

MINISTRY OF FORESTS, LANDS, NATURAL RESOURCE OPERATIONS
AND RURAL DEVELOPMENT

Selkirk Natural Resource District

Kootenay Lake TSA Forest Health Strategy 2019-20



Updated by:

Dean Christianson, RPF #3331
Stewardship Forester
Selkirk Resource District
July 10, 2020

Approved by:

Tara DeCourcy, RPF
District Manager
Selkirk Resource District

23 July 2020
Date



Douglas-fir beetle



Photo courtesy of Gerald Cordeiro

Cover Photo: Courtesy of Kailee Woodbeck

Table of Contents

1.	Goal	5
2.	Objectives	5
3.	Kootenay Lake Timber Supply Area description	6
3.1.	Previous Forest Health Strategies in the Kootenay Lake TSA	8
4.	TSA Priority Ranking of Forest Health Agents.....	8
5.	Description of the Priority Forest Health agent status	9
5.1.	Mountain Pine beetle IBM (<i>Dendroctonus ponderosae</i>).....	10
5.2.	Douglas-fir beetle IBD (<i>Dendroctonus pseudotsugae</i>).....	12
5.3.	Spruce bark beetle (<i>Dendroctonus rufipennis</i>).....	13
5.4.	Windthrow	15
5.5.	Amillaria Root Disease (<i>Armillaria ostoyae</i>).....	15
5.6.	Western Balsam bark beetle (<i>Dryocoetes confuses</i>)	16
5.8	Larch needle cast (<i>Meria laricis</i>) and blight (<i>Hypodermella laricis</i>)	16
5.9	Hard pine rust: Western gall rust (<i>Endocronartium barknessii</i>), Stalactiform blister rust (<i>Cronartium coleosporioides</i>), Comandra blister rust (<i>Cronartium comandra</i>)	17
5.11	Various deciduous diseases and pests	17
5.12	Animal Damage	17
6	Management objectives for priority forest health agents.....	21
6.1	Integrated Forest Health Management objectives	21
6.2	Management objectives for bark beetles (IBM, IBD and IBS)	21
6.5	Roles and Responsibilities.....	24
7	Provincial Ranking and BMU Strategy for IBM, IBD & IBS	25
	Table 9: Mountain pine beetle BMU ranking.....	25
8	Recommended activities to manage IBM, IBD and IBS	27
8.1	Mountain pine beetle.....	27
8.1.2	Pheromone Use	27
8.1.3	Single tree treatment and other treatments	27
8.1.4	Detailed Flight and Ground Surveys.....	27
8.2	Douglas-fir beetle.....	28
8.2.2	Pheromone Use	28
8.2.3	Single tree treatment and other treatments	28
8.2.4	Detailed Flight and Ground Surveys.....	28
8.3	Spruce beetle.....	28
8.2.1	Harvesting.....	29
8.3.2	Pheromone Use	29
8.3.3	Single tree treatment and other treatments	29
8.3.4	Detailed Flight and Ground Surveys.....	29
9	Priority Activities in BMUs.....	29
10	2019-20 Fiscal Year Tactical Plan	29
11	Stocking Standards	29
14	Information Links	32



Douglas-fir beetle

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 Kootenay Lake Timber Supply Area (TSA) and other area based tenures with Kootenay Lake TSA including 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 Arrow TSA forest stakeholders, primarily forest tenure Licencees;
- 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 strategic forest health objectives are to:

1. **Pest impacts are monitored and assessed**
The evaluation of pest impacts on forest resource values is supported by forest health monitoring and assessments.
2. **Practices are adapted to accommodate known forest health risks**
Forest practices are modified to minimize the impacts of forest health factors based on the best available information.
3. **Resources are protected**
Forest resources are protected from pest damage through appropriately applied direct management actions.

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. Kootenay Lake Timber Supply Area description

The Kootenay Lake TSA lies in the West Kootenay area in the southeastern portion of the province and is part of the Selkirk Resource District. The main communities in the TSA are Nelson, Creston, Kaslo and many smaller communities scattered along Kootenay Lake and River.

