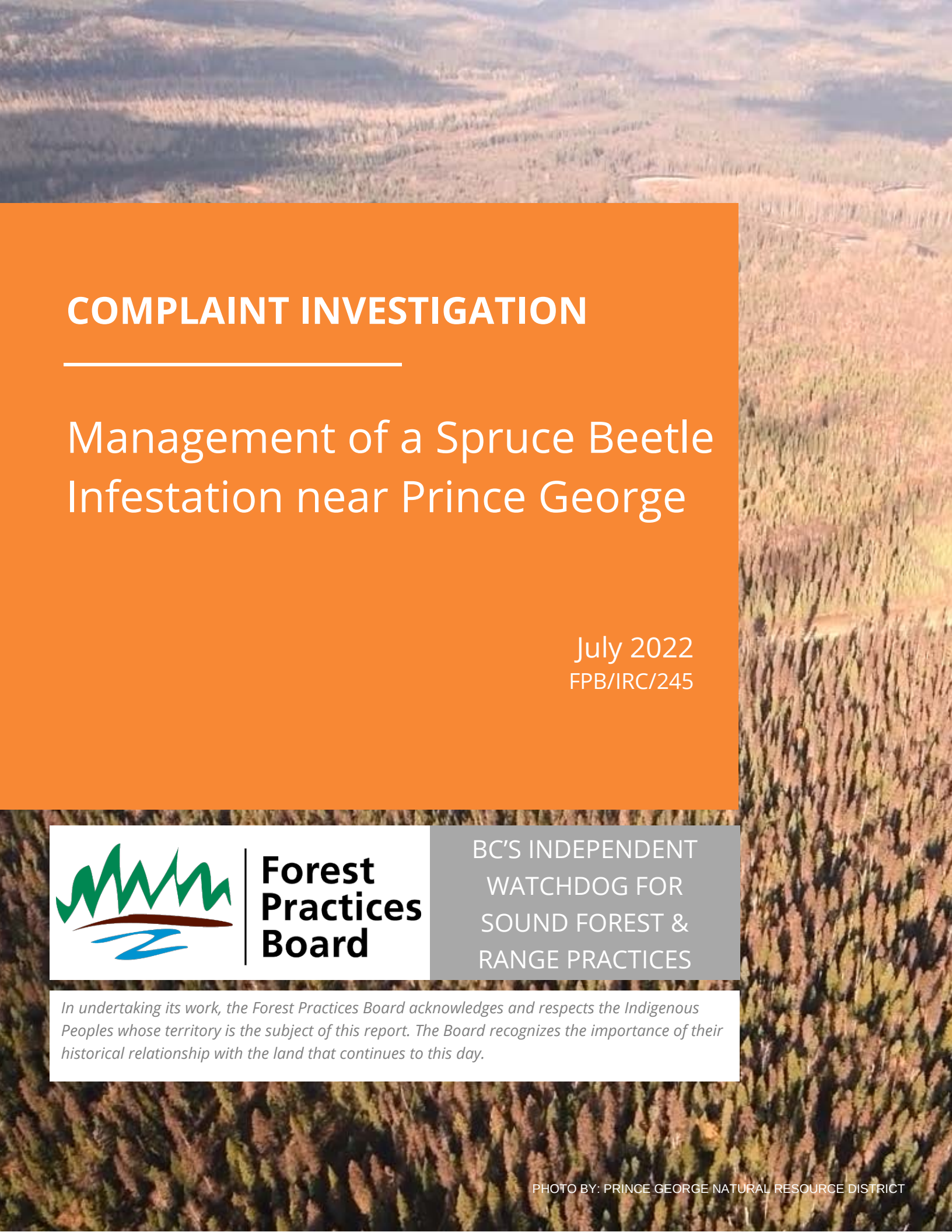

COMPLAINT INVESTIGATION

Management of a Spruce Beetle Infestation near Prince George

July 2022

FPB/IRC/245

Forest Practices Board

BC'S INDEPENDENT WATCHDOG FOR SOUND FOREST & RANGE PRACTICES

In undertaking its work, the Forest Practices Board acknowledges and respects the Indigenous Peoples whose territory is the subject of this report. The Board recognizes the importance of their historical relationship with the land that continues to this day.

PHOTO BY: PRINCE GEORGE NATURAL RESOURCE DISTRICT

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List of Acronyms Used

AOS	Aerial Overview Survey
BCTS	British Columbia Timber Sales
BMU	Beetle Management Unit
DMK	Mackenzie Natural Resource District
DPG	Prince George Natural Resource District
DSN	Stuart Nechako Natural Resource District
FPPR	Forest Planning and Practices Regulation
FRPA	Forest and Range Practices Act
MPB	Mountain Pine Beetle
RED	Regional Executive Director
THLB	Timber Harvesting Land Base
TSA	Timber Supply Area

Board Commentary

Since 2014, a spruce beetle outbreak in the Omineca Natural Resource Region (Omineca region), which includes the Prince George Natural Resource District (DPG), has affected a significant area. Although the majority of the outbreak's intensity has remained low, repeated attacks in the same area have killed tens of millions of spruce trees. The outbreak and associated salvage efforts may affect economic, biodiversity, forest carbon, and wildlife habitat values across the Omineca region.

The Board investigated a public complaint that BC Timber Sales (BCTS) and Canadian Forest Products Limited (Canfor) have not prioritized the harvest of spruce beetle-infested stands in the DPG. The complainants are concerned that future timber supply will be affected to the detriment of the region's economy if the most heavily infested stands are not harvested.

Choosing the appropriate response to the outbreak is challenging for the forest industry and government. Licensees and the ministry are attempting to limit losses to the mid-term timber supply. In light of the scale of the infestation, higher-level plan requirements, economics, and other forest values (such as endangered species habitat and biodiversity), some of the infested areas will never be harvested by BCTS or licensees.

It is clear to the Board that licensees are making progress in harvesting infested and dead spruce trees. Through the licensee-led development of action plans, it is now clearer what proportion of beetle-infested stands are available for harvest, considering forest resource values, access, and other factors. Licensees have also indicated that they plan to harvest accessible and available stands that have been significantly affected, within the shelf life of dead spruce. However, a considerable area of affected stands contribute to the timber harvesting land base where land use, and the issues noted above, result in no current plans to harvest these stands. Resolving those issues at the strategic level is required to determine if harvesting beetle-infested stands is appropriate. In addition, it is not clear how government will ensure the licensee action plans are being implemented.

The ministry has hosted annual bark beetle summits to provide Indigenous and local governments, forest professionals, and stakeholders with information on the outbreak. However, the investigation found that the ministry has neither systematically monitored nor publicly reported whether the forest industry is meeting government expectations. Improvements to how government monitors licensees' performance would allow the ministry and the public to better understand the management response to the impacts of the spruce beetle outbreak.

Thus, under section 131 of the *Forest and Range Practices Act* (FRPA), the Board is making the following recommendation:

1. The ministry should monitor and report annually to the public on BCTS's and licensees' performance to determine whether they are meeting government expectations and implementing beetle action plans.

Under section 132 of FRPA, the Board requests that the ministry respond to this recommendation by December 31, 2022, indicating that they:

a) accept the recommendations and describe how they will address or have addressed them; or
b) partially accept the recommendations and provide reasons why, and describe how they will address or have addressed them; or
c) do not accept the recommendations and provide reasons why.

The complainants put significant time and professional effort into collecting and analyzing data to support this complaint. They also took the time to meet with the ministry, BCTS, and licensees to discuss the reliability of their findings and to try to resolve their concerns.

The Board acknowledges the complainants' efforts and concern for this significant public policy issue.

Introduction

The Complaint

On March 23, 2021, the Forest Practices Board received a complaint about how government, BCTS, and Canfor are managing a spruce beetle infestation in the Prince George Natural Resource District (DPG).

The complainants are forest professionals. They compared spruce beetle infestation mapping with historical and planned harvesting activity in eight watersheds and concluded that harvest activity did not always focus on the most severely infested stands.

