LAND MANAGEMENT HANDBOOK

64

Compatible Management of Timber and Pine Mushrooms

2010

British Columbia
The Best Place on Earth

Ministry of Forests and Range
Forest Science Program

Royal Roads
University

Centre for Non-Timber Resources

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Shannon M. Berch and J. Marty Kranabetter

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FOREWORD

The British Columbia Inter-agency Non-timber Forest Resources (IANTFR) Committee was established in January 2006 to facilitate a co-ordinated approach to non-timber forest resource management in the province. The Ministry of Forests and Range and Ministry of Agriculture and Lands co-chair the IANTFR Committee. Other government partners include or have included what are now the Ministry of Small Business, Technology and Economic Development, the Ministry of Aboriginal Relations and Reconciliation, and the Ministry of Community and Rural Development (names of some Ministries have changed since 2006). Representatives from the First Nations Forestry Council and the First Nations Mountain Pine Beetle Initiative have participated in committee meetings. The Centre for Non-Timber Resources at Royal Roads University provides expert advice and support services to the Committee. The Ministry of Forest and Range also contributes to the Committee by providing staff time and expertise, and resources to produce publications.

The goals of the Committee are (1) to improve communication and co-ordination across the provincial government, and (2) to advise government on issues related to non-timber forest resource management in British Columbia. The IANTFR Committee members have produced a communication strategy that includes the production of publications designed to improve awareness about non-timber forest resources so that they are managed appropriately.

A series of Land Management Handbooks on this theme are being co-published by the Ministry of Forests and Range and the Centre for Non-Timber Resources at Royal Roads University:

- **Understanding Non-timber Forest Products Activity on the Land Base** by Gerrard Olivotto (LMH 62)
- **Non-timber Forest Products, Tourism, and Small-scale Forestry: Income Opportunities and Constraints** by Darcy Mitchell (LMH 63)
- **Compatible Management of Timber and Pine Mushrooms** by Shannon Berch and Marty Kranabetter (LMH 64)
- **Non-timber Forest Product Development in British Columbia's Community Forests and Small Woodlands: Constraints and Potential Solutions** by Emily Jane Davis
- **Managed Access to Non-timber Forest Products on Private Land and Eligible Tenures** by Wendy Cocksedge, Emily Keller, Art Mercer, and Grace Wang
- **Creating a Regional Profile for Non-timber Forest Products** by Wendy Cocksedge, Tom Hobby, Kathi Zimmerman, Dan Adamson, Russell Collier, and Emily Keller
- **What about the Berries? Managing for Understorey Species** by Wendy Cocksedge and Michael Keefer

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1 INTRODUCTION

Compatible management is the practice of managing forests for both timber and non-timber values, including non-timber forest products (Titus et al. 2004). This series of guidebooks developed out of a survey conducted in 2006, in which a wide range of participants in the forestry sector provided their views on the opportunities for, and barriers to, compatible management (Cocksedge et al., [2010]). Incorporating non-timber forest products within forest management can provide social, ecological, and financial benefits for land managers and surrounding communities and ecosystems. The purpose of the guidebook series is to provide a concise overview of the key issues and concerns for each topic, and to suggest resources that can help forest managers overcome some of the barriers to the compatible management they have identified.

To manage two or more forest resources on a specific land base, reliable inventories of each resource must be available. Although pine mushrooms are an important and highly sought-after forest resource, unlike other forest resources, there are no provincial standards or collection of inventory for this species.

The purpose of this guide is to describe the scientific and technical approach to understanding pine mushroom habitat and the compatible management of pine mushrooms and timber. To actually implement compatible management also takes integration of social, economic, and other ecological values, which are beyond the scope of this paper. However, a well-designed harvest plan as presented in this report should allow for both timber and pine mushrooms with little impact on timber supply.

1.1 Who should read this guide?

Landowners
Private lands, including settled treaty claims, are an ideal place to consider managing for pine mushrooms and timber on the same land base.

Forest managers
On forested lands in many parts of British Columbia, pine mushrooms are an important non-timber forest product that provides commercial and recreational opportunities for local residents, itinerant pickers, and eco-tourists.

1.2 Contents of this guide

This guide includes:

- a basic description of the ecology, distribution, and habitat of pine mushrooms in British Columbia;
- four steps toward compatible management of pine mushrooms and timber;
- some recommendations for longer term management decisions to retain pine mushroom production in British Columbia; and
- a list of references relevant to the compatible management of pine mushrooms and timber.