The 2010 timber supply analysis report identifies the total area of the TSA as 1,240,843 hectares, of which 569,620 hectares are Crown forested land, and 199,282 hectares are considered to be available for timber harvesting and are referred to as the timber harvesting land base (THLB). Management units include: Kootenay Lake TSA, 3 Community Forests, 14 Woodlots and several larger Provincial Parks - West Arm, Goat Range, Kokanee Glacier, Purcell Wilderness Conservancy, Lockhart Creek and Kianuko. The Kootenay Lake TSA has been divided into 24 Beetle Management Units (BMU) corresponding to Landscape Unit boundaries.

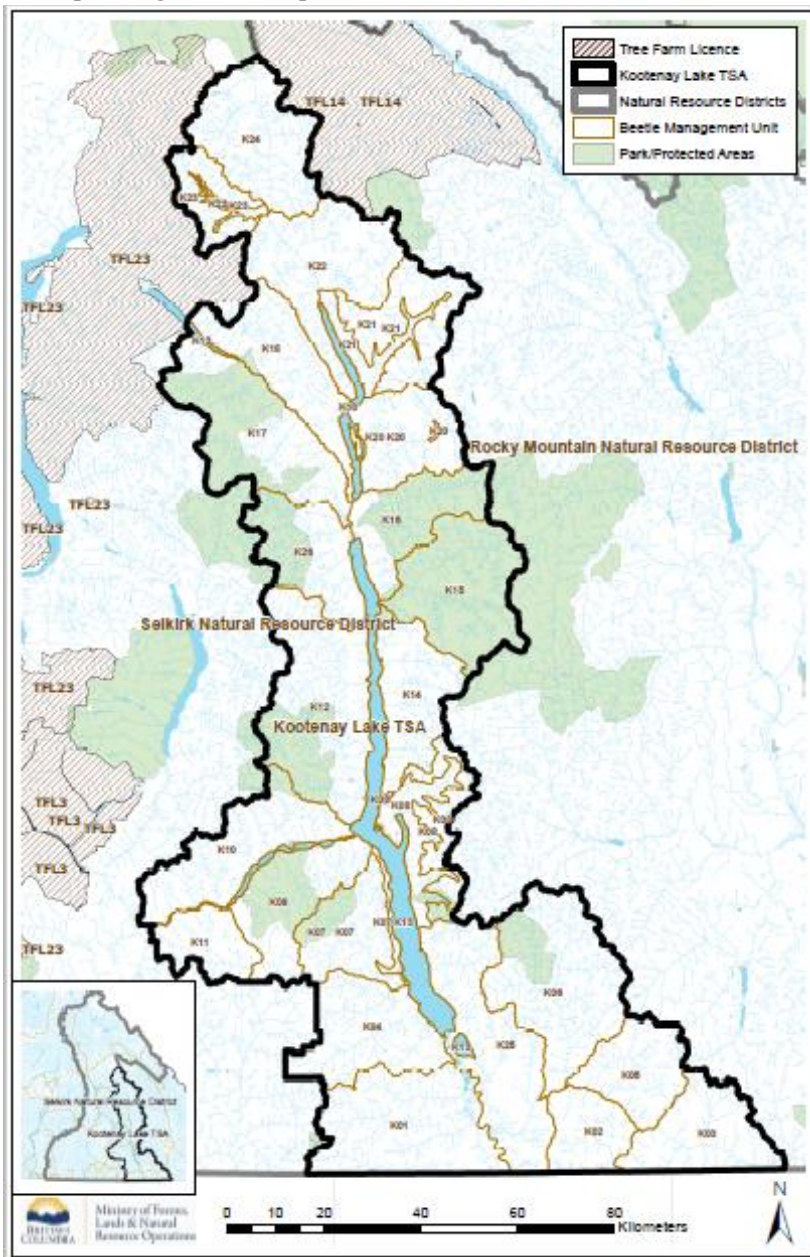


Figure 1: Kootenay Lake TSA.

Table 1 shows the BMU names and associated numbers and the following figure shows a map of the entire district with its associated BMU boundaries. No BMU updates have taken place in Kootenay Lake for 8 or more years.

Table 1: Kootenay Lake TSA Beetle Management Units (BMUs) and Associated Numbers.

