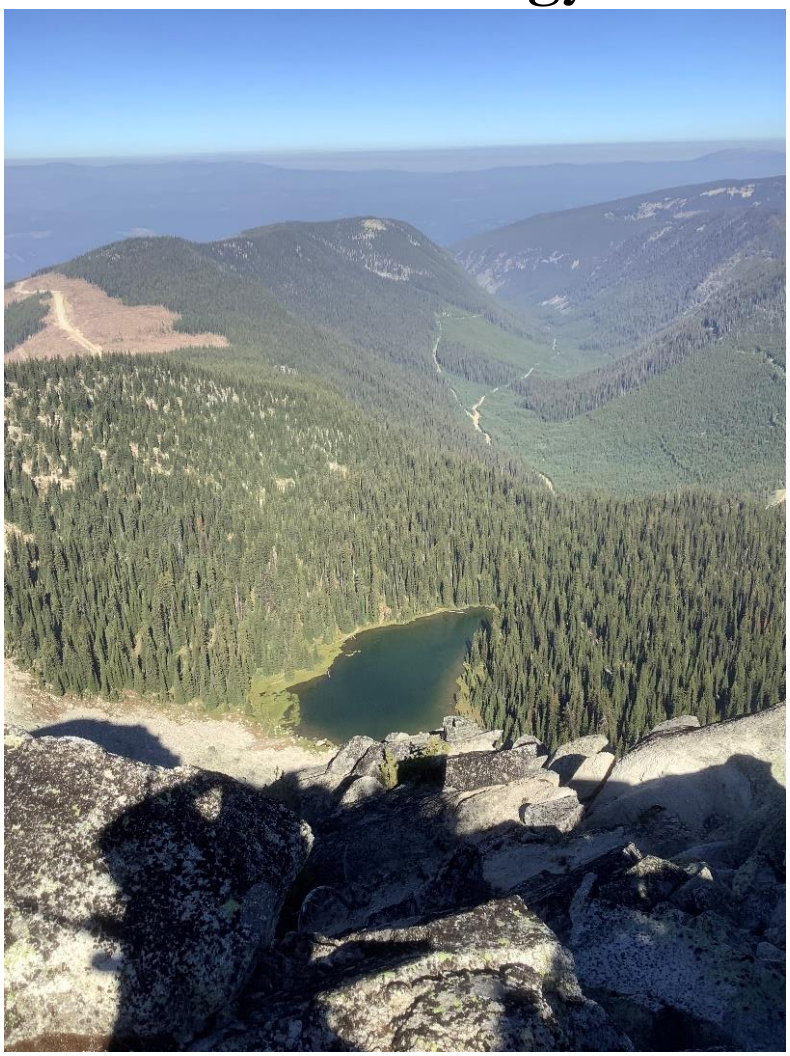
MINISTRY OF FORESTS

Selkirk Natural Resource District

Boundary TSA

Forest Health Strategy 2022-23



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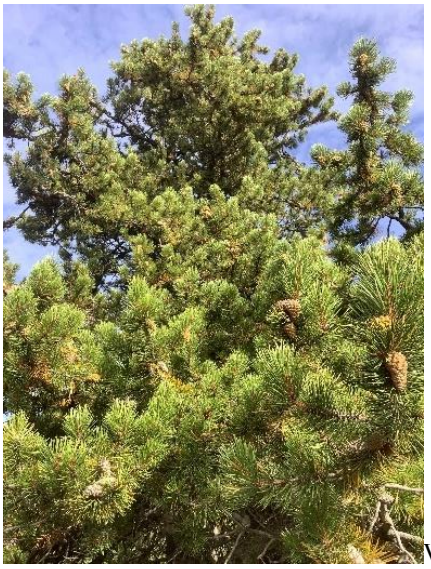
Rock Ck Area IBD or Woodborers?

Wood Borer damage – Courtesy of Randy Waterous

Cover Page: Paturages Ck – Jamie Hibberson

Table of Contents

1. Goal 5
2. Objectives 5
3. Boundary TSA description 6
3.1. Previous Forest Health Strategies in the Boundary TSA 8
4. TSA Priority Ranking of Forest Health Agents 8
5. Description of the Priority Forest Health agent status 9
5.1. Bark Beetles 9
5.2. Defoliators 11
5.3. Diseases 103
5.4. Animal and Abiotic Factors 10
5.5. Invasives 117
6. Management objectives for priority forest health agents 18
7. Provincial Ranking and BMU Strategy for IBM and IBD 22
8. Proposed activities to manage IBM and IBD 23
8.1. Mountain pine beetle 23
8.2. Douglas-fir beetle 23
9. 2023-24 Fiscal Year Tactical Plan 24
10. Stocking Standards 25
11. Non-Recoverable Losses Section – Boundary TSA (fire, wind, pests, total current AAC comparisons) 25
12. Anecdotal observations/ comments 26
13. **Summary Comments 26**
14. Information Links 27



White bark Pine

Black army cutworm trap.

1. Goal

The goal of this Forest Health Strategy is to serve as a resource for directing forest health management and for communicating hazards or other relevant information on major pests in the Boundary Timber Supply Area (TSA) including area-based tenures - TFLs, CFAs and Woodlots. It provides some of the tools necessary to improve sustainability and resiliency of forested ecosystems by identifying strategies and tactics to minimize losses from damaging insects, diseases, and abiotic disturbances. The Provincial Forest Health Strategy guides government's forest health program to achieve the goals of:

- maintaining and improving the productivity of British Columbia's forests
- extending the supply of the remaining timber resource
- protecting other forest resource values

2. Objectives

The overall objective is to minimize timber losses and the hazard and risk from forest health factors by:

- maintaining a detection program for forest health agents over the land base;
- assessing the potential risks and impact of the identified forest health agents on resource values and timber supply;
- identifying prevention and suppression strategies and tactics for major pests;
- implementing ecologically sound, economically feasible and socially acceptable mitigating strategies and tactics to address forest health agents while considering constraints and limitations placed on the land base;
- encouraging and fostering knowledge sharing on forest health agents amongst Boundary TSA and area-based tenure forestry licence stakeholders, primarily forest tenure Licensees;
- evaluating management practices for the purposes of adaptive management; and
- provide strategic direction for management activities.

2.1 Provincial Forest Health Mandate

The goal of the Provincial Forest Health Program is to manage pests to meet forest management objectives. The provincial government's three key forest health strategic objectives are to:

1. **Forest Health Factors are detected and assessed.**
   New and recurring disturbances caused by forest health factors are detected, and assessments of risk and impact to forest resource values are provided.
2. **Practices are adapted to accommodate known forest health risks.**
   Evidence-based information is used to develop recommendations and modify forest management practices to mitigate the impacts of forest health factors.
3. **Resources are protected.**
   Forest resource values are protected from forest health factor damage through appropriately applied direct management actions including treatment and monitoring. This includes the support and implementation of proactive management activities.

Additional information on the Provincial Forest Health Program can be found at:

https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/forest-health

3. Boundary TSA description

The Boundary Timber Supply Area (TSA) lies in the southeastern part of the province and is part of the Selkirk Resource District. The TSA covers 580,000 hectares (ha) with about 288,000 considered to be available for timber harvesting. Biogeoclimatic zones include Interior Cedar Hemlock (ICH), Engelmann Spruce-Subalpine Fir (ESSF), Montane Spruce (MS), Interior Douglas fir (IDF) and Ponderosa pine (PP). Forests are dominated by Lodgepole pine, Western larch, Douglas-fir, Spruce, and Sub-alpine fir. Management units include: Boundary TSA, Tree Farm Licence 8, West Boundary Community Forest, 34 Woodlots and Gladstone and Granby Provincial Parks. Important non timber values include domestic water, forest recreation, scenic, mule deer winter range and habitat for a threatened grizzly bear population. The last Timber Supply Review (TSR) determination concluded that non recovered losses due to forest health factors and growth losses due to Armillaria root disease are important factors driving allowable annual cut calculations.

The main communities in the TSA are Grand Forks, Christina Lake, Greenwood, Midway and Rock Creek.

Table 1: Total Volume (m^3) by Species Composition for Boundary TSA, over 60 years old & >17.5 cm diameter for all non-Pli species, >12.5cm for Pine species in the THLB as of February 2021. Does not include TFL8, Parks or private land.

