Extension Note – DRAFT

Black huckleberry: Implications of logging, site and climatic factors on plant cover and berry abundance in British Columbia

Julia Chandler, Evelyn Hamilton, Garth Mowat, Cora Skaien and Ellen Simmons

October 14, 2025

EXECUTIVE SUMMARY

1. The conclusions from this meta-analysis are generally consistent with those found in other studies. Other studies were done in locations in and outside of BC in different kinds of ecosystem and for a specific year or set of years. Our study is provincial in scope and sampling included a range of years. We found berry production is affected by: (i) logging; (ii) climatic conditions, including previous years; and (iii) site factors. This comprehensive BC-based, multiyear analysis provides more specific recommendations for BC resource managers.
2. Although optimal conditions for huckleberry plant cover can differ from those for berry abundance, berry abundance is positively correlated with huckleberry plant cover so management should focus on maintaining and or enhancing huckleberry plant cover.
3. Huckleberry plants are well suited for the moist cool climatic condition typically found at higher elevations in the ESSF and ICH Zones. In the wetter ESSF subzones, the best conditions for huckleberry plants were on the warmer aspects. Management should focus on sites that are most suited for plants and therefore berry production now and in the future.
4. High levels of canopy cover can have negative effects on berry production so management practices should seek to provide open sites with lower levels of other vegetation that overtop the plants or limit resources including sun, water and nutrients over time.
5. Although huckleberry plants are tolerant of burning, resprout readily and can be reinvigorated by “pruning”, reproduction from seeds is very limited and recovery from severe disturbance associated with logging and severe fires can be slow. Therefore, management practices should avoid elimination or severe damage to huckleberry plants while reducing cover of competing vegetation.
6. Climatic conditions in previous years impact berry production therefore management should strive to provide for berry patches distributed over a wide geographic area to better ensure there are some areas with sufficient berry production every year even if climatic conditions in some areas are poor.

1. INTRODUCTION

1.1 Cultural Context

Across the diverse ecological regions of British Columbia, spanning from the northern to southern areas, black huckleberries (*Vaccinium membranaceum*), henceforth "huckleberries", are a highly regarded and important species to British Columbia's First Nations (Trusler & Johnson, 2008; Turner et al., 2013; Turner & Reid, 2022). For generations, these berries have been and continue to be revered by Nations and people, where they are treated and cared for as kin, and recognized beyond the label of a "non-timber forest product." People would travel great distances to gather huckleberries, treasured for their sweetness (Armstrong, 2020).

To many Nations, huckleberries are a sacred berry; they are valued in ceremonies, such as the first fruit ceremonies, distributed at potlatches (Trusler & Johnson, 2008), and symbolically regarded as a Chief (Turner, 2005). Traditional stories reference them (Turner, 2005; Forney, 2016), affirming evidence that they have long been part of Indigenous Peoples' lives.

Long-standing harvesting protocols, practices and land stewardship knowledge have been passed down through the generations. (Trusler & Johnson, 2008; Forney, 2016). These practices include controlled burning (Trusler & Johnson, 2008; Deur & James, 2020; Ferguson, 2025), as well as pruning and specific harvesting methods to ensure sustainable use and availability for future generations. Indigenous people are intimately aware of the conditions required for huckleberry growth, such as forest stand structure and the factors necessary to enhance huckleberry production (Kerns, Alexander, & Bailey, 2004). They understand the ecological cues, timing and seasonal dynamics specific to each region to support huckleberry growth (Forney, 2016).

Traditionally, these berries were central to trade for many Nations (Trusler & Johnson, 2008). They were prepared in multiple ways within communities for food, including being dried for berry cakes (Trusler & Johnson, 2008; Turner, 1999), eaten fresh with meat or partially or fully dried. Today, huckleberries continue to be widely gathered, and in addition to traditional preparations, they are also canned (Turner, Bouchard & Kennedy, 1980). Beyond food, some Nations have used this berry as a dye for basket materials (Turner, 2007). In some Nations, Indigenous languages carry place-specific names or references to huckleberries (Turner, Bouchard & Kennedy, 1980) which reflect Indigenous peoples' time-honoured reverence and care for this species, a relationship that continues today (Turner, 2005).

1.2 Management Context

Black huckleberry (Figure 1*)* berries are also a very important food source for grizzly bears (McLellan 2018, 2023, Lamb et al. 2018, Proctor et al. 2023). Despite the interest in understanding and increasing habitat suitability for huckleberry and grizzly bears (e.g., Lamb et al. 2018, Proctor et al. 2023), little work has been done to understand how timber harvesting and silvicultural practices influence berry production. Burton et al. (2000) and Beaudry et al. (2001) work focussed on north central BC; Lamb et al. (2018), Proctor et al. (2023) and McLellan (2023) provide information relevant to huckleberry management, specifically in southeast BC. They found berry production was best in high elevation open sites - including wildfire burns and logged areas. They recommended protecting and enhancing existing plants by minimizing damage during logging, providing open canopies over time, removing competing vegetation manually and pruning and planting huckleberry plants.

Huckleberry is common throughout British Columbia in dry to moist forests and openings in montane and subalpine zones. It is most common in the Engelmann Spruce – Subalpine Fir (ESSF), Interior Cedar – Hemlock (ICH), and Sub-Boreal Spruce (SBS) Biogeoclimatic Ecosystems Classification (BEC) zones, although it occurs across much of the province (Figure 2). Its distribution in BC is described in BEC Regional Field Guides (BECweb 2025).

This study was done to determine how forestry practices influence huckleberry cover and berry production and provide guidelines regarding how to maintain or enhance huckleberry production during and after forest harvest.

Figure 1. Black huckleberry (*Vaccinium membranaceum*) berries and leaves in early fall. The leaves turn a distinctive crimson red colour in late summer which fades through the fall.

2. METHODS

Sampling occurred in locations with bear foods and did not include sites where bear foods (i.e. berries) were not expected to be found (See Lamb 2019, Clarke 2022, and Proctor et al. 2023 for site selection and sampling methods)[1]. Surveys occurred within the SBS, ESSF and ICH zones in logged and unlogged sites. Only 9% (8/91) of SBS sites were logged, whereas 61% (385/631) of the ESSF sites and 54% (55/102) of the ICH sites were logged. This study is a meta-analysis of data collected in different time periods and BEC subzone variants; many variants were not sampled.

Plant cover (%), mean ($\bar{x}$) berry abundance (#/100m^2) and associated predictor variables were collected from 864 sites across the province in 2016, 2017, 2018 and 2020 (Figure 2) using standard

[1] Further details regarding methods, results and literature cited references are provided in Chandler et al. 2025 Research Report "*Black huckleberry: Implications of logging, site and climatic factors on plant cover and berry abundance in British Columbia*".

ecological methods (British Columbia Ministry of Forests and Range and British Columbia Ministry of Environment 2010). The predictor variables included site variables[2] (canopy cover, elevation, latitude, longitude, slope and aspect), site history (unlogged or logged using various silviculture systems) and climate data for the current year and the two preceding years. Site history data came from the BC government RESULTS[3] database. Climate data were retrieved from the ClimateBC database (see ClimateBC.ca).