2 WHY UNDERTAKE COMPATIBLE MANAGEMENT OF TIMBER AND PINE MUSHROOMS?

Pine mushrooms are an important non-timber forest resource in certain locations in British Columbia, contributing cash to communities and thereby improving their sustainability. However, because this mushroom is associated with living trees, timber harvesting reduces pine mushroom production for many decades until mature forest conditions are re-established. Mapping the most productive pine mushroom areas on the timber land base can allow the development of logging plans that accommodate the continued production of pine mushrooms. In areas of the province that have a history of commercial picking, pine mushroom picking ground ranges from as low as 5 to 20% of the forested area and tends to be on poorer sites that are not the most productive for timber. Therefore, compatible management of timber and pine mushrooms should be a win/win situation for both timber and pine mushroom harvesters.

2.1 Economic value of pine mushrooms

Shipments of pine mushrooms for all of British Columbia to Japan, the primary market, range from 200,000 to 600,000 kilograms per year, with an average annual total sale of approximately 350,000 kilograms (CNTR 2006). Annual production varies with climatic factors such as precipitation and also with the prices paid to pickers. Export values of pine mushrooms from British Columbia are estimated to be from CDN $8 to 42 million per year.

2.2 Ecology, distribution, and habitat of pine mushrooms in British Columbia

The pine mushroom (*Tricholoma magnivelare* [Peck] Redhead) is an ectomycorrhizal fungus that fruits in association with mature, living trees. It occurs naturally in western North America. In British Columbia, recent research has determined that pine mushrooms occur most productively in xeric to submesic (rarely mesic) ecosystems on nutritionally poor to moderate sites with well-drained, coarse-textured soil in mature forests (about 80–120+ years old) dominated by western hemlock (*Tsuga heterophylla*), Douglas-fir (*Pseudotsuga menziesii*), or lodgepole pine (*Pinus contorta*) (see Figure 1) (Trowbridge et al. 1999; Berch and Wiensczyk 2001; Kranabetter et al. 2002; Bravi and Chapman 2003, 2006; Vaughan and Chapman 2003; Trowbridge 2005; Ehlers et al. 2007). Pine mushrooms certainly occur in other ecosystems, such as the Coastal Douglas-fir (CDF) zone, but usually in smaller amounts that are not commercially harvested.

Using site information collected during fieldwork in commercially or recreationally harvested productive pine mushroom forests throughout the province and the biogeoclimatic ecosystem classification (BEC) information generated from this fieldwork, it is possible to map the occurrence of productive pine mushroom habitat in the province (Appendix 1).

To date, productive pine mushroom habitat in British Columbia has been described in specific site types in the following BEC zones: Coastal Western Hemlock (CWH), Engelmann Spruce–Subalpine Fir (ESSF), Interior Cedar–Hemlock (ICH), Interior Douglas-fir (IDF), Sub-Boreal Pine–Spruce (SBPS), and Montane Spruce (MS) (Appendix 2). At the local level, pine mushroom habitat can be located and mapped using information from local harvesters, ground surveys, and published reports.

FIGURE 1 *A typical submesic forest associated with pine mushroom harvests from the Interior Cedar–Hemlock zone near Terrace, B.C.*

Overview of the four steps for the landowner or land manager to follow

1. Map productive pine mushroom habitat using information from local harvesters, published information, and directed fieldwork. It is important to prioritize each identified area of interest based on ease of access, terrain, and productivity. Local information, such as whether the sites are easily accessible and flat and therefore likely to be harvested by children and elders, should also be taken ino account.
2. Identify where proposed timber harvesting and pine mushroom harvesting overlap.
3. Develop a management plan that balances the many values (e.g., ecological, economic, social, and cultural), and uses the best scientific and technical information available to design appropriate silvicultural systems for the land base. Because there has been no research on the best silvicultural systems for maintaining pine mushroom productivity, expert knowledge will play a major role in system design.
4. Monitor, over time, the effects of the timber harvesting on pine mushroom production. There can be no claim of compatible management of these two resources if the resulting impacts on the productivity of both resources are not carefully assessed.