The complainants are concerned that:

1. The maintenance of timber supply may be jeopardized by not harvesting severely attacked stands of spruce and by logging less severely impacted spruce stands.
2. The harvesting of uninfested and minimally impacted stands, inadequate planning, and minimal use of pest reduction strategies are not appropriate forest health management.
3. Insufficient monitoring and minimal transparency hinder forest management and public understanding of the publicly owned forestland base.

To address these concerns, the complainants request a measured and transparent approach that targets severely impacted areas over marginally attacked stands and sufficient government oversight.

Background

Spruce Beetle and Its Effects on Spruce Trees and Forests

The spruce beetle (Dendroctonus rufipennis) is a native bark beetle that occurs across the range of spruce in North America. It has a hard, cylindrical body and is about 0.5 centimetres long.

The spruce beetle typically needs two years to complete its life cycle. In early summer, female beetles bore through the bark of a tree into the sapwood and lay eggs that hatch as larvae and overwinter the first year. The feeding larvae create galleries and, together with fungi, damage the tree's inner bark. The damage interrupts the flow of water and nutrients between the roots and the crown, ultimately killing the tree. Over the next summer, the larvae grow into immature adults that overwinter once more. In the spring, adult beetles emerge and fly to a new host, and the cycle repeats.

However, the warming climate in the region has enabled some spruce beetles to complete their life cycle within one year instead of two years. The ability to complete a generation in less time boosts population numbers and may contribute to intensifying an infestation.

When spruce beetles are present in low numbers, they infest weakened, mature and wind-felled trees, logging debris, and stumps. After the attack, large trees die, and the remaining trees benefit from more resources and space, enabling them to grow more rapidly. When the spruce beetle population increases quickly and rises above endemic levels, they also attack and kill healthy trees by overwhelming their defence mechanisms. Cold winter conditions can kill spruce beetles and may contribute to keeping population numbers in check. Cold snaps during early winter and late spring, when beetles cannot survive freezing conditions, and very low temperatures (-40°C) in mid-winter result in beetle die-off. In the past decade, the absence of very cold winter conditions means more beetles survive and emerge in the spring

to attack spruce trees. Winter mortality is further reduced by the spruce beetles' habit of overwintering under the snow in the organic surface layer of forest soils, where they are protected from the impact of cold snaps.

Monitoring Forest Health Conditions in BC

A myriad of factors drives year-over-year changes in spruce beetle-infested areas. Examples are the availability of spruce trees, environmental conditions, the number of beetles emerging in the spring after overwintering, and animals preying on spruce beetles, such as birds.

Every year, the Ministry of Forests (the ministry) conducts aerial overview surveys to assess forest health conditions across the province.[1] During the flight, surveyors map the current forest health damage caused by diseases, animals, abiotic factors,[2] and insects, such as the spruce beetle. The surveyors estimate the intensity of tree mortality[3] based on the colour of the spruce trees' needles. The intensity indicates the number of spruce trees recently killed by the spruce beetle. Table 1 shows the five severity rating classes of tree mortality that surveyors use and the corresponding proportion of spruce trees killed in an area.

The aerial overview surveys only capture trees killed over the past year. One cannot add up damaged forest areas recorded in previous years. This is because surveyors may record new damage in all or a part of the same area. This means that surveyors may record tree mortality as light in an area this year. However, in the next year, they may record a moderate intensity in the same area. Thus, adding up damaged forest areas recorded over past years amounts to double counting.

In summary, aerial overview surveys provide a snapshot of the intensity of tree mortality caused by the spruce beetle in the last year.

TABLE 1. Intensity Classes to Record the Level of Spruce Tree Mortality That Occurred Over the Past Year During Aerial Overview Surveys

INTENSITY CLASS OF TREE MORTALITY	% OF SPRUCE TREES RECENTLY KILLED IN AN AREA
Trace	<1%
Light	1-10%
Moderate	11-29%
Severe	30-49%
Very severe	+50%

Current Spruce Beetle Infestation in the Omineca Region (2014 to present)

The complaint concerns government's and licensees' response to the spruce beetle infestation in the DPG. Information about the extent of the infestation is available at the scale of the Omineca Natural Resource Region (Omineca region). Besides the DPG, the Omineca region includes the Mackenzie (DMK) and the Stuart Nechako (DSN) Natural Resource Districts. The information is also available at the timber supply areas (TSAs) level but is not reported at the district level.

[1] The ministry's summary reports provide details over the results from annual aerial overview surveys.
[2] Abiotic factors are non-living agents, which may impact or damage trees or forests in in BC. They include frost, ice/snow/hail, red belt/winter kill, drought, sunscald, cedar flagging, and road salt. Modified from: Burleigh, J., T. Ebata, K.J. White, D. Rusch and H. Kope. (Eds.) 2014. Field Guide to Forest Damage in British Columbia.
[3] The ministry uses 'mortality intensity' to indicate the amount of mortality related to a mortality event.

The infestation has not been uniformly distributed throughout the Omineca region and has affected some licensees' operating areas more than others. The map in Figure 1 [page 4] shows the cumulative extent of the three most severe intensity classes of tree mortality (moderate, severe, and very severe) between 2014 and 2021. The map highlights the uneven distribution of the infestation. The map in Figure 4 [Appendix 1] shows the infestation's cumulative extent across all five intensity classes over the same period. Figure 2 shows a chart of the infested area broken down by intensity class of tree mortality and year. Table 2 [Appendix 1] shows the same data in a table.

In 2014, the ministry detected 217,300 hectares of spruce beetle-infested stands in the Omineca region. The vast majority of the infested areas had trace and light intensities of tree mortality.

In 2015, the ministry officially declared an outbreak, which is "an explosive increase in the abundance of a particular species that occurs over a relatively short period."[4] The same year, surveyors more accurately mapped the spruce beetle-infested area and found it to cover 156 000 hectares.[5] Compared to 2014, the 2015 survey showed an increase in areas with more severe levels of tree mortality.

Since 2018, the ministry's ground surveys have indicated that more spruce beetles are completing their life cycle within one year rather than two years.[6] This shift to a shorter lifecycle may contribute to faster population growth. It may also contribute to an increase in areas with severe spruce mortality.

The spruce beetle populations in the Omineca region have remained at high levels. This has resulted in the death of mature spruce over an expanding area (Figure 2). As spruce beetles run out of mature and weakened spruce trees, they shift to attacking younger spruce trees, and ministry staff began to notice this in 2020.

Managing the spruce beetle, and other bark beetles, involves direct and indirect tactics. Indirect tactics focus on reducing the number of susceptible trees and the likelihood of fast population growth. Direct tactics aim to destroy infested trees and directly reduce the beetle population. In areas accessible for harvesting, a licensee may log infested trees and haul them to a processing facility, thus killing the immature beetles in the bark. Licensees may use sanitation harvesting together with tactics to attract beetles into specific areas by using trap trees or chemical factors.[7]

Depending on the infestation's scale, sanitation harvesting may reduce, but rarely ends, insect outbreaks. At endemic levels, the factors that control the population include host resistance, the depletion of susceptible hosts, competition between insects of the same and other species, and natural enemies, such as woodpeckers. At epidemic levels, the impact of natural enemies on the spruce beetle population is small. Instead, the controlling factors are the depletion of susceptible trees and cold temperatures during susceptible beetle life stages.

Previous spruce beetle infestations in British Columbia have lasted between seven and eight years.

[4] Singh, T., Satyanarayana, J. 2009. Integrated Pest Management: Innovation-Development Process, In: Insect Outbreaks and Their Management. Springer, Netherlands, pp. 331–350.
[5] Ministry of Forests, Lands and Natural Resource Operations, Resource Practices Branch. 2015. 2015 Summary of Forest Health Conditions in British Columbia (p. 22).
[6] Dr. Jeanne Robert, Director, Provincial Bark Beetle Response. Personal communication.
[7] Aggregation pheromones are chemical factors excreted by insects to attract others of the same species.