Species	Leading Species Total Volume m3	2nd Species Total Volume m3	3rd Species Total Volume m3	4th Species Total Volume m3	5th Species Total Volume m3	Total Volume	Species Volume %
Lodgepole pine	12,092,085	2,222,162	1,221,129	99,661	11,089	**15,646,126**	**43.4%**
Western larch	4,686,906	2,809,806	507,909	66,480	12,063	**8,083,163**	**22.4%**
Douglas-fir	4,658,617	1,130,028	498,837	46,366	11,039	**6,344,887**	**17.6%**
Spruce	1,781,470	1,104,041	285,864	77,827	11,755	**3,260,957**	**9.1%**
Sub-alpine fir	1,092,051	599,871	140,850	34,813	7,912	**1,875,498**	**5.2%**
Cedar	87,034	58,941	37,629	10,682	3,526	**197,811**	**0.5%**
White Pine	30,336	31,699	65,040	28,617	5,453	**161,144**	**0.4%**
Aspen	11,612	64,508	34,600	22,096	4,190	**137,007**	**0.4%**
Hemlock	86,459	27,538	14,461	6,753	1,220	**136,432**	**0.4%**
Ponderosa pine	12,924	43,797	40,709	14,950	887	**113,266**	**0.3%**
Cottonwood	1,925	14,069	13,867	8,970	826	**39,656**	**0.1%**
Birch	1,711	10,533	6,626	4,644	864	**24,379**	**0.1%**
Whitebark pine	1,227	2,470	2,336	9	-	**6,043**	**0.0%**
Total						**36,026,368**	

The following BMUs contain area in both TFL 8 and in the Boundary TSA.

TFL8 BMUs
B01 – South Kettle (portion)
B07 – Boundary South (portion)
B08 – Beaverdell North (portion)

The following 14 BMUs are fully included in the Boundary TSA:

BMU #	BMU Name	BMU #	BMU Name
B01	South Kettle (portion)	B05	Beaverdell South
B02e	Grand Forks East	B06	Kettle River

B02w	Grand Forks West	B07	Boundary South (portion)
B03e	Mid Granby East	B08	Beaverdell North (portion)
B03w	Mid Granby West	B09	Upper Granby
B04e	Christina East	B10	Burrell Creek
B04w	Christina West	B11	Rendell Creek

Comprehensive descriptions of the Boundary TSA are included in the following documents:

- Boundary TSA Website
  https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/timber-supply-review-and-allowable-annual-cut/allowable-annual-cut-timber-supply-areas/boundary-tsa
  - Information Report
  - Analysis Report
  - Rational for Allowable Annual Cut Determination.

- Kootenay-Boundary Land Use Plan
  https://www2.gov.bc.ca/gov/content/industry/crown-land-water/land-use-planning/regions/kootenay-boundary/kootenay-boundary-rlup

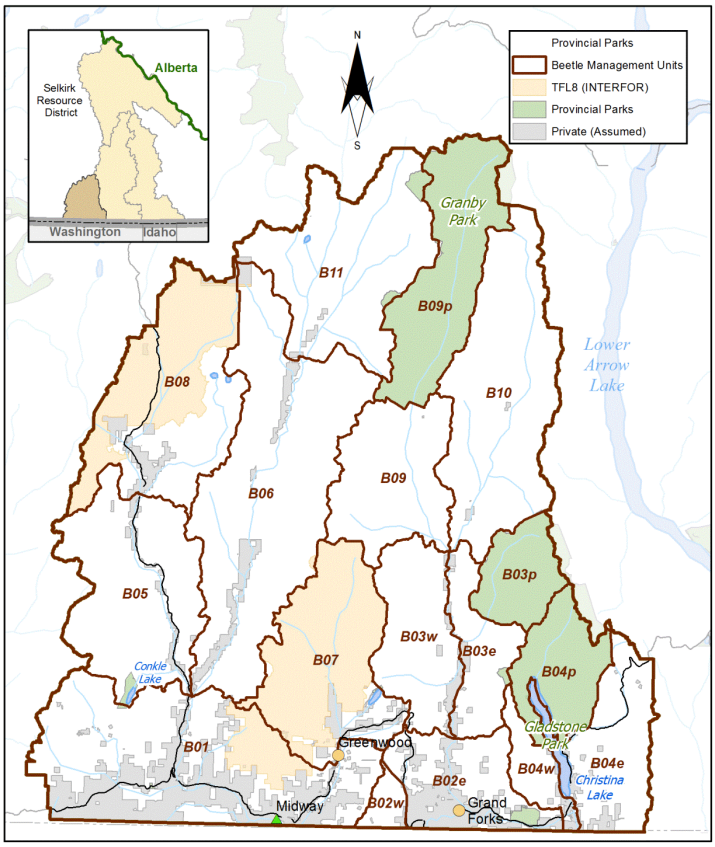


Figure 1. Boundary TSA showing BMUs, TFL8, Parks and Private Land.

3.1. Previous Forest Health Strategies in the Boundary TSA

The last forest health strategy update was completed in 2021. Since 2005, there have been annual reviews to Beetle Management Strategies (BMUs) based on annual aerial overview mapping, detailed mapping, ground surveys and other local information.

4. TSA Priority Ranking of Forest Health Agents

The priority forest health agents have been ranked following the Provincial Forest Health Strategy (Table 2). Rankings were based on the following factors:

- The collective knowledge of the regional and district forest health specialists, forest managers, licencees and contractors.
- Historic recorded occurrence patterns.
- Known or suspected impacts to forest resource values, based on the knowledge of local forest professional and regional forest health specialists.
- Availability of operational detection and treatment methods.
- Costs and benefits of applying detailed detection and treatment activities.
- Overall level of knowledge about the hazard and risk zones.
- Distribution of pest and current incidence levels.

The rankings are somewhat subjective, so an additional approach is to consider what the impact of the forest health factor would be equivalent to in terms of area. This approach provides a useful perspective to the rankings and generally applies as follows:

Ranking	***Predicted potential damage loss per year (ha)***
Very High	>400
High	200-400
Moderate	100-200
Low	50-100
Very Low	<50

Note: some abiotic injuries (i.e. flooding) are not ranked, as the severity can change with each event. Also note that not all forest health factors are ranked, only the more significant pests within the TSA. The following table covers the major forest health agents which can potentially impact the timber supply.

Table 2: Ranking of FH agents by **potential** impact on forest management activities in the Boundary TSA

	Very High	**High**	**Moderate**	**Low**
Defoliators	Western Spruce Budworm	Douglas-fir tussock moth		Aspen Serpentine Leaf Miner Birch Leaf Miner
Diseases	Armillaria root disease		Hard pine rusts (Western gall rust, Stalactiform blister rust & Comandra blister rust, Larch Needle Blight, White Pine Blister Rust)	Dwarf mistletoe (pine and larch) Black Stain root disease
Insects	**Mountain pine, Douglas-fir, Spruce & Western balsam bark beetles**		Wood Borers	Western pine beetle Spruce weevil Balsam Wooly Adelgid
Mammals		Bear & other animals		
Abiotic Factors	**Fire, Drought**		Windthrow	

5. Description of the Priority Forest Health agent status

The following table provides an overview of the activity status of some of the priority forest health agents which were reported during the 2022 provincial overview survey.

Table 3: Selected summary of 2021 & 2022 Boundary TSA significant Forest Health damaging agents

Forest health agents	2021 Affected Area(ha) (includes # of trees in spots)	2022 Affected Area(ha) (includes # of trees in spots)	Trend	Current Impact on Timber Supply	**TSA Priority**
Fire	8,340	266	Significant Decrease	Very High	**1**
Douglas-fir bark beetle	676	1935	Increased significantly	Very High	**1**
Mountain pine beetle	64	218	Slight Increase	Low	2
Western balsam bark beetle	327	937	Increased significantly	Low	3
Post Burn Mortality	0	0	No change	Nil	3
Drought	0	0	No change	Nil	3
Windthrow	0	0	No change	Nil	2
Western Spruce Budworm	0	0	No change	Nil	3
Spruce bark beetle	0	0	No change	Nil	3
Pine Needle Cast & other Pine foliar diseases	0	0	Decreased significantly	Nil	3
Animal (Bear)	0	0	No change	Nil	3
Aspen Serpentine Leaf Miner	361	537	Slight Increase	Nil	n/a
Douglas-fir Tussock Moth	0	0	Slight Decrease	Nil	3
Larch Needle Blight	**9,189**	108	Significant Decrease	Very Low	n/a
Western Pine Beetle	0	0	Slight Decrease	Nil	n/a

5.1 Bark Beetles

Mountain Pine beetle –IBM (*Dendroctonus ponderosae*)

The mapped polygon area of current mountain pine beetle infestation has increased in 2022 compared to 2021. 2022 attack was about 75% in Light Severity with the balance in Trace and then moderate plus spots. Most of the Polygon Attack was noted in the west of Conkle Lake and north of this location and west of Highway 3 to the border with Okanagan TSA. Mountain pine beetle has been active in the Boundary TSA since 2002 and has peaked and is declining significantly but remains a potentially significant cause of tree mortality and non-recoverable losses if not harvested

immediately. There are 117,752 ha, out of a total of 659,000 ha of susceptible (>33 rating) forest types to Mountain pine beetle in the Boundary TSA (2014 analyses). Based on a 2021 BMU analysis, Lodgepole Pine is the dominant tree species in this TSA, representing 43.4% of volume over the age of 60 (exclusive of TFL8, parks and private land).