3.1 **Step 1** Map high-value pine mushroom habitat

3.1.1 Gather information

Initial selection of the areas of interest will be based on any available published information that is relevant to those areas (Appendix 1), on expert advice from local pickers, and on preliminary ground surveys of productive pine mushroom forests under the guidance of local pickers. Pickers may be protective of their expert knowledge, so it is essential to build relationships of trust with them before they may agree to participate. Advice on how to establish trust would be as varied as the individuals involved. Ultimately, it is important that there be ongoing communication, transparency, and a clear understanding about the potential risks and benefits of sharing information. Many pickers will be willing to share information if they understand how it will, and will not, be used. Be open to suggestions on how to maximize the privacy and security of the information.

Before the fieldwork, the landscape should be stratified into local physiographic features so that the fieldwork can efficiently sample a reasonable subset of the existing strata of interest. In general, sites of interest will be xeric to submesic ecosystems with pine, hemlock, or Douglas-fir; drier and poorer than average soil moisture and nutrient regimes; moisture-shedding attributes; rapidly to very rapidly drained, coarse textured and/or shallow soils, and mature forests.

3.1.2 Do ground surveys

Ground surveys along transects through the forest of interest can be used to systematically locate and reference pine mushroom patches. Without expert local knowledge, these surveys will have to be done during pine mushroom fruiting season, which may commence in August in the north and September or October in the south and on the coast. Mushroom productivity varies tremendously from year to year, and in a bad year, no mushrooms may be evident. The surveys will then have to be repeated in subsequent years. Pine mushroom patches can be marked with flagging tape, referenced with GPS or relative to the nearest transect, and later located on maps.

Habitat characteristics of identified pine mushroom harvesting sites can be described in the absence of pine mushrooms if trusted, local, expert knowledge can be obtained on precisely where the pine mushroom fruits. However, it is certainly important at some point to confirm that pine mushrooms are produced in the identified sites.

3.1.3 Describe habitat characteristics

Habitat characteristics of pine mushroom patches should be described in detail. The plot centre should be established in the middle of a pine mushroom patch. Site, vegetation, and soil characteristics should be described following procedures outlined in the *Field Manual for Describing Terrestrial Ecosystems* (British Columbia Ministry of Environment, Lands and Parks and British Columbia Ministry of Forests 1998). Biogeoclimatic site series should be classified using the appropriate regional field guide, located at www.for.gov.bc.ca/hre/becweb/resources/classificationreports/regional/index.html.

Site indices should be estimated based on height-age models (site index curves) using the SiteTools software, located at www.for.gov.bc.ca/hre/sitetool/. For some plots, a soil pit should be excavated next to a pine mushroom to a depth of 60 cm, and where possible, organic and mineral soil horizons characterized (British Columbia Ministry of Environment, Lands and Parks and British Columbia Ministry of Forests 1998). A modified Ground Inspection Form (GIF) could be used instead of the more detailed Ecosystem Field Forms (FS882) as long as the complete set of relevant site, vegetation, and soil information is collected.

Use the information collected to define the site, vegetation, and soil characteristics of productive pine mushroom habitat specific to your area. Mark these locations on airphotos (by GPS or nearby landmarks) to compare with the surrounding landscape and characterize the photo signature for these drier pine mushroom ecosystems. An example of a photosignature is "upper slope to crest positions with smaller tree crowns occurring close together, appearing as a smooth, even texture on the air photograph" (Kranabetter et al. 2002).

Map the mushroom habitat throughout the landscape using the photosignature (Figure 2), and ground check a subset of polygons to ensure that the ecosystem identity is consistent and correct (xeric to submesic). This is also why having localized BEC and site information from Step 1 is useful as it allows better quality ground-truthing of habitat maps. Depending on the experience of the mapper, the process can be iterative (draw polygons, ground-truth, redraw polygons).

3.2 Step 2 Determine areas of overlap with timber harvest

Have the polygons digitized to produce GIS map files for operational planning, including timber supply analysis, road layout, and old-growth management areas. Overlaying the polygons on forest cover can also give useful data on the distribution of stand ages across the mushroom habitat.