2A

2B

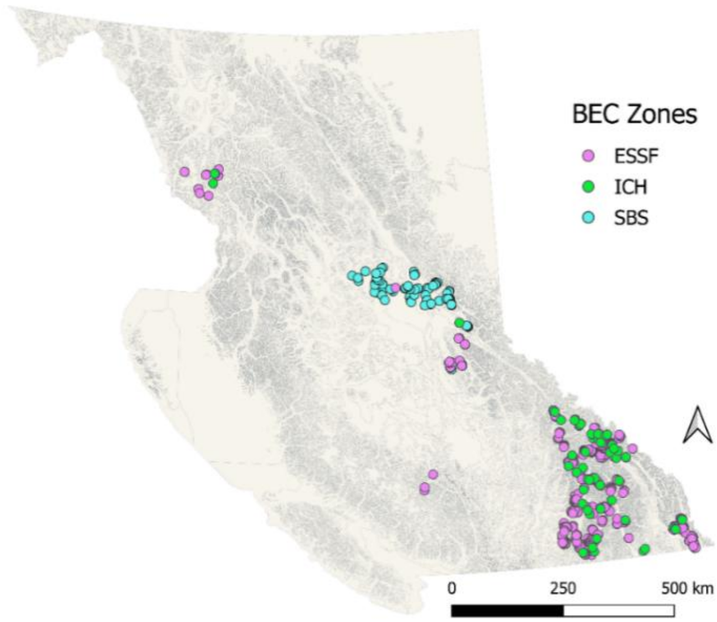


Figure 2A. Distribution of huckleberry (*Vaccinium membranaceum*) across North America[4].

Figure 2B. Distribution of black huckleberry (*Vaccinium membranaceum*) sample sites (n=864) located in SBS, ICH and ESSF biogeoclimatic zones across British Columbia, Canada. Elevation is represented in gray with areas of higher elevations represented by darker shading.

3. RESULTS

3.1 Huckleberry Cover

Huckleberry cover was highest in the ESSF ($\bar{x}$=21%, sd=16.7) followed by the ICH ($\bar{x}$=13.3%, sd=15.4) and was considerably lower in the SBS zone ($\bar{x}$=2.7%, sd=3.7). Within the ESSF zone the highest average cover was in the ESSFdc, mh, wc, wh and wm subzones (i.e. >20% cover) (Table 1A).

---

[2] Site data included BEC unit, canopy cover, % slope, aspect (azimuth), and elevation. Azimuth values were converted to "folded aspect" such that the sites that receive comparable solar radiation hence heatload have comparable aspect values https://sites.science.oregonstate.edu/~mccuneb/JVSreprint13.603-606.pdf(See McCune, 2007).

[3]https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/silviculture/silviculture-reporting-results

[4] *Vaccinium membranaceum* North American distribution map from Virginia Tech Dendrology Fact Sheet.

The most important factor determining huckleberry cover was whether the site had been logged or not (Figure 4A); logged sites had significantly greater cover ($\bar{x}$=29% n =448) compared with other sites ($\bar{x}$=4.6 n=375) ($p<.05$). In logged sites A3YMAP was the most important determinant of cover. There was higher huckleberry cover in the sites where there had been more precipitation (i.e. A3MAP >1004 mm). Within these wetter sites huckleberry cover was greater in the sites in southern BC (i.e. below 500N) and on the south-facing aspects (i.e. SSE- to SSW-facing).

Sites where huckleberry cover was recorded were distributed across climatic conditions characterized by a Mean Annual Precipitation (MAP) average over the last 3 years (A3YMAP)[5] of 400 to 2500mm/year) and an average 3 year Mean Annual Temperature (A3YMAT) of 0^0C to about 8^0C. (Figure 3A). Most of the sites were in the ESSF zone, followed by the ICH and SBS zones; most of the sites with high cover were in ESSF zone. The following Results focus on these 3 Zones.

Average cover in the ESSF, ICH and SBS zones increased from about 1% to about 20% as MAP increased from about 400mm to 1400mm (R^2=.45) in an analysis based on subzone averages (Table 1). No relationship between cover and A3YMAT was detected (R^2=.02) indicating that cover is more sensitive to precipitation than temperature (in the range of temperatures observed on these sites for the year surveyed).

Logged sites in the ESSF and ICH had higher huckleberry cover and lower canopy cover than unlogged sites (Figure 4). In logged sites huckleberry cover declined to zero where canopy cover was >50% (Figure 5A); in unlogged sites, where huckleberry cover was typically much lower, no significant effect of canopy cover was apparent.

In logged sites huckleberry cover increased with elevation in the range from about 1200 to about 2000m asl (Figure 5B). In unlogged sites there was no obvious trend with respect to elevation.

Huckleberry cover and canopy cover increased with time since logged for about 30 or 40 years; after that canopy cover continued to increase but huckleberry cover declined. Sites logged up to about 20 years prior to sampling, which was done between 2016 and 2020, featured a range of harvest methods including clearcut, clearcut with reserves, retention and selective logging; almost all sites logged about 20 to 35 years prior were clearcut. A number of sites logged around 35 years prior were selectively logged. No information on logging method was available for most sites logged over 40 years prior. In sites logged ~5 to 50 years prior huckleberry cover was high (>30%) in some sites that featured a range of canopy cover and was low (<5%) in other sites; the later sites typically featured high canopy cover.

3.2 Huckleberry Berry Abundance

The most important factors determining berry abundance were huckleberry cover, climatic conditions, canopy cover and whether the site had been logged.

[5] A3YMAP and A3YMAT values were based on the average of the current and 2 previous years data.

There was a strong positive relationship[6] between huckleberry cover and berry abundance (R^2=.71). The ESSFu[7] subzone is a notable outlier with low cover but high berry abundance.

Berry abundance was highest in the ESSF ($\bar{x}$=1980/100m^2, sd=4168), followed by the ICH ($\bar{x}$=1684/100m^2, sd=3616) and was considerably lower in the SBS ($\bar{x}$==330/100m^2, sd=978) (Figure 3B).

Climatic conditions observed in previous years had influences on plant cover and berry abundance. Berries were found in the same range of sites where the huckleberry plant cover was recorded (i.e., in sites where A3YMAP ranged from about 400 to 2500 mm and A3YMAT ranged from 0^{0}C to 8^{0}C) (Figure 3B).

In most sites (i.e. those with huckleberry cover <=50%), elevation and aspect influenced berry abundance. Overall, higher elevation sites (>1200 m asl) had greater berry abundance (Figure 5D). In sites where huckleberry cover was between 25% and 50%, berry abundance was greater at lower elevations (<1450 m asl; $\bar{x}$=9388, *n*=16) vs at higher elevations (>1450 m asl; $\bar{x}$=2769, *n*=196). Greater berry abundance was found in the higher elevation sites (i.e. >1450 m asl) that were NNW- to NNE-facing ($\bar{x}$=7035, *n*=17) vs ($\bar{x}$=2364, *n*=179) on other aspects.