Since 2018, the IBM attack levels have remained extremely low, continued active management of any new outbreak areas is recommended. The total Pli volume killed from 1999 to 2019 from Mountain Pine Beetle has been calculated at 1,681,230 cubic metres based on the Aerial Overview Survey data within the Crown Forest Land Base.

Douglas-fir beetle –IBD (*Dendroctonus pseudotsugae)*

The Douglas-fir beetle attack area increased by almost 3X from the previous year. The infested area is up from 676 ha in 2021 to 1935 ha in 2022. The severity of attack in 2022 was noted in each of mostly in Light with significant numbers in Trace and Moderate Severity classes with spots noted in Severe. A small amount of area was flown for detailed IBD survey in the area East of Christina Lake and south of Hwy 3 between Grand Forks and Christian Lake and found 60 spots of 3 trees or more per spot for a total of 490 red trees. IBD attack is concentrated in the southern half of the TSA.

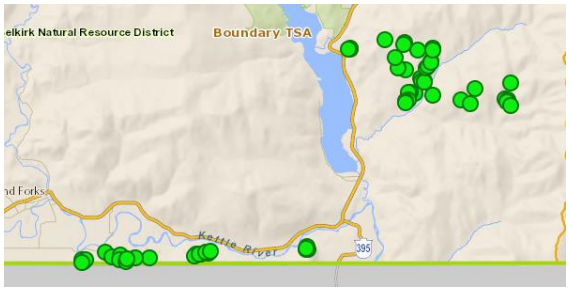


Figure 2. 2022 IBD detailed flight spots detected.

Douglas-fir is a common and the third most predominant species, 17.6% of the volume over age 60, in this TSA and is of an age and diameter to be susceptible to the beetle. based on a 2021 BMU analysis. Proactive management of Douglas-fir beetle and Douglas-fir leading stands remains a high priority for the Boundary TSA given this species' higher wood value. Trap trees and/ or funnel trap programs and monitoring post-harvest slash and monitoring blowdown in recently harvested blocks and removing or burning any slash would be considered good practice to minimize future losses.

The Bark Beetle Guidebook is an additional source to guide treatments (a revised publication should be available this year). In recent years, a small amount of IBD attacked trees and blowdown have been salvaged through the District Small Scale Salvage Program, reducing potential non recoverable losses to a small degree.

Spruce bark beetle –IBS (*Dendroctonus rufipennis*)

Spruce bark beetle was not detected again in 2022. Spruce blowdown or Bark beetle attack, when identified, is a high priority for harvest and treatment. A 2021 analysis identifies that Spruce represents 9.1% of the volume (> 60 years old) within the Boundary TSA. The Bark Beetle Guidebook will guide treatments. Link is as follows:
http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/beetle/betletoc.htm

Western Balsam bark beetle-IBB (*Dryocoetes confuses*)

There are large areas of subalpine fir leading forest stands in the Boundary TSA that are susceptible to western balsam bark beetle. Sub-alpine fir represents 5.2% of the total volume (m^3) by species composition, over 60 years old as of 2021 for the Boundary TSA. Western balsam bark beetle has

been chronically causing mortality over many years. Attack levels have increased significantly in 2022 from 327 ha to 937 ha. Most of the attack is within Trace Severity polygons and small amount in Light plus a few spots and was located mostly in the north half of the TSA. Direct control action on that insect is very difficult due to its attack dynamics and the scattered distribution of the stands.

Western pine beetle-IBW (*Dendroctonus brevicomis*)

Western pine beetle has been identified in the Boundary TSA in the past and appears to be present in low levels in the extensive Py stands along the main valleys especially on private land. No IBW was detected in 2021 or 2022 compared to 59 ha in 2020. Management of Py blowdown is an important component of IBW control.

5.2 Defoliators

Western Spruce Budworm –IDW (*Choristoneura occidentalis*)

Western spruce budworm reduces incremental growth and can kill trees after multiple years of defoliation. The IDW population was not oberved for 2021 and 2020. The last major outbreak was in 2012 at 43,064 ha. Detection, prediction and treatment of defoliators remain the responsibility of the Kootenay Boundary Regional staff. Egg mass surveys have been conducted in the fall in the Boundary TSA at 18 sites over the last couple of years. These surveys provide an estimate of the defoliator population thus predicted defoliation for the next season. Egg mass surveys conducted in 2021 indicated that 10 of 18 sites had no egg masses and 8 sites were in Light category averaging 3.1 eggs per 10 m^2 of foliage and a maximum of 56 at one site. This is down from 7.8 in 2020. (Nil=0; light 1-50 egg masses; Moderate 51-150 egg masses; Severe> 150 egg masses). More specific information on the defoliator program can be obtained from them and in the Defoliator Management Guidebook (1995)
http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/defoliat/defoltoc.htm .
Forest tenure holders should give thought to appropriate silviculture systems to manage for this pest where other management constraints allow. This would include limiting the amount of single tree selection harvesting or heavy retention systems where trying to regnerate a younger layer under an established canopy. Multi-layered multi-aged stands are especially vulnerable to damage by IDW.

Douglas-fir tussock moth – IDT (*Orgyia pseudotsugata*)

Douglas-fir tussock moth feeds on the needles of Douglas-fir, true fir and spruce and population can errupt cyclically with outbreaks occurring approximately every 10 to 12 years. Severe defoliation can result in tree mortality, top-kill or weakened trees, making them susceptible to bark beetle attack. The caterpillars' hairs, cast of laval skins, egg masses, cocoons and female moths can also cause a serious human and other animal health risk which can cause an allergic reaction called tussockosis. The symtoms of tussockosis range from itching, skin rashes, and eye irritation to anaplyaxis in extreme cases depending on the severity of the outbreak, degree of exposure and sensitivity of the individual.

Douglas-fir tussock moth has had a long history in the Boundary TSA with recorded outbreaks as far back as 1929 in the Kettle Valley and near Grand Forks. Tussock moth has most likely been at very lows levels throughout low elevation IDF stands in the south.

No incidence was recorded in 2022 or 2021. Annual trapping with pheromones at permanent sample sites (PSPs) has been conducted by the Minstry since 2009 to provide trends in populations and for predicting imminent defoliation. Three-tree beatings are conducted annually at PSPs to determine species richness and abundance and in 2021 only a single Tussock moth caterpillar was observed at

any of the PSPs. Monitoring will continue but it is unlikely there will be significant defloiation in 2023.

Successful management of Douglas-fir tussock moth depends on carefully monitoring populations within high-hazard stands during the non-outbreak and building phases. Long-term management strategies include stand-manipulation such as conversion to alternative species, promotion of species mixes, stand-structure manipulation such as harvesting and thinning. Once the outbreak begins, viable treatment options exist where management objectives warrant. The preferred treatment is the application of the biological insecticide *Bacillus thuringiensis* var. *Kurstaki* (*Btk*).