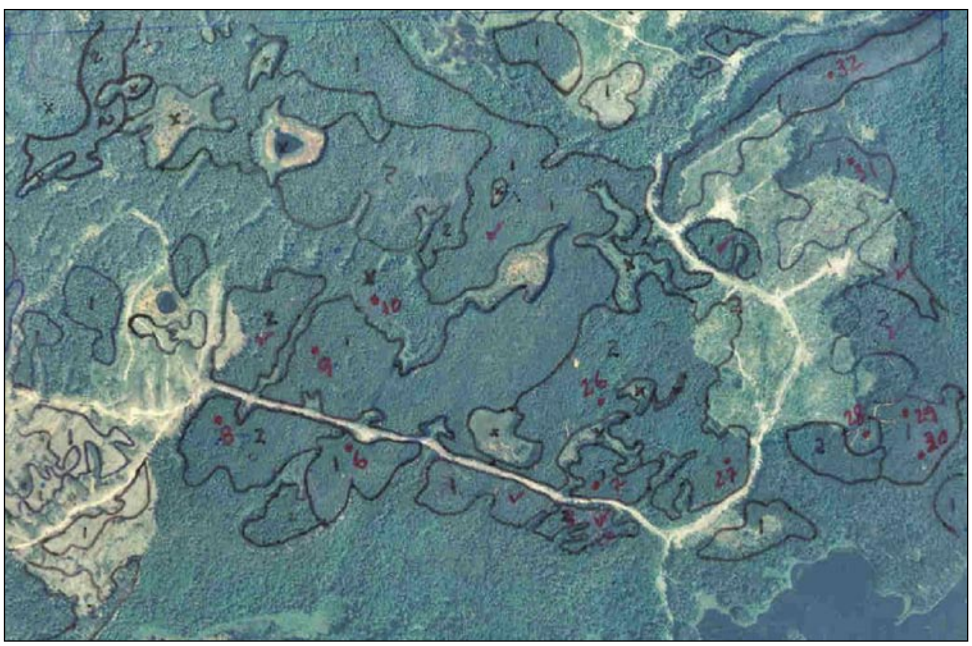

FIGURE 2 *An example of submesic forests identified from an aerial photograph through the use of crown characteristics and surface topography (provided by Rick Trowbridge, Boreal Research, Smithers, B.C.).*

3.3 **Step 3** Implement or develop a compatible management plan

In some communities, the management objectives for pine mushrooms have been defined in the Land and Resource Management Plan. Once a good habitat map has been produced, the industry and public can consider the numbers (how much habitat is there? how accessible? what age classes?) and come to an agreement as to how the land will be managed.

Research results on the compatible management of timber and pine mushrooms are not available. Therefore, management recommendations will have to be based on first principles from the literature and expert knowledge from field observations. What is known is that the pine mushroom fruits most abundantly in mature forests (about 80–120+ years old) dominated by western hemlock, Douglas-fir, or lodgepole pine, depending on the location in the province. It is also known that the pine mushroom fruits in association with living trees and not in clearcuts.

3.3.1 Compatible management at the stand level

If compatible management is being planned at the stand level and the goal for the short-term is *to retain pine mushroom fruiting while removing some timber*, then pine mushroom patches must not be clearcut. After the pine mushroom patches are mapped on site, then timber can be harvested around the patches, leaving a tree-length buffer. Productive pine mushroom patches often occur on sites that are poor in moisture and nutrients. At the landscape scale, this may permit timber harvesting to be focussed on more productive timber sites and pine mushroom production on the poorer timber sites.

The resulting microclimate changes in the retained patch may still impact mushroom fruiting. Anecdotally, pine mushrooms have been observed to fruit abundantly on stand edges, so a small amount of disturbance may not be overly detrimental. With enough buffers around the patches, changes to microclimate and moisture conditions can be minimized.

If the goal is *to retain some pine mushroom fruiting while removing more timber,* then some type of selective timber harvesting or alternative silvicultural system is recommended as long as soil disturbance is kept to a minimum. Some of the most popular commercially productive pine mushroom sites in the West Kootenay are in stands that have a history of selective logging. Various methods to consider are:

a) **Removal of non-host tree species**
If the stand is composed of host tree species (western hemlock, Douglas-fir, or lodgepole pine) and non-host tree species (such as western redcedar, yellow-cedar, maple, alder, and aspen), then the non-host trees could be removed selectively.

b) **Strip harvesting**
Harvesting timber in strips that run through the pine mushroom patch should retain the fungus on site on the roots of mature host trees in the uncut strips but may decrease fruiting for an extended period.

c) **Retention of single or small patches of host green trees**
At the far extreme, retaining single or small patches of host green trees in pine mushroom-producing sites may ensure that the fungus is retained on site and may colonize the new crop of host trees, but fruiting is likely to be eliminated until the stand around the retained green trees matures.

