquefolium*)<sup>19</sup>. However, there are difficulties in using current vegetation inventories (in the absence of specific NTFP species inventories) because probabilities of prediction are not as good as might be hoped for (Vance et al. 2002, Kerns et al. 2002). While application of presently available mapping tools by NTFP harvesters may seem trivial to the forestry community, this is not necessarily so. A range of cultural, educational and jurisdictional barriers may prevent NTFP harvesters from seeking the tools because of fear of authority, fear of being denied access to land if they ask too much about it, bravado, language and cultural barriers, lack of education, and lack of knowledge of the use of applicable tools (maps, compass, GPS, altimeter, etc.).

## 6. Compatible management case studies: Active management

We found examples of compatible management for the following forest management treatments or scenarios, and categorize these as they would arise over a rotation (i.e., from harvesting through stand establishment and stand tending, to re-harvesting)<sup>20</sup>:

Stand-ending disturbance	Stand establishment	Stand tending
Road building	Site preparation	Fertilization
Tree harvesting	• Prescribed fire	Pruning
• Delayed felling	• Mechanical site preparation	Thinning
• Before felling	Regeneration	Pre-commercial
• Pattern of felling	• Mycorrhizal inoculation	Commercial
• After felling	• Species choice	
Tree salvage	• Genotype	
• Fire/insect/disease	• Inter-planting	

Active management case studies are described below. All are actual applications of compatible management, unless clearly stated otherwise. Plant common names are in bold, and scientific names in italics. Provinces or states from which specific examples come are listed in brackets if

<sup>18</sup> See

[http://www.agr.gov.sk.ca/docs/crops/northern\\_agriculture/HarvestWMrms.asp?firstPick=Crops&secondpick=North ern%20Agriculture&thirdpick=NULL](http://www.agr.gov.sk.ca/docs/crops/northern_agriculture/HarvestWMrms.asp?firstPick=Crops&secondpick=North ern%20Agriculture&thirdpick=NULL)

<sup>19</sup> See <http://www.a-spi.org/AGF/manual1.htm#siting>

<sup>20</sup> As an alternative way of considering disturbance and its effects on NTFPs, Duchesne et al. (2001) consider three classes of disturbance and their effects on NTFP species: (i) “Constant adjustment of forest ecosystems to the variation in climatic patterns and various types of disturbance related to this variability” (e.g., frost, insects, disease, wind, fire, herbivory), (ii) “Human disturbance not directed specifically at NTFPs” (e.g., forest harvesting, mining, land development); this disturbance can be detrimental: “[G]atherers of NTFPs should be directed to areas where disturbances are planned that will severely impact important NTFP species” (e.g., timber sales and balsam boughs), or can be beneficial: “[F]orest harvesting... [can] result in an increase in production of NTFPs, such as fruits and berries. Where it is possible, these areas should be identified and gathering for personal and commercial use should be encouraged.”), and (iii) “Human disturbances specifically related to NTFPs” (e.g., fire for regeneration, NTFP harvesting techniques, NTFP planting, etc.).

locations are not identified in the text. (Contact names for further details of examples can be obtained from the corresponding author.)

**6.1 Road building:** Plants salvaged from future roadbeds can be sold as sustainably harvested native plants. (The native plant market will not usually handle plants that come directly from forests, as this is considered unsustainable and can lead to local extinction of species.) On Vancouver Island, BC, NTFP harvesters cooperate with local forestry companies and salvage plants from future roadbeds, once they have been surveyed. Sought-after species include **western sword fern** (*Polystichum munitum*) and **Oregon grape** (*Mahonia aquifolium*)<sup>21</sup>, but harvesting **mosses** and other plants would also be possible. Salvaging plants from future roadbeds should be widely applicable, but certifying the source of plants (“chain of custody”) may be problematic.

**6.2.1 Tree harvesting – Before felling:** **Western redcedar** (*Thuja plicata*) bark is harvested in UBC’s Malcolm Knapp Research Forest<sup>22</sup> in BC by the Katzie First Nation. The forester marks redcedars that are destined for later felling (through stand harvesting or thinning). The Katzie first use these trees as an educational opportunity to teach traditional bark stripping methods to local school and university students. The Katzie then come back and completely strip trees prior to felling. This successful partnership has been on-going for over 15 years.

**Western yew** (*Taxus brevifolia*) can be harvested in the PNW for its bark before felling takes place. However, activity has dramatically decreased and is now almost non-existent because of the more readily available **ground hemlock** (*Taxus canadensis*), which can be sustainably harvested because the desired taxanes are in the foliage and can therefore be repeatedly pruned.

**Moss** stripping from trunks of trees to be felled can be carried out (coastal BC; see also recommendations in Muir 2004).

**Paper birch (white birch;** *Betula papyrifera*) bark harvesting one year before felling is also a possibility<sup>23</sup>.

**Ground hemlock** (*Taxus canadensis*) does not usually survive harvesting of the overstory and subsequent site preparation in eastern Canada, and therefore removal of yew before harvesting overstory trees may be possible.