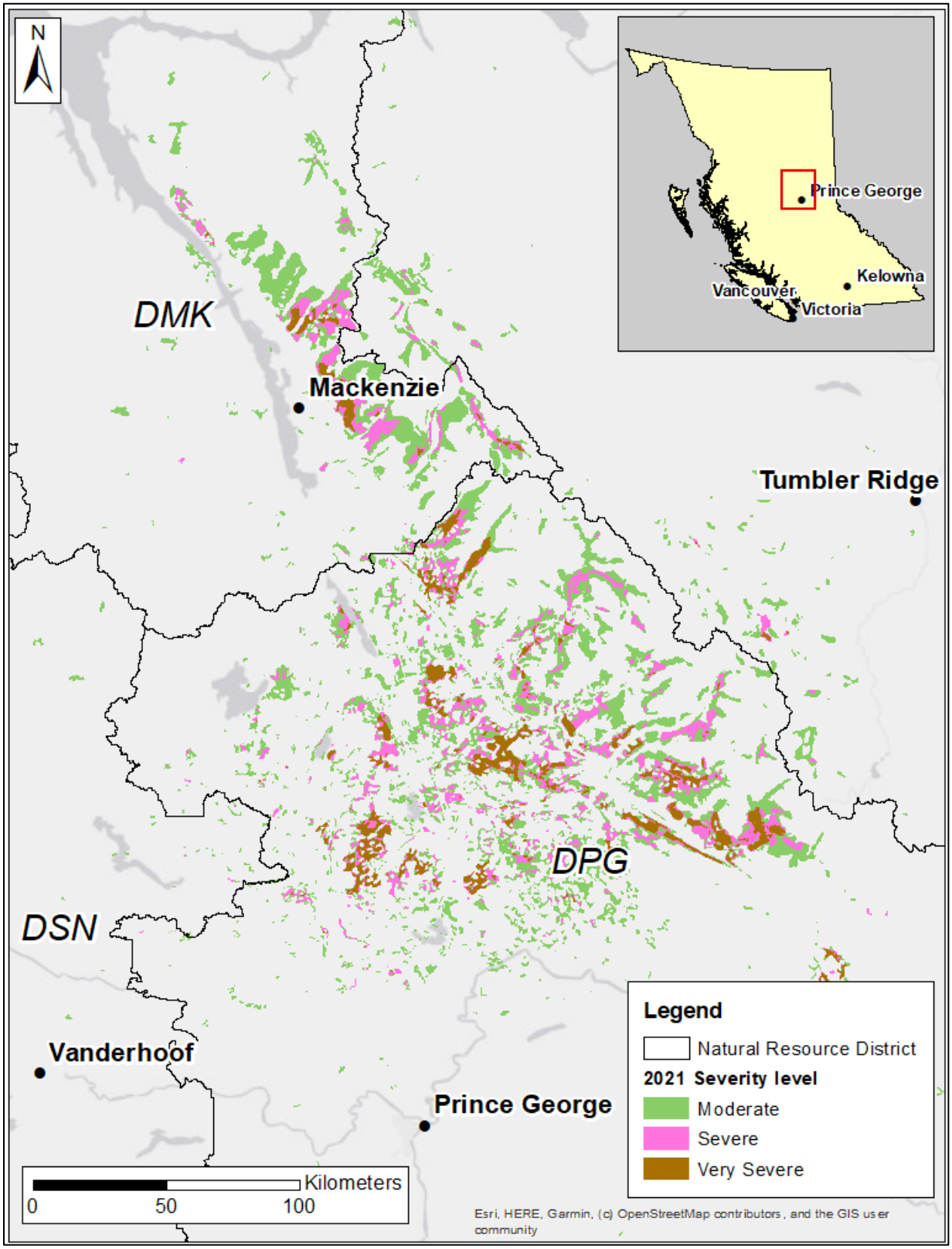

FIGURE 1. Cumulative severity and extent of the spruce beetle infestation in the Omineca region between 2014 and 2021, including the 'Moderate,' 'Severe,' and 'Very Severe' severity levels. For clarity, we omitted 'Trace' and 'Light' severity levels. Figure 4 (Appendix 1) shows the infestation's cumulative severity and extent across all five severity classes over the same period.

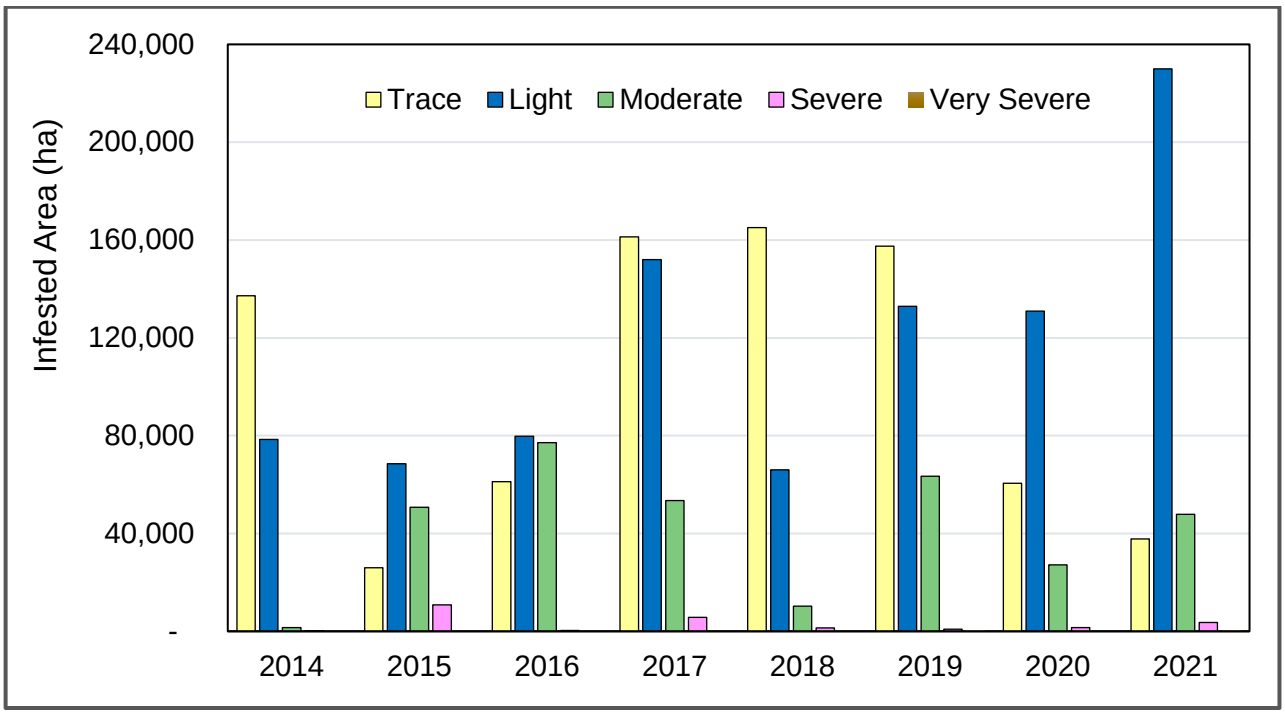

FIGURE 2. Spruce beetle-infested area in hectares by year and mortality intensity in the Omineca region, adopted from the 2014 to 2021 BC Forest Health survey data (see Table 1 for a description of the severity classes).

How does a spruce beetle infestation differ from an infestation by the mountain pine beetle?

After more than 15 years of the forest industry salvaging dead pine trees in response to the mountain pine beetle (MPB) infestation, the public might expect the management response to the spruce beetle infestation in the Omineca region would be similar. However, there are differences in how the two bark beetles affect forests, and how easily infestations can be detected and managed.

Detection

Once the MPB has successfully attacked a lodgepole pine tree, its needles will turn bright red by the following spring. By comparison, the colour change of spruce needles is variable, turning from green to yellow-green to purple, between 13 to 18 months after the attack. The discolouration may also start in the lower part of the crown, thus hindering detection from the air. The delayed colour change and the difficulty in detecting dead spruce crowns from the air mean that the proportion of trees recently killed in the area may not be fully recognized until two years after spruce beetles were active. Surveyors may not pick up infested spruce trees during the aerial overview surveys if the colour change happens outside of the survey period.