3.3.2 Compatible management at the landscape level

Even the complete cessation of timber harvesting in pine mushroom areas would probably not preserve mushroom production over the long term. Stands age and conditions change. Given this, it will be necessary to plan for compatible management at the landscape level and for the long term by retaining pine mushroom patches near younger stands with potential to become colonized. Some of the factors to consider are:

a) **Effect of fire**
In the Nass Valley, productive pine mushroom patches occur in even-aged forests of fire origin. This indicates that the pine mushroom is able to become established in forests regenerating after most host trees have been killed. Pine mushrooms form spores that are aerially dispersed, and it may be that these spores, originating from unburned pine mushroom stands close by, are able to establish new colonies in the developing forest. New colonies might also form in developing forests by below-ground migration from the established stand. Anecdotal evidence from the Kootenays and Squamish areas suggests that pine mushrooms may fruit in association with "vets," old trees that escaped decades-earlier forest fire.

This evidence may mean that green tree retention of host trees within pine mushroom patches retains the fungus on site.

b) **Effect of harvest rotation timing**
Regardless of how and when the fungus becomes established, fruiting does not occur abundantly until the forest is about 80 years old. Therefore, to retain pine mushroom harvesting on the landscape, it must have a mix of mature stands producing pine mushrooms and adjacent stands susceptible to colonization and eventual production. Extended rotation length (perhaps to 120–160 years) would likely permit pine mushroom production and harvesting for many decades.

c) **Effect of pine beetle**
In the West Chilcotin, lodgepole pine is under attack from the mountain pine beetle. If the eradication of lodgepole pine from productive pine mushroom stands in the Interior of British Columbia is complete, then the re-establishment of pine mushroom production in the new forest will be delayed until after spores arrive from surviving stands and establish new colonies. When possible, retaining Douglas-fir or western hemlock, which are also host trees for pine mushrooms, on beetle-attacked sites will help retain pine mushroom production on-site and in the landscape, and will help attacked sites recover some production more quickly.

3.4 **Step 4** Monitor the results of the harvesting activity

Monitoring is essential to the success of compatible management or any other type of adaptive management, but monitoring can be expensive. If a trusting relationship has been developed with local pickers, they can provide anecdotal information to the manager on pine mushroom productivity following timber harvesting. Sound research to determine the best approaches to compatible management is needed. Where sufficient resources are available, studies of pine mushroom productivity after timber harvesting should be considered. Such studies are technically feasible, and would contribute greatly to the information needed for the improvement of compatible management efforts.

4 CONCLUSIONS AND RECOMMENDATIONS

It is possible to describe and map habitat for productive pine mushroom sites and integrate this information with timber harvesting plans to retain the harvest of both resources in the same land base. In historical commercial picking areas, approximately 5–20% of the forested land is comprised of mushroom picking ground; therefore, these areas provide a win/win situation for both timber and pine mushroom harvesters.

Productive pine mushroom patches occur on sites that are poor in moisture and nutrients, which may allow timber harvesting to be focussed on more productive timber sites and pine mushroom production on poorer timber sites.

In the parts of the province where productive habitat exists for pine mushrooms, compatible management of timber and pine mushrooms is possible. In the short term, harvesting timber in productive pine mushroom habitat reduces or eliminates fruiting of the mushroom, depending on the type of timber harvesting system used, until the new stand reaches maturity. It is possible to retain mushroom production in the short term by logging around productive pine mushroom habitat or minimizing the removal of host trees through alternative silvicultural systems.

The productive pine mushroom habitat that has been described in British Columbia occurs in mature coniferous forests. Forest fire has been the main natural disturbance agent in pine mushroom habitat. Over time, the pine mushroom and all other species have shifted on the landscape in response to disturbance and stand aging. Conserving important pine mushroom harvesting areas from timber harvesting will retain mushroom production for some period of time, but old forests cannot be protected forever as they will eventually succumb to disturbance. Maintaining a younger cohort with extended rotations over the long term would help ensure a good proportion of mature timber age classes on the landscape and the potential for significant pine mushroom production.

It is not known whether timber harvesting will create site conditions similar enough to forest fire to permit pine mushrooms to again occupy the site and fruit in harvestable amounts once the trees have reached maturity. The outcome of compatible management of pine mushrooms and timber requires monitoring to determine whether the specific strategy selected works.