Some native plant salvage for nurseries is a possibility, if it can be shown that they do not survive tree felling and the new environment on a cutover. Research is presently being carried out to see if this is possible for **western sword fern** (*Polystichum munitum*) in the PNW (Cocksedge, pers. comm.).

Mickman Brothers<sup>24</sup>, one of the largest wreath makers in the US, cooperates with UPM, Blandin Paper Company to harvest branches from **balsam fir** (*Abies balsamea*) before stands are

<sup>21</sup> See web links to North Island NTFP Demonstration Project at <http://www.royalroads.ca/Channels/for+learners/divisions+centres+and+schools/centre+for+non-timber+resources/default.htm>

<sup>22</sup> See <http://www.mkrf.forestry.ubc.ca/>

<sup>23</sup> See <http://www.extension.umn.edu/specializations/environment/components/birchbark1.html>

<sup>24</sup> See <http://www.mickman.com/>

felled<sup>25</sup>. Mickman Brothers lease the right to the boughs (by volume), and arrange for bough harvesters to tour areas to be felled during the off-season. Bough harvesters therefore go into the bough harvesting season knowing where and how much of the resource is available to them. This increases stability in the NTFP sector and access to a bough resource that would otherwise not be available. (Harvesters can strip all the boughs from trees, not just tips.) The benefits to the forestry company include some income from the boughs, contracting out of NTFP management, knowledge of who is on their land base but also, and perhaps more importantly, the knowledge that they are cooperatively contributing to a stable, local rural economy by optimizing the value of their forests.

**6.2.2 Tree harvesting – Delayed felling (retention of mature stands):** In northern BC, anecdotal evidence suggests that mature stands of timber may be more valuable for **pine mushrooms** (**American matsutake**; **white matsutake**; *Tricholoma magnivelare*) than timber: “Our company cuts 400-500 m<sup>3</sup> year<sup>-1</sup>, which after costs are taken into account equals about \$3.5 million in revenue. That revenue must be amortized over the 70-90 year rotation period. If a 70 year rotation, that equals \$0.5 million year<sup>-1</sup>. If mushrooms are getting \$1.5 million year<sup>-1</sup>, the mushroom harvest has a higher sustainable value (\$105 million). (Forest Industry).” (Quoted in Atwood 1998, but see also Olivotto 1999a and Alexander et al. 2002b for comparisons of mushroom and timber values.)

On the Queen Charlotte Islands/Haida Gwaii, tree harvesting in good mushroom habitat in the Skidegate Lake is delayed to allow mushroom pickers more years in which to harvest. The stand (4900 ha = 12,000 acres) originated from a fire in 1951 (a rare event in this ecosystem), and consists of almost pure second growth **Sitka spruce** (*Picea sitchensis*) of exceptional productivity (leading Sitka spruce: 80-90%; some western hemlock at edges; alder along riparian areas). The stand is now 53-years-old. Commercial quality mushrooms are usually present between 15 to 70 years in Sitka spruce stands, usually with 30 to 40 years of good mushroom productivity. The site produces ~\$250,000 to \$500,000 worth of mushrooms per year (mostly **chanterelles** (*Cantharellus* spp.) with **king boletes** (*Boletus* spp.) and **chicken-of-the-woods** (*Laetiporus* spp.) beginning to appear), with ~100 pickers establishing a “tent village” for the two months of active picking (early Sept. to early Nov., depending on the year). This leads to economic spin-offs in the local communities for supplies and services. Tree harvesting in prime mushroom habitat began to be restricted around 5 years ago (1999) when the public expressed concerns about tree harvesting by licensees. Tree harvesting will be allowed in areas where mushroom productivity drops off. Surveying potential cutblocks in the fall when mushrooms are visible allows identification of areas to be left, and also trains foresters to recognize good mushroom habitat. (For a narrative description of picking in this area, see Cocksedge 2000.)

Timber and **pine mushroom** (**matsutake**; *Tricholoma magnivelare*) supply analyses for the Cranberry Timber Supply Area in the Prince Rupert Forest Region, northern BC, have also recommended delays in harvesting to optimize the value of both timber and mushroom resources (Olivotto 1999a). The suggested management scenario is harvesting to achieve even age-class distribution in the TSA, which would take 200 years. The analysis suggests that the maximum total economic forest yield (pine mushroom value + timber value<sup>26</sup>) would then be achieved with

<sup>25</sup> See <http://www.extension.umn.edu/specializations/environment/components/balsam1.html>

<sup>26</sup> For other comparisons of timber + mushroom values, see Pilz et al. (1999) and Alexander et al. (2002b).

a rotation of 145 years. This would give a harvest of 90,000 m<sup>3</sup> yr<sup>-1</sup>, with economic values of ~\$2 million for mushrooms (19% of total value) and ~\$11 million for timber (81% of total value).