Black army cutworm – IDA (*Actebia fennica)*

Black army cutworm was a major pest in the 1980's associated with prescribed burns and with increased wildlife activity and tight timelines for reforestation increased monitoring is required to ensure this defoliator does not impact recently planted areas. Larvae actively feed April through June on a variety of hosts causing "shot-hole" type defoliation. Included in the host preference is a variety of shrubs and herbaceous plants as well as western larch, Douglas-fir, Engelmann/hybrid spruce and lodgepole pine. At low populations black army cutworm feeds on it's preferred hosts of shrubs and herbaceous plants as well as larch, but at moderate and outbreak populations feeding switches to conifer seedlings such as Douglas-fir, Engelmann/ hybrid spruce and lodgepole pine. Seedling mortality can occur as quickly as a single year dependant on black army cutworm population density. Most seedlings can sustain moderate defoliation (i.e. less than 60%) with limited impact on their growth or survival. Moister sites also recover quicker, whereas drier sites experience greater affects of reduced height growth and mortality because of reduced root growth from moisture stress.

Wildfire timing is critical to determine if black army cutworm populations might increase post fire. For early season fires, from April through June, IDA populations are expected to increase the following spring and for late season fires, occurring July through October, IDA populations can increase as early as the following summer.

High risk sites such as burned openings are the preferred egg laying areas. The more severe the burn (i.e. no to little vegetation remaining) the following year leads to the highest levels of defoliation on natural or planted conifer seedlings. ESSF, MS, SBS, ICH and IDF BEC zones are the highest risk areas, especially the drought-prone sites in the drier subzones.

Management strategies for black army cutworm include.

1. Conducting spring surveys on the natural vegetation to determine presence of IDA.
2. Conducting adult pheromone monitoring in the summer (July 1 – September 15th) annually one to three years post fire using baited multi-pher or unitraps.
3. Depending on population levels avoid spring planting or delay planting for one to three years following a burn.

Predicted defoliation risk the following year using multi-pher traps can be categorized as low for <350 moths/ trap, moderate >350-1200 moth per trap and high >1200 moths per trap.

Traps should be placed at least 200 meters apart, well within the burn area, away from stand edges, with a vapona strip placed inside, check and empty traps weekly, place traps at 0.5 to 1 m height on south-facing slopes, in a line across prevailing winds if possible.

Kootenay Boundary Region has been monitoring black army cutworm in various locations since 2018 using multi-pher traps.

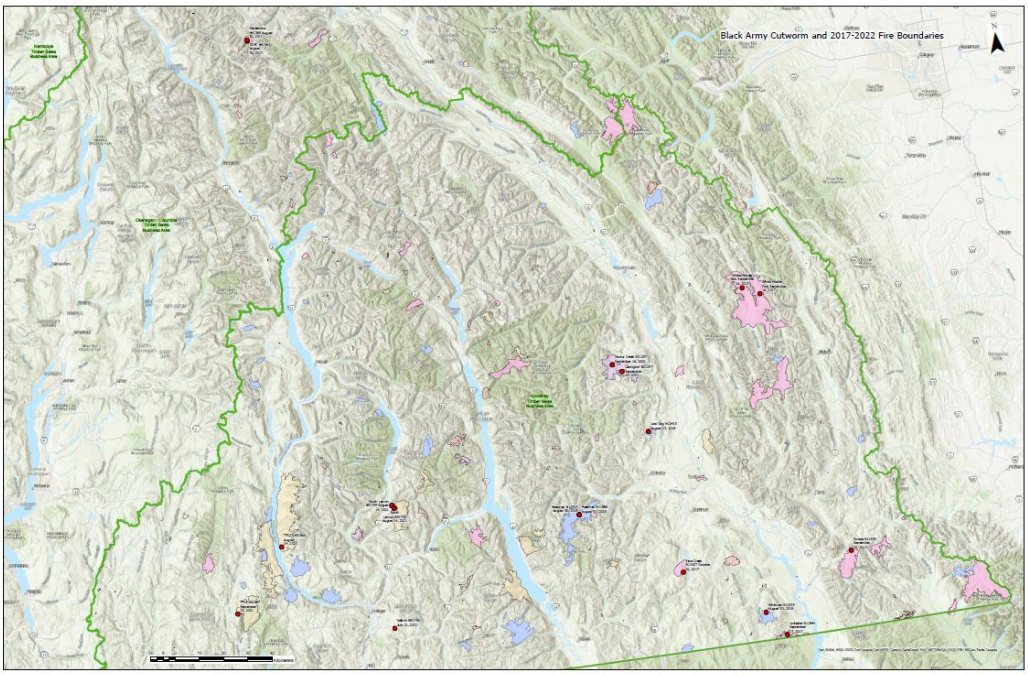


Figure 3. Black army cutworm trapping program sites throughout the Kootenay Boundary Region, 2018-2022.

Deciduous Pests

537 ha of Aspen Leaf Miner of Light and Moderate severity attack was observed in 2022 which compares to 361 ha in 2021. The impact of this pest on the TSA is not deemed to be significant. No management is planned. As per Chief Forester direction, deciduous species should not be included in stocking standards. Chronic damage impacting deciduous species in the Boundary and other adjacent TSAs over the last many years, possibly related to climate change or weather patterns, supports this recommendation.

5.3 Diseases

Armillaria Root Disease –DRA (*Armillaria ostoyae*)

Management of Armillaria and other root diseases in the TSA is recommended to follow the "Managing Root Disease in BC" guide published by MoF (2018). Treatments for root diseases include stump removal and planting appropriate tree species. Practitioners are recommended to apply best management options such as those described in the Province's report "Managing root disease in British Columbia" (MOF 2018). Because deciduous brush thinning can promote spread of Armillaria, such action should be applied carefully. Options might include earlier treatment to maintain conifer crop tree growth vigour when competing deciduous broadleaves have a less extensive root network.

Stocking Standards for Free Growing Stands are contained in each licensee's Forest Stewardship Plan, most of whom have adopted the DSE Default stocking standards and have been developed to mitigate this disease.

Young plantations with DRA tend to suffer a distinct early wave of mortality due to young roots contacting infected stump systems. Mortality usually peaks between 9 and 16 years after planting. Thus, applying free-growing surveys after this time period would provide the most useful information on plantation success. A later FG survey than typical is recommended for areas with known Armillaria, such as ICH sites.

Interfor was the only Major Licencee reporting any stump removal, 45.7 ha for 2022 as of May 2022. Two woodlots completed 30.4 ha as well. No other Licencees appear to be conducting stump removal treatments even though a significant portion of Boundary is covered by ICH BEC subzones that are considered highly susceptible to DRA and treatment levels seem to be very low.

https://www.for.gov.bc.ca/ftp/DAB/external/!publish/Forest%20Health/

Dwarf mistletoe: Larch -DML (*Arceuthobium laricis*), Lodgepole Pine-DMP (*Arceuthobium americanum*), & Douglas-fir-DMF (*Arceuthobium douglasii)*

Dwarf mistletoes will cause losses in volume. However, there is no recent field data to verify level of impact or occurrence. Refer to the new land management handbook, "Dwarf Mistletoe Management in BC" for guidance.

Larch needle cast-DFM (*Meria laricis*) and blight-DFH (*Hypodermella laricis*)

There was a very significant decrease of Larch need cast / blight in 2022, 108 ha compared to 9,189 ha in 2021. The disease is associated with cool damp spring and early summer conditions and this last year saw wetter conditions throughout the spring season. These diseases infect Western larch of all ages. Defoliation by these diseases may cause minor growth reduction in large trees and young trees may be killed. Occurrence is variable from year to year. Negligible impact on the TSA is expected at this time and no management is proposed except continuous monitoring of the occurrence.

Black Stain Root Disease-DRB (*Leptographium wageneri*)

Black Stain root disease has caused some mortality of lodgepole pine and was noted in past monitoring and can be associated with Ips beetle. The impact on TSA is not known to be significant and no management actions are planned or recommended.

Lophodermella (Pine) Needle Cast -DFL (*Lophodermella concolor*) and Dothistroma Needle Blight – DFS (*Dothistroma septosporum*)

2022 and 2021 both had 0 ha observed for Pine Needle Cast 2020. The impact on the TSA can be significant in local areas, especially on regenerating plantations. Careful consideration should be given to species selection in higher risk areas such as the ICH BEC zone. Licencees may want to give some consideration to timing of Free Growing surveys for high percentage Pli plantations in high-risk areas to ensure these diseases are detected. One strategy recommended is to do a sample of FG surveys on Pli dominated stands earlier in the season.