Impact on Spruce Forests

Spruce beetle infestations unfold in a patchy manner. An infestation may flare up in spots and then disappear. Sometimes, it can build up to a smaller wave and then dissipate. While the MPB follows a similar pattern at endemic levels, once it reaches epidemic levels, it may have epicentres and attacks unfold like a wave across the forest landscape. Thus, an MPB infestation kills a significant percentage of trees across large, continuous swaths of pine forests.

In spruce forests, insects, disease, and windthrow tend to kill single trees or smaller groups of trees. This leads to diversity in tree ages, species, and the appearance of the forest. The diversity supports the

irregular dispersal and attack of spruce beetles. Spruce beetles also spread more slowly across the forest than MPB. Typically, a greater proportion of spruce trees will survive a spruce beetle infestation compared to the proportion of lodgepole pine trees surviving an MPB attack.

Management

In an attempt to manage the MPB, harvesting was initially focused on the leading edge of the infestation. This meant clearcut harvesting of lodgepole pine stands within one year of the attack. The terrain was relatively flat, roads already existed or could easily be built, and mechanized harvesting could proceed quickly. This approach is neither desired nor possible for managing a spruce beetle infestation for several reasons. There is no "leading edge" to focus salvage harvesting on; the spruce beetle spreads unevenly through the forest and does not attack all spruce trees within a forest area.

The DPG's spruce forests affected by the infestation are primarily located on the western slopes of the Rocky Mountains. The steep terrain and wet climate make planning, road building, and harvesting challenging and costly. Developing cutblocks in spruce beetle-infested areas requires experienced layout contractors. Harvesting in the spruce forests requires logging contractors with experience and equipment suited to steep slope harvesting. Both were in short supply at the beginning of the outbreak, as the industry started to shift its attention to spruce beetle harvesting after more than 15 years of salvaging timber in flat pine forests.

To minimize soil disturbance, logging in spruce forests is often restricted to the winter season when soils are frozen and/or covered by snow. Access to these areas and the condition of roads and bridges was challenging at the beginning of the outbreak because the forest industry had not operated in these areas for decades. In dealing with the spruce beetle infestation, BCTS and licensees have faced a different set of operational challenges when compared to those encountered during the MPB infestation.

What tools can government use to manage the spruce beetle infestation in the Omineca region?

The most recent MPB outbreak in BC (1999 to 2015) had severe economic, environmental and social impacts on BC's forests and communities. Although the MPB affects forests in different ways than the spruce beetle, government has used what it learned from the MPB outbreak to respond to the spruce beetle infestation in the Omineca region.

One example of a response tool is assigning insect-specific management strategies to landscape areas, known as beetle management units (BMU). When assigning a strategy to a BMU, the ministry considers an infestation's extent and severity, the potential for spread, and the ease of access. Another response tool used during previous infestations is requesting that BCTS and licensees develop insect-specific action plans to help coordinate the management response.

Informed by the successes and shortcomings of responding to the recent MPB infestation, government's approach to managing insect infestations has evolved. In addition to learning from past practices, there is recognition that managing insect infestations will be more complex in the future due to the impacts of climate change. The effects of climate change include long-term shifts in temperatures and weather patterns. Warmer winters, for example, have enabled more spruce beetles to survive the winter and emerge in the spring to attack spruce trees. Warmer summers have allowed spruce beetles to complete their lifecycle in one rather than two years. As a result, climate change has contributed to an increase in local spruce beetle populations.

Government engages in public outreach and facilitates communication amongst the parties involved in responding to the spruce beetle infestation. It also has legal and non-legal tools to manage the infestation and influence BCTS's and licensees' behaviour. These tools are discussed below.

Public Outreach

The ministry established the Omineca Spruce Beetle Public Advisory Committee in 2016. It aims to support collaboration amongst the different levels of governments, First Nations, forest industry, and stakeholders involved in planning and implementing the response to the infestation. Since 2016, the ministry has also organized annual bark beetle summits. They allow government staff, researchers, community representatives, and forest practitioners to share the latest science and updates on the spruce beetle infestation with Indigenous and local governments, forest professionals, and stakeholders.

Government also hosts websites providing the public with information on the spruce beetle[8], the outbreak[9] in the Omineca region, and documents such as ministry guidance and the licensees' action plans. An interactive map[10] shows the outbreak's progression in the Omineca region over time. The ministry updates the map with data from the most recent aerial overview survey every year.

Table 3 [Appendix 2] shows the information that the Board reviewed as part of this investigation and indicates what information is publicly available and what is not.

Legal Tools

The spruce beetle infestation affects many values across the forest landscape. It is important to note that the relevant legislation still applies in managing the infestation's impact on forests. An example is land use orders, which the ministry may issue under the *Land Act*, *Government Actions Regulation* under the *Forest and Range Practices Act (FRPA)*, and previously, the *Forest Practices Code of British Columbia Act*. The orders applicable to the DPG include, but are not limited to, the:

1. Order Establishing Provincial Non-Spatial Old Growth Objectives, and
2. Order Establishing Landscape Biodiversity Objectives in the Prince George Timber Supply Area (TSA).[11]

FRPA includes provisions for dealing with forest health issues, including exempting a person from specified requirements in the legislation to limit and/ or mitigate the spread of forest pests (section 25); ordering a landowner or licence holder to limit the spread of insects, diseases, animals, or abiotic factors, such as wind, floods or avalanches (section 26); and declaring a forest health emergency (section 27).

The *Forest Planning and Practices Regulation* (FPPR) includes provisions to authorize forest health treatments and the use of trap trees or pheromones to attract insects to reduce beetle populations before the flight.

Although legal tools are available to government, it has chosen to influence BCTS and licensees by using non-legal tools. We discuss them below.

[8] BC government, Spruce beetle website.
[9] BC government, Spruce beetle outbreak website.
[10] BC government, Spruce beetle infestations in the Omineca Region.
[11] A Timber Supply Area (TSA) is a geographically based administrative area designated under the Forest Act (Section 7). TSAs have an allowable annual cut set by the chief forester, and are used to provide a sustainable flow of timber to both replaceable and non-replaceable forms of volume-based tenures. From: 2008, Ministry of Forest and Range, Glossary of Forestry Terms in British Columbia.

Non-Legal Tools

After declaring a spruce beetle outbreak in 2015, the ministry published its spruce beetle mitigation strategy[12] in December 2016. The strategy includes five priorities:

1. Coordinate effective planning and implementation of mitigation measures.
2. Safeguard non-timber values.
3. Prevent or reduce damage to ecosystems in areas that are susceptible to (but not yet experiencing) spruce beetle infestations.
4. Recover the greatest value from dead spruce timber before it decays or is damaged by wildfires.
5. Restore forest resources in areas affected by spruce beetle infestations.

Key outcomes of the strategy relevant to this complaint are government expectations for harvest prioritization and the need for BCTS and licensees to prepare an annual Omineca Joint Spruce Beetle Action Plan (Action Plan). Both are discussed below.

Guidance

In the past, government issued guidance documents with expectations for how licensees are to manage specific aspects of forest disturbances. The chief forester issued two documents[13] guiding licensees on when, where, and how to harvest spruce beetle-infested areas. Because this complaint concerns whether BCTS and Canfor have been prioritizing harvesting of the most spruce beetle-infested stands, we examined the 2020 chief forester's expectations for prioritization in response to spruce beetle outbreaks. However, the investigation did not consider the 2017 chief forester's guidance on stand- and landscape-level retention because the complaint is not concerned with retention related to spruce beetle harvesting.

Since 2017, the ministry's regional executive director (RED) for the Omineca region has shared letters with BCTS and licensees to complement the chief forester's expectations. The RED's letters provide expectations or responses to the spruce beetle-focused Action Plans that BCTS and licensees have submitted annually. The Action Plans are discussed in more detail below.