**Club mosses** (*Lycopodium* spp.) in northern hardwood forests would also benefit from delayed tree harvesting. It was concluded in one study that, in stands of second-growth origin, a minimum of 80 years following disturbance is required for greater levels of *Lycopodium* frequency to develop, and for substantial increases in *Lycopodium* cover to take place through clonal expansion<sup>27</sup>. However, unlike pine mushrooms, which can be harvested annually, slower club moss growth rates would likely not allow frequent re-harvesting.

**6.2.3 Tree harvesting – Pattern of felling:** Variable retention (or alternative silvicultural) systems have an impact on shade, both under “dispersed retention” (e.g., shelterwood, greentree), and in the increased forest edge if a clearcut block is not simply a rectangle or circle, and has undulating edges.

In the Saguenay region near Lac-St-Jean, QC, there is a demand for more access to forest land for **lowbush blueberry** (*V. angustifolium*) production, which is economically important in the region. However, the forest sector is also economically important. In a process of “integration through separation”, permanent blueberry patches (60-m wide) are separated by strips of forest (42-m wide)<sup>28</sup>. Intensive forest management of the remnant stands between the blueberry blocks is carried out with the objective of no net loss of forest productivity at a landscape level. It is possible that a similar approach could be used to create vertical strips up mountains in the PNW for permanent (or semi-permanent) **huckleberry** (*Vaccinium* spp.) habitat, to simulate traditional First Nations/Native American burning patterns for berry production without reducing overall forest productivity<sup>29</sup>.

Moving from even to uneven-aged management may benefit wild **American ginseng** (*Panax quinquefolius*) production, based on the observation that highgraded **sugar maple** (*Acer saccharum*) stands in west VA can contain excellent wild ginseng, as well as medicinal plants. However, this must be tempered with the possibility that NTFP species subject to heavy harvesting pressure, like ginseng, may be prolific in some circumstances because of relative lack of harvesting, rather than ecological preference.

In the PNW, mosses suitable for commercial harvesting are usually found on hardwoods and shrubs. Leaving these species behind at harvesting may therefore reduce the length of time required for commercial-quality **moss** to become re-established (Muir 2004).

**Club mosses** (*Lycopodium* spp.) in northern hardwood forests respond differently to different harvesting regimes. In one study, mean percent cover of all *Lycopodium* species combined was greater in managed (selection harvesting and group felling in an old-growth-origin stand, and crop tree release and thinning to give un-even aged management in a ~100-year-old even-aged stand) than in unmanaged stands, and greater in second-growth than in old-growth

<sup>27</sup> See <http://www.extension.umn.edu/specializations/environment/components/lycopodium1.html>

<sup>28</sup> See regulation at <http://www.canlii.org/qc/laws/regu/m-25.2r.0.02/20040623/whole.html>; for a viable production unit of 200 ha: “60-metre wide rows reserved for intensive lowbush blueberry growing alternate with 42-metre wide wooded strips intensively managed in such manner that previously granted forestry rights are fully respected”.

<sup>29</sup> See Burton (2000) for a fuller discussion of silvicultural and forest management treatments that would benefit berry production from *Vaccinium* and other species.

stands (see summary of Nauertz 1999 in Nauertz and Zasada 2001<sup>30</sup>). Overall, the authors recommend “fewer management entries and less excessive and intensive soil disturbance and compaction” (Nauertz and Zasada 2001).

One timber harvest plan in coastal BC recommends creating a sustainable supply of dead organic matter from roots for mushrooms through periodic partial overstory removal (Olivotto 1999b). The plan was designed for a fully stocked 135-year-old forest with 550-650 live stems ha<sup>-1</sup> of **western white pine** (*Pinus monticola*), **Douglas-fir** (*Pseudotsuga menziesii*) and **western hemlock** (*Tsuga heterophylla*), trees 40-60 cm DBH and 30-35 m tall, and with an MAI of 4-6 m<sup>3</sup> ha<sup>-1</sup> yr<sup>-1</sup>. The plan calls for a first entry (year 0) to remove 50% of standing volume (300 m<sup>3</sup> ha<sup>-1</sup>), a second entry (at year 20) to remove half the remaining large trees (200 m<sup>3</sup> ha<sup>-1</sup>), and a third entry (at year 70) to remove some of the remaining large veterans and some of the smaller (now large) trees that were released in the first entry (250 m<sup>3</sup> ha<sup>-1</sup>). Whether or not the plan is ever implemented, thinking through and constructing a plan for compatible management is a significant step forward.

In one silvicultural systems trial in BC, it was found that partial cutting in a **western hemlock – western redcedar** (*Tsuga heterophylla* – *Thuja plicata*) forest five years previously did not have an effect on ectomycorrhizal **mushrooms** over a three-year period (Kranabetter and Kroeger 2001). The treatments included (i) control, (ii) light removal (~30% of volume removed in single stems or small groups of stems), (iii) heavy removal (~60% of volume removed in combination of small patch cuts of 1000 to 5000 m<sup>2</sup> (= 0.10 to 0.50 ha) and single-tree to small group selection in forest matrix between patches).