Hard pine rusts: Western gall rust-DSG (*Endocronartium harknessii*), Stalactiform blister rust-DSS (*Cronartium coleosporioides*), Comandra blister rust-DSC (*Cronartium comandra*)

There is no new information or observations for 2022. The hard pine rusts have been a minor concern in the Boundary TSA in the past and often found in Lodgepole pine plantations. Low levels of Western Gall Rust were noted on post Free Growing Stand Development Monitoring plots completed from 2008-2011. Stocking Standards should be modified to ensure stands are not declared free growing without the stand being old enough or tall enough to more fully allow for the expression of the potential for these diseases, especially in ICH sites where Pli is planted or regenerated. Where possible, a mix of species is highly recommended to be planted or regenerated naturally. None of these diseases were detected in the last 4 years' flights but due to the timing of the flight it is possible they would be undetected.

White Pine Blister Rust DSB (*Cronatium ribicola*)

White Pine blister rust is an introduced pathogen which has caused extensive mortality of western white pine and whitebark pine within the Boundary TSA. Theses 2 species represent a small amount of the timber volume in Boundary < 0.5% in stand > 60 years old. On the neighbouring Arrow TSA, SDM sampling found 35.5% of Layers 1, 2, 3 Pw being dead or unacceptable. The availability of disease-resistant white pine makes it possible to ensure this valuable timber species is restored. Disease resistant white pine should be promoted as a reforestation species on appropriate sites. Based on successfully yielding approximately 65% survivorship of white pine, a similar rust-resistance effort should continue to be supported for whitebark pine, which is occasionally harvested, federally endangered, and especially valuable for wildlife. Forest Licencees are encouraged to consider planting rust resistant Pw seedlots.

Birch Decline

During 2000-2007 paper birch (*Betula papyrifera*) decline was widespread throughout the Southern Interior region of the province. Characterized by crown die-back, most mature birch appear susceptible. The spatial distribution patterns and actual causation remain poorly understood. A variety of agents have been observed including bronze birch borer (*Agrilus anxius*), non-native birch leaf miners (*Fenusa pussila* and *Profenusa thomsoni*), *Fomes fomentarius, Cryptosporella tomentella, Armillaria ostoyae* and *Cerrena unicolor*. All are possible agents that could be contributing to birch decline. Climatic perturbations may be a pre-disposing factor, but no definitive research has concluded.

No Birch decline was mapped in Boundary in 2021 or any of trhe other 4 TSAs within Selkirk District. In 2019, wide scale birch leaf "browning" and mining were noted May through June, in the Kootenay Boundary and Thompson Okanagana Regions in the south, and Omineca Region in the north, throughout the range of paper birch, Betula papyrifera.

The decline of birch can accelerate the impacts of *Armillaria* within mixed conifer-broadleaf stands. A particularly important aspect of forest health relates to birch's resistance and tolerance of *Armillaria* root disease. In fact, the roots of deciduous trees often provide a barrier to disease spread, thus protecting neighbouring conifers such as Douglas-fir and lodgepole pine from infection. When birch are harvested, thinned or killed by other causes, the *Armillaria* fungus is able to quickly spread along dead birch roots and transfer to conifers. Overall, the incidence accelerates. Thus, careful consideration should be given in regards to thinning birch and other deciduous brush. One potential action is to consider treatments when the deciduous is younger and smaller with a less developed root network that would come into greater contact than if older and larger.

Whitebark Pine Decline

Whitebark pine (*P. albicaulis*) often occurs within harvest units at elevations above 1600 meters. About half of all whitebark pine in the Boundary TSA is dead or dying. The causes are primarily white pine blister rust and mountain pine beetle. To a lessor extent, the exclusion of fire has favoured its less fire-hardy competitors. As a result, this tree species was placed on the federal endangered species list in 2012. Whitebark pine is valuable to grizzly bears and many other wildlife for its very large seeds.

The cutting or damaging of whitebark pine should be strictly avoided. Whitebark pine stands, especially those with many healthy cone-bearing trees are good candidates for wildlife tree reserves, Old Growth Management Areas, and Wildlife Habitat Areas for grizzly bears. In harvest areas, the thinning of competing trees can promote whitebark pine suvivorship by reducing competition and providing seed regeneration habitat.

An article on Whitebark pine retention can be found on link below:

https://www.mdpi.com/1999-4907/12/6/654

5.4 Animal and Abiotic Factors

Bear-AB and other Animal Damage

No Bear or other animal damage was mapped in 2022 for the thirdyear in a row. During FREP SDM sampling (2009-2013) bear damage and possibly other animals were found to be killing and damaging young Pli trees by stripping their bark and the damage levels are likely significantly higher than can be mapped by the overview survey. Potential solutions to managing animal damage and, bear damage in particular might include high species diversity at time of planting, less Pli, and perhaps higher establishment density as well. Consideration should be given to avoiding or careful consideration of spacing, pruning and fertilizing.

A 2017 District project assessing spaced and/ or pruned Pli stands found that Bear damage was significant and one of the 2 leading mortality agents, especially in Pli stands that were both spaced and pruned.

Windthrow-NW

No windthrow was identified from the AOS in 2022 for the fourth year in a row. Instances of blowdown associated with very small patches or individual trees occur undetected by the AOS survey. Historically, Spruce bark beetle and Douglas-fir beetle outbreaks have been closely associated with windthrow events. Prompt removal of Spruce and Douglas-fir windthrow trees are imperative to avoid the buildup of these two bark beetles. The direct impact of windthrow on the TSA is usually minimal, however, the indirect impact in the form of bark beetle outbreak, can be significant.

Hot Droughts - ND

The frequency and intensity of drought combined with higher summer temperatures appears to be increasing in the southern interior of BC. As a result, trees become stressed, especially young regeneration and overstocked (high density) mature stands. From 2020-22 no mapped drought damage was observed. Sub-lethal effects of drought are often not well documented so often go undetected. Impacted trees often don't die until a year or two post hot drought. The hot droughts of 2003 and 2007 are implicated in the timing of deaths of Armillaria infected regeneration on the Knappen Creek Stump Removal Trial. Often, trees do not die until the growing season following the drought. In a report to the Chief Forester, Axelson and Ebata (2015) predict the following impacts:

- Bark beetles of various species populations will increase.
- Plantation pests such as spruce weevil or lodgepole pine terminal weevil will increase.
- Defoliator activity could increase. Decline syndromes already being experienced in aspen and birch, they will continue or will become accelerated.
- Root diseases impacts will accelerate.

Significant plantation losses of all ages were experienced by Licencees in 2017. Drought kill of multiple-age class Douglas-fir and lodgepole pine was evident in early 2019 in the Beaverdell area.

Recommendations to manage drought include:

- careful species selection and mix (more drought resistant) and higher density at time of planting,
- obstacle planting and leave trees to shade young planted trees,
- additional monitoring plantation post drought,
- consider time of planting moisture retention fertilizer paks.

In June 2021, a heat dome event occurred setting record temperatures throughout southern BC and into the US. As a result of these high temperatures and combined moisture stress trees expereinced siginifcant stress. In the spring of 2023 a significant number of mature Douglas-fir and to a lesser extent, lodgepole pine and western larch, displayed symptoms of attack by larger woodborers as the bark was stripped by woodpeckers, in many cases from crown to duff within a week or so. Woodborers are not usually primary tree killers but when trees are severely stressed they often attack and overcome weakened trees.

Figure 4. Douglas-fir trees infested and killed by larger woodborers and stripped of their bark by woodpeckers (Loon Lake, BC near Grassmere, April 2023).

Fire and Post Fire Mortality NF/ NPB

2022 had no fire area recorded compared to 2021 8,340 ha burned. 266 ha of Post Fire Mortality was noted in 2022. Havest of these areas is highly recommended if economical to reduce NRLs and IBD and IBS population growth.

5.5 Invasive Species

Spongy moth (*Lymantria dispar dispar*)

The Ministry of Forests (MoF), Canadian Food Inspection Agency (CFIA), and Canadian Forest Service (CFS) cooperatively monitor for the occurrence of European spongy moth, *Lymantria dispar dispar* at approximately 5,000 sites provincially. 72 sites are monitored by the Region annually at various high-risk areas including forest recreation sites, campgrounds, and rest stops (Figure 4).

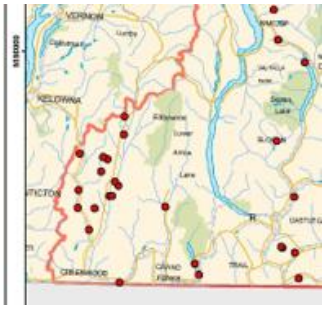


Figure 5. Kootenay Boundary Regional Spongy moth pheromone trap placements.