Abundance was greater in logged sites ($\bar{x}$=2641, *n*=448) vs other sites ($\bar{x}$=712, *n*=375). In logged sites factors related to location (i.e. longitude, latitude, elevation) and recent climatic conditions (i.e. A3YMAP) affected berry abundance. Logged sites that were west of -118 W longitude (i.e. west of the Kootenays) had higher abundance ($\bar{x}$=3063, *n*=359) than those east of there ($\bar{x}$=939, *n*=69). In the eastern Kootenays (i.e. in sites > -118 longitude) and south of 52^{o}N, abundance was greater above 1899 m ($\bar{x}$=4713, *n*=71) vs below that elevation ($\bar{x}$=2455, *n*=281)[8]. In the higher elevation sites, berry abundance was greater where A3YMAT was >2.3^{0}C ($\bar{x}$=10,240, *n*=21) vs where it was <2.3^{0}C ($\bar{x}$=2392, *n*=50).

Berry abundance increased from virtually none to about 2000/100m^2 as MAP increased from about 500mm to 1500mm then abundance levelled off (R^2=.59) (Figure 3B). The ESSFu and ESSFwc are notable outliers in that they have considerably more berries than other subzones with similar MAP. No relationship between productivity and A3YMAT was detected (R^2=.03) indicating that productivity was more sensitive to precipitation than temperature (in the range of temperatures observed on these sites for the year surveyed).

In logged sites, berry abundance was highest in sites with canopy cover less than 25%. In unlogged sites berry abundance was highest when canopy cover was <10% (Figure 5C). In the ESSF, ICH and SBS (with only one occurrence), high berry abundance (i.e. >2000 berries/100m^2) was found in logged plots that had a canopy cover of no more than 40% and at elevations ranging from 982–2168 m asl; these sites were 20% (162/823) of the logged plots. Only 1% (22/374) of plots in unlogged sites (with elevations ranging from 803-1760 m asl and canopy cover not exceeding 45%) had berry

---

[6] For the relationships reported with R^2 values for abundance, outliers (i.e., 3 subzones with >4,000 berries/100m^2) were removed.

[7] The ESSFu (undifferentiated) occurs in the in the Kalum District in the NW corner of BC in the Kalum District bordering the Alaska Panhandle. It is above the ICHvc and ICHwc and west of the ESSFwv and is likely most similar to the ESSFwv and ESSFvc – i.e. a wet to very wet and cold to very cold subzone variant.

[8] All noted differences are significant at p<0.5)

production >2000 berries/100m^2; none occurred in the ICH and two occurred in the SBS. We did not detect strong effects for any of the variables describing logging methods, including year since logging.

4. DISCUSSION

4.1 Relationship Between Huckleberry Plant Cover and Berry Abundance

There was a positive relationship between huckleberry cover and berry abundance (i.e. R^2=.71). Because berry abundance varies so much year to year, using huckleberry cover as a metric to identify best sites to manage for potential berry abundance is reasonable but it should be noted that berry abundance was greater in sites with <25% canopy cover while plant cover was tolerant of a higher level of canopy cover (i.e. up to 40%).

4.2 BEC Unit, Site Factors, and Climatic Impacts

We found that huckleberry was well adapted to cooler, moister climatic conditions typical of the ESSF and higher elevations in the ICH Zone; others have reported good berry abundance in moister SBS subzones (I. Ronalds pers.com 2024). This is consistent with others who determined that favourable conditions for plants and berries are more likely to be found at higher elevations and in cool moist climates (Klinkenberg 2020, BECweb), such as on Mt. St. Helens (Hunn and Norton 1984, Yang 2008), and in mid-elevation and subalpine sites such as on Mt Hood, Oregon (Norton et al. 1999), and in BC (Proctor et al. 2023). Proctor et al. (2023) found good huckleberry berry patches were more common in a range of 1084–2246 m asl, on mid vs. upper slope sites, on slopes between 10-35%, and on west facing slopes, i.e. on slopes typically associated with lower solar radiation and moderated heat.

Our results indicated that berry abundance was correlated with climatic conditions, particularly those associated with temperature and moisture regime in previous months, seasons, and years. This is consistent with other studies that found that weather conditions in current and preceding years impact berry production (Holden et al. 2012, Friesen et al 2016, McLellan 2023). This is likely because of the general health of the plants, and bud set, which occurs the year before berry production and then influences subsequent berry abundance. For example, in the SBS and ICH, higher berry yields were related to cooler, moister conditions in preceding time periods. However, exceedingly low temperatures may mean exposure of plants to freezing damage if snowpack levels are low. Hence there could be significant differences in berry abundance with the same level of plant cover in different years depending on snow cover and winter and spring temperatures. Deep snow cover helps protect plants from exposure to freezing temperatures and desiccation that can have detrimental effects on flower buds and hence berry abundance (Minore et al 1979, Stark and Baker 1992). A near freezing dormant period has been shown to be beneficial for berry production (Barney 1999). However, heavy spring rains, hail and frost can negatively impact flowering and pollination success, and prolonged summer snowpack and cold temperatures as well as drought and hot temperatures can lead to failure of berry crops (Martin 1983, Stark and Baker 1992, Hobby and Keefer 2010, Holden et al. 2012, McLellan 2023). Holden et al. (2012) found that berry production was positively correlated with July daily temperature range, first snow free date, maximum snow water equivalent, and November-April cumulative precipitation, and was negatively correlated with the number of growing degree days above 1^{0}C and 5^{0}C and April-June average minimum temperature.

A complex and correlated set of climatic factors at multiple temporal scales influence berry abundance; these are important to consider when managing for huckleberry production.

4.3 Canopy Cover

We found optimal tree canopy cover varied depending on the climatic and site factors. In wetter climatic regions such as the ESSF and ICH, huckleberry plant cover and berry abundance were generally greater in sites with lower canopy cover (<50%), whereas in areas with warmer drier climatic conditions, such as that found in the SBS zone, canopy cover of up to 50% may be beneficial for huckleberry cover. Within the ESSF and ICH, huckleberry cover increased as the shrub recovered with more time since logging, but this increase over time is relatively short-lived because of the negative effect of shading due to the rapid increase in canopy cover post-harvest.

In the Pacific Northwest, canopy cover provides huckleberry plants with shade, moist conditions and protection from frost (Minore, Smart and Dubrasich (1979), Forney (2016), Barney (1999); however, competition for resources from trees and other plants can reduce abundance of berry patches (Barney 2005). Canopy cover greater than 30-50% has been found to decrease overall black huckleberry plant growth (Stark and Baker, 1992; Martin, 1996; Barney 1999, Burton, 2001, Forney 2016) and berry production (Forney 2016). Optimal canopy cover for berry production was 34% in west-central Alberta (Nielsen et al. (2004b), <30% in NW Montana (Martin 1979, 1980), 20% in SE BC (Keefer et al. 2011) and about 10% in the central BC ICHmc subzone (Burton 1998).

Some canopy cover is likely beneficial in exposed drought and frost prone sites, whereas on moister and/or cooler sites, tree cover will likely negatively impact huckleberry berry abundance.