**6.2.4 Tree harvesting – After felling:** The bark of **paper birch** (**white birch**; *Betula papyrifera*) contains actual (betulinic acid) and potential (betulin) medicinal compounds<sup>31</sup>. The bark on a load of logs can be worth as much as the logs themselves, and can be stripped at mills (MN). In the PNW, the bark of **western redcedar** (*Thuja plicata*), which is used by First Nations/Native Americans for basket weaving, could potentially be stripped at roadside, or before logs are processed at mills.

Boughs from conifers could potentially be used for oil extraction, but the thujone concentration in **western redcedar** (*Thuja plicata*) foliage drops within a few days of felling, and collecting boughs from industrially-harvested sites in the PNW is too dangerous to be possible within a suitable time-frame. Similarly, **balsam fir** (*Abies balsamea*) boughs from industrially-felled trees are not suitable for greenery because their quality deteriorates too much within about two days. Although salvaging boughs for greenery from individual **balsam fir** that are too small for pulpwood has been tried by felling them before stands are clearcut, it has not proven to be economic as compared to pruning (MN). However, small private landowners in the PNW have found that **western redcedar** trees can be individually felled in the autumn and foliage immediately cut for Christmas floral greenery, and the stands felled within a short time afterwards. There is clearly the potential for salvage of conifer boughs for essential oils or greenery – the key determinants are (i) a very narrow window of opportunity (hours, rather than

<sup>30</sup> See also summary of Nauertz’s (1999) Master’s thesis at <http://www.extension.umn.edu/specializations/environment/components/lycopodium1.html>

<sup>31</sup> See <http://www.extension.umn.edu/specializations/environment/components/birchbark2.html>

days), (ii) safety issues on industrial clearcuts, and (iii) the practicality and economics of felling individual trees for bough salvage, prior to felling the stand.

Tops of **paper birch** (*Betula papyrifera*) trees can be salvaged for use as artificial trees (in MN; Mater 1997), as can **manzanita** (*Arctostaphylos* spp.) cleared from felled sites (CA; Mater 1997). Although a non-North American example, tops of some conifers harvested in the late autumn for pulpwood in the UK, especially at higher elevations where quality is retained because of lower temperatures, are saved for use as Christmas trees.

**Coarse woody debris** on the forest floor is often removed or chipped in the Appalachians. However, if it is left after harvesting it will later become excellent habitat for commercial-quality **mosses** (Muir 2004).

Salvage of **biomass** for energy is also a re-emerging area. Technologies for utilizing slash for energy that were well developed after fuel shortages in the 1970s may become more applicable again, with rising oil costs. Newer technologies, such as pyrolysis for producing bio-oils from biological materials, may also become more cost-effective<sup>32</sup>.

**6.3 Tree salvage after wildfires, insects or disease: Morel** (*Morchella* spp.) mushrooms are found at low numbers in healthy forests, but will proliferate after insect attack and especially after wildfires<sup>33</sup>. In one study in Oregon that used un-biased sampling to determine counts (no. of morels ha<sup>-1</sup>) and weights (biomass ha<sup>-1</sup>) of morels, there was a trend of wildfire-burned forest > insect-damaged forest > healthy forest ( $p = 0.018$  for counts,  $p = 0.111$  for weight). However, the only significant comparison was for counts, with more morels after wildfire than in the healthy forest (Pilz et al. 2004). As morels appear in largest numbers in the first spring/early summer after a wildfire or insect attack, delaying wood salvage until after this time will allow mushroom pickers access to the resource. However, wood salvaged after a wildfire is usually only good for pulp and paper for up to one year after the fire because of changes in the wood moisture content (Watson and Potter 2004).

Species with edible berries that proliferate after wildfire include many members of the Ericaceae, especially **huckleberries** (*Vaccinium* spp.) in mountains of the PNW, and **lowbush blueberries** (*Vaccinium angustifolium*) in the boreal and northern forests of Canada and the US. Unlike morels, productivity will increase with time over a number of years until the developing forest canopy begins to shade the *Vaccinium* out again.

**6.4.1 Site Preparation – Prescribed fire:** As with wildfire, **morel** mushrooms and *Vaccinium* species are typically stimulated by prescribed fire. With morels, there are anecdotal suggestions from some mushroom pickers that spring morel crops increase the later in the year that the fire occurs, with late fall being particularly beneficial. If this is true, then there may be an opportunity to increase morel harvests through judicious timing of fires.