Balsam woolly adelgid (*Adelges piceae*)

Balsam woolly adelgid (BWA) was accidentally introduced to North America from Europe around 1900 and into Canada in 1910. Adelgids are inconspicuous, aphid-like pests that appear as a white, woolly mass about 1mm long on the bark. Due to their small size they can be easily overlooked. Despite this size, they are an extremely destructive pest that can kill a tree after several years of heavy feeding, with sub-alpine firs (*Abies lasiocarpa*) being the most susceptible. BWA injects toxic saliva into its host plant when feeding, thus inhibiting bud formation and causing tree decline such as yellowing of the needles, premature needle loss, swelling of branch nodes and terminal buds.

BWA has been confirmed in the Boundary TSA in past years and appears to have spread naturally from Washington State forests via wind, birds, and animals and likely from transportation of trees within BC from infested to non-infested areas.

In the fall of 2022, three impact plots were established in the Boundary TSA at Jewel Lake, Phoenix Skill Hill near Grand Forks and Rossland. These plots will be monitored overtime to assess damages of this invasive species.

6. Management objectives for priority forest health agents

6.1. Management objectives for bark beetles (IBM, IBD and IBS)

The following are the management objectives, **in order of priority,** to be implemented for the three main bark beetles in the Boundary TSA: Mountain Pine beetle, Douglas-fir beetle and Spruce beetle. Any reference to "bark beetles" in the following management objective refers to the three bark beetles listed above.

1. **Sanitation and salvage harvesting of beetle killed areas where economically feasible, especially moderate, or higher severity IBM, IBD and IBS attacked polygons and larger Light attack polygons identified by the Aerial Overview Survey or other surveys. Limit unsalvageable losses due to bark beetles. Target a minimum of 50% of these areas identified as an attack polygon in the last 12 months to maintain a targeted strategy IBM within BMUs. And 80% of the area to maintain the targeted strategy for IBD and IBS.**
2. Prioritize the forest management to higher hazard forest stands by harvesting or reducing the susceptibility of stands to bark beetles.
3. Maintain the annual IBM/ IBD/ IBS affected volumes to no greater than the one year of the current AAC, 700,000 m^3.

Definitions:
Sanitation harvesting: harvesting operations specifically designed to maximize the extraction of currently infested or infected stands to reduce the damage caused by forest pests and to prevent their spread, e.g., bark beetles.
Salvage Harvesting: harvesting operations primarily designed to recover timber damaged or degraded by fire, an old insect attack, wind, or disease before the potential wood products become un-merchantable. Control of forest health factors such as bark beetles is incidental and is not the primary objective of salvage logging.

6.2 Harvesting Treatments

Harvesting is to be considered the preferred treatment for all infestations where it is operationally feasible. Treatment may include a single harvest regime or combination of harvest regimes ranging from large cut blocks to single tree selection or small patch where appropriate.

The treatment goal is to remove as much, if not all the current attack prior to the next beetle flight period. Within the Suppression Zone action plans must contemplate harvest before the next flight

period. If this is not achievable, or the likelihood of pre-flight harvest is low, then these areas should be tabled as opportunities for other Licencees by at least April 1st of the following year.

Direct single tree treatments are not to be considered an alternative for harvest where the recovery of otherwise lost timber values and sanitation of beetles, i.e., removal of trees with brood can be attained. Where resources are insufficient to address the removal of all infestations prior to the next beetle flight, consideration must be given to minimizing block sizes and/or harvesting only those portions of the block that are infested this should be considered a short-term strategy until resources permit the removal of logical openings.

It is imperative the operational planning requirements are scheduled accordingly and where necessary to meet tight time frames. If necessary, expedited approvals should be requested and are appropriate where infestations are identified post-flight and where harvest is planned to take place prior to the next beetle flight.

Licencees should consider a small-scale sanitation program as required to meet overall objectives. Sanitation is defined as the removal of infested material prior to beetle flight. Sanitation is to be used, where necessary, to balance resource allocations to optimize the effectiveness of harvesting and single tree treatment strategies and maximize the recovery of otherwise lost timber values.

Sanitation should also be considered where landscape level disturbances and impacts dictate a light footprint approach and where a minimum of one truck load (40 m^3) of operable timber can be recovered, within reasonable skid distance (400 metres) of established logging truck access; the objective is to remove all infested trees prior to the next beetle flight. Only under exceptional circumstances where the methods cannot be applied should these sites be baited and held over flight.

If it is determined that harvesting prior to the next beetle flight is impossible, then consideration should be given to expanding the harvest area to include the area baited, as well as sufficient susceptible host.

6.3 Hauling and Milling Guidelines

The following guidelines should be considered when areas surrounding the mill site are in or near urban areas, or in areas not yet affected by bark beetles.

In recognition of the potential for bark beetles to fly from milling facilities into adjacent areas the following guidelines apply during the period of April 1 to September 15 (Beetle species dependent):

- Manage -spring break up inventories of infested timber for priority processing prior to the above-noted period;
- Keep mill inventories and deliveries of bark beetle infested wood at a minimal operational level to meet business needs;
- Mill profile requirements permitting, prioritize processing beetle- infested sources over uninfested sources.
- Establish funnel traps (especially for IBD) in and around log yards, log decks and log booms to assist in monitoring bark beetle flight and to serve as a control measure. Traps should be monitored at weekly to biweekly depending on catch and contents destroyed.

In recognition of the potential for bark beetles to fly from infested cut blocks (standing trees or decks) to adjacent timber, the following guidelines apply:

- In Salvage BMU's, no special considerations

- In Suppression and Holding BMU's:
    - For infested cut blocks that are not harvested/hauled prior to beetle flight, consider baiting in an attempt to minimize spread. Licensees should, where practical, plan operations that avoid leaving decks of infested timber on site.
    - Communication of business needs/expectation for awareness between licensee and DSE staff prior to spring break-up/next beetle flight is recommended.

In recognition of the potential for bark beetles to fly from trucks during transport the following guidelines apply:

- Inform truck drivers when they are hauling green attack loads and that the beetle flight period extends from April 1st to Sept. 15th (beetle species dependent).
- Inform truck drivers that extended delays along the way can result in bark beetles flying from the load into the adjacent forest land base.
- When practical, hauling of beetle infested logs should be as direct as possible from the cutting area to the mill.

6.4 Pheromone Placement

Pheromone placement is to occur in **infested stands only**, where beetle control activities cannot be implemented until after the next flight and in mop up operations around harvested and treated infestations. In the case of larger blocks with isolated concentrations of attack, only the infested portions of the block should be baited.

The use of pheromone baits must always be followed by actions to remove or eradicate the concentrated beetle populations. All pheromone placement plans should be shared at operational beetle planning meetings, including scheduling follow-up treatments and responsibilities.

Pheromone placement can be implemented throughout the spectrum of treatment strategies including fall and burn. Pheromones should not be placed in operable areas where population levels are extremely high and increasing, or in inoperable areas where population levels are endemic and declining.

The responsibility to carry out follow-up treatments to remove or eradicate concentrated beetle populations resulting from baiting lies solely with the placement agency (Section 41 of the Forest Planning and Practices Regulation (FPPR)). Follow-up actions must be carried out prior to the subsequent beetle flight unless specifically exempted by the District Manager (Section 91 of the FPPR).

Licensees, excluding TSL holders not operating under a cutting permit authority, should consider pheromone bait placement in unharvested portions of beetle infested blocks prior to biological beetle flight times where due to unforeseen circumstance the Licensee will not be able to complete harvest prior to the beetle flight.

All pheromone placement activities must be carried out in a manner which allows for future identification and location of baited trees. Baited trees must be marked conspicuously in the field using flagging, and the placement agency must be identified at each bait site. Maps identifying all baited areas should be provided to the District by September 15th each year. Detailed guidance and protocols on the use of pheromones is provided in "Strategies and Tactics for Managing the Mountain Pine Beetle", developed for the B.C. Forest Service by Lorraine Maclauchlan and J. E. Brooks (*http://www.for.gov.bc.ca/ftp/HFP/external/!publish/MPB_booklet/*).

6.5 Roles and Responsibilities

Detailed bark beetle surveys are carried out to determine the nature and extent of bark beetle infestations within the area of the plan. Specific areas requiring surveys are identified from aerial overview maps and previously known infestations.