Expectations set by the chief forester

In 2020, the chief forester issued "Expectations for Prioritization in Response to Spruce Beetle Infestations."[14] The expectations result from discussions between the ministry, BCTS, and licensees and are part of their ongoing collaboration to manage the infestation. Because spruce beetles behave differently than the MPB, the chief forester expects BCTS and licensees to take a different approach to managing this infestation than they did during the MPB outbreak. BCTS and licensees are to work with the ministry to mitigate the impact of the spruce beetle infestation on forest values. Furthermore, the chief forester also expects BCTS and licensees to work with Indigenous peoples to integrate their interests in mitigating the infestation. The chief forester also expects the ministry to continue to monitor and report on the progress of BCTS's and licensees' spruce beetle mitigation activities.

[12] Available at Working Together: British Columbia's Spruce Beetle Mitigation Strategy.
[13] 2017 Omineca Region Guidance: Stand and Landscape-Level Retention for Harvesting in Response to Spruce Beetle Outbreaks, and 2020 Expectations for Prioritization in Response to Spruce Beetle Infestations.
[14] Available at Chief Forester's Expectations for Prioritization in Response to Spruce Beetle Outbreaks.

The chief forester's 2020 expectations document includes a decision table called the harvest prioritization matrix (the Matrix) (Table 6 [Appendix 5]). Its purpose is to guide BCTS and licensees on prioritizing planning and harvesting the most severely beetle-impacted stands. Aside from directing BCTS and licensees to focus on stands infested with live spruce beetles at the time of harvest, the chief forester expects BCTS and licensees to consider a range of objectives. Examples of those objectives include:

- Avoiding harvesting live un-infested timber
- Protecting secondary stand structure wherever practicable
- Applying beetle control tactics outlined in Regional and District /TSA Forest Health Strategies
- Avoiding or minimizing potential impacts on Indigenous rights, title and interests, and culturally significant features and resources

Depending on the management strategy in a BMU, the chief forester expects licensees to either use salvage or pest reduction tactics. Salvage harvesting focuses on reducing the infestation's economic impacts by removing dead timber while maintaining live timber and non-timber values. Pest reduction is about reducing the spruce beetle population by removing trees that are likely infested with live spruce beetle at the time of harvesting. The ministry anticipates that pest reduction harvesting may assist in reducing spruce beetle populations. It may also contribute to slowing the spread of the infestation across the Omineca region. However, the ministry wants to safeguard the mid-term timber supply and protect non-timber values. Thus, harvesting all spruce beetle-infested areas is not the ministry's strategic goal.

Expectations set by the regional executive director

After declaring the outbreak in 2015, the ministry asked BCTS and licensees to develop annual plans showing their spruce beetle harvesting. Since 2017, the RED has shared letters with BCTS and licensees to complement the chief forester's guidance and to reiterate government's objectives concerning the infestation. The annual RED expectation letter sets out expectations for the annual Action Plan, which we discuss in more detail below. Although the RED shares expectations with BCTS and licensees and responds to their Action Plan, the RED is not required to approve it.

The RED's expectations have evolved along with the infestation and BCTS's and licensees' response to it. In a 2017 letter, the RED expected BCTS and licensees to collaboratively conduct landscape-level planning. In a 2018 letter, the RED expected BCTS and licensees to spatially define the extent of their harvest operations. The RED also expected BCTS and licensees to work with ministry staff to prioritize planning and harvesting of severely infested stands while following legal orders and ensuring the protection of non-timber values.

In 2018, the RED asked BCTS and licensees to step up their efforts in harvesting spruce beetle-affected stands on steep slopes located within operable areas. The RED explained this is important because the ministry has included forests on operable steep slopes in their annual allowable cut determination for the TSAs in the Omineca region.

In 2020, the RED's letters advised BCTS and licensees that, except for Canfor, their past harvest data showed limited harvesting in the most severely impacted stands and on steep slopes. The RED reaffirmed the expectation that BCTS and licensees are to harvest timber from all infested forest types and on steep slopes within operable areas. The RED underscored that timber from steep slopes within the operable boundaries supports the allowable annual cut.

Spruce beetle-focused Action Plans

BCTS and licensees, including Canfor, prepare an annual Action Plan upon the RED's request. In it, they show the amount of their annual allowable cut they will direct towards spruce beetle-infested stands over the next seven years. The seven-year period for each Action Plan is due to the estimated shelf life of

spruce trees. In summary, BCTS and licensees use the Action Plans to coordinate and communicate their response to the infestation in the Omineca region.

BCTS and licensees estimate the planned harvest area in the Action Plan by starting with the most recent, cumulative spruce beetle-infested aerial overview survey (AOS) area. Next, they apply a "netdown" process, in which they remove areas that are either reserved from harvesting or do not meet specific criteria. For example, planners may exclude areas from harvesting because they overlap with old-growth management areas, ungulate winter range areas, fisheries-sensitive watersheds, or existing agreements. Criteria for removing a candidate area include considerations on accessibility, species composition, stand age, harvest volume, and infestation severity.

Figure 3 shows the impact of the "netdown" process in the DPG for the 2020 and 2021 Action Plans (see Table 4 in Appendix 3 for the data table). BCTS and licensees do not plan to harvest all infested areas because some of them are outside of the timber harvesting land base (THLB). Aside from these, BCTS and licensees identified some areas within the THLB as unavailable due to other land use issues, agreements with First Nations, or because they are not economical to harvest. The unavailable areas within the THLB are significant. BCTS and licensees identified the need to resolve uncertainties around access to these areas through integrated planning at the strategic (or land use) level. The 2020 and 2021 Action Plans focus on "prioritizing and planning harvesting activities to reduce beetle populations, minimizing the impact to timber supply, while maintaining non-timber values in spruce ecosystems." Although the Action Plans account for past spruce beetle harvesting, they do not explicitly compare the planned harvest area from the previous year's plan against the actual harvest area. In the absence of reporting on harvesting, it is not possible to assess BCTS's and licensees' performance.

