Babine Watershed Monitoring Trust
Non-Timber Forest Resources, Project 2011-1

April 15th, 2012

1. Introduction

The Babine Watershed Monitoring Trust (BWMT) prioritizes and independently funds the monitoring of government-approved land-use plans in the Babine Watershed. The monitoring aims to ensure that resource management strategies are successful at achieving publicly defined objectives (BWMT, 2010). The Trust's Monitoring Framework facilitates the identification of monitoring priorities based on the level of risk or uncertainty around a given objective – thus the focus has been management of riparian ecosystems, fish, and grizzly bear habitat. This is the first time that the monitoring framework has taken a closer look at management of non-timber forest products – namely pine mushrooms and black huckleberries.

To help reduce the level of uncertainty around the management of pine mushroom and black huckleberry habitat, in 2011 the Trust made it a high priority to obtain indicator data for these species. The objective of this project was to identify and summarize existing information that could be used to assess the current state of high value pine mushroom and huckleberry areas in the Kispiox portion of the Babine Watershed including: existing mapping of mushroom areas, predictive ecosystem mapping (PEM), vegetation resources inventory (VRI) data, vegetation plots, and information from First Nations on berry gathering areas. The report also makes recommendations for further modeling of black huckleberry habitat capability for the Babine Watershed.

2. Land-Use Objective Context

The Kispiox LRMP (1996) includes the goal: "*to maintain and use botanical forest products by taking these non-timber resources into consideration at the landscape and operational levels of planning*". The West Babine SRMP (2004) is an ecosystem-based management plan intended to implement the objectives of the Kispiox LRMP and the Babine Local Resource Use Plan (LRUP) through adaptive management. Management direction for **pine mushrooms** within the West Babine SRMP (2004) includes the objective: "*to maintain high-value pine mushroom sites through time*". The target on which to measure the success of achieving this objective is: "*to maintain greater than 60% of the 01b sites series phase of the ICHmc1 and ICHmc2 biogeoclimatic subzone variants greater than 80 years of age. Partial-cut stands with greater than 50% retention would be considered to have a stand age of greater than 80 years*."

Management direction for **black huckleberries** within the West Babine SRMP includes the objective: "*to maintain and enhance berry productivity within berry management areas, as mapped by the Gitx̱san*". Where timber harvesting occurs in berry management areas, strategies are to be applied to "*remove sufficient forest cover to provide at least 60% exposure to sunlight, and to minimize disturbance of soils and vegetation*". The SRMP also recommends that: "*appropriate cultural and silvicultural practices be applied to enhance berry productivity, such as prescribed low-intensity burning, within management areas*".

3. Amount And Condition Of Pine Mushroom Habitat

3.1 Attributes of Pine Mushroom Habitat

The pine mushroom (Tricholoma magnivelaire) is an ectomycorrhizal species with very specific site requirements. The occurrence of pine mushrooms is tightly correlated with the 01b biogeoclimatic site series in the Interior Cedar Hemlock moist cool (ICHmc) subzone (Kranabetter et al. 2000). The 01b site series phase reflects drier and poorer soil moisture and nutrient regimes than average for these ICH subzone variants (Banner et al. 1993). It is characterized by moisture shedding, rapid to very rapidly drained, coarse textured and/or shallow soils. In mature forests, a particularly sparse herb and shrub layer, with abundant step and feather mosses, characterize understory vegetation. The tree canopy is typically made up of western hemlock as the leading species, a component of lodgepole pine, and stands are noticeably denser and less productive (meaning lower site indices) than the mesic phase (01a) (Kranabetter, pers. com., 2012).

3.2 2002 Pine Mushroom Habitat Mapping

At the time that the West Babine SRMP was being developed, The BC Ministry of Forests and Range commissioned a mapping project to identify the high-value pine mushroom habitat within the planning area based on air photo interpretation (Friesen, 2002). In the plan area the 01b site series occurs on thin morainal veneers over bedrock and coarse textured glaciofluvial terraces, in upper slope positions, where tree composition is dominated by western hemlock and site productivity is poor. This combination of site attributes has a distinctive air photo texture, or “air photo signature”, that lends itself particularly well to air photo-interpreted mapping by a skilled air photo interpreter. Friesen mapped all of the submesic 01b sites within the ICHmc Nass variant (1) and ICHmc Hazelton variant (2) within the plan area, by examining 64 1:18,000 scale black and white air photo pairs. All age classes within the site series were mapped. Figure 1 provides an overview of where these high value pine mushroom habitats are located.

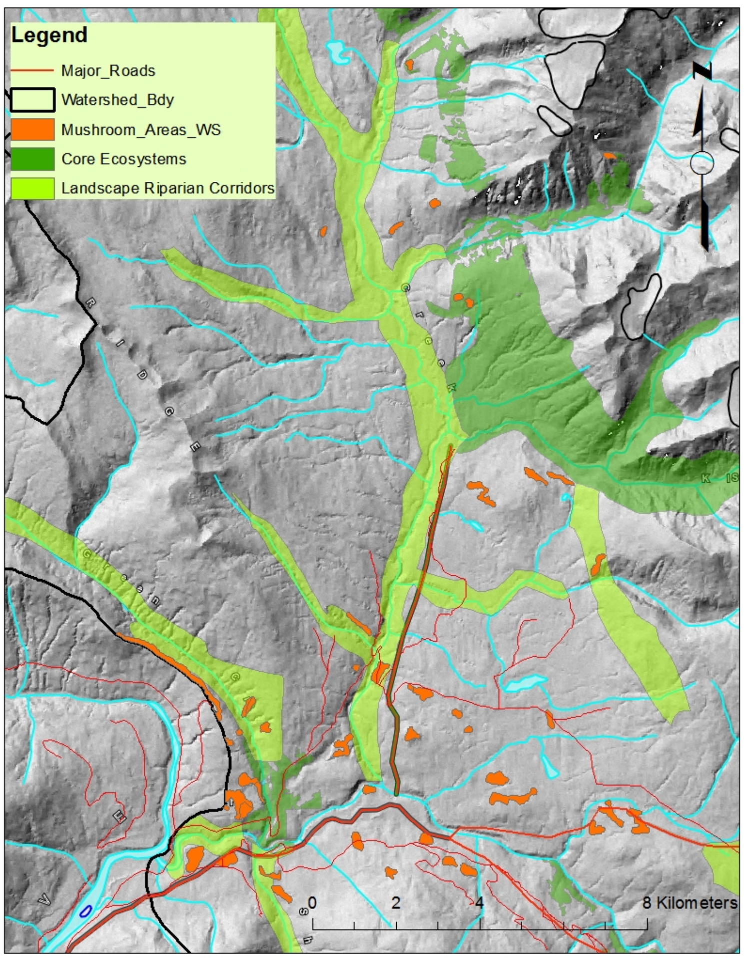


Figure 1. High value pine mushroom habitat (orange) within the West Babine SRMP derived from air photo analysis.

Friesen delineated the ICHmc1 01b and ICHmc2 01b sites on mylar overlays (of the air photos) and transferred them by hand to 1:20,000 scale forest cover maps. The polygons were then digitized and used in 1:100,000 scale landscape level planning. At a scale of 1:100,000 numerous small polygons (generally less than 4 ha in size) in close proximity were represented on the map as a single larger polygon. A total of 410 hectares of high value pine mushroom habitat were mapped within the plan area, amounting to less than 1% of the ICHmc1 and ICHmc2 in the plan area and less than 1% of Timber Harvesting Land Base (THLB). Map accuracy was verified in the field by Friesen and a government biologist. Map accuracy was estimated to be 85% and identified errors were corrected on the final map (Friesen, 2002). This level of accuracy and scale of mapping ensures that these polygons are useful at the operational planning scale with minimal field surveying required.

3.3 Predicting Pine Mushroom Habitat Using PEM and VRI

At the time that this monitoring contract was initiated, the BWMT Knowledge Base indicated that pine mushroom habitat could be potentially identified by carrying out a GIS analysis using Predictive Ecosystem Mapping (PEM). Consequently, early in the contract, efforts were made to provide a reasonable representation of pine mushroom habitat using available PEM data and the Vegetation Resources Inventory (VRI). Results from this approach must be used with caution however, as the PEM accuracy has been assessed at 75% (Mahon, 2002) and the PEM data do not differentiate between the mesic 01a site series and the submesic 01b site series with the ICHmc1 and ICHmc2 - an important limitation in identifying pine mushroom habitat. As a best approximation, a GIS query was performed selecting polygons with the predicted 01 site series, leading in lodgepole pine (*Pinus contorta*) or western hemlock (*Tsuga heterophylla*), with crown closure greater than 49%, and a Site Index less than 15. Eliminating any polygons above 700 meters elevation further narrowed the results of the GIS query, as pine mushroom habitat is considered to occur below this elevation (Trowbridge, 2005). This GIS exercise identified roughly 5090 hectares of potential pine mushroom habitat, or roughly 12 times what Friesen actually found by looking at air photos[1].