4.4 Forest Management Practices

We found greater huckleberry cover in logged areas. Previous research has demonstrated a complex, non-linear relationship between huckleberry response with time since logging. High berry production has been observed in clearcuts across many studies (Nielson et al. 20024a, Proctor et al. 2023, Souliere et al. 2020), particularly in winter logged sites that were not planted or treated with herbicide (Proctor et al. 2023) and in sites that were not scarified (Martin 1983). Further, high berry production was found in stands that were logged 10-20 years ago (Souliere et al. 2020, Proctor et al. 2023). Mature forests had poorer berry production compared to younger stands on cooler aspects in NW Montana; however, in this same study, berry production was lower on logged sites on dry warm aspects (Martin 1983). Thinning overstory trees increased light availability to understory vegetation, extending the successional period conducive to huckleberry growth and berry abundance on cool aspects (Simonin 2000). Forest management activities that negatively impact the presence and abundance of plants (e.g. mechanical site preparation, summer logging) have enduring negative impacts on berry production (Martin 1983; Proctor et al. 2023). Our results and those of others suggest that berry production will decline over time as forests develop and the canopy closes. Silviculture practices that speed up the development of a dense canopy such as high stocking levels, brushing, and fertilization will therefore be detrimental to huckleberry production over time. Prescribed burning can enhance huckleberry cover by reducing the abundance of competing shrubs like rhododendron and azalea (Chandler et al. 2017).

4.5 Predictions in Consideration of Climate Change

Climatic determinants from past years may not be a reliable indicator of berry abundance in the future given the differences between past, current, and predicted climatic conditions (Prevey et al. 2020). The distribution of huckleberry shrubs is predicted to change in the future. A 2020 study predicted a decrease in suitable habitat of 5-40% at lower latitudes and an increase of 5-60% at higher latitudes in coastal western North America, from southern California north through British Columbia and east to central Alberta and Montana by 2100 (Prevey et al. 2020). Another study predicted an overall increase in suitable habitat by 84-122% in the southern Canadian Rocky Mountains by 2080, with more suitable habitat at higher elevations (1139-2035m asl; Roberts et al. 2014). The phenology of berry production in huckleberries is predicted to advance by as much as 24-52 days by 2100, and result in earlier flowering that may be more susceptible to spring frosts and lead to subsequent reduction in berry yield (McLelland et al. 2020; Prevey et al. 2020). These studies suggest land managers should focus enhancement efforts at higher elevations on the landscape.

5. CONCLUSIONS AND EXPLANATION

5.1 Huckleberry Cover

1. **Cover was greater in logged sites vs other sites.** Open logged sites provide a better environment as they typically have a lower canopy cover which likely means huckleberry plants experience more sun and warmer temperatures and less competition for resources from other plants particularly overtopping trees. These sites may have fewer shrubs like rhododendron and false azalea, as these shrubs are less tolerant of burning than huckleberry, and slash burning was a very common practice on cutblocks up until the late 1980s.
2. **In logged sites cover declined to virtually zero where canopy cover was >50%.** Huckleberry plants are not well adapted to high canopy cover conditions possibly as they are too cold and wet and have limited sunlight.
3. **Overall cover increased as MAP increased and then increased as MAP declined**. There is a maximum threshold of about 1400mm MAP after which more moisture is a negative i.e. conditions are too wet.
4. **In logged sites although MAP was the most important determinant of cover: cover was greater where MAP was higher.** Since logged site are more open than other sites they may not as negatively affected by high MAP as they would experience higher levels of solar insolation and warmer temperatures that would promote evaporation allowing for warmer and less water saturated soil conditions etc.
5. **In logged sites with higher MAP cover was greater on south facing sites.** In the very wet sites, the warm conditions on S facing slopes provides a better environment for huckleberry plants. In contrast in drier regions S-facing slopes may be less favourable as plants are exposed to too hot and or dry conditions.

6. **Cover was highest in the ESSF, followed by ICH and SBS zones.** The conditions in the ESSF are optimal for huckleberry, providing a suitable climate and less competition from other plants. In the ESSF the other shrubs are typically rhododendron and false azalea, both of which are negatively impacted by slashburning, whereas in the ICH and SBS there are a number of shrubs including species of elderberry, current, *Rubus* that are tolerant or even promoted by burning.

5.2 Huckleberry Berry Abundance

7. **Black huckleberry berry abundance was positively correlated with black huckleberry plant cover.** Sites with greater plant cover have the potential to yield more berries as more flowers can be supported on larger plants.
8. **Berry abundance was greater in more open logged sites.** Logged areas are less shady than other sites; although shade could be beneficial in dry hot sites, huckleberry tends to do grow in areas where conditions are neither hot or dry and therefore shade doesn't confer an advantage but rather likely impacts plant vitality and hence berry abundance as higher levels of sunlight allow for greater photosynthesis, plant growth and flowering success.
9. **Berry abundance was greater in the ESSF compared with ICH and SBS Zones.** The ESSF provides better conditions for huckleberry plants than the other Zones for reasons discussed under *Huckleberry Cover,* and this allows for greater berry abundance.
10. **Within the ESSF zone, berry abundance was greatest in the wetter colder subzones and sometimes higher in the more open cooler moister parkland and woodlands variants than in the forested variant below.** Climatic conditions in the ESSF tend to be cooler and moister than those in the ICH and SBS and this appears to be more conducive to berry production. As with the differences associated with Zones, cooler moister conditions associated with certain subzones appear to be more suitable to berry production - as huckleberry is best adapted to cool moist conditions.
11. **In ESSF optimal climatic conditions for berry production were slightly cooler than was the case for optimal plant cover.** Cooler temperatures ensure less drought stress during fruit maturation resulting in higher berry yields whereas the plants themselves were more tolerant of drier warmer conditions. Berry production is very sensitive to climatic events at specific times of the year. For example, although cool moist weather may be generally favourable, periods of hot dry weather when the plants are flowering may result in flower desiccation and hence poor berry yields.
12. **Berry abundance was correlated by climatic conditions in previous years.** Berry production is sensitive to climatic conditions, for example pollination asynchrony leading to poor berry crops can occur if the weather at the time of flowering is too cold or wet to allow for successful pollination. Likewise, periods of extreme cold and frost, heavy rains and or high winds can damage flowers while hot dry periods can desiccate the fruit.

6. MANAGEMENT RECOMMENDATIONS

6.1 Identify Areas Most Likely to Lead to Good Berry Production with Management

a. Identify geographic areas known to support high huckleberry cover. Refer to Table 1 and the vegetation tables in the BEC field guidebooks to determine the subzones and site series that feature significant amounts of huckleberry in mature forests as these are likely to provide for the greatest huckleberry cover in early seral stages after logging.
b. Use PEM/TEM maps of site series where available to map key candidate sites, or map areas of higher huckleberry cover using remote sensing-based huckleberry mapping.
c. Use the BEC system field guides, subzone maps, and projections of future climate envelopes to identify the areas where management to enhance huckleberry plant cover and berry production is most likely to be successful now and in the future given the climatic indicators for the zones (see BECweb, Centre for Forest Conservation Genetics | CFCG | UBC Forestry). These will typically be the upper elevation portions of the current distribution.