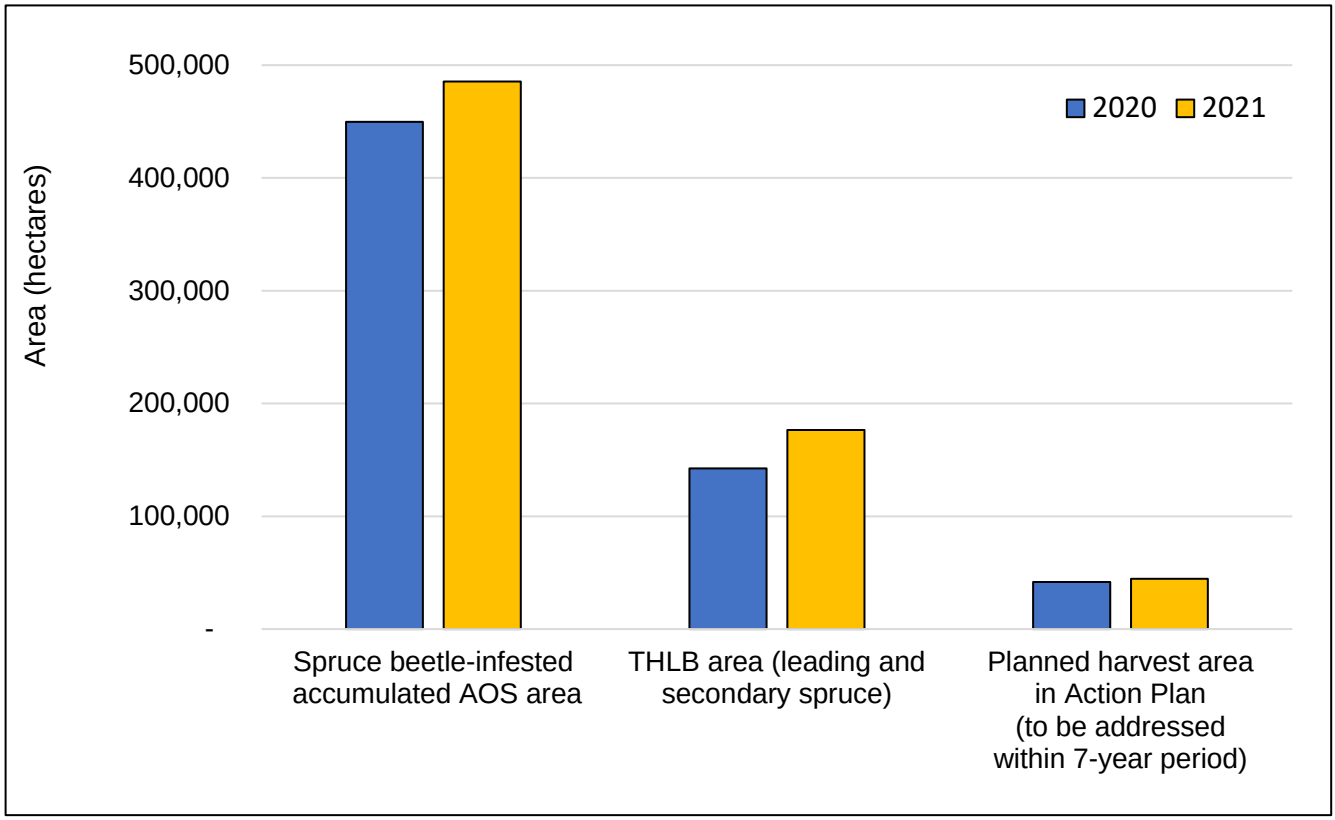

Figure 3. Cumulative spruce beetle-infested AOS and netdown areas for DPG, adopted from the 2020 and 2021 Action Plans.

The Investigation

The investigation first considered if BCTS and Canfor complied with any applicable FRPA requirements regarding the spruce beetle infestation. Next, it considered if government has been monitoring BCTS's and licensees' activities, including Canfor, to determine if they are meeting government's expectations for harvest prioritization. If monitoring is happening, the results could inform the investigation's third question – are BCTS's and Canfor's activities consistent with government's expectations on harvest prioritization. The Board addressed the following questions below.

1. Are BCTS and Canfor complying with FRPA requirements concerning the spruce beetle infestation?

To date, the ministry has not used any FRPA or FPPR pest management requirements to direct licensees on how they should respond to the infestation. Thus, BCTS and Canfor have not had to follow any specific legal requirements concerning the infestation.

Finding

There are no legal requirements in place for BCTS or licensees, including Canfor, to respond to the spruce beetle infestation in the Omineca region.

2. Is government monitoring whether BCTS and licensees, including Canfor, are meeting the chief forester's expectations for harvest prioritization?

The chief forester expects the ministry to monitor and report on the progress of spruce beetle harvesting in the Omineca region. In the investigation, we examined whether government has been monitoring and publicly reporting on BCTS's, licensees', and Canfor's harvesting.

Between 2015 and 2020, BCTS and licensees self-reported their spruce beetle harvesting to the ministry twice a year. The ministry considered these reports when responding to the Action Plans. For example, the RED's response letter to the 2020 Action Plan indicates that government has been conducting some monitoring of spruce beetle harvesting. The RED's letter addressed to major licensees and BCTS operating in the Mackenzie and Prince George TSAs, states:

> Limited action in isolated or difficult-to-access stands, as well as steep slope harvesting, are an ongoing concern. The 2020 Action Plan effectively demonstrates that, excluding Canfor, there has been virtually no performance in spruce beetle impacted stands that require steep slope harvest systems. Past harvest data also highlights limited performance by any licensee in the most severely impacted stands.

In the 2021 expectation letter, the RED requested that the ministry, BCTS, and licensees identify performance metrics in the 2021 Action Plan. These metrics would enable government to better monitor and report on the harvesting progress of spruce beetle-infested timber in the Omineca region. In response to the RED's request, BCTS and licensees referred to the bi-annual reports they had previously submitted to the ministry. They also suggested that the ministry should consider developing tools to query

government databases. The data would enable the ministry to monitor the performance of harvesting spruce beetle-infested timber.

At the 2021 bark beetle summit, ministry staff presented a high-level summary of how BCTS and licensees responded to the spruce beetle infestation. For this, the ministry compared the cruise volume of spruce beetle-infested timber against the total cruise volume of spruce timber collected between 2016 and 2020 in a sub-area[15] of the Prince George TSA. The ministry found that about a third (36 percent) of the total spruce volume cruised over the four years showed some level of spruce beetle damage (see Table 5 in Appendix 4 for cruise data). From this case study, the ministry concluded that BCTS and licensees need to ensure they are closely following the chief forester's expectations on harvest prioritization. By focusing their harvesting on stands with high levels of active beetle attack and on the most severely infested stands, they can contribute to reducing non-recoverable losses, thus mitigating potential impacts on the mid-term timber supply.

Aside from these examples, government has not systematically been monitoring and reporting on whether BCTS's and licensees', including Canfor's, spruce beetle harvesting aligns with government expectations. Government staff told the Board that government systems are currently not set up to do so. However, the ministry is currently preparing a monitoring report that summarizes the 2021 spruce beetle harvesting based on data from the Electronic Commerce Appraisal System.[16] This monitoring report, planned for release shortly, will present the forest industry's response to the infestation in the Omineca region as a whole, but not separated by licensee.

Finding

Although government has conducted ad-hoc analyses of spruce beetle harvesting, it has not systematically monitored and reported on whether BCTS's, licensees', and Canfor's spruce beetle harvesting is consistent with government expectations.

3. Have BCTS's and Canfor's activities been consistent with the chief forester's and the RED's expectations on harvest prioritization?

The Board examined the 2020 and 2021 Action Plans for evidence indicating if BCTS's and Canfor's planning and harvesting are consistent with the chief forester's and the RED's expectations on harvest prioritization. To date, the Action Plans have been forward-looking in nature. They indicate what proportion of the allowable annual cut BCTS and licensees, including Canfor, plan to assign towards spruce beetle harvesting. The Action Plans also identify if licensees are planning to harvest priority stands within the shelf life of the dead forests. In summary, the Action Plans show over what period and roughly where this harvesting will take place.

In 2020, BCTS and licensees, including Canfor, had submitted their Action Plan before the chief forester finalized the expectations on harvest prioritization. Because of this, BCTS and licensees did not incorporate the expectations. But they did consider the draft expectations in the Action Plan because they were aware of them.

However, BCTS and licensees acknowledged that not all stands planned for harvesting could meet the chief forester's expectations. In their view, this is mainly because of the mismatch between the inputs considered in the Action Plan compared to what is needed for the Matrix. The Action Plan is based on spruce beetle data from the aerial overview survey (AOS), which does not capture information on the

[15] Supply Block E - map of the Prince George TSA Supply Blocks available here.
[16] The Electronic Commerce Appraisal System is an online portal to which licensee submit their appraisal data to the Ministry of Forests.

number of live spruce beetles present in a stand. The Matrix, in comparison, requires BCTS and licensees to collect data on live spruce beetles to determine where to log first. We discuss the challenges of this mismatch further in the 2021 Action Plan section below.

In summary, the 2020 Action Plan submission predated the publication of the chief forester's expectations for harvest prioritization. Therefore, it does not provide evidence as to whether BCTS's and Canfor's planning and harvesting operations were consistent with the expectations.

In the 2021 Action Plan, BCTS and licensees reiterated that, for the reasons mentioned above, their harvest plans do not relate well to the chief forester's expectations for harvest prioritization. In general, they do not undertake surveys to collect data on the amount of dead and live spruce beetles immediately before or at the time of harvest. Instead, they believe that the most recent cruise data provides them with information representative of the stand and the amount of dead and live spruce beetles at the time of harvest to fine-tune their harvesting plans.

In contrast, the chief forester expects BCTS and licensees to make harvest decisions based on the amount of dead timber and timber with live beetles "at the time of harvest." For this, the chief forester expects BCTS and licensees to conduct spruce beetle-focused ground surveys in candidate stands. With the survey results in hand, BCTS and licensees then use the Matrix to prioritize some infested forest areas over others. For example, stands with a higher percentage of live spruce beetles in an area designated for pest reduction take priority over those designated for salvage harvest with few or no live spruce beetles.