The GIS query likely captured much of the mesic 01a site series, which is unlikely to support good pine mushroom habitat. PEM polygons are often listed as a complex of site series and the query was performed on all polygons leading in 01, whether it was a complex or not. The GIS exercise was useful in that it serves to illustrate the challenges of applying PEM at an operational scale, and to underscore the importance of good field data.

3.4 Current Condition of Pine Mushroom Habitat

Pine mushrooms are fungi that form a symbiotic relationship with the roots of their host tree, forming a sheath around the root tip of the plant with some hyphae penetrating the root cortex, thus allowing the fungus to get carbon and other essential organic substances from the tree and in return helping the trees obtain water, minerals, and metabolites. If the host tree is removed, the hyphal network in the soil between trees is interrupted and there is less area that can produce sporocarps (mushrooms). In a study in Date Creek, Durall et al (1999) found that ectomycorrhizal fungal richness decreased exponentially as gap size increased and concluded that the creation of aboveground gaps through tree harvesting or natural disturbance can create below ground gaps in this hyphal network, eliminating or reducing the supply of carbon to the fungus. Marty Krannabetter (pers. comm. 2012) speculated that stands in which the crown closure of mature trees is less than about 50% would not be good candidates for pine mushrooms.

A summary of the area in hectares by age class for the high value pine mushroom sites identified by Friesen within the plan area is provided in Table 1 below. Approximately 310 hectares, or 75% of the pine mushroom

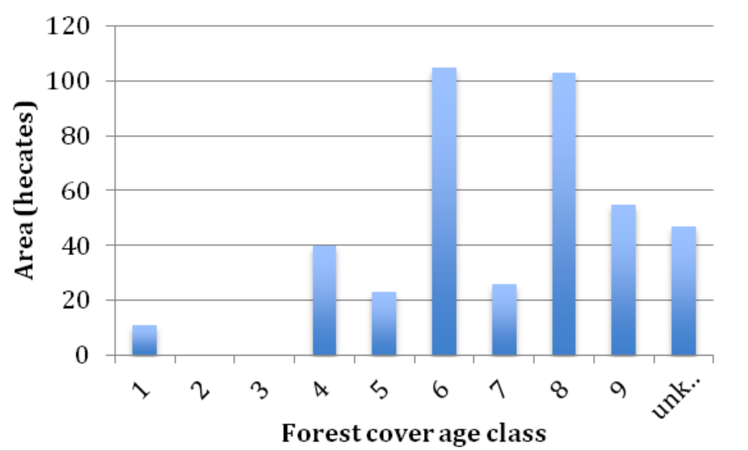
[1] As a point of reference, in the North Cranberry TSA, generally recognized as the epicenter of pine mushroom productivity within northwestern British Columbia, 2105 hectares of productive pine mushroom habitat have been mapped (Trowbridge, 2005).

sites are greater than 80 years of age, and the total may be as high as 86% if the 47 ha of “unknown” age class are included[2], which is well within the 60% objective described in the SRMP. Note that age class 4 areas in the table below were never harvested but originated from fire. Pine mushroom habitat productivity has been observed to be high within 75-year-old stands and to remain so even in 300 year old stands (M. Kranabetter, pers. com.), so the SRMP management direction appears to be conservative in managing for pine mushroom habitat.

Table 1. Area by age class of pine mushroom habitat.

Age Class	Area (hectares)	% of Total
1 (1-20 years)	11	3
2 (21- 40 years)	0	0
3 (41- 60 years)	0	0
4 (61- 80 years)	40	10
5 (81-100 years)	23	6
6 (101-120 years)	105	26
7 (121-140 years)	26	6
8 (141-250 years)	103	25
9 (>250 years)	55	13
Unknown	47	11
Total	410	100

Figure 2. Area of pine mushroom habitat by age class



3.5 Logging Impacts on Pine Mushroom Habitat

Pine mushrooms do not occur in clear cuts, only in association with living trees (Berch and Kranabetter, 2010). Even on the right site types within the ICHmc1 and ICHmc2, pine mushrooms do not fruit abundantly until the stand reaches 70 years in age and has a minimum of 50% crown closure.

Roughly 75% of the mapped pine mushroom habitat falls within the Integrated Resource Management (IRM) Zone of the plan area. Glen Buhr, Stewardship Officer, Ministry of Forests, Lands, and Natural Resource Operations (FLNRO), reports that no logging has occurred within or in proximity to the pine mushroom habitat

[2] VRI focuses on the mature and immature forest types. Non-forest polygons may include lakes, gravel pits, alpine meadows, and non-productive forest and brush (RIB, 1998).

areas, since the plan was implemented in 2004. The pine mushroom sites are relatively remote and the wood is of low value (pers. com., 2012).

The following images were created in ArcMap to illustrate the extent of logging activity relative to the areas of high value pine mushroom habitat within the plan area. Figure 3 is a 2006 orthophoto with all pine mushroom areas superimposed on it (orange polygons), and roads are shown in red. The image shows that no logging has occurred in the northern half of the area mapped for pine mushrooms.

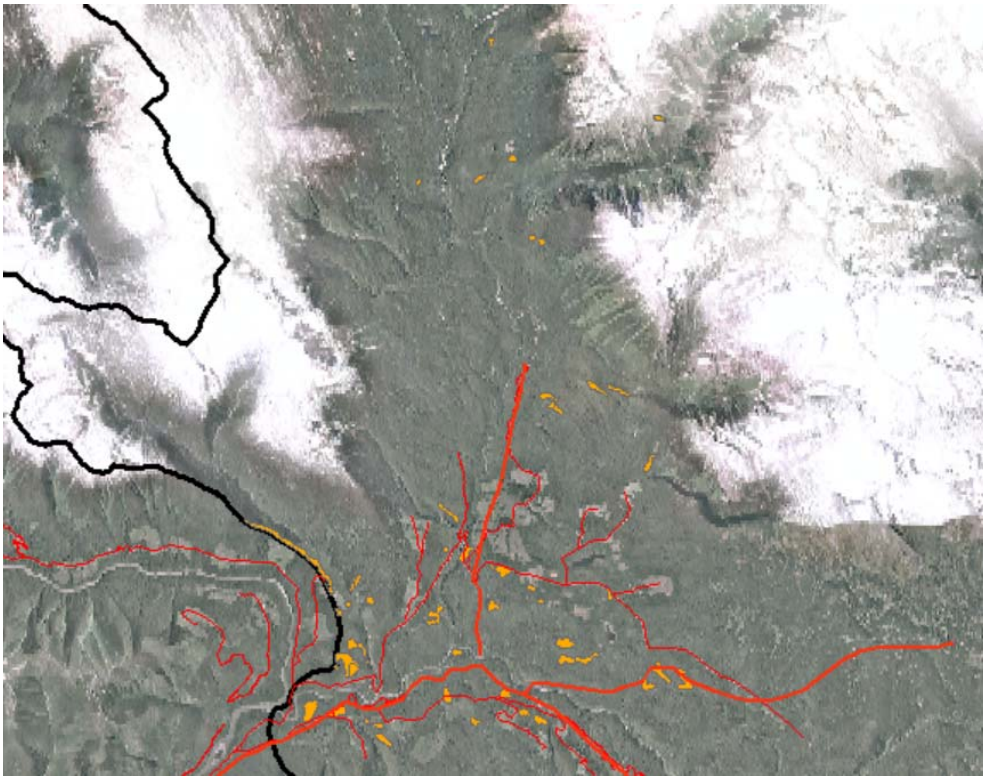


Figure 3. Area of pine mushroom habitat (orange polygons) superimposed onto 2006 orthophoto.

Figures 4 and 5 provide a more detailed view of the southern portion of the plan area where more recent logging has occurred. In Figure 5, VRI polygons that do not have mature forest cover are indicated – the logged areas with no stocking information, non-productive brush (NPBr), and swamps are yellow; and other logged areas are red. Figure 6 is an enhanced satellite image from 2010 with the pine mushroom areas superimposed. These photos reveal that the current condition of pine mushroom habitat has not been affected by logging except in very minor areas.