6.2 Plan Operations

a. At the regional scale, provide for a range of suitable conditions such that when there are unfavourable climatic conditions in one area, other places with suitable conditions may exist.
b. At the landscape level – locate and schedule forest harvesting to provide for open canopy sites within watersheds and across Grizzly Bear Population Units over time.

6.3 Implement Stand Level Practices That Enhance Huckleberry Cover

a. Implement silvicultural practices that provide open canopy berry patches over time. This could be a variety of alternative silviculture systems such as shelterwood systems with partial cutting, variable retention cutting, and clearcutting with reserves.
b. Implement management practices that minimize damage to huckleberry plants during logging (e.g. avoid widespread use of heavy machinery when sites have limited snow cover and consider winter logging operations).
c. Avoid mechanical site preparation that damages or destroy huckleberry plants (above ground and below ground).
d. Consider the use of prescribed burning to enhance huckleberry cover by reducing the abundance of competing shrubs like rhododendron and azalea.
e. Maintain open patches within cutblocks by reducing conifer stocking or use cluster planting with openings.
f. Avoid widespread intensive forest management practices designed to speed up canopy closure across a site such as mechanical brushing, herbicide application, or fertilization, or use topical treatments rather than broadcast application.
g. Consider periodic entry into blocks to remove some overstory trees to help retain open berry patches in the long-term.

h. Consider how access may affect how bears are able to use the resources in the block post-harvest. The simplest way to ensure access is to deactivate in-block roads after silviculture work is done.

7. ACKNOWLEDGMENTS

Thanks to Laura Smit for her help with the data. Earlier versions of the report were reviewed by Will Mackenzie, Irene Ronalds, Deb McKillop, Peter Ott, Catherine Denny, Bruce McLellan and Genevieve Lachance. Many thanks to all the people who contributed data, expertise, and advice including Mackenzie Clarke, Clayton Lamb, Michael Proctor, Bruce McLellan, Tony Hamilton and the many field crew members.

8. REFERENCES

Armstrong, J. (2020). Living from the Land: Food Security and Food Sovereignty Today and into the Future. In N.J. Turner (Ed.), Plants, People, and Places: The roles of ethnobotany and ethnoecology in Indigenous Peoples' land rights in Canada and beyond (pp. 36-50). McGill-Queen's University Press. https://doi.org/10.1515/9780228003175

Barney, D. 1999. Growing Western Huckleberries. Moscow, ID: Agricultural Publication of Cooperative Extension System, University of Idaho. 22 p.

Barney, D. 2005. Prospects for Domesticating Western Huckleberries. Small Fruits Review. 2 (1):15-29. See Forney 2016.

Beaudry, L., M. Martin and J. Paczkowski. 2021. Using Silviculture to Maintain and Enhance Grizzly Bear Habitat in Six Variants of the Prince George Forest Region. Prepared for Habitat Branch Ministry of Environment, Lands and Parks. Victoria, British Columbia.

BECweb. 2025. Biogeoclimatic Ecosystem Classification Program Website. https://www.for.gov.bc.ca/hre/becweb/resources/classificationreports/index.html. [Accessed April 22, 2025].

British Columbia Ministry of Forests and Range and British Columbia Ministry of Environment. 2010. Field Manual for Describing Terrestrial Ecosystems (2nd ed., 266 p). Land Manag. Handbook (25), Victoria, BC: Research Branch B.C. Ministry of Forests and Range. https://www2.gov.bc.ca/assets/gov/environment/plants-animals-and-ecosystems/conservation-data-centre/field_manual_describing_terrestrial_ecosystems_2nd.pdf. [Accessed April 24, 2025].

Burton, P. 1998. Inferring the Response of Berry-Producing Shrubs to Different Light Environments in the ICHmc. FINAL REPORT. SCBC Project Number FR-96/97-118. FRBC Project Number SB96030-RE Unpublished.

Burton, P., Burton, C., and McCulloch, L. 2000. Exploring Options for the Management of Wild Berries in the Kispiox Forest District: Phase One of a Pilot Project Focusing on the Suskwa River Area. Prepared for the B.C. Ministry of Forests, Kispiox Forest District, Hazelton, B.C.

Burton, P.J. 2001. Response of berry-producing shrubs to different light environments in northwestern British Columbia. Unpublished Report, prepared by Symbios Research and Restoration. Smithers BC.

Chandler J.R., Haeussler S, Hamilton EH, Feller M, Bradfield G, Simard SW (2017). Twenty years of ecosystem response after clearcutting and slashburning in conifer forests of central British Columbia, Canada. PLoS ONE 12(2): e0172667. https://doi.org/10.1371/journal.pone.0172667

Clarke, M. 2022. Quantifying grizzly bear (*Ursus arctos*) habitat selection for a seasonal resource, the Canadian buffaloberry (*Shepherdia canadensis*) in southern British Columbia. MSc. UBC Okanagan, Kelowna, BC. https://open.library.ubc.ca/media/stream/pdf/24/1.0413210/3. [Accessed April 25, 2025].

COSEWIC. 2012. COSEWIC assessment and status report on the Grizzly Bear Ursus arctos in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xiv + 84 pp. https://publications.gc.ca/collections/collection_2013/ec/CW69-14-166-2012-eng.pdf. [Accessed April 25, 2025].

Deur, D. & James, J.E. Jr. (2020). Cultivating the Imagined Wilderness: Contested Native American Plant-Gathering Traditions in America's National Parks. In N.J. Turner (Ed.), Plants, People, and Places: The roles of ethnobotany and ethnoecology in Indigenous Peoples' land rights in Canada and beyond (pp. 220-237). McGill-Queen's University Press. https://doi.org/10.1515/9780228003175

Ferguson, R. (2025). Effects of fire and landscape management of st'xalq (black huckleberry), a key Indigenous food plant in the Okanagan (Master's thesis, University of British Columbia Okanagan). University of British Columbia Okanagan.

Friesen, C. 2016. Ecology and Management of Big Huckleberry Literature Review. USFS R6 Ecology Program. https://docsbay.net/doc/960516/ecology-and-management-of-big-huckleberry. [Accessed April 25, 2025].

Forney, A. 2016. Patterns of harvest: Investigating the social-ecological relationship between huckleberry pickers and black huckleberry (*Vaccinium membranaceum* Dougl. Ex Torr.; Ericaceae) in southeastern British Columbia. M.A thesis, University of Victoria, Victoria, BC.

Hobby, T. and Keefer M.E. 2010. A black huckleberry case study in the Kootenay region of British Columbia. BC Journal of Ecosystems and Management 11(1&2):52–61. https://jem-online.org/index.php/jem/article/view/66/24. [Accessed April 25, 2025].

Holden, Z.A., Kasworm, W.F., Servheen, C., Hahn, B., Dobrowski, S. 2012. Sensitivity of berry abundance to climatic variation in the Cabinet-Yaak Grizzly Bear Recovery Zone, Northwest United States, 1989-2010. Wildlife Society Bulletin, DOI: 10.1002/wsb.128.