The retention of pine mushrooms on the landscape and the potential for their harvest in the longer term requires that sites with suitable conditions for the growth of pine mushrooms cycle through age classes. Some of the most lucrative mushroom harvests in the province are found in predominantly mature stands (approx. 160 years), but commercial picking still occurs through the oldest forests (250–400 years).

In Asia, the production of matsutake (their pine mushroom equivalent) is intensively managed at the stand level through the use of various silvicultural techniques (e.g., thinning and organic litter removal) and agricultural techniques (e.g., irrigation and protection of the developing mushroom) (Berch et al. 2007). In areas of British Columbia with secure tenure and some control over the mushroom harvesters, such as private and First Nations treaty lands, the application of similar techniques might result in improved quality and quantity of pine mushrooms.

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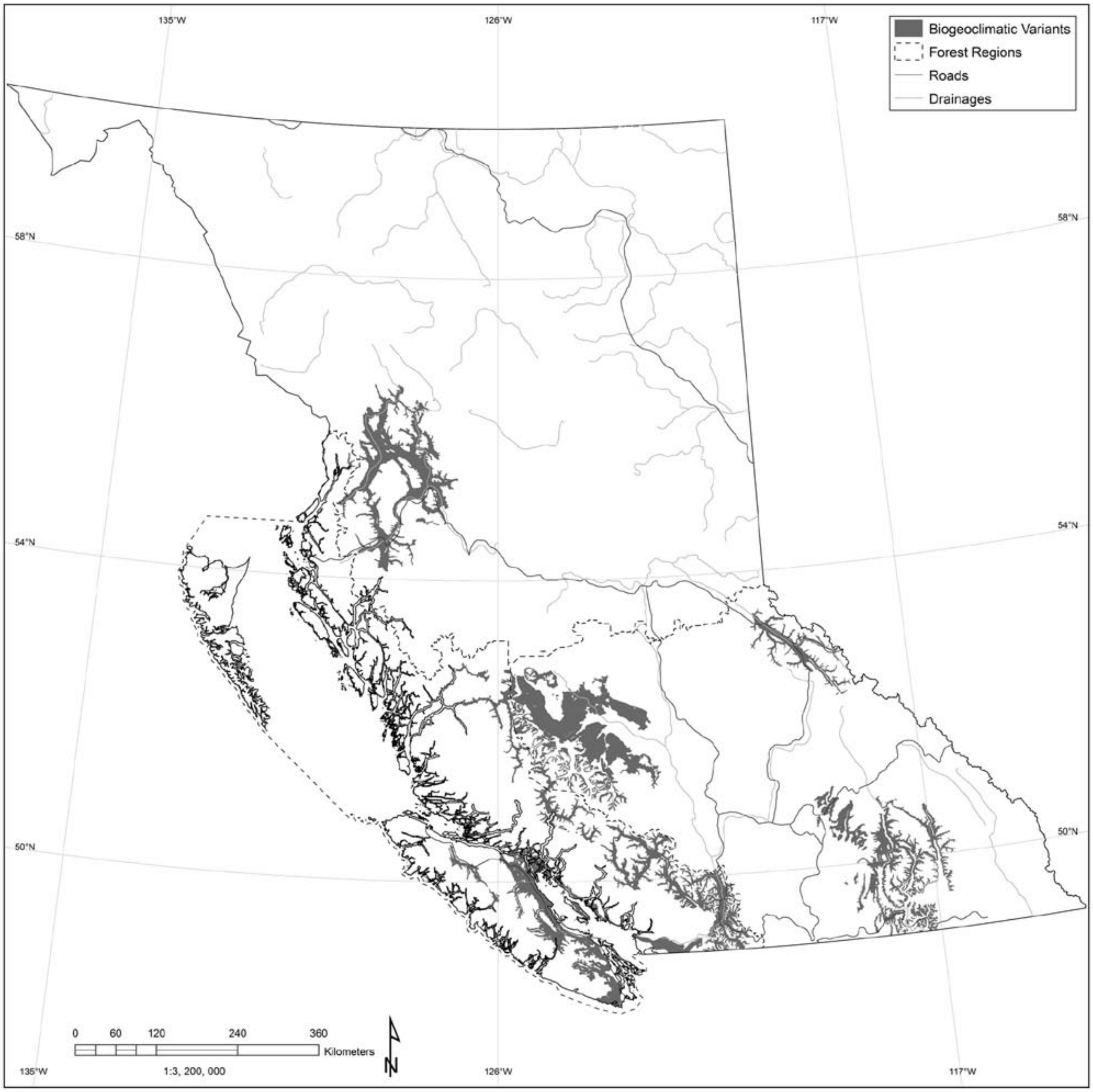
APPENDIX 1 Ecosystems of British Columbia (Biogeoclimatic Variants) Where Commercial Picking of Pine Mushroom has Occurred