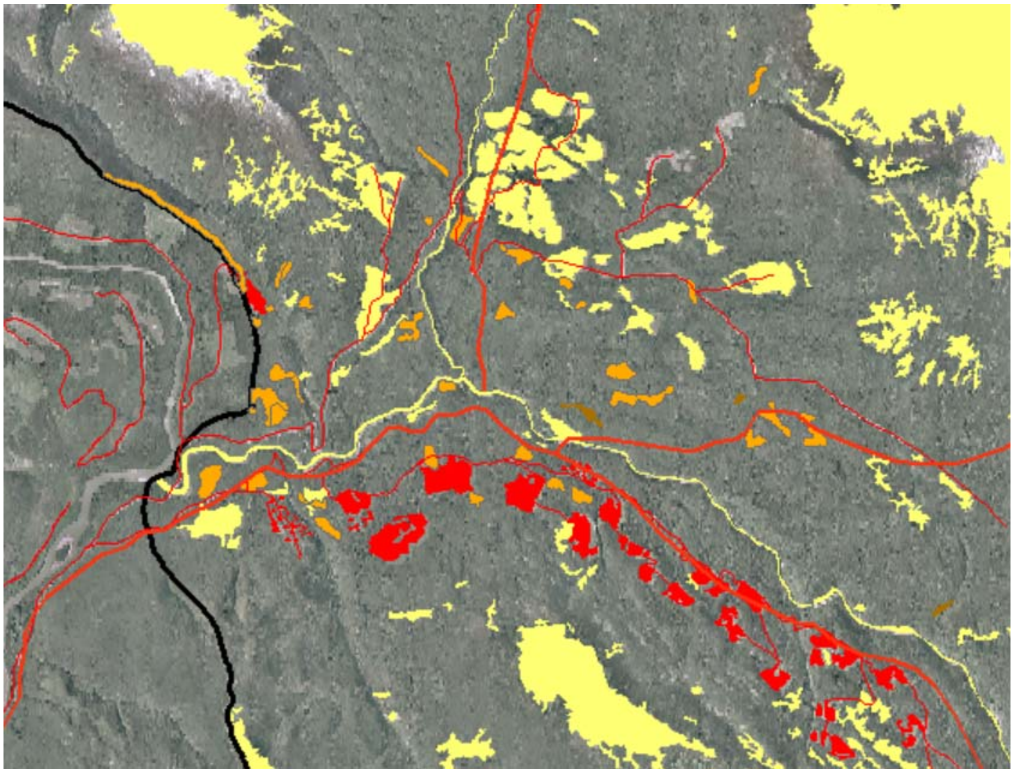


Figure 4. VRI polygons that do not have mature forest cover (yellow and red polygons) and pine mushroom habitat (orange polygons).

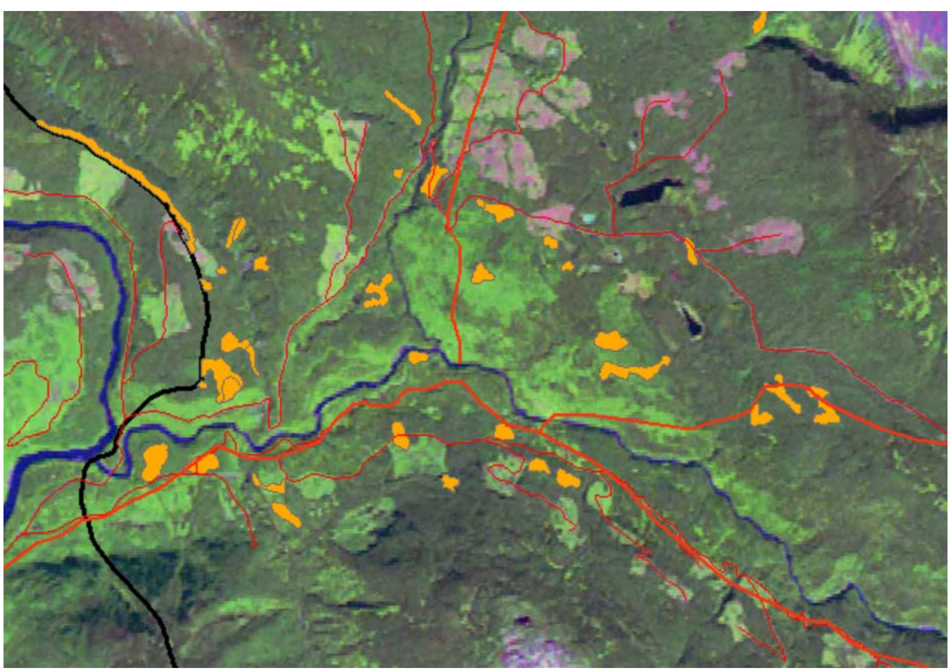


Figure 5. Pine mushroom habitat superimposed on 2010 enhanced satellite imagery (green and purple areas correspond to areas with no mature forest canopy).

3.6 Potential Pine Beetle Impacts on Pine Mushroom Habitat

Mountain pine beetle caused mortality in stands in which pine is the leading species could have a significant impact on pine mushroom productivity in those stands. While there is currently little pine beetle induced mortality in the plan area, by 2020 mountain pine beetle is expected to be widespread in the Babine watershed. Figure 7 shows areas where pine mortality is expected by the year 2020 by mortality class (dark brown is >66%, light brown is 33-66%, and green is <33% mortality). It is important to note however that hemlock is actually the dominant host to the ectomycorrhizal fungus within the ICHmc1 and ICHmc2 (Trowbridge et al. 1999). Even with significant pine mortality, these stands should remain productive pine mushroom habitat because the proportion of pine in most of these stands is small. The light blue highlighting shows PEM/VRI polygons in which pine is the dominant species (where pine occurs on a 01 sites series, has a site index <15, and crown closure is >50%). The total area of such sites in the ICH mc1 and mc2 is small at 240 ha and there is little overlap of such sites with forecast mortality and identified mushroom habitat (orange polygons) so the impact of mountain pine is expected to be low.

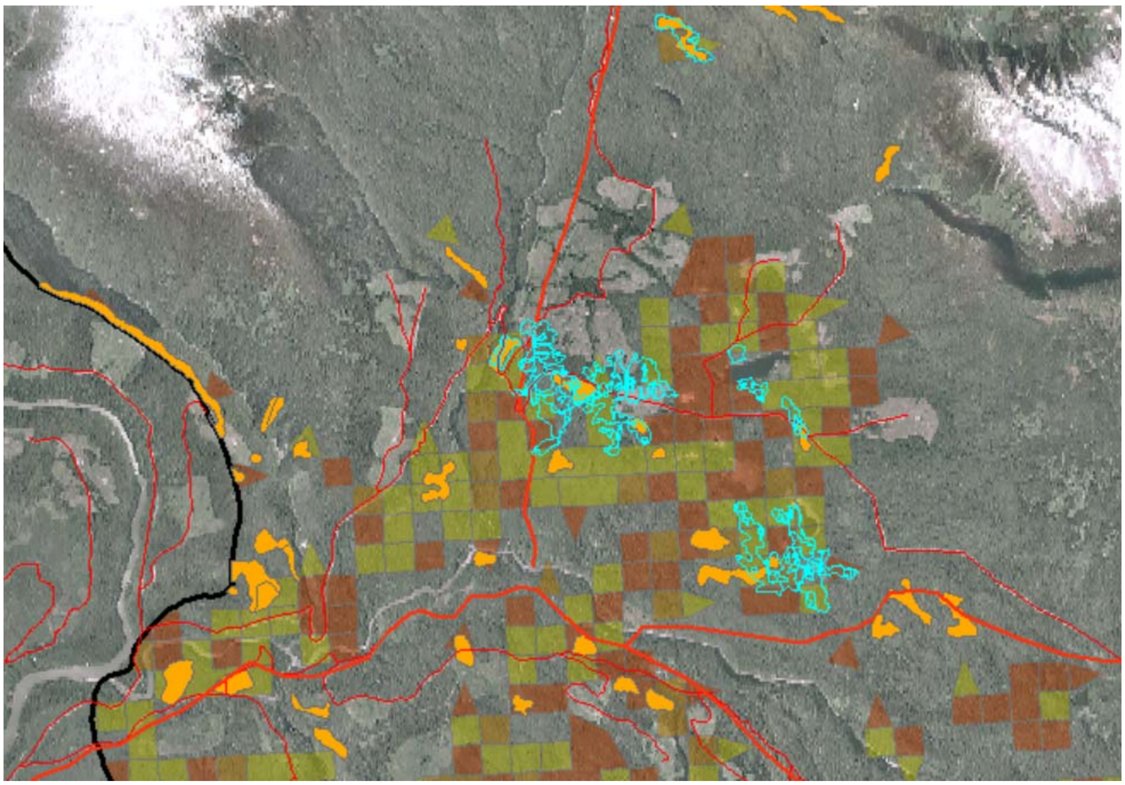


Figure 6. Pine mushroom habitat (orange polygons) in relation to mountain pine beetle induced mortality forecast by 2020 (dark brown, light brown, and green pixels) and PEM polygons in which pine is the dominant species (light blue lines), superimposed on 2006 orthophotos.

3.7 Summary - Amount and Condition of Pine Mushroom Habitat

A total of 410 hectares of productive pine mushroom habitat have been identified within the plan area. The main risks to pine mushroom habitat are logging and lodgepole pine mortality due to the spread of the mountain pine beetle. Since the SRMP was produced, no logging has occurred within the pine mushroom sites and there does not appear to be interest in logging these areas in the near future, as the timber quality is low. Should logging pressures change, it is useful to know that some of the most commercially productive pine mushroom sites in the West Kootenays occur in stands that have a history of selective logging (Kranabetter and Berch, 2010). And locally, a study was carried out in 2002 to develop a management protocol for partial-cut harvesting in high value pine mushroom habitat (Friesen and Kranabetter). Mountain pine beetle mortality was assessed and determined to be a low threat to pine mushroom habitat.