**6.4.2 Site Preparation – Mechanical site preparation:** MSP can often damage or kill plants that are disturbed by the machinery, and this is sometimes one of the objectives of the treatment. The roots of **devil's club** (*Oplopanax horridus*) are used for medicinal purposes. It can be extensive

<sup>32</sup> [http://www.canren.gc.ca/tech\\_appl/index.asp?CaID=2&PgId=183](http://www.canren.gc.ca/tech_appl/index.asp?CaID=2&PgId=183)

<sup>33</sup> See <http://bcmushrooms.forrex.org/ntfp/pages/sustainableharvest.html> for further comments on fires and mushrooms, in general

on clearcuts in BC right after harvesting, but is usually killed by MSP. Communication with harvesters would allow them to excavate devil's club before MSP takes place. The same practice could be used with other NTFP species found on cutovers that would be killed by MSP, including **ground hemlock** (*Taxus canadensis*).

**6.5.1 Regeneration – Mycorrhizal inoculation:** Mycorrhizae are fungal symbionts that generally increase plant productivity<sup>34</sup>. Promotion of the practice of inoculating tree nursery stock with beneficial mycorrhizal species was therefore often suggested though the 1970s and 1980s (e.g., Molina and Trappe 1984). With the exception of extreme site conditions (rehabilitation, planting of some exotics), there was little evidence of widespread growth increases, and the practice has not become widely operational. However, Europeans and other non-North American cultures inoculate some tree seedlings with edible mycorrhizal mushroom species<sup>35</sup>, and there is no reason why this practice could not be introduced into Canadian and American forest tree nurseries. Patience is required, however, as commercial mushroom production may not begin for 25-30 years, for conifers. In one case in North America, micropropagation techniques have been developed to produce **hazelnut** (*Corylus* spp.) and **oak** (*Quercus* spp.) seedlings that are inoculated with truffles. Hazelnuts should produce truffles in 10-15 years, as well as nuts, and although oaks take several decades to produce truffles, they can also be silviculturally managed for wood production. If successful, plantations with truffles are estimated to produce up to \$40,000 ha<sup>-1</sup> year<sup>-1</sup>.

**6.5.2 Regeneration – Species choice:** Choice of species for planting can have a major impact on future NTFPs, both through products from the tree species itself, and because of tree species-induced changes in succession. For direct tree products, choice of species will affect, for example, potential for bough harvests for floral greenery or for oil extraction. In addition, **eastern black walnut (American walnut; *Juglans nigra*)** produces both nuts<sup>36</sup> (see Jones et al. 1998 re: nut production) and high quality logs. Although the time before nut production can take many years, this can be reduced to ~8 years by using shoots grafted on to root stock. It is also important to use high-yielding cultivars<sup>37</sup> that will yield good crops of nuts and also good stem form for logs, as nut yields can be greatly increased through proper selection.

Choice of tree species also affects mycorrhizal associates, and hence **mushroom** production: there are usually more mushrooms under pine and spruce than under fir species.

**Hazelnuts** (also known collectively as **filberts**, or **cob nuts**; **American hazel** = *Corylus americana*<sup>38</sup>, **beaked hazel** = *C. cornuta*<sup>39</sup>) can be planted for both nuts and biomass for

<sup>34</sup> See <http://www.ces.purdue.edu/extmedia/FNR/FNR-104.html>, or extensive list of reviews on the topic at <http://mycorrhiza.ag.utk.edu/mrevi.htm>

<sup>35</sup> For example, see <http://www-mykopat.slu.se/Newwebsite/ex/lina/lina.html>

<sup>36</sup> See <http://www.black-walnuts.com/>

<sup>37</sup> See (i) Reid, W., M.V. Coggeshall and K.L. Hunt. 2004. Cultivar evaluation and development for black walnut orchards. In: Michler, C.E. and others, ed. Proc., 6th Black Walnut Symposium. Gen. Tech. Rep. NC-. St. Paul, MN: USDA FS NCRS (in press), (ii) <http://www.black-walnuts.com/page.asp?category=growing&subcategory=growingandresearch> and (iii) <http://www.walnutcouncil.org/>

<sup>38</sup> See <http://www.rook.org/earl/bwca/nature/shrubs/corylusam.html>

bioenergy (as well as truffles; see above). It has been suggested that they could be grown in short-rotations for biomass, and harvested every 8-10 years by coppicing<sup>40</sup>. This would also allow for nut production.

**6.5.3 Regeneration – Genotype:** The use of **high-yielding cultivars of black walnut** (*Juglans nigra*) for nut production was mentioned above. In addition, one forest company in BC is researching the possibility of using or breeding genotypes of **western redcedar** (*Thuja plicata*) with high terpene contents, which is thought to reduce deer browse. Costs of protecting redcedar seedlings from browse damage until they are free-to-grow can be very expensive (up to ~\$10,000 ha<sup>-1</sup>). However, an identification/tree breeding program for high terpene genotypes would also be of benefit to a local cedar oil extraction plant in coastal BC.

**6.5.4 Regeneration – Inter-planting:** Multiple species planting has been tried experimentally in the Atlantic provinces of Canada by Natural Resources Canada under a “Forest 2020” initiative. The main objective of this program is afforestation of old fields to sequester carbon. Three 1-ha plantations containing **30 tree species** were established in 2004, and two more are scheduled for establishment in the spring of 2005. All 30 species selected for these demonstration trial areas were chosen for their potential to produce products other than just fibre, but without compromising minimum stocking standards of what will eventually be merchantable plantations. This approach could also be used in more traditional reforestation programs. One of the key advantages is that small, private landowners do not have to wait for a full rotation before deriving some modest income from, for example, berries, or tree foliage for greenery (i.e., tips).