The grey areas show productive pine mushroom habitat based on biogeoclimatic (BEC) information from Appendix 2. BEC zone and subzone descriptions can be found at www.for.gov.bc.ca./hre//becweb/resources/classificationreports/subzones/index.html



APPENDIX 2 Attributes of Commercially Productive Pine Mushroom Stands in British Columbia

Geographic region	BEC information [a]	Tree species [b]	Stand condition	Key soil attributes [c]	Reference
Hazelton, Kispiox, Cranberry-Meziadin, and Terrace areas	ICH mc1/01 submesic, poor ICHmc2/01 submesic, poor CWHws1/03 subxeric–submesic, poor	Hw (Pl, Ep) Hw (Pl, Cw, Ep, Sx) Hw, Pl (Cw, Ep)	Some stands were even-aged; others had veterans mixed with younger trees (70–)80–160(–230) years	SL–LS rapidly well drained SL, LS, L, rapidly well drained LS, SL very rapidly well drained	Trowbridge et al. 1999 Kranabetter et al. 2002
Nass Valley	ICHmc2/01 subxeric–submesic, poor	Pl or Pl, Hw	Maturing seral succession	SL, LS, S 20–80% coarse fragments rapidly well drained	Berch and Wiensczyk 2001
Chilcotin	SBPSxc/02 ESSFxv1/02 subxeric–submesic, poor	Pl	–	S, LS 0–65% coarse fragments rapidly well drained	Berch and Wiensczyk 2001
West Chilcotin	SBPS ESSF MS IDF subxeric, submesic, mesic	Pl at higher elevation Fd or Pl, Fd at lower elevation	Poor condition with high proportion of snags, dwarf mistle-toe, small crowns (70)–120–160–(240) years	coarse to very coarse texture	Bravi and Chapman 2006 Bravi and Chapman 2003
Bella Coola	IDFww/03 CWHds2/01 subxeric–submesic, poor–medium	Fd or Pl, Fd	–	LS, S, SL 0–65% coarse frag-ments well drained	Berch and Wiensczyk 2001
Nahatlatch Valley	IDFww/01, CWHds1/03, CWHms1/03 submesic–mesic, me-dium	Fd (Cw, Pl) or Pl, Fd, or Fd	–	SL, S, LS 35–60% coarse frag-ments	Berch and Wiensczyk 2001
Nahatlatch Valley	IDFww, CWHms, CWHds xeric–subxeric, very poor–medium	Fd, Pl, Pw	61–250 years Younger stands with vets	shallow and coarse textured	Freeman 1997
Pemberton	CWHww/01 IDFww/01 submesic, medium	Hw (Cw) or Fd (Cw, Hw) or Fd	–	SL, LS	Berch and Wiensczyk 2001
West Kootenays	ICHmw2/01 subxeric to mesic, and was mostly submesic poor	Hw or Fd	100–140 years	high sand content well to rapidly drained	Ehlers et al. 2007
Nakusp	ICHmw2/01 xeric–subxeric poor–medium	Hw, Fd (Cw) or Fd, Cw (Hw) or Hw (Pa, Cw)	Average age of domi-nant and co-domi-nant trees is 110 years	SiL, SL, LS	Berch and Wiensczyk 2001

a Biogeoclimatic ecosystem classification (BEC) zone and subzone descriptions can be found at www.for.gov.bc.ca/hre/becweb/resources/classificationreports/subzones/index.html

b Cw = western redcedar; Ep = paper birch; Fd = Douglas-fir; Hw = western hemlock; Pa =whitebark pine; Pl = lodgepole pine; Pw = western white pine; Sx = spruce hybrid

c L = loam; LS = loamy sand; S = sand; SiL = silty loam; SL = sandy loam