The SRMP recommends that a minimum 60% of pine mushroom habitat be in stands older than 80 years of age. At present, 87% of the habitat is older than 80 years. The pine mushroom habitat areas have a good age-class distribution, with the majority of stands within the productive age window of 75 to 300 years for the next 100 years, well within the lifespan of the current land use plan.

4. Amount And Condition Of Black Huckleberry Habitat

4.1 Attributes of Productive Black Huckleberry Habitat

Black huckleberry habitat has reasonably broad ecological amplitude and is circum zonal, meaning that productive habitat could potentially be found over large portions of the plan area. In their research on managing for wild berries, Burton et al. found that the productive potential of black huckleberry habitat varied according to a number of fixed habitat attributes, which are summarized and ranked in Table 2 below (2000). They found that the highest quality huckleberry habitat is to be found in the ICHmc1, at elevations of 930 to 1050 meters, on south-facing slopes of 16 to 28%, on mesic or better sites, with a site index of 11.2 to 15. Sites that are optimal with respect to all attributes are uncommon, however. Sites having a combination of high and moderate habitat attributes are more likely to occur.

Table 2. Black huckleberry habitat rankings (Burton et al., 2000)

Variable	Nil (0)	Low (1)	Mod (2)	High (3)
Elevation (m)	<312.4 or >1787.5	312.4-863.3 or 1140-1787.5	863.3-931.5 or 1047.7-1140	931.5-1047.7
Slope (%)	>106.1	<10.78 or 37.18-106.1	10.78-16.10 or 28.03-37.18	16.10-28.03
Site Index	>22.6	0.1-9.8 or 16-22.8	9.8-11.2 or 15-16	11.2-15
Aspect		W, N, NE or flat	SE, SW, NW	S
BEC variant		ICHmc2, AT, ESSFmc[3]	ESSFwv[4]	ICHmc1
Leading Spp	Ep or Cw	Ac, At, Hw, Pl	Sw	Bl

4.2 Berry Management Areas in the Plan Area

Site conditions ideal for berry production typically occur within a mosaic of other forest types so that only a portion of a given berry patch is suitable for berry production. Traditional Gitxsan berry patches typically coincided with the site of old forest fires, occurred near treeline where the forest canopy opened up, or occurred in old growth forests with sufficient light penetration. These sites were often maintained through the use of repeated prescribed burns. With the initiation of B.C. Forest Service fire suppression policy in the 1930's these sites have become overgrown with competing vegetation and thus have become less productive for berries (Burton, 2000).

The Berry Management Areas (BMAs) identified in the West Babine SRMP are traditional Gitxsan berry-harvesting areas taken from two sources. The first source was an extensive traditional knowledge review and

[3] Engelmann spruce – Subalpine Fir moist cold subzone
[4] Engelmann spruce – Subalpine Fir wet very cold subzone

field-based survey conducted by the Strategic Watershed Analysis Team, titled *General Biodiversity Project Taking Stock II: Sam Green and Shedin Watersheds Wildlife Inventory and Habitat Assessment* (1999, in MSRM, 2004b). The second was a map produced by the Gitxsan Watershed Authority GIS department, titled the *Selected Gitxsan Ecology* (2002, in MSRM, 2004b). These BMAs are the pink polygons delineated in Figure 7, below. The two principle areas of interest for berry management are just north of the Babine River confluence with the Skeena, and on the southwest-facing slopes of Kisgegas peak. The Historic Gitxsan Berry polygons identified by black hatching in Figure 7 indicate documented berry patches which extend beyond the plan area, and which would have served the local Gitxsan communities (Budhwa, 2007).

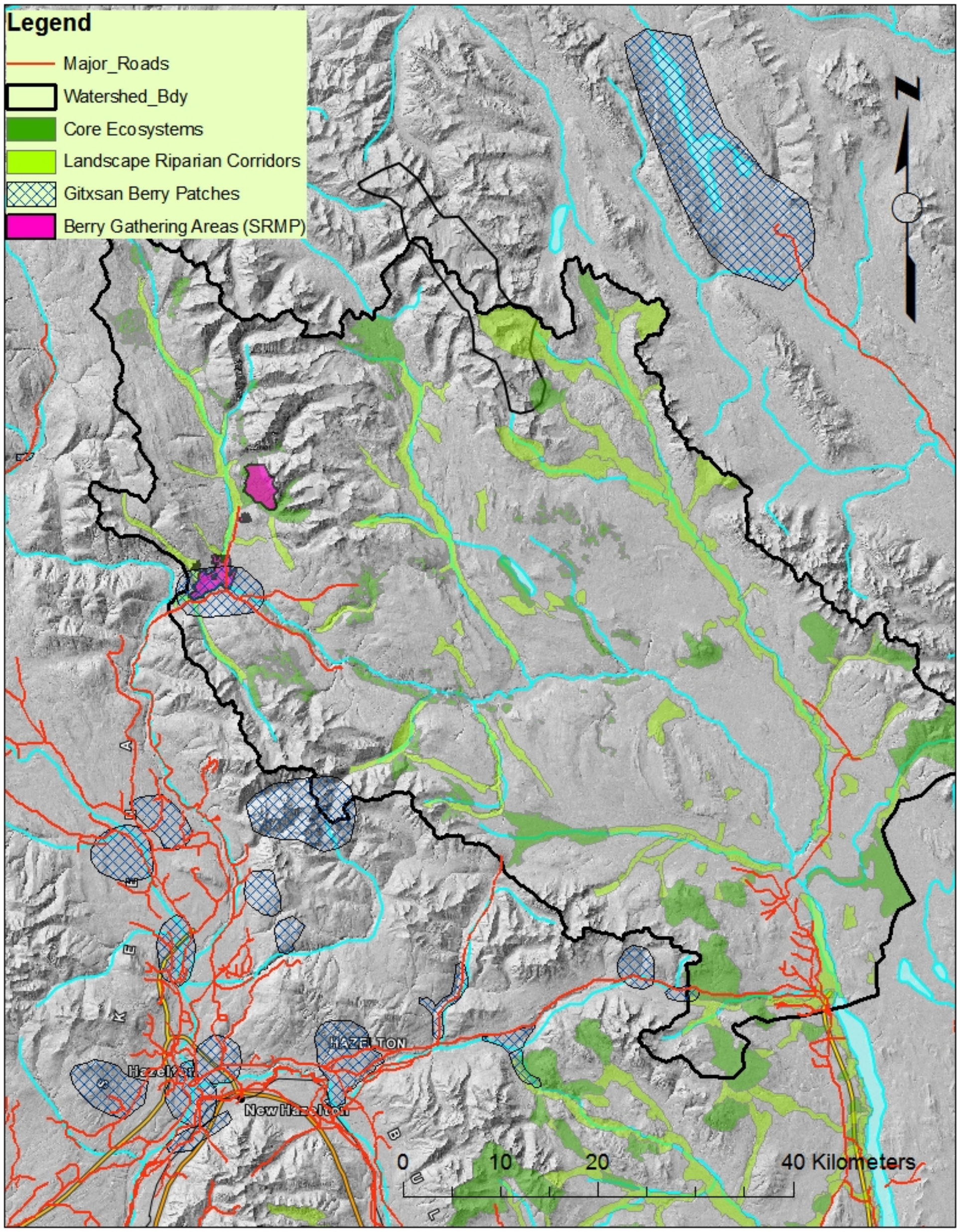


Figure 7. Berry management areas as identified in West Babine SRMP and historic Gitxsan berry harvesting locations.

The location of berry patches in relation to human settlement is important. In the past, when logging was closer to villages and when burns to maintain berry patches were permitted, berry collection was more prevalent, especially with First Nations. With logging becoming more remote and fire suppression preventing burning, there is less opportunity to create or maintain berry-producing areas.

4.3 Current Condition of Black Huckleberry Management Areas

The BMA at Kisgegas Village, located at the confluence of the Babine and Skeena Rivers ranges in elevation from 250 to 1000 meters and falls predominantly within the ICHmc2 biogeoclimatic zone (70%), with lesser amounts in the ICHmc1 (30%). While the ICHmc2 is ranked as having low potential for black huckleberries, it is possible that there are pockets of good habitat potential at this site on cool aspects, given that the area is transitional to the ICHmc1, which is rated highest for huckleberry potential. Undoubtedly, other important berry crops were harvested within this BMA, situated so ideally for the seasonal harvest and processing of sockeye salmon (*Oncorhynchus nercka*).

The BMA on the southwest-facing slopes of Kisgegas Peak and the small BMA slightly south of that are situated within the ICHmc1 and the Engelmann Spruce – Subalpine Fir wet very cold (ESSFwv) biogeoclimatic subzones, both of which are rated favorably for black huckleberry habitat potential.