In the 2021 Action Plan, BCTS and licensees pointed out that the expectation of having live spruce beetle data "at the time of harvest" is operationally challenging because of the lengthy time lag between timber cruising, issuance of cutting authorization, and the start of harvesting. In their view, the chief forester's expectation seems to suggest that they can rapidly collect ground survey data, and adjust their harvest plans based on how the infestation develops over time and across the forest landscape. They argue that the expectation implies flexibility that overlooks the complexity of harvest planning and the time and resources required to complete it. Despite the concerns around timing, BCTS and licensees confirmed that they conduct a re-sweep of an area if a significant amount of time has passed since the cruise, or if they are expecting that stand conditions have changed between the original cruise and the start of harvesting operations.

In summary, neither Action Plan demonstrates if BCTS's and Canfor's planning and harvesting are consistent with the government's expectations on harvest prioritization. This is mainly due to the forward-looking nature of the Action Plans. BCTS and licensees highlighted some of the challenges in combining aerial and ground-level data to plan and prioritize their spruce beetle harvesting.

However, the Action Plans do indicate how BCTS and licensees are incorporating government expectations, including the harvest prioritization guidance, in their strategic and operational planning. The plans show the proportion of the allowable annual cut BCTS and licensees are directing towards spruce beetle-infested stands. The Action Plans also show if BCTS and licensees plan to harvest available priority stands within the estimated shelf life of dead spruce. For the 2021 Action Plan, BCTS and licensees showed that they intend to harvest the planned targets within the estimated shelf life of seven years for dead spruce. However, the Action Plans also show that a significant amount of beetle-infested area is not available for harvest due to strategic issues related to land use and economic factors. BCTS and licensees have no plans to harvest those stands.

To date, the ministry has not requested that BCTS and licensees summarize past spruce beetle harvesting by the level of mortality, or compare it against the Action Plans' targets. Instead, BCTS and licensees have been self-reporting their spruce beetle harvesting to the ministry twice a year. In the future, the ministry should be able to monitor BCTS's and licensees' spruce beetle harvesting against government expectations as expressed in the planned harvest targets in the Action Plans.

BCTS Shared Information on Spruce Beetle Harvesting

After learning about this complaint, BCTS provided the complainants and the Board with cruise information from 64 cutblocks in the eight areas relevant to the complaint. The cruise compilation dates ranged from January 2013 to February 2021. BCTS is confident that the information demonstrates they are following the government's harvest prioritization expectations in those areas.

The cruise data showed that 61 percent of the cutblocks (39 out of 64) ranked with either high or moderate harvest priority. In comparison, 36 percent of the cutblocks (23 out of 64) ranked with a low harvest priority. Because of the lack of spruce beetle damage, 3 percent of the blocks (2 out of 64) were not a harvest priority. The cruise data indicates that BCTS has prioritized harvesting on spruce beetle-infested stands in the eight areas that the complainants examined.

However, BCTS has encountered challenges in completely following the chief forester's expectations. Aside from the time lag between planning and harvesting discussed earlier, BCTS considers seasonal harvest constraints, road development, and the isolation of timber when planning their spruce beetle harvesting. BCTS also noted that some of the cutblocks harvested in the early days of the spruce beetle outbreak had less severe levels of spruce beetle attack. This was mainly due to BCTS's transition from harvesting MPB-affected areas to spruce beetle areas.

Concerning the chief forester's expectations of providing the ministry with ground survey information, BCTS outlined its spruce beetle assessment strategy. It includes the following steps: review of AOS information, aerial reconnaissance of infested areas and planned blocks, ground reconnaissance surveys (using a walk-through spruce beetle survey), and timber cruise. If more than two years have passed since the last cruise, BCTS will conduct a re-sweep. BCTS does not undertake ground surveys to provide information on the amount of dead and live spruce beetles immediately before harvest. BCTS assumes that the most recent cruise data is representative of the forest area and the amount of dead and live spruce beetles at the time of harvest.

In summary, while there is evidence that BCTS and licensees, including Canfor, are working to incorporate the chief forester's and the RED's expectations on harvest prioritization in their planning, the lack of systematic monitoring and reporting by government to date means the Board cannot determine the extent to which activities are consistent with the expectations.

Finding

The Board could not determine if BCTS's and Canfor's activities are consistent with the chief forester's and the RED's expectations for prioritizing spruce beetle harvesting.

Conclusions

This investigation examined a complaint about how government, BCTS, and Canfor have been managing a spruce beetle infestation in the DPG. We looked at whether government has been monitoring BCTS's and licensees', including Canfor's, activities in the DPG to determine if they are complying with FRPA requirements specific to infestations. We also reviewed if BCTS and licensees, including Canfor, have been meeting government's expectations on prioritizing harvesting in the most infested areas.

The investigation considered whether BCTS's and Canfor's spruce beetle-related activities have complied with FRPA requirements on the infestation. To date, government has not brought into play any FRPA or FPPR requirements specific to managing the infestation. Thus, BCTS and Canfor have not had to follow any legal requirements specific to their response to the infestation.

In terms of monitoring, government has done some work analyzing BCTS's and licensees', including Canfor's, spruce beetle harvesting. One analysis looked at data from a sub-area of the Prince George TSA. In addition, the RED reviews the BCTS and licensee-led Action Plans. In response to the Action Plans and the spruce beetle harvesting data BCTS and licensees shared with the ministry, the RED has been refining expectations for spruce beetle harvesting.

Despite this work, government has not systematically been monitoring and reporting on whether BCTS's and licensees', including Canfor's, spruce beetle harvesting aligns with government expectations.

Finally, BCTS and licensees, including Canfor, have been incorporating the government expectations on prioritizing spruce beetle harvesting in their planning. The Action Plans and BCTS's cruise data in the eight watersheds support this conclusion. However, we cannot tell if their actual harvest performance has been consistent with government expectations.

The chief forester issued expectations for harvest prioritization in 2020. BCTS and licensees had challenges in combining the stand-level expectations with AOS data because of the different scales. The expectations provide direction on when, where, and how to harvest infested areas. However, they do not establish a monitoring framework against which the ministry can assess BCTS's and licensees' activities. In the future, the ministry can track BCTS's and licensees' spruce beetle harvesting against government expectations as expressed in the planned harvest targets in the Action Plans.