Hunn, E.S. and Norton, H.J. 1984. Impact of Mt. St. Helens ashfall on fruit yields of mountain huckleberry, *Vaccinium membranaceum*, important Native American food. Economic Botany. 38(1): 121-127. Contact cfriesen@fs.fed.us or http://ecoshare.info/ for a copy.

Keefer, M., Cocksedge, W., Munro, R., Meuleman, J., and MacPherson, N. 2010. What about the berries? Managing for understory species. Royal Roads University The Centre for Livelihoods and Ecology.

Ferguson, R. (2025). Effects of fire and landscape management of st'xalq (black huckleberry), a key Indigenous food plant in the Okanagan (Master's thesis, University of British Columbia Okanagan). University of British Columbia Okanagan.

Forney, A. (2016) Patterns of harvest: Investigating the social-ecological relationship between huckleberry pickers and black huckleberry (Vaccinium membranaceum Dougl. Ex Torr.; Ericaceae) in southeastern British Columbia (Master's thesis, University of Victoria). University of Victoria.

Klinkenberg, B. (Editor) 2020. E-Flora BC: Electronic Atlas of the Flora of British Columbia [eflora.bc.ca]. Lab for Advanced Spatial Analysis, Department of Geography, University of British Columbia, Vancouver.

Lamb, C.T., Garth, M., Reid, A., Smit, L., Proctor, M., McLellan, B.N., Nielsen, S.E., and Boutin, S. 2018. Effects of habitat quality and access management on the density of a recovering grizzly bear population. Journal of Applied Ecology, 55: 1406-1417.

Lamb, C. 2019. Grizzly bear population dynamics across abundance and human influence gradients. PhD thesis, University of Alberta, Edmonton, Alberta, Canada.

Martin, P. 1983. Factors Influencing Globe Huckleberry Fruit Production in Northwestern Montana. Bears: Their Biology and Management, 5:159–165. https://doi.org/10.2307/3872533.

McClelland, C.J.R., Coops, N.C., Kearney, S.P., Burton, A.C., Nielsen, S.E., and Stenhouse, G.B. 2020. Variations in grizzly bear habitat selection in relation to the daily and seasonal availability of annual plant-food resources. Ecological Informatics, 58: 101116.

McLellan, B. 2023. Grizzly bear science and the art of wilderness life: forty years of research in the Flathead Valley. Rocky Mountain Books Ltd.

McLellan, C. 2018. Food availability and grizzly bear (*Ursus arctos*) selection of post-fire and thinned forests in the mountain national parks of Canada. MSc thesis. University of Alberta, Dept. of Renewable Resource, Edmonton, Alta, Canada.

Minore, D. 1972. The wild huckleberries of Oregon and Washington: a dwindling resource. USDA Forest Service research paper PNW, 143. https://doi.org/10.5962/bhl.title.87986.

Minore, D. 1979. Huckleberry ecology and management research in the Pacific Northwest. USDA Forest Service PNW GTR PNW-93.

Nielsen, S.E., Boyce, M.S., and Stenhouse, G.B. 2004. Grizzly bears and forestry: I. Selection of clearcuts by grizzly bears in west-central Alberta, Canada. Forest Ecology and Management, 199: 51-65.

Prevey, J.S., Parker, L.E., Harrington, C.A., Lamb, C.T. and Proctor, M.F. 2020. Climate change shifts in habitat suitability and phenology of huckleberry (*Vaccinium membranaceum*). Agricultural and Forest Meteorology, 280: 107803.

Proctor, M., Lamb, C.T., and MacHutchon, G. 2017. The grizzly dance between berries and bullets: relationships among bottom-up food resources and top-down mortality risk on grizzly bear populations in southeast British Columbia. Trans-border Grizzly Bear Project. Kaslo, BC, Canada.

Proctor, M. F., B. N. McLellan, G. B. Stenhouse, G. Mowat, C. T. Lamb, and M. Boyce. 2018. Resource Roads and Grizzly Bears in British Columbia, and Alberta. Canadian Grizzly Bear Management Series, Resource Road Management. Trans-border Grizzly Bear Project. Kaslo, BC. Canada. http://transbordergrizzlybearproject.ca/research/publications.html

Proctor, M. F., B. N. McLellan, G. B. Stenhouse, G. Mowat, C. T. Lamb, and M. S. Boyce. 2020. Effects of roads and motorized human access on grizzly bear populations in British Columbia and Alberta, Canada. Ursus 2019:16–39.

Proctor, M., Lamb, C., MacHutchon, A.G., Kasworm, W., Paetkau, D., Lausen, C., Palm, E., Boyce, M. and Servheen, C. 2023 Berries and bullets: influence of food and mortality risk on grizzly bears in British Columbia. Wildlife Monograph 2023:213:e1078. Doi:10.1002/wmon.1078.

Roberts, D.R., Nielsen, S.E. and Stenhouse, G.B. 2014. Idiosyncratic responses of grizzly bear habitat to climate change based on projected food resource changes. Ecological Applications, 24:1144-1154.

Simonin, Kevin A. 2000. *Vaccinium membranaceum*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). www.fs.usda.gov/database/feis/plants/shrub/vacmem/all.html. [2025, January 1].

Souliere, C.M., Coogan, S.C.P., Stenhouse, G.B., and Nielsen, S.E. 2020. Harvested forests as a surrogate to wildfires in relation to grizzly bear food-supply in west-central Alberta. Forest Ecology and Management, 456: 117685.

Spencer, M., Willsey, T., Berg, K., and Anderson, J. 2020. A literature review for the western science state of knowledge for huckleberries.

Stark, N. and S. Baker. 1992. The Ecology and Culture of Montana Huckleberries: A guide for growers and researchers. Misc. Pub 52. University of Montana School of Forestry, Missoula MT.

Trusler, S. L., & Johnson, L. M. (2008). "Berry patch" as a kind of place: the ethnoecology of black huckleberry in northwestern Canada. Human Ecology, 36 (4), 553-568. http://www.jstor.org/stable/27654313

Turner, N.J. (2007). Plant technology of First Peoples in British Columbia. Royal BC Museum.

Turner, N.J. (2005). The earth's blanket: Traditional teaching for sustainable living. University of Washington Press.

Turner N.J., Bouchard, R.M. & Kennedy, D.I.D. (1980). Ethnobotany of the Okanagan-Colville Indians of British Columbia and Washington (Occasional Paper No. 21). British Columbia Provincial Museum.

Turner, N., Deur, D., & Lepofsky, D. (2013). Plant management systems of British Columbia's First Peoples. BC Studies, (179), 133-155. https://doi.org/10.14288/bcs.v0i179.184112

Turner, N.J. & Reid, A.J. (2022). When the wild roses bloom: Indigenous knowledge and environmental change in northwestern North America. FACETS, 7(1), 265-288.

Virginia Tech Department of Forest Resources and Environmental Conservation. https://dendro.cnre.vt.edu/dendrology/syllabus/factsheet.cfm?ID=460. [Accessed April 12, 2025].