For a site with good huckleberry habitat potential to produce berries abundantly, sufficient light must be available. Burton has documented that berry productivity is optimal when global irradiance (light availability) is 50 to 80%, and that production drops markedly below 60% irradiance. Optimal light conditions are found in age class 1 stands (clear cuts) and the openings of older age class 8 and 9 stands. Age class 1 stands typically have high (1200 to 2500 stems per hectare (sph)) stem density and low crown closure (below 40%), while age class 8 and 9 stands have low (500 to 1000 sph) stem density that allows adequate light penetration for berry production (Burton, 1998). Non-crop vegetation in the understory also affects light availability, but to a lesser extent. While global irradiance hasn't been directly correlated to crown closure, Burton's berry productivity research revealed that berry production in general drops off at greater than 50% crown closure (Burton et al. 2000).

Other site characteristics that contribute to the degradation of berry productivity include competition from deciduous trees, competition from shade tolerant shrubs, sparsely distributed plants, and rhizomes damaged by forest harvesting activities or by fire that was too hot. Most of these attributes need to be evaluated on site, except for canopy closure, which can be analysed using GIS technology. Table 3 below provides a summary of area by crown closure for the BMAs.

Table 3. Area by crown closure for berry management areas.

Crown Closure	Area (Ha)	% of total
20%	11	0.5
30%	65	3.0
40%	294	13
50%	503	23.4
60%	345	16.0
70%	243	11.3
80%	84	3.9
cutblock	24	1.1
swamp	14	0.7
avalanche track	544	25.3
river/ landslide	23	1.1
Grand Total	**2150**	**100.0**

The rows with red values in table 3 indicate areas within the BMAs that could be productive berry habitat at present, based on crown closure alone. Areas with 50% crown closure or greater, in which sunlight would be insufficient for good berry production, amount to 1175 hectares, or 55% of the BMAs by area. Another 25% of the BMAs are in avalanche tracks, which are typically dominated by shrubby thickets of Sitka alder (*Alnus sitchensis*), and sloping herbaceous meadows dominated by cow parsnip (*Heracleum lanatum*) and Indian hellebore (*Veratrum viridis*). Swamp and river occupy another 1.8% of the BMAs. This leaves 394 hectares or 18% of the BMAs that have sufficiently open canopies for optimal berry production.

Yellow and blue cross hatch in Figures 8 and 9 indicate areas in which open canopy conditions exist **including** rivers, wetlands, and avalanche tracks (the obvious linear features in blue cross hatch). There is also a large area of alpine/avalanche terrain on the southwest facing slopes of Kitsegas mountain in figure 9 that appear to be under snow cover. Two recently logged areas (amounting to about 24 hectares), indicated by blue cross hatch with a light grey background within the BMA closest to the Babine River, are also evident in figure 8.

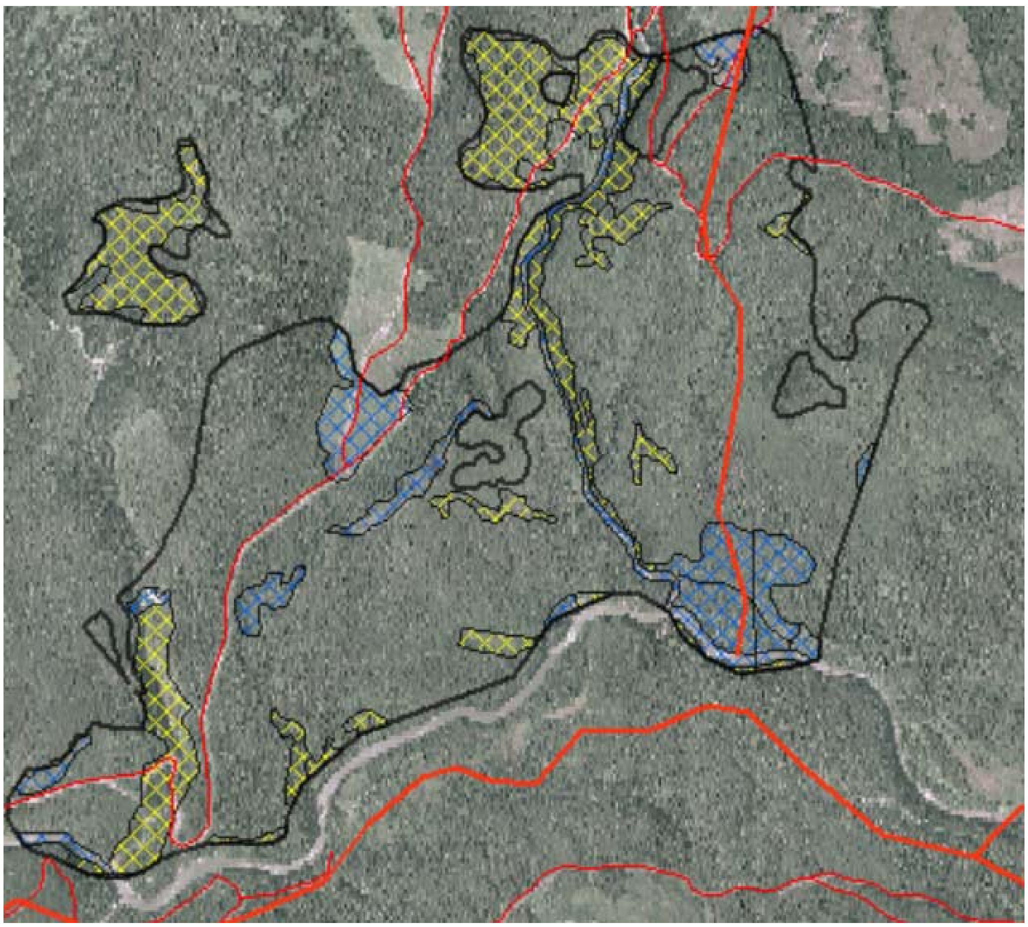


Figure 8. Area in which crown closure is 40% (yellow cross hatch) and <40% (blue cross hatch) within identified berry management areas at the confluence of the Babine and Skeena Rivers.

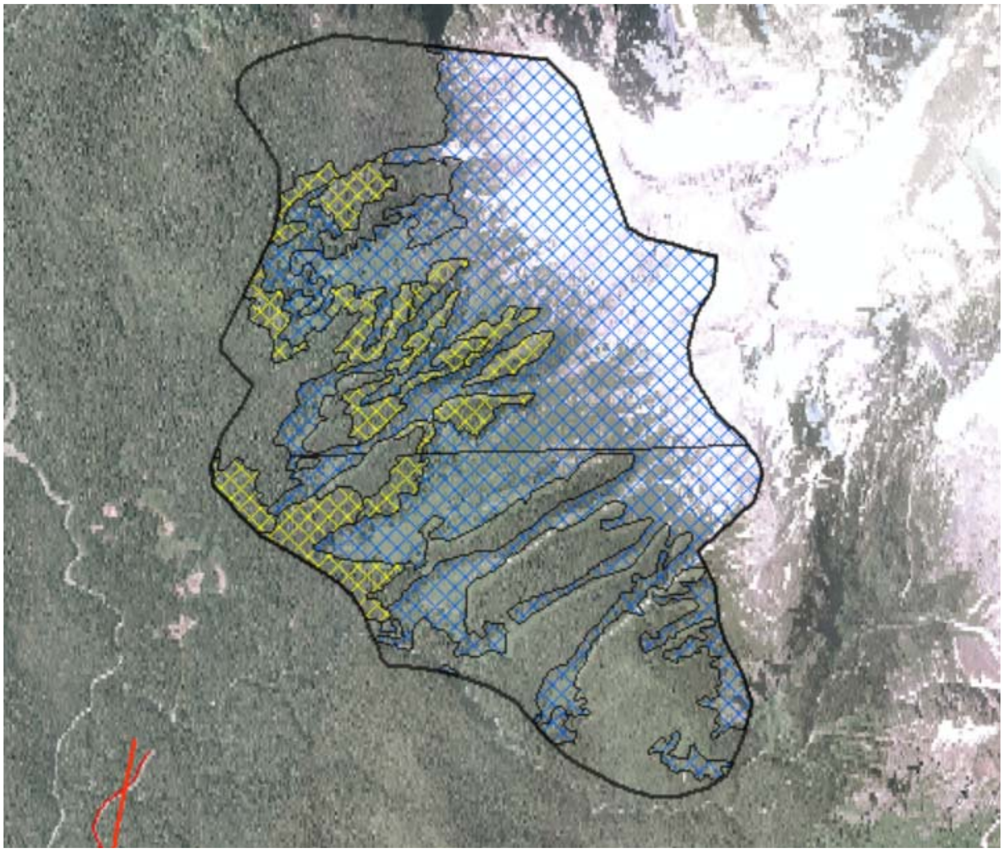


Figure 9. Area in which crown closure is 40% (yellow cross hatch) and <40% (blue cross hatch) within identified berry management areas on the southwest-facing slopes of Kisgegas Peak (includes avalanche tracks and swamps).