In a similar vein, **Christmas trees** could theoretically be combined with commercial plantations by interplanting them between the desired commercial plantation species, thus giving a higher overall density. The Christmas trees would warrant more silvicultural treatments than might otherwise be economic (e.g., fertilization, competition control), thus increasing site productivity. The Christmas trees could then be harvested, which would thin the plantation to the desired commercial density, and generate income early in a rotation, rather than just at the end. This approach – along with other NTFP management regimes – is being applied experimentally to off-set silvicultural costs on high elevation sites that are difficult to regenerate (see Weigand 1998 and Amaranthus et al. 1998 below).

**6.6 Vegetation management:** These treatments can confer benefits to both timber and non-timber values if (i) the species that is a problem to forest managers is harvested as an NTFP, or (ii) vegetation control benefits crop trees as well as NTFP species who’s growth or productivity is also impaired by the species targeted by vegetation control treatments. For example, in the central states, **eastern red cedar** (*Juniperus virginiana*) is an invasive species, but can be harvested to produce aromatic shavings for pet litterboxes, etc. In the eastern states, ~50,000 plants of **mountain laural** (*Kalmia latifolia*) and native **Rhododendron** (*Rhododendron* spp.)

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<sup>39</sup> See <http://www.rook.org/earl/bwca/nature/shrubs/coryluscorn.html> and <http://www.hort.purdue.edu/newcrop/NewCropsNews/94-4-1/nuts.html#filbert>

<sup>40</sup> See <http://www.extension.umn.edu/specializations/environment/components/hazelnut1.html> and <http://www.badgersett.com/>

are dug up from regenerating sites annually, and sold as native plants. These species can be associated with regeneration and site productivity problems.

In Quebec, **ground hemlock** (*Taxus canadensis*) used to be eradicated from under sugar bushes if it formed dense mats and inhibited access to sugar maple trees within the stands. However, with some creative thinking, sufficient ground hemlock is now removed to permit full access to the taps and lines, while the rest is clipped (harvested) using appropriate guidelines.

**Sheep laurel** (*Kalmia latifolia*) can cause serious regeneration problems on some sites in Quebec and Newfoundland. When a cutover in Newfoundland that was dominated by sheep laurel was treated with different herbicides in an efficacy trial, **lowbush blueberry** (*Vaccinium angustifolium*) cover increased proportionately as sheep laurel cover decreased (Titus and English 2000). Spruce growth can greatly improve when sheep laurel is controlled (Titus and English 1997, English and Titus 2000), and therefore herbicide application may have the double benefit of increasing plantation growth while at the same time promoting growth of blueberries, a local commercial crop.

In coastal BC, **huckleberries** (*Vaccinium* spp.) are sometimes mechanically cut when they overtop conifers in young plantations. After the first fall frosts, stems of some *Vaccinium* species turn red (“red huck”), and can be harvested for the floral industry. Although it may be difficult to combine both mechanical vegetation control and red huck stem harvesting because of lost efficiency if the objective is vegetation management, there may be opportunities for silvicultural workers to collect and sell some of the stems that they have cut.

**6.7 Fertilization:** Depending on the NTFP species, fertilization may increase productivity of the NTFP as well as crop trees by either increasing available nutrients, or by changing stand characteristics (notably light/shade) as conifers respond to increased nutrition. Commercial **salal** (*Gaultheria shallon*) is harvested in the semi-shade of developing stands; salal growing in full sunlight is not of commercial quality, but is later shaded-out as plantations develop and conifer canopies close. Young plantations containing salal on northern Vancouver Island are often aerially fertilized because salal is associated with poor conifer growth rates (e.g., Prescott and Weetman 1994, Blevins and Prescott 2002<sup>41</sup>). Salal productivity (measured as total above-ground biomass) also increases ~55% when plantations are fertilized with 500 kg N ha<sup>-1</sup> + 200 kg P ha<sup>-1</sup> (Bennett et al. 2004), and local salal harvesters actively seek out fertilized sites because they find it to be good salal habitat. However, it is unknown if fertilization increases salal productivity because of enhanced nutrition, or because it increases shade sooner in a rotation through faster conifer canopy development. Biological salal productivity (measured as salal foliar biomass) in the area is proportional ( $r = -0.86$ ) to conifer canopy cover (measured with a densiometer), regardless of silvicultural treatment (Bennett et al. 2003), and this suggests that salal harvesters may be benefiting from an earlier “window of opportunity” for picking, rather than increased site productivity *per se*. However, caution must be used when assuming that biological productivity is proportional to commercial productivity for any species: it may not necessarily be.