Yang, S. et al. 2008. Colonization genetics of an animal-dispersed plant (*Vaccinium membranaceum*) at Mount St. Helens, Washington. Molecular Ecology 17:731-740. Contact cfriesen@fs.fed.us or http://ecoshare.info/ for a copy.

Table 1. Huckleberry plant cover (%) (A) and berry abundance (berries/100m²) (B) by BEC zone and subzone.

1A.

	Huckleberry Cover (%) by Subzone in the ESSF, ICH and SBS Zones																
	dc	**dk**	**dm**	**dv**	**dw**	**mh**	**mk**	**mm**	**mv**	**mw**	**un**	**vc**	**vk**	**wc**	**wh**	**wk**	**wm**
ESSF	*n* = 84	*n* = 61		*n* = 5		*n* = 42		*n* = 86	*n* = 2		*n* = 41	*n* = 93		*n* = 127	*n* = 34	*n* = 16	n=40
%	30	17		9		24		10	9		8	19		29	26	5	26
MAP	1179	1242		1032		1114		1306	675		1524	1902		1394	1316	1026	1202
MAT	3.5	2.5		2.2		4.6		2.7	1.5		1.0	2.3		2.5	4.3	3.1	2.8
ICH			*n* = 4		*n* = 2		*n* = 27			*n* = 35			*n* = 12	*n* = 3		*n* = 18	
%			41		3		6			14			17	3		18	
MAP			1159		648		849			1039			1480	728		1631	
MAT			4.6		5.6		4.5			5.2			4.6	3.5		4.3	
SBS					*n* = 5		*n* = 32						*n* = 31			*n* = 23	
%					1		2						3			3	
MAP					459		536						878			716	
MAT					3.4		3.2						3.5			3.9	

0-4.9
5-9.9
10-19.9
20-29.9
>30

1B.

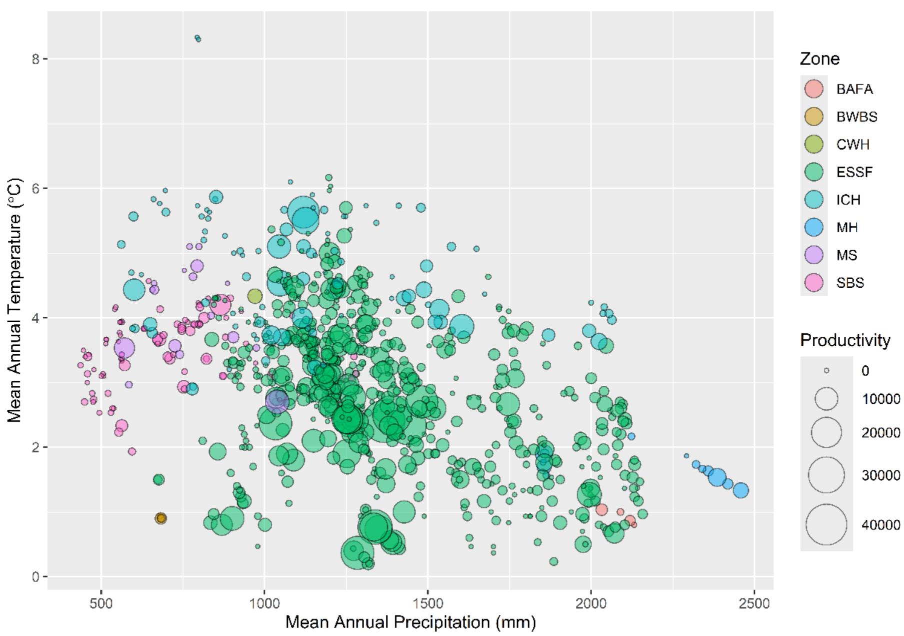
	Huckleberry Berry Abundance (berries/100m²) by Subzone in the ESSF, ICH and SBS Zones																
	dc	**dk**	**dm**	**dv**	**dw**	**mh**	**mk**	**mm**	**mv**	**mw**	**un**	**vc**	**vk**	**wc**	**wh**	**wk**	**wm**
ESSF	*n* = 84	*n* = 61		*n* = 5		*n* = 42		*n* = 86	*n* = 2		*n* = 41	*n* = 93		*n* = 127	*n* = 34	*n* = 16	n=40
#	1616	1408		721		910		741	852		4105	903		4121	1546	710	2037
MAP	1179	1242		1032		1114		1306	675		1524	1902		1394	1316	1026	1202
MAT	3.5	2.5		2.2		4.6		2.7	1.5		1.0	2.3		2.5	4.3	3.1	2.8
ICH			*n* = 4		*n* = 2		*n* = 27			*n* = 35			*n* = 12	*n* = 3		*n* = 18	
#			7529		533		800			1808			1862	665		1652	
MAP			1159		648		849			1039			1480	728		1631	
MAT			4.6		5.6		4.5			5.2			4.6	3.5		4.3	
SBS					*n* = 5		*n* = 32						*n* = 31			*n* = 23	
#					86		141						431			512	
MAP					459		536						878			716	
MAT					3.4		3.2						3.5			3.9	

0-199
200-599
600-1399
1400-2999
>3000

Figure 3. Black huckleberry plant cover (%)[9] (A) and berry abundance (berries/100m^2)[10] (B) by BEC zone with Mean Annual Precipitation and Mean Annual Temperature (climate variables are an average of the sample year and one and two years previous).

3A.

3B.

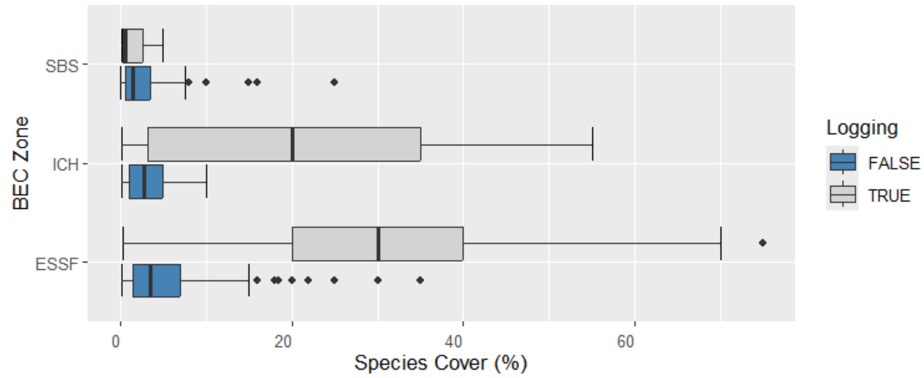


[9] Regarding the key the different colours represent different BEC zones. The bubble size represent a reference value of a continuous variable (i.e. huckleberry cover and berry abundance). For example, the bubble labelled 20 represents a cover value of 20%.