4.4 Vegetation Plots Within Berry Management Areas

Another potential source of data that could be used to assess habitat potential and the condition of berry plants, is existing vegetation plots. The BEC master database was checked, but did not contain any plots within the BMAs. In another project, MacHutchon and Mahon (2003) assessed habitat use by grizzly bears in the Kispiox Forest District, collecting vegetation data within the vicinity of the berry management areas. Unfortunately, only one plot was within a BMA on an avalanche track on Kisgegas Peak. The plot confirmed that the avalanche track was dominated by red elderberry, cow parsnip and Indian hellebore.

Predictive Ecosystem Mapping (PEM) verification plots were also explored as a source of vegetation data (Mahon et al., 2004), however, while information on site series was collected, vegetation data were not. Mahon was not assessing black huckleberry habitat per se, but he did recall that vaccinium plants were common on mesic forested sites within the ICH and that berry production was generally poor. The best crops he saw were in the transition to ESSF and in the ESSF (pers. comm., April, 2012).

4.5 Sidina Mountain Berry Prescription Management Plan

Another source of information that was considered in assessing berry habitat for this project was the Sidina Mountain Berry Prescription Management Plan. In the late 1990’s and early 2000’s, knowledge and interest in berry management within the Skeena-Stikine Forest district was advanced by research carried out by Phil and Carla Burton (1998, 2000) and by Scott Trusler (2002). Their research coincided with a renewed interest in local berry harvesting and enterprise on the part of the Gitxsan people, and its subsequent recognition in land use planning.

In 2008 efforts were made by the Skeena Stikine Forest District to initiate Gitxsan/Gitanyow berry ecosystem restoration through the North West Forest Restoration and Enhancement Program (NWFREP). Sidina Mountain was the traditional berry-harvesting site chosen for restoration due to its proximity to Gitxsan communities. McElhanney Consulting Services was contracted to write a Berry Prescription Management Plan. While the prescription itself was never carried out due to access issues, (the ecological assessment information can be used to infer condition of the berry management areas within the plan area.

The Sidina Mountain Traditional Berry Harvesting site is characterized by steep to moderately steep, southwest-facing terrain. The area falls predominantly within the ESSFwv with a lesser amount of ICHmc1. Canopy cover ranges from open alpine at the northern boundary to relatively closed older forest types dominated by subalpine fir and western hemlock. (The BMA on the slopes of Kisgegas Mountain is similar in slope and aspect, although it contains more ICHmc1 than ESSFwv.)

At high elevations within the Sidina Mountain Traditional Berry Harvesting Site, ESSFwv/01(05) old forest occurs on steep (40%) slopes. This forest is dominated by subalpine fir and western hemlock and has significant gaps in the canopy where black huckleberry shrubs are still abundant. Sitka valerian (*Valeriana sitchensis*) and Indian hellebore (*Veratrum viride*) dominate the herb layer.

At somewhat lower elevations within the ESSFwv/01(05) old forest, the canopy gaps are dominated by the ericaceous shrub, false azalea (*Menziezia ferruginea*) also known as fool's huckleberry, with a much lower percent cover of oval-leaved blueberry (*Vaccinium ovalifolium)* and black huckleberry. Trusler observed that in the absence of burning, fire-tolerant black huckleberry appears to get over-topped by more fire-sensitive species such false azalea (2002), which appears to be the case here.

At lower elevations, old forest (ICHmc1/01/03) occurs. These stands are dominated by western hemlock and subalpine fir with Devil's club (*Oplopanax horridus*) and Oakfern (*Gymnocarpium dryopteris*) in the understory. Huckleberry is uncommon as the canopy is quite closed. Given the age of these sites, the canopy would have been relatively closed, even prior to the 1930's. Where they are bisected by avalanche tracks, however, one would suspect that they would have sufficient light penetration to be productive for berries along their edges, even at present.

4.6 Areas of Black Huckleberry Potential Identified by GIS analysis

To get a sense of black huckleberry habitat potential across the entire planning area a GIS analysis was performed using PEM and VRI data in conjunction with black huckleberry prominence charts developed by MacKenzie and presented in Table 5, below. For each biogeoclimatic subzone, and site series, MacKenzie listed the prominence of black huckleberry on a 7-point scale based on the BEC plot data (Banner et al., 1993). To simplify the rating scheme for GIS purposes, Buhr assigned a rating from 1 to 5 to each of MacKenzie's 7 prominence values to create a form of crosswalk table presented in Table 4. Where a berry species was likely to be dominant, the site series would get a rating of 1 (highest potential suitability), where it was medium the site series would get a 3 and so forth. In the table below, black symbols mean that data were available to support the weighting, while grey symbols mean that the prominence weighting was inferred.

Table 4. Ratings for each prominence level.

Symbol	Symbol	Rating	Meaning
♦♦♦♦♦		1	Dominant
♦♦♦♦	♦♦♦♦♦	2	High
♦♦♦	♦♦♦♦	3	Medium
♦♦	♦♦♦	4	Low
♦	♦♦	5	Very low
•	♦	5	Very low
blank		0	Nil

Table 5. Black huckleberry prominence charts.[5]

BEC Unit	Prominence rating	Assigned Code
ESSFwv /01	♦♦♦♦	2
ESSFwv /03	♦♦♦♦	2
ESSFwv /04	♦♦♦♦	2
ESSFwv /05	♦♦♦	3
ESSFwv /06	♦♦	5
ESSFwv /07	♦♦♦	4
ESSFwv /08	♦	5
ESSFwv /09	♦♦	4
ICH mc 1 /01	♦♦♦	3
ICH mc 1 /03	♦♦	4
ICH mc 1 /04	♦	5
ICH mc 1 /06		0
ICH mc 2 /01	♦♦	5
ICH mc 2 /03	•	5
ICH mc 2 /04	•	5
ICH mc 2 /05		0
ICH mc 2 /07	•	5

The data in the tables above were used in a GIS analysis to provide an overview of black huckleberry potential for the watershed, as shown in Figure 10 below. As previously stated, it is important to consider that PEM data are not necessarily very reliable in terms of predicting individual site series. Nor do the ratings actually mean that there are good berry patches at these sites because there are many other factors that impact berry production including aspect, elevation, tree crown closure, stand age, edaphic factors, and past management practices like burning.

[5] Mackenzie assigns the highest prominence values to ESSFwv/ 01, 03, and 04 site series while Burton et al. rate circum-mesic ICHmc1 sites highest for black huckleberry habitat potential. Further investigation is required to resolve this difference.