Experiments have shown that fertilization affects **balsam fir** (*Abies balsamea*) foliage, but there is little benefit to the bough sector because, unlike salal, there is enough resource available of commercial quality. Furthermore, there is not enough financial return on improved tree

<sup>41</sup> See also <http://www.forestry.ubc.ca/schirp/homepage.html> and publications listed on this site at <http://www.forestry.ubc.ca/schirp/reports.htm> and <http://www.forestry.ubc.ca/schirp/publications.htm>

growth to warrant fertilization from a timber point of view, unlike the situation with salal on northern Vancouver Island.

**6.8 Pruning:** There are two main NTFP tree products obtained by pruning: (i) swags for floral greenery (Christmas decoration made from complete boughs, rather than tips of boughs), and (ii) boughs as a raw resource for essential oil extraction. In both cases, bough harvesters can carry out a desirable silvicultural treatment by applying proper pruning techniques, and will normally do so at no cost to the forest company or landowner, simply for access to the resource. Swags are typically made from boughs from pine trees, including **red pine** (*Pinus resinosa*), **western white pine** (*Pinus monticola*), and **eastern white pine** (*Pinus strobus*). In the case of white pines, pruning is also one of the only silvicultural treatments that can be used against blister rust<sup>42</sup>. Pruning for essential oils (e.g., **western redcedar**: *Thuja plicata*, **eastern white cedar**: *Thuja occidentalis*) can also result in free silvicultural treatment for forest managers.

In the PNW, **salal** (*Gaultheria shallon*) pickers will sometimes prune trees for free, if they have a long-term lease on secure land and can therefore benefit from the practice. As commercial-quality salal is found in semi-shade, it is often best closer to tree trunks in young plantations, and hence can be intertwined in low branches. Pruning is carried out in one forest on Vancouver Island, BC, to increase the accessibility to this salal, to improve light conditions for salal growth, and to reduce the potential danger to pickers of facial and eye injuries from tree branches<sup>43</sup>.

In all cases, bough and salal harvesters carry out pruning for commercial reasons, and are constrained by logistics and considerations (e.g., commercial quality of products) that are different than those for traditional silvicultural workers. As a result, pruning may not be carried out at a stand level, as an operational silvicultural treatment would be. (The advantage is that the treatment is free; the disadvantage is that it may not be as complete as a forest manager might hope for.)

Finally, although “tipping” balsam fir and other conifers for wreaths and greenery is not pruning (because pickers leave enough of a branch so that it can regenerate for future picking), it is considered compatible with forest management in that there is no measurable decrease in tree growth, at least in one study in NB. This is likely because sustainable tipping removes a small proportion of the total tree foliage, with minimal impacts on overall photosynthesis.

**6.9 Pre-commercial thinning:** This treatment has an impact on NTFP species mainly by increasing the light regime on the forest floor, and slowing down successional changes in the understory species. Thinning can therefore increase the time over which an NTFP species is present and suitable for commercial harvesting, while at the same time accelerating production of large diameter trees (Harrington et al. 2002<sup>44</sup>)

In Quebec, some pre-commercial thinning is carried out to promote healthy, vigorous growth of **sugar maple** (*Acer saccharum*), sometimes including thinning of the understory and

<sup>42</sup> See more on blister rust at [http://www.na.fs.fed.us/spfo/pubs/howtos/ht\\_white/white.htm](http://www.na.fs.fed.us/spfo/pubs/howtos/ht_white/white.htm)

<sup>43</sup> One case is known of a salal picker blinded in one eye from a branch; some pickers wear sports safety glasses, for protection.

<sup>44</sup> See also figures for number of species present and percent cover of species present after variable density thinning in western WA in Harrington et al. (2002).

of canopy non-crop trees. This will stimulate **ground hemlock** (*Taxus canadensis*), if present. Pre-commercial thinning of small diameter trees of a number of different species is also carried for use in rustic furniture<sup>45</sup>. In Minnesota, walking sticks (~250,000 yr<sup>-1</sup>) are made from small stems of **aspen** (*Populus* spp.), thus contributing to pre-commercial thinning. In one forest in BC, salal pickers with a long-term lease from the forest company are willing to pre-commercial thin stands, if forest workers first mark trees for thinning.

Again, treatments applied by NTFP harvesters may not be at a stand level. However, the advantage is that they are carried out for free.

**6.10 Commercial thinning:** As with pre-commercial thinning, this treatment mainly benefits NTFP species that require more light than is found under a closed forest canopy. Although usually carried out with specific timber management objectives, some commercial thinning was recently carried out in Mt. Hood National Forest with the specific objective of enhancing **big huck** (*Vaccinium membranaceum*) productivity. Commercial salal harvesting at the Shawnigan Lake Levels-of-Growing Stock (LOGS)<sup>46</sup> Cooperative Thinning Trial, in BC, also clearly showed the beneficial impacts of thinning on commercial **salal** (*Gaultheria shallon*) productivity.