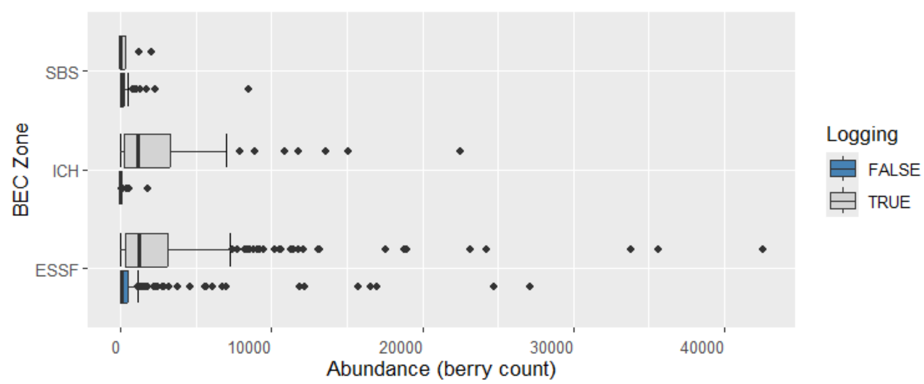
[10] Regarding the key the different colours represent different BEC zones. The bubble size represent a reference value of a continuous variable (i.e. huckleberry berry abundance). For example, the bubble labelled 1000 represents a berry abundance value of 1000 berries/100m^2.

Figure 4. Black huckleberry cover (A) and berry abundance[11] (berries/100m^2) (B) and tree canopy cover (C) in logged and unlogged sites by BEC zone.

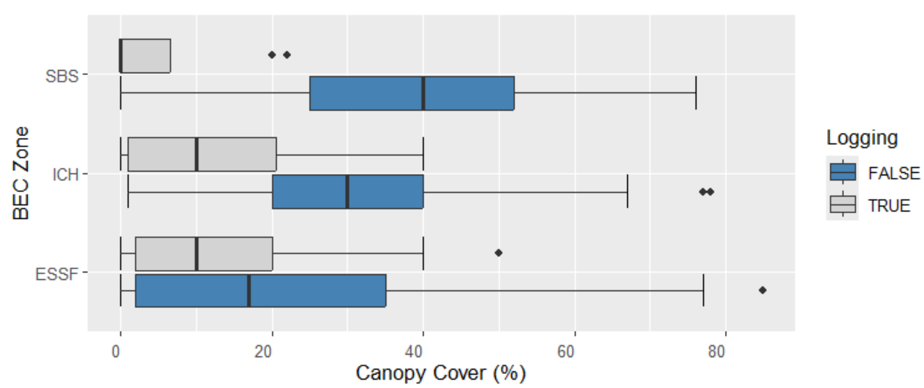
4A. Black huckleberry cover



4B. Black huckleberry abundance



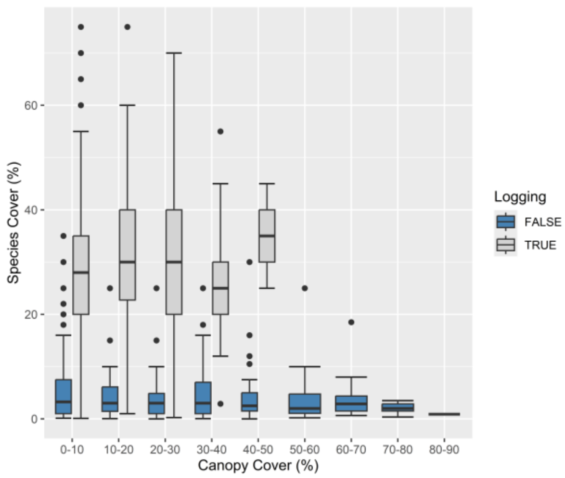
4C. Canopy cover



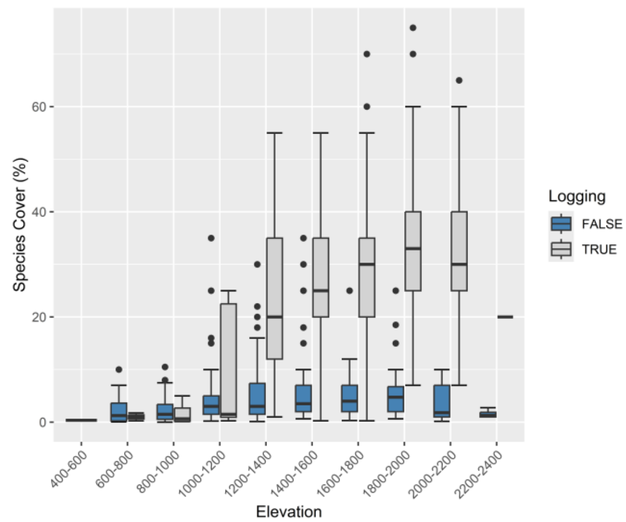
[11] Berry abundance outliers (greatest 5%) removed.

Figure 5. Black huckleberry species cover (%) by canopy cover (A) and elevation (B) in logged and unlogged sites; and berry abundance[12] (berries/100m^2) by canopy cover (C) and elevation (D) in logged and unlogged sites.

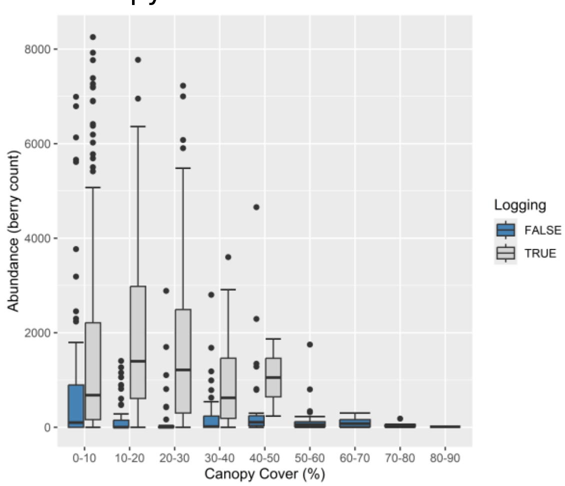
5A. Canopy Cover



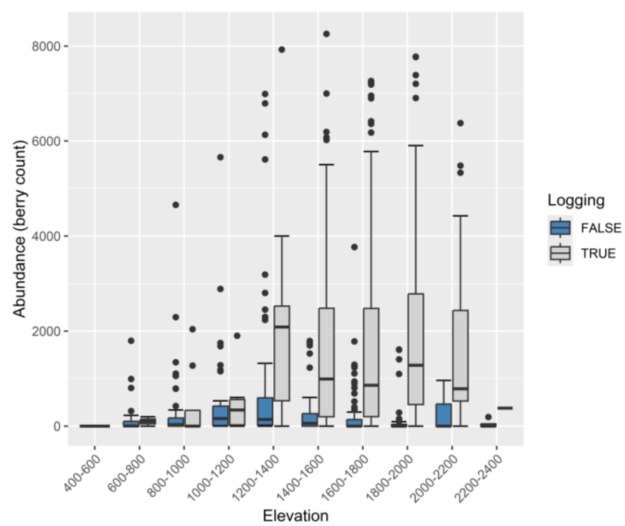
5B. Elevation



5C. Canopy Cover



5D. Elevation



[12] Berry abundance outliers (greatest 5%) removed.