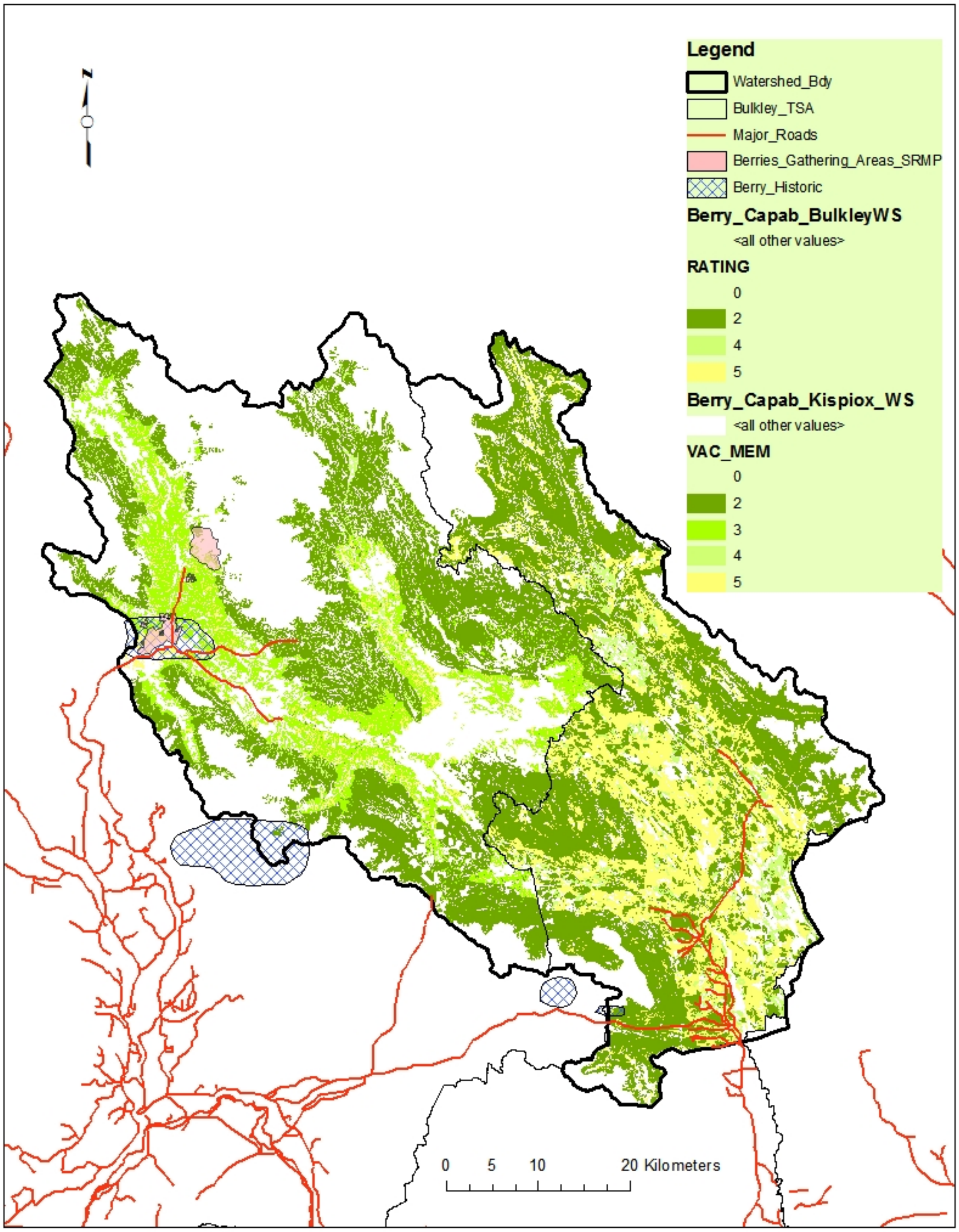


Figure 10. Berry potential in the Babine watershed.

Tables 6 and 7 below provide an area summary of black huckleberry habitat potential by biogeoclimatic subzone for the Kispiox and Bulkley portions of the Babine watershed respectively. Note that the Bulkley PEM did not have site series listed for parkland ecosystems and so the map likely underestimates the area of potential berry habitat by up to 10,000 hectares (yellow cell).

Table 6. Area (ha) by BEC unit and berry potential in the Kispiox portion of the watershed.

Rating/BEC Unit	ESSFmc	ESSFmcp	ESSFwv	ESSFwvp	ICH mc 1	ICH mc 2	SBS mc 2	Grand Total
(Nil) 0	0	0	0	0	7946	261	0	8207
(High) 2	31398	99	35755	4181	0	0	412	71845
(Med) 3	1755	1	0	0	15752	0	15106	32614
(Low) 4	0	0	5474	437	0	0	756	6667
(Very Low) 5	0	0	0	0	1784	795	4368	6947
Grand Total	33153	100	41229	4618	25482	1056	20642	126280

Table 7. Area (ha) by BEC unit and berry potential in the Bulkley portion of the watershed.

Rating/BEC Unit	AT	ESSFmc	ESSFmcp	ESSFmvp3	ESSFwv	SBS mc 2	Grand Total
(Nil) 0	0	0	0	0	0	4785	4785
(High) 2	0	52191	0	0	96	24859	77146
(Low) 4	0	0	0	0	7	7818	7825
(Very Low) 5	0	5783	0	0	60	35400	41243
(Blank)	13710	10259	10169	9	56	9523	43727
Grand Total	13710	68232	10169	9	218	82386	174726

4.7 Areas of Black Huckleberry Potential and Logging

It is expected that logging, particularly if undertaken in the winter, will normally benefit huckleberry production although this effect will not be prolonged under a timber management objective. It is not possible within the limited scope of this project to determine actual condition of berry habitat in the areas that have been logged. This would require fieldwork across a sample of habitats. It is expected, however, that, if berry rhizomes have not been damaged, light levels exceed about 65% of full sunlight (less than ~ 100 to 200 mature conifer stems/ha or about 20 to 25% crown closure), berry species cover prior to logging was greater than 20%, and brush competition from aspen or other shrubs (e.g. willow, alder, black twinberry, high bush cranberry, thimbleberry, birch-leaved spirea) is low, logging will have a beneficial effect on berry production.

In figure 11, below, the Black Huckleberry Potential Map (Figure 10) was overlaid with a map of recent cutblocks to get a sense of where areas of high huckleberry habitat potential intersect with favorable light conditions (cut blocks) on the landscape. The majority of the cutblocks in Figure 11 are red in colour indicating a stand that is less than 20 years old.

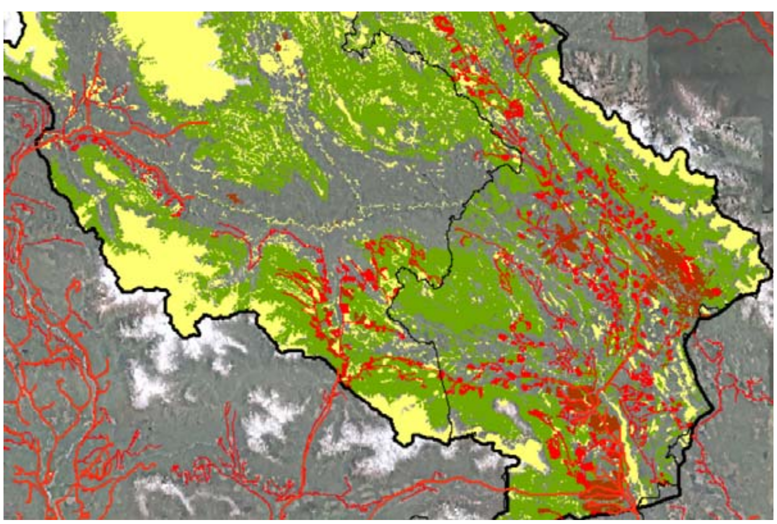


Figure 11. Cutblock locations (red polygons) relative to high potential black huckleberry habitat.

Figure 12 is a more detailed view of a portion of the area depicting the overlap between high potential berry habitat and recent clear cuts. Cutblocks that are pink do not coincide with high potential berry habitat while those that do, are medium brown. Dark brown polygons are swamps.

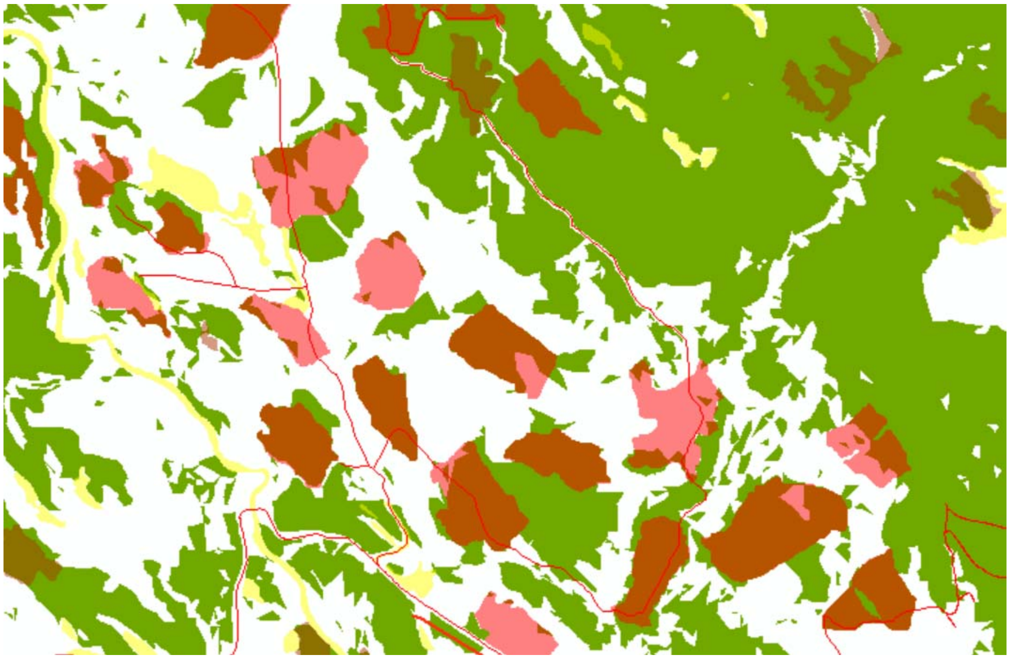


Figure 12. High potential black huckleberry habitat and cut blocks (1:40,000).

This rough "capability" map of high potential black huckleberry habitat and cut blocks could be further refined by modeling for optimal elevation, slope and aspect. This GIS analysis would identify areas of high potential black huckleberry habitat, as defined by Mackenzie, that occur at favorable elevation, slope, and aspect, as defined by Burton, and which intersect with recent cut blocks.

4.8 Areas of Black Huckleberry Potential and Mountain Pine Beetle

The maps below show current (2010) areas of mountain pine beetle mortality (of varying intensity) and expected cumulative kill by 2020 (figures 13 and 14). While the area of pine leading sites in the Kispiox is much smaller than in the Bulkley portion of the watershed, the area becomes significant by 2020. It is important to note with these maps that they show all mortality even if it is less than 30% and that the percent value refers to pine mortality (as opposed to other tree species). If pine is a small component of the stand the impact of pine beetle on berry production will not be high.