If significant risks to forest resources are identified from surveys, actions to reduce risks are identified and reported within bark beetle survey reports and shared with the appropriate licencee. The responsibility to carry out these actions or measures is the responsibility of the licencee.

1. Responsibilities are assigned in this matrix according to funding source. Although there are allowances for some activities under the appraisal system, the responsibilities assigned include the implementation and funding of these activities.
2. In the event that a Forest Licencee must carry out activities within the operating area of another Forest Licencee, the responsibility for bark beetle management activities post-harvest are to be negotiated in advance.
3. Where special management areas have been identified such as areas of interest for the Protected Areas Strategy, the responsibilities identified in this matrix may be amended to address specific management guidelines for these areas.

DSE Forest Health Responsibility Matrix

DISTRICT RESPONSIBILITIES	REGIONAL RESPONSIBILITIES
Prepare an annual Boundary TSA Forest Health Strategy when time and funding permits	Conduct annual aerial overview surveys and provide digital data to districts to produce overview maps and to distribute to DSE clients
Info sharing at TSA Steering Committee meetings and directly to Forest Licencees and other clients	Produce and distribute the Provincial annual forest health overview surveys
Conduct detailed aerial and ground surveys within the Boundary TSA where deemed appropriate	Conduct aerial treatments for defoliators (ex. spruce budworm Btk spraying)
	Conduct defoliator monitoring
Produce maps from the aerial surveys and provide ground survey information and maps to Licensees and clients	Provide overwinter mortality estimates of bark beetles

Within DSE, Forest Licensees have a responsibility to track, monitor and treat forest health factors. The following table covers the responsibilities for Licensees and the Ministry of Forests.

ACTIVITY	***MoF***	***LICENCEES***
Monitor and evaluate forest health activities (Utilize the best current information to detect and manage forest health factors)	***X***	
Conduct treatment of defoliator outbreaks (MoF regional responsibility)	***X***	
Develop annual reports of bark beetle activities for the Province	***X***	
Conduct bark beetle treatments when required by the Forest Health Strategy	***X***	***X***

Maintain and share records of collected survey information	✗	
Conduct ground surveys when required to verify incidence and severity of forest health pests	✗	✗
Conduct aerial overview forest health surveys and report on results (MoF region)	✗	
Conduct detailed aerial surveys focusing on suppression beetle management units	✗	
Submission of survey and treatment data to MoF		✗

7. Provincial Ranking and BMU Strategy for IBM and IBD

Ranking for the two bark beetles with the highest potential impact on the TSA will be covered in this section: Mountain pine beetle and Douglas-fir beetle. The two ranking tables below follow the methodology outline in the Provincial Bark Beetle Strategy and also include the strategy for each BMU.

Table 4: Mountain pine beetle BMU ranking and strategies

BMU#	BMU Name	Susceptibility	Provincial Ranking	BMU-Strategy
B01	South Kettle	High	4	Salvage
B02e	Grand Forks E	Low	7	Salvage
B02w	Grand Forks W	High	4	Salvage
B03e	Mid Granby E	High	4	Salvage
B03w	Mid Granby W	High	1	Salvage
B04e	Christina E	High	4	Salvage
B04w	Christina W	Low	6	Salvage
B05	Beaverdell S	High	4	Salvage
B06	Main Kettle River	High	1	Salvage
B07	Boundary S	Low	8	Salvage
B08	Beaverdell N	High	1	Salvage
B09	Upper Granby	High	4	Salvage
B10	Burrell	High	3	Salvage
B11	Rendell	High	4	Salvage

If the MPB infestation declines sufficiently these strategies should be reassessed and possibly reassigned to suppression or holding, however at this time all the BMUs have been changed to Salvage designation for a BMU strategy as harvest levels over the last many years had not achieved the minimum harvest area of 50% for holding strategy.

Table 5: Douglas-fir beetle BMU ranking and strategies

BMU#	BMU Name	Susceptibility	Provincial Ranking	BMU Strategy
B01	South Kettle	High	3	Targeted
B02e	Grand Forks E	High	3	Targeted
B02w	Grand Forks W	High	3	Targeted
B03e	Mid Granby E	High	3	Targeted
B03w	Mid Granby W	High	3	Targeted
B04e	Christina E	High	3	Targeted
B04w	Christina W	High	3	Targeted
B05	Beaverdell S	High	3	Targeted
B06	Main Kettle River	High	3	Targeted
B07	Boundary S	Moderate	3	Targeted

B08	Beaverdell N	Low	8	Targeted
B09	Upper Granby	Low	8	Targeted
B10	Burrell	Low	8	Targeted
B11	Rendell	Low	8	Targeted

8. Proposed activities to manage IBM and IBD

8.1. Mountain pine beetle

8.1.1. Harvesting

Timber harvesting in infested (1st priority) and red/grey attack (2nd priority) and un-infested stands (3rd priority) with high hazard and/ or infestation is critical to meeting holding strategy objectives and reducing non-recoverable losses. Failure to address these losses continues to impact future timber supply determinations negatively. Due to insufficient funds to single tree treat the entire area and a lack of coordinated harvesting of Beetle infested stands in BMUs previously designated with a Suppression strategy all Suppression BMUs were downgraded to Salvage as of 2017-18.

8.1.2. Pheromone Use

No planned pheromone use by DSE at this time but it is covered by the Southern Interior Region Pest Management Plan.
http://www.for.gov.bc.ca/rsi/ForestHealth/PDF/PMP_2013-2017_FH_Southern_Interior_Feb_19_2013.pdf.

8.1.3. Single tree treatment

Given previous holding strategy no treatments were have been carried out for many years and none planned for future at this time.

8.1.4. Detailed Flight and Ground Surveys

No detailed flights have been completed for many years and future detailed flights for IBM are not planned with current Salvage designation of all BMUs. Fall and Burn treatments would be ineffective without adequate harvesting support given the past and current high beetle populations. If IBM populations remain low throughout the next few years, then re-evaluating suppression strategies and resuming ground treatments may be an option with adequate harvesting support.

8.2. Douglas-fir beetle

8.2.1. Harvesting

The overall strategy for Douglas-fir beetle (IBD) management is that of suppression/monitor through the use of one or a combination of the following:

1. Sanitation Harvesting;
2. Clean harvesting practices;
3. Trap trees;
4. Anti-aggregation pheromones (MCH);
5. Funnel trapping.

Timber harvesting in infested (1st priority) and red/grey attack (2nd priority) and un-infested stands (3rd priority) with high hazard and/ or infestation is critical to meeting suppression strategy objectives and reducing non-recoverable losses. A combination of sanitation and salvage harvesting for Douglas-fir beetle suppression should be carried out in areas of current-attack in order to reduce the existing population and inhibit the infestation expansion. Failure to address these losses continues to impact future timber supply determinations negatively.

Trap trees are highly recommended as an effective tool to reduce overall beetle population levels in any IBD areas or Douglas-fir stands and complete a post-harvest mop-up where necessary. Baited funnel traps and MCH anti-aggregant may be used where conditions are appropriate, primarily but not limited to near larger fires from previous years.

8.2.2. Pheromone Use

Pheromone use (Enhanced lures and MCH) is planned for use with IBD funnel trapping projects only at this time under Land Based Investment Funding works through Selkirk resource District and is covered by the Southern Interior Region Pest Management Plan.
http://www.for.gov.bc.ca/rsi/ForestHealth/PDF/PMP_2013-2017_FH_Southern_Interior_Feb_19_2013.pdf.

At this time, DSE plans to deploy 15-20 funnel trap sites in Southwest Boundary area and 40 funnel trap sites in Grand Forks and north area for IBD for 2023. Some funnel trapping was also planned by a few other licencees within Boundary at this time.

2022 IBD District funded funnel trapping in SW Boundary resulted in 272,405 IBD captured at 17 sites and 873,448 IBD captured in SE Boundary at 41 sites. BCTS had 27 funnel trap sites and captured 136,600. West Boundary CF captured 5,000 IBD. A few Woodlots in Boundary had traps out to with unknown results. Total known capture IBD was almost 1.3 million which saved an estimated 757 Fdi trees from being killed.

A 2020 study by Marnie Duthie-Holt and Boundary Woodlots concluded that the Synergy lite lures performed significantly better than WestGreen lures in trapping beetles with marginally higher rates of spill over attack levels within 25 to 50- and 50-75-meter distance from the baited traps. Therefore, if traps are to be used for a smaller opening than 100-meter radius the choice would be for the Synergy lite lures. However, caution should still be taken to ensure that any susceptible host trees within 100 meters are protected with MCH bubble caps or if population levels are significant, alternative control techniques such as trap trees, should be employed to minimize spill over attack.