Appendix 1:
Spruce Beetle Infestation in the Omineca Region

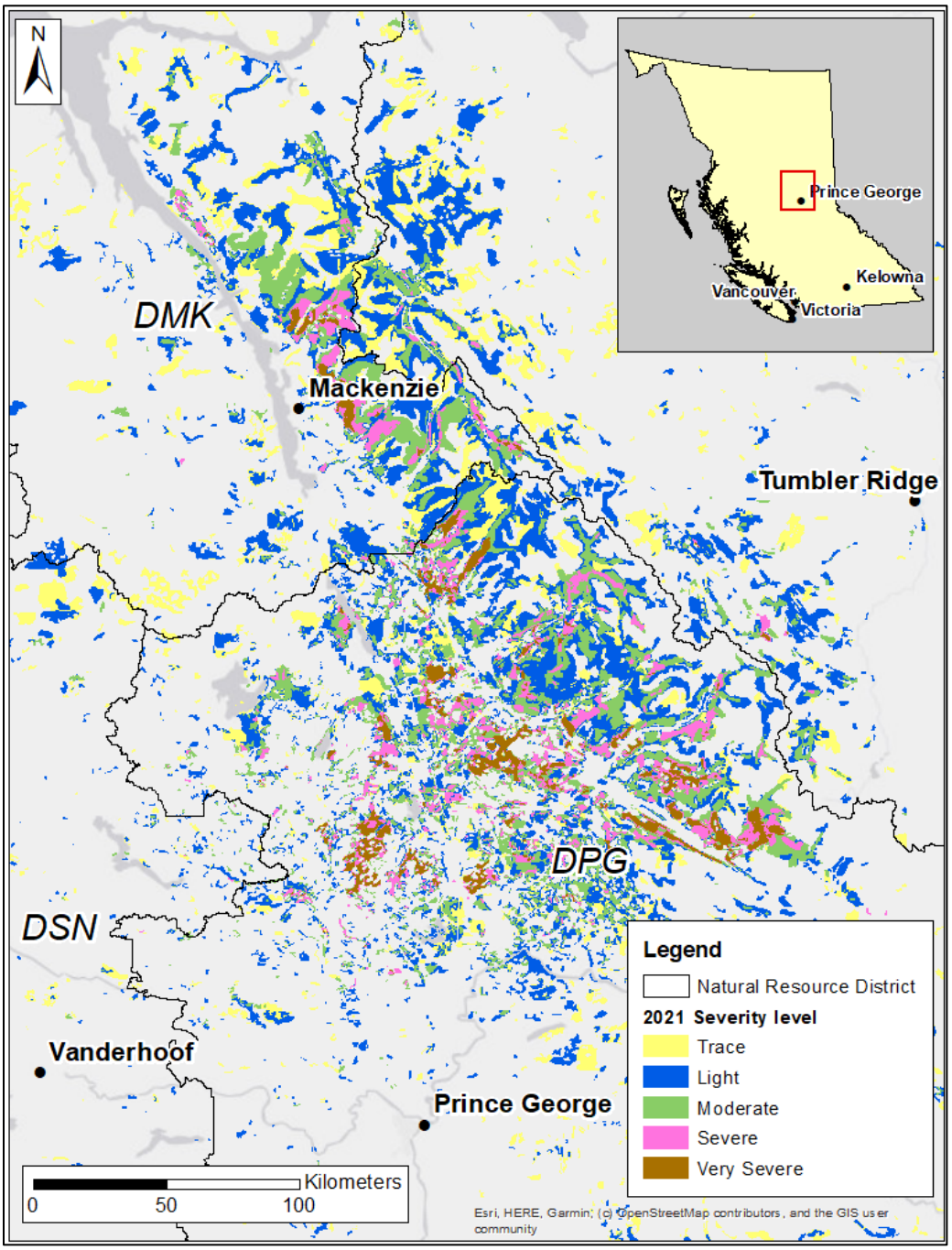

FIGURE 4. Cumulative severity and extent of the spruce beetle infestation in the Omineca region between 2014 and 2021, including all five severity classes.

TABLE 2. AOS Spruce Beetle Areas (hectares) by Year and Severity Level in the Omineca Region

YEAR/ SEVERITY LEVEL	2014	2015	2016	2017	2018	2019	2020	2021
Trace	137,267	26,036	61,186	161,342	165,117	157,509	60,570	37,824
Light	78,454	68,496	79,791	151,979	65,964	132,927	130,973	229,934
Moderate	1,524	50,746	77,120	53,453	10,241	63,363	27,188	47,809
Severe	8	10,780	309	5,709	1,380	895	1,487	3,637
Very Severe	-	-	-	-	-	156	-	56
Total	**217,252**	**156,057**	**218,406**	**372,483**	**242,703**	**354,851**	**220,218**	**319,260**

Appendix 2: Information Reviewed

TABLE 3. Summary of Information Reviewed as Part of This Investigation

INFORMATION AVAILABLE TO THE PUBLIC	INFORMATION NOT AVAILABLE TO THE PUBLIC AT THE TIME OF THE INVESTIGATION
AOS data (2013 to 2021)	Presentation at 2021 bark beetle summit on how licensees are responding to the spruce beetle infestation
Licensees' Action Plan (2020) Licensees' Action Plan (2021)	Licensees' Action Plans (2017 to 2019)
RED response letter (2021)	RED expectation and response letters (2017 to 2020)
Chief forester's harvest prioritization guidance (2020)	
Summary of Forest Health Conditions in British Columbia (2015-2020)	
Web map with spruce beetle infestations in the Omineca Region	
Working Together: British Columbia's Spruce Beetle Mitigation Strategy (2016)	
Information on the spruce beetle outbreak Information on the spruce beetle	

Appendix 3:
Cumulative AOS and Netdown Areas for DPG

TABLE 4. Cumulative Spruce Beetle AOS Area and Netdown Areas for DPG, From 2020 and 2021 Action Plans

YEAR	CUMULATIVE SPRUCE BEETLE AOS AREA (HA)	THLB - LEADING AND SECONDARY SPRUCE (HA)	PLANNED HARVEST (HA)
2020	449,651	142,412	41,633
2021	485,436	176,464	44,496

Appendix 4:
Ministry Analysis of Spruce Cruise Data

TABLE 5. Breakdown of Spruce Cruise Volume in the Prince George TSA Supply Block E (January 2016 to February 2020), Adopted from Ministry Presentation at the 2021 Bark Beetle Summit held in Prince George, BC

ATTACK TYPE	TREE CONDITION	NET SPRUCE CRUISE VOLUME (M3)	PROPORTION OF TOTAL NET SPRUCE CRUISE VOLUME
No attack	alive	4,422,447	64%
Grey	dead	1,242,531	18%
Green (full)	girdled and dead	1,059,412	15%
Green (strip)	alive	224,418	3%
Total		6,948,808	100%

Appendix 5:
Chief Forester's Matrix for Relative Harvest Priority

Table 6 is a matrix of harvest priority for BMUs with a salvage focus (as indicated in red and by an 'S') and for BMUs with a pest reduction focus (as indicated in green and with a 'P').

TABLE 6. Relative Harvest Priority in Spruce Beetle Impacted Stands in Unconstrained THLB[17]

CRITERIA	RELATIVE HARVEST PRIORITY					ADDITIONAL CONSIDERATIONS
	Not a Priority	Very Low	Low	Moderate	High	
Stands with > **50%** (greater than) dead merchantable stems or basal area, and with live* spruce beetle present at the time of harvest. Stands with **> 50%** dead and no live spruce beetle present at the time of harvest are lower relative priority.					S P	Removal of timber with live beetle in these stands is high priority. Stands with >30% live beetle should be highest priority. Undamaged timber should be retained wherever practicable.
Stands with 3**0% to 50%** dead merchantable stems or basal area, and with **> 10%** of timber with live* spruce beetle present at the time of harvest.				S P		An assessment of live secondary stand structure should be conducted to determine the natural stand re-establishment potential of live stems.
Stands with **30% to 50%** dead merchantable stems or basal area, and with < 10% of timber with live* spruce beetle present at the time of harvest.			S P			Focussed harvest to remove live beetles is recommended. Stands with >30% live beetle should be highest priority, stands with no live beetle should be the lowest priority.
Stands with **10% to 30%** dead merchantable stems or basal area, and with **> 10%** of timber with live* spruce beetle present at the time of harvest.			S		P	Removal of timber with live beetle in these stands is high priority. Stands with >30% live beetle should be highest priority, stands with no live beetle should be the lowest priority. Undamaged timber should be retained wherever practicable, Focussed harvest to remove live beetles is recommended.
Stands with 1**0% to 30%** dead merchantable stems or basal, and with **< 10%** of timber with live* spruce beetle present at the time of harvest.		S		P		
Stands with **< 10%** dead merchantable stems or basal area, and with **> 10%** of timber with live* spruce beetle present at the time of harvest.			S	P		Removal of timber with live beetle in these stands is high priority. Consider applying partial harvest systems and retaining live uninfested timber. Stands with no live beetle should be the lowest priority.
Stands with **< 10%** dead merchantable stems or basal area, and with **< 10%** of timber with live* spruce beetle present at the time of harvest.		S P				Focussed harvest and/or mitigation measures (e.g. trap trees) to remove live beetles is recommended.
Stands with little to no insect-induced mortality, and no live* beetle present at the time of harvest.	S P					Harvest of undamaged stands should not be prioritized for harvest in areas with spruce beetle outbreaks.

*A tree containing "live spruce beetle" is defined as an attacked tree (tree code 1, 2, 3 or 4 in the Spruce Beetle Ground Survey Guidelines) or using a timber cruise, damage codes 5 or 6.

[17] Taken without alteration from the 2020 Chief Forester's Expectations for Prioritization in Response to Spruce Beetle Outbreaks.

PO Box 9905 Stn Prov Govt
Victoria, BC V8X 9R1 Canada
Tel. 250.213.4700 | Fax 250.213.4725 | Toll Free 1.800.994.5899
EGBC Permit to Practice #1001000

For more information on the Board, please visit our website at: www.bcfpb.ca