The autecology of huckleberry species is such that good patches are less often associated with pine stands than spruce or sub-alpine fir stands. Huckleberries can be found in such stands though, especially when pine occurs in a mix with spruce or sub-alpine fir, and it is expected that in such circumstances, pine beetle kill, if it opens the canopy sufficiently to achieve about 65 to 70% of full sunlight will be beneficial for huckleberry production. No literature on the impact of mountain pine beetle on berry producing sites was available for this area.

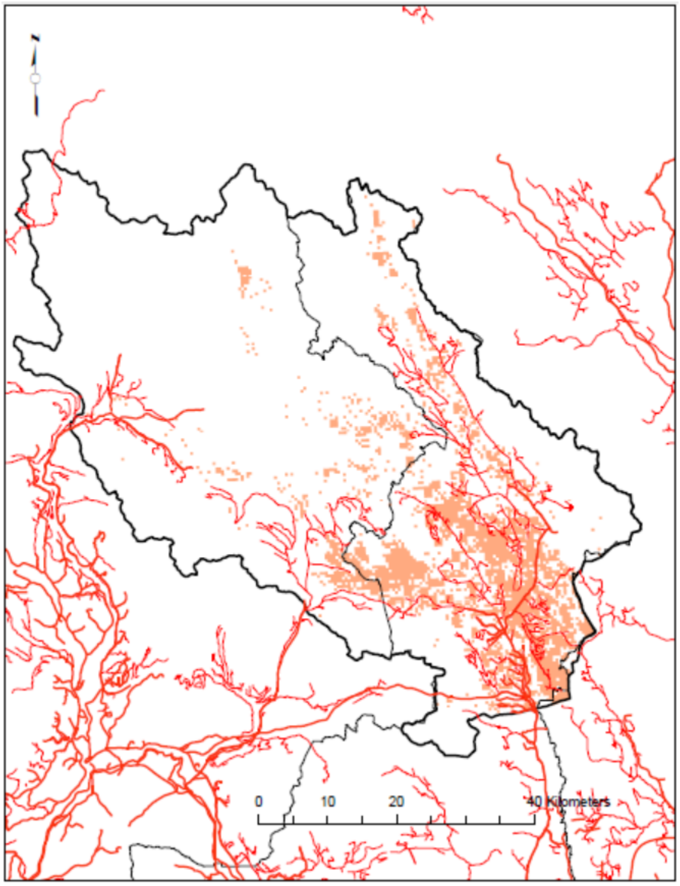


Figure 13. Area of cumulative kill by mountain pine beetle in 2010.

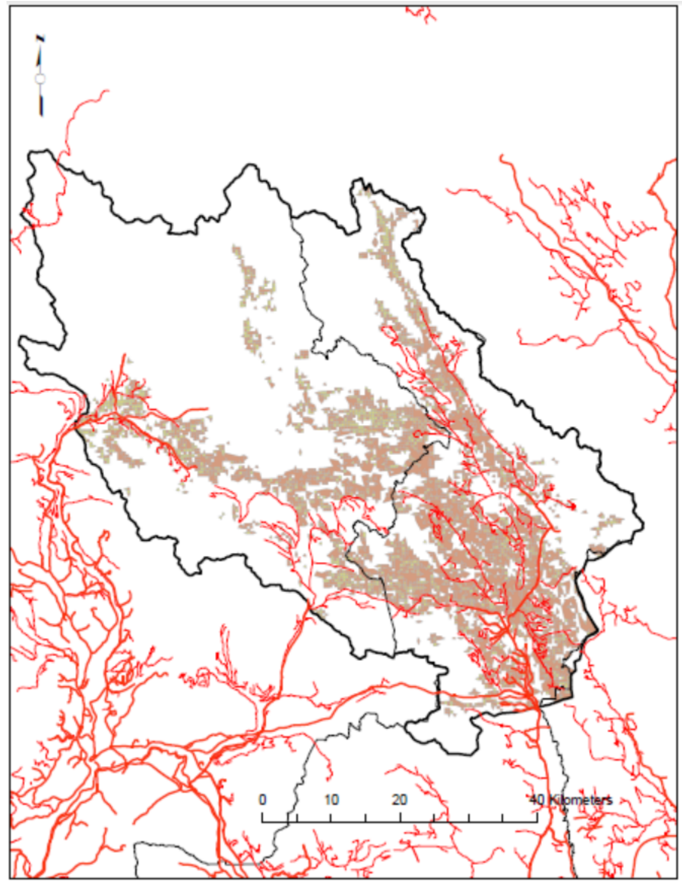


Figure 14. Area of projected kill by mountain pine beetle by 2020.

4.9 Summary Regarding Condition of Berry Management Areas

Traditional berry harvesting areas contained a network of productive berry habitats within a matrix of other ecosystems that were either not maintained for black huckleberries or had low berry potential. Little disturbance has occurred within the BMAs within the last 80 years so that openings that were previously maintained by fire by the Gitxsan have become overgrown with vegetation that competes with black huckleberry for light and thus results in declining berry productivity.

Using GIS technology and some field sampling, it is possible to predict where the areas of best black huckleberry habitat potential are on the landscape. This black huckleberry potential mapping provides a coarse method of estimating the amount of berry habitat that occurs within the BMAs and within the watershed at large. Modeling for elevation, slope and aspect could further refine the map. Overlaying recent cut blocks onto such a map would provide a simple means of identifying sites with good black huckleberry "capability", which could be used to manage for berries across the landscape.

Skeena – Stikine Forest District staff have made efforts to rehabilitate berry habitat within Gitxsan Traditional Berry Gathering Areas outside of the plan area using prescribed fire with mixed results. Berry habitat rehabilitation requires funding and is complicated by overarching Land Claim issues. If berry management is considered to be important, one or more stakeholders will need to champion efforts to rehabilitate selected sites. Because there is little economic incentive to do this, it may fall upon Skeena-Stikine Forest District staff, in partnership with the Gitxsan, to lead this initiative in the short term.

5.0 Stakeholder Involvement

Pine mushrooms and berries are important cultural resources. No further work appears to be necessary in monitoring for pine mushrooms at present. Berry habitat rehabilitation continues to be a concern of the Gitxsan, and the BMA (within the plan area) that they appear to be most concerned about is the one located at the Babine and Skeena River confluence (Stevens, pers. com., 2012). The information in this report should be shared with the Gitxsan, and Skeena-Stikine Forest District staff should continue to seek opportunities for berry habitat enhancement as funding allows.

Debbie Wellwood, who is writing a BWMT report on Grizzly Bear Habitat, stresses the importance of managing for black huckleberries within the context of grizzly bear access management. She cautions that huckleberry habitat enhancement should not be encouraged in locations where there is potential for human-bear conflicts (i.e. human access is restricted for grizzly bear habitat management purposes) (pers. comm., March, 2012). In her report she makes a number of recommendations for a public and stakeholder involvement process to work around this type of potential conflict.

6.0 Summary

The pine mushroom management areas, as defined in the West Babine SRMP, were derived by air-photo interpretation and are recognized at the operational planning level, thus risk to these habitats is low. The BWMT knowledge base for pine mushroom management areas has been improved upon by the addition of Friesen's pine mushroom habitat mapping, an assessment of age class distribution within the pine mushroom sites, and a model predicting the impacts of mountain pine beetle. There are no further recommendations for management or monitoring of the pine mushroom sites at this time.

Black huckleberry habitat potential was estimated using GIS technology and PEM, VRI, and huckleberry prominence data for the berry management areas and the Babine watershed as a whole. By adding recent clearcuts to the model, a crude map of berry habitat "capability" was generated that illustrates areas of high black huckleberry habitat potential that have a high probability of producing berries because insolation effects are optimal. This model could be further refined by the addition of elevation, slope, and aspect parameters.

This report confirms concerns for the continued decline in berry production within the West Babine berry management areas. A rough assessment of black huckleberry habitat condition within the berry management areas was determined based on crown closure class. By this calculation, 394 hectares, or 18% of the berry management areas, appear to have sufficient sunlight for optimal berry production and only a portion of these will actually produce good berry crops because of the many other factors influencing berry production.

The amount and condition of black huckleberry habitat was further assessed based on existing vegetation plots; as well as inferred from a Berry Prescription Management Plan for a nearby Gitxsan Berry Harvesting Area in the same BEC zones. The data and anecdotal information provided from these sources are helpful in confirming that black huckleberry habitat occurs within a matrix of other habitat types within the berry management areas, and, that its condition continues to decline due to overcrowding by competing vegetation.

7.0 Acknowledgements

We thank Rick Buhdwa, Glen Buhr, Marty Kranabetter, James Cuell , and Will Mackenzie for providing background materials, maps, and data, and Grant MacHutchon and Todd Mahon for providing information regarding the condition of the berry management areas. Our thanks also to Cameron Stevens for providing input regarding Gitxsan berry management priorities and to the Babine River Foundation for funding this project.

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