In one study in a 50-year-old **Douglas-fir** (*Pseudotsuga menziesii*) stand in OR, **chanterelle** (*Cantharellus* spp.) mushroom numbers and biomass were reduced in the four years immediately following commercial thinning in the order control > light thin > heavy thin<sup>47</sup>. Along with the work of Kranabetter and Kroeger (2001) discussed above in Section 6.2.3, it is reasonable to infer that multiple light thinnings may be preferable to one heavy thinning. However, increased soil compaction may negatively affect mushroom productivity (Amaranthus et al. 1996) and reducing compaction through judicious choice of felling and extraction techniques is recommended<sup>48</sup>.

**6.11 Synergies through multiple treatments:** Synergies are possible though applying multiple treatments to benefit a number of NTFP species and timber. For example, an experiment has recently been established (Weigand 1998, Amaranthus et al. 1998) to use gaps (uneven-age management), thinning and pruning (for blister rust protection) for timber, mushrooms, Christmas trees, boughs, pine cones and prince's pine on high elevation sites (1675-1750 m) in Oregon. The overall objective is to cushion uncertainty in tree regeneration, and generate income early in the rotation to finance costs for augmenting stand productivity. The plan calls for annual **matsutake (pine; Tricholoma magnivelare)** mushroom harvesting, annual harvesting of **prince's pine** (*Chimaphila umbellata*), collection of **cone** crops annually up to every three years (because western white pine produces large cone crop about one in three years), **bough** harvesting every three years, **Christmas tree** harvesting every 10 years, and partial **timber** cuts every 25-50 years.

<sup>45</sup> E.g., see <http://www.appalachiandesigns.com/catalog.htm>

<sup>46</sup> See [http://www.pfc.forestry.ca/silviculture/logs/about\\_e.html](http://www.pfc.forestry.ca/silviculture/logs/about_e.html) for more information on the LOGS Cooperative.

<sup>47</sup> See study poster at <http://www.fsl.orst.edu/mycology/youngstndthin/Yss.html>

<sup>48</sup> See also <http://bcmushrooms.forrex.org/ntfp/pages/sustainableharvest.html>

On northern Vancouver Island, BC, **western redcedar** (*Thuja plicata*) boughs are harvested from young plantations for oil extraction, and this improves the quality of and access to **salal** (*Gaultheria shallon*) under individual trees. While the effect of fertilization on redcedar oils is unknown, salal productivity appears to increase. Through further pruning as the redcedar grows, salal productivity may be maintained for longer if more light reaches the forest floor. If outplanting of oil-rich genotypes of cedar takes place for deer browse protection, the local oil extraction industry will also benefit. While the economics of these synergies are unknown, the potential for managing for multiple resources with several different silvicultural treatments exists on these sites.

## 7. Conclusions

Before embarking on *compatible management* for timber and non-timber values, a forest manager should first consider:

- There may only be a small financial return from permits or leases for NTFP harvesters because NTFP harvesters themselves usually only make a modest income;
- Returns from compatible management may only subsidize rather than pay for silvicultural costs;
- However, small financial returns from NTFPs are often made well before revenue from timber harvesting, and can therefore be highly advantageous;
- NTFP harvesters may carry out some free silvicultural treatments, but only in a limited number of cases, and likely not at a stand level;
- There may be benefits to compatible management on private land if a company's seasonal workforce can also harvest NTFPs in the "off season";
- Small private landowners who harvests NTFPs themselves may see the most financial benefit from compatible management;
- The biggest benefits to larger companies may be more intangible: stability of rural communities, wider social sustainability, better acceptance of forest industry, certification, adherence to C&I, demonstration of commitment to SFM, practical movement closer to objective of managing forests as ecosystems.

Before embarking on *active compatible management*, immediate and relatively easily implemented considerations that could increase the value of NTFPs to harvesters include:

- Secure gates and long-term leases so that NTFP harvesters benefit from their own stewardship of the NTFP resource;
- Availability of maps (road networks, forest inventory, ecological classification) and aerial photographs to NTFP harvesters;
- Communication of timing of forest management practices that might have an impact on NTFP resources.

Practical steps towards implementing compatible management include:

- Familiarization with local NTFP harvesters and buyers to understand commercial quality of plant species, local knowledge of habitat and impacts of forest management on NTFP resource;
- Familiarization with the ecology of NTFP species;

- Establish good communication with NTFP harvesters: many compatible opportunities require coordination of timing, communication of forest management plans, understanding of timing of NTFP harvester needs;
- Training of NTFP harvesters in proper silvicultural techniques (e.g., pruning and thinning), if applicable.

Overall, the wide range of examples of compatible management that we have found across Canada and the US suggests that there are many imaginative ways that NTFP values can be increased within our forests as part of forest management; that some of these ways will also increase the value of our forest timber products; and that some will help forest managers realize financial returns early in a rotation. The next decade promises to be an exciting one, as NTFP considerations increasingly become a part of main-stream sustainable forest management.

## 8. Acknowledgements

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