8.2.3. Single tree treatment and other treatments

Funnel trapping currently planned for the Rock Creek / Southwest Boundary area and the SE Boundary area. No single tree treatments took place in 2022-23 and none planned at this time for 2023-24.

8.2.4. Detailed Flight and Ground Surveys

Detailed flights took place in 2 small areas – East of Christina Lake and South of Hwy 3 between Grand Forks and Christina Lake in 2022-23. Likely no or minimal flight area planned for 2023-24.

9. 2023-24 Fiscal Year Tactical Plan

The tactical plan will be to continue to monitor forest health agents through the aerial overview survey and possibly small areas to be flown for IBD under a detailed survey. District IBD funnel trapping around the Rock Creek Fire/ SW Boundary and areas north of Grand Forks and east to Christina Lake is planned for 2023. Forest Licencees have been encouraged to consider their own funnel trapping programs and trap tree programs for IBD. The focus will continue to be providing Licencees with data to address IBM, IBD, IBS, NF, NW and ND impacted areas through harvesting to reduce non-recoverable losses and attempt to limit the spread of the various bark beetles. No

planned single tree treatments. Georeferenced maps of Boundary TSA showing Fire, IBD, IBS & IBM 2019-2021 polygons and spots are available on the Selkirk District Forest Health FTP location. Updated maps will be prepared for the 2020-22 time period later this year.

10. Stocking Standards

While there are some recommendations within current stocking standards for forest health agents, the risk to Lodgepole pine (Pli) on ICH sites may be inadequately dealt with to date. Consideration should be given to increasing the minimum free growing height for Pli by up to 50% and/ or perhaps increasing the target and minimum density by 200 to 400 sph for stands regenerated to a high percentage (>60%) of Pli in the ICH subzones. Significant concerns relating to rusts, bear damage and other damaging agents exist for this species especially when stands are declared Free growing at such a young age due to the fast-growing nature of this species. Evidence for this includes historical FREP SDM surveys within Boundary TSA as well as other SDM surveys in adjacent TSAs and research by Alex Woods and David Coates.

Licensees and prescribing foresters need to be cognizant of climate change and how this can impact future timber supply through stocking recommendations and forest health issues that may have greater, lesser or different impacts in the future as a result of climate change. The 2018 drought damage was a significant mortality loss and possibly a good indicator of selecting species more drought resistant on sites than in the past.

An additional consideration to professionals completing Free Growing declarations is the age at which plantations are allowed to undergo Free Growing evaluation. The average FG declaration age is 9 years in the South Area. However, Armillaria root disease, the primary agent of mortality in a substantial number of plantations, does not typically spread until 12-16 years. Thus, FG evaluations prior to 16 years of age risk underestimating stand mortality. New Stocking Standards for Selkirk District are available based on newly developed BEC and incorporate some Forest health concerns from previous standards.

11. Non-Recoverable Losses Section – Boundary TSA (fire, wind, pests, total current AAC comparisons)

Table 6 presents the estimated forest volume killed in the Timber Harvesting Land Base (TSA only, excludes TFL8 and other non-TSA areas) by selected Aerial Overview Forest Health Factors, as well as the amount of that killed volume that has not been harvested as of the year 2019. The AAC from 1996 to present is 700,000 m3 annually. There is no 2020-22 update to this table as it was not supplied at the time of this report preparation.

2019 NRLs were the lowest recorded since 2003. It is likely based on a review of the 2020 data that the NRL are not significantly different from the 2019 levels. 2018 had the highest Non-recoverable losses on record in the last 21 years and represents over 20% of the current AAC for Boundary TSA, 90% of which has been attributed to drought. Over the 21 years reported in this table the volume lost represents just under 10% of the AAC and harvested killed volume is less than 50% of a single year's AAC.

Table 6: 1999-2019 Non-recoverable losses not harvested within the Boundary Timber Supply Area Timber Harvesting Land Base (2020-22 data not available at this time)

THLB Volume (m3) killed and not harvested as of 2019

	Forest Health Factors							Volume Killed & Harvested	
Year	IBM	IBD	IBB	Fire	Drought	Wind throw	Totals	M^3	% of Total Killed
1999-2009	491,103	12,175	54,166	8,317	6,333	1,294	572,094	163,015	22%
2010	53,504	-	342	-	-	344	53,846	16,618	24%
2011	57,363	-	37	328	-	-	57,728	20,911	27%
2012	74,419	80	133	61	-	54	74,693	25,018	25%
2013	98,939	77	129	86	-	372	99,231	27,052	21%
2014	82,024	135	349	36	-	-	82,544	21,754	21%
2015	54,425	236	416	23,718	-	-	78,795	22,750	22%
2016	42,086	777	1,643	86	125	-	44,717	9,008	17%
2017	46,040	1,768	95	37,876	-	-	85,779	8,336	9%
2018	581	3,080	435	8,322	132,275	9,363	144,693	3,025	2%
2019	**1,613**	**1,801**	**210**	**-**	**23,838**	**-**	**27,462**	-	0%
Totals	**1,002,097**	**20,129**	**57,955**	**78,830**	**146,869**	**11,427**	**1,407,416**	**317,487**	19%

12. Anecdotal observations/ comments

- Larch Moth (*Cydia laricana*) came up as an up an coming top kill and mortality agent on Western Larch and Douglas-fir in Idaho and Montana including Kettle Falls, Washington just south of the border near Grand Forks. We should keep an eye out for it. It is unique in that it is a wood-boring moth. Not a whole lot is known on it yet but likely it is a native species causing more damage as a result of stressed trees. It has been spotted on trees associated with larch needle cast.

13. Conclusion/ Comments

The last several years have seen significant increases in Douglas-fir beetle attack and this should remain a primary focus for all Forest Licencees. Related to this is fire and drought damage which in themselves are causing significant timber losses but also result in more losses with IBD or woodborers. Woodborers have become a primary mortality agent it appears in the last year or so and careful management for these in mills and sort yards should be considered as well as in forest settings. Mountain Pine Beetle appears to be on the rise again and should not be discounted and should be considered for harvest planning. Licencees are encouraged to be proactive and incorporate mitigating or improving forest health factors and issues into the full range of forest activities from harvest planning to free growing and beyond. Proactive management where possible is highly recommended.

The active co-operation of licencees and MoF staff working together to promote and manage healthy forests through diversity, early detection of forest health issues, and direct action as required, will ensure a sound and sustainable industry.

Please contact Dean Christianson, Stewardship Forester – Forest Health if any issues or questions related to Forest Health within the District. Dean. Christianson@gov.bc.ca or 778-364-1145.

14. Information Links

Report: 2022 Overview of Forest Health Conditions in Southern British Columbia
https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/forest-health/aerial-overview-surveys/summary-reports

Provincial Forest Health Strategy 2019-2022
https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/forest-health/fh-strategies/final-2019-22_bc_pfhs.pdf

Provincial Bark Beetle Management Technical Implementation Guidelines (formerly Bark Beetle strategy
https://www.for.gov.bc.ca/hfp/health/fhdata/bbstrategy.htm

Spatial Data:
Bark Beetle Hazard Ratings
https://www.for.gov.bc.ca/rsi/foresthealth/hazard_rating.htm

2022 and earlier Annual Overview Surveys. (fixed wing based aerial mapping of all visible forest pests).
http://www.for.gov.bc.ca/ftp/HFP/external/!publish/Aerial_Overview/

2022 and earlier Detailed Mapping (Helicopter based aerial mapping of Beetle Management Units with a Douglas-fir beetle strategy of suppression). Available upon request from District Forest Health Staff or at following FTP location:
https://www.for.gov.bc.ca/ftp/DAB/external/!publish/Forest%20Health/Detailed%20and%20Aerial%20Overview%20flight%20data/

2019-21 Maps of IBD, IBS and IBM for the area are available on the FTP site at
https://www.for.gov.bc.ca/ftp/DAB/external/!publish/Forest%20Health/Detailed%20and%20Aerial%20Overview%20flight%20data/2021%20Data/2019-2021%20GEORef%20Maps/

Additional maps and data are available on the Branch FTP site at
https://www.for.gov.bc.ca/ftp/HFP/external/!publish/Aerial_Overview/