BMU #	BMU Name	Comments	BMU #	BMU Name	Comments
K01	Summit Creek		K14	Riondel	
K02	Little Moyie River		K15	Fry Creek	100% Prov Park
K03	Hawkins Creek		K16	Hamill Creek	High % Prov Park
K04	Darkwoods	90%+ Private Land	K17	Goat Range	High % Prov Park
K05	Kid Creek		K18	Lardeau River	
K06	Goat River		K20	Glacier Creek	
K07	Midge Creek		K21	Howser Creek	
K08	Gray Creek		K22	East Creek	
K09	Lasca Creek	High % Prov Park	K23	Westfall River	
K10	West Arm		K24	Duncan River	
K11	Fortynine Creek		K25	Duck Lake	
K12	Kaslo River		K26	McKian-Schroeder	High % Prov Park

The TSA is characterized by mostly steep, mountainous terrain. Less than half of the TSA is productive forest land and only about 16% is currently classified as Timber Harvesting Land Base under the most recent Timber Supply Review. A significant portion of the productive forest land area is unavailable for timber harvesting for various reasons, including: operability, environmental sensitivity, unstable soils and steep slopes, non-merchantable forest types, the Caribou GAR order, Ungulate Winter Range, Old Growth Management Areas and Connectivity Corridors.

Table 2: Kootenay Lake TSA THLB Species volumes for > 60 year old stands.

Species	Leading Species Total Volume m ³	Secondary Species Total Volume m ³	Third Species Total Volume m ³	Fourth Species Total Volume m ³	Totals	Species %
Douglas-fir	20,505,872	3,767,060	1,319,315	275,333	25,867,579	21%
Sub-alpine fir	16,749,106	4,600,723	936,889	480,237	22,766,954	19%
Spruce	11,393,452	8,577,482	1,767,250	432,044	22,170,228	18%
Western Larch	9,145,385	5,574,951	1,248,604	517,156	16,486,096	13%
Western Hemlock	10,260,835	2,554,495	754,472	213,334	13,783,136	11%
Lodgepole Pine	8,595,425	2,179,481	1,618,957	417,569	12,811,431	10%
Western Red Cedar	1,721,106	2,289,672	763,570	278,807	5,053,154	4%
Cottonwood	702,750	73,566	39,060	20,844	836,221	1%
Trembling Aspen	352,593	247,839	132,177	82,204	814,813	1%
Ponderosa Pine	186,256	233,007	98,524	27,364	545,151	0%
Paper Birch	82,851	160,500	128,014	73,052	444,416	0%
Alpine Larch	113,446	183,701	64,176	8,493	369,816	0%
Grand Fir	38,709	88,362	73,959	48,465	249,495	0%
Whitebark Pine	17,124	97,479	70,184	10,348	195,135	0%
Western White Pine	11,936	25,875	47,495	44,256	129,561	0%
Totals	79,876,844	30,654,194	9,062,644	2,929,505	122,523,186	

The TSA is situated in the Interior Wet Belt, and its forests are among the most productive in the B.C. interior. Major biogeoclimatic zones include the Interior Cedar Hemlock, Engelmann Spruce-Subalpine Fir, and Interior Mountain – heather Alpine zones. The dominant tree species (10% or greater) are Douglas-fir, Sub-alpine fir, Spruce, Western larch, Spruce, Western Hemlock and Lodgepole pine (see Table 2). Minor species found in the TSA include Western red cedar, Ponderosa pine, Alpine Larch, Grand fir, Whitebark pine, Western White Pine and Broadleaf species. A significant portion of the area in the THLB is between 60 and 120 years of age.

Comprehensive descriptions of the Kootenay Lake TSA are included in the following documents:

- Kootenay Lake 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/kootenay-lake-tsa>
 - Information Report
 - Analysis Report
 - Data Package
 - Rational for Allowable Annual Cut Determination
- Kootenay-Boundary Land Use Plan
<https://www.for.gov.bc.ca/tasb/slrp/pdf/LRMP/Kootenay%20Boundary%20Land%20Use%20Plan%20Implementation%20Strategy.pdf>

3.1. Previous Forest Health Strategies in the Kootenay Lake TSA

The last forest health strategy was completed in 2019. **Unsalvaged losses due to wildfire and Mountain pine beetle were both highlighted in the 2010 Kootenay Lake TSR AAC rationale as concerns for future timber supply by the Chief Forester and remain a concern along with other bark beetles as priority issues to reduce non-recoverable losses.**

4. TSA Priority Ranking of Forest Health Agents

The priority forest health agents have been ranked following the Provincial Forest Health Strategy (Table 3).

Rankings were based on the following factors:

- The collective knowledge of the regional and district forest health specialists, forest managers, licensees 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:

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

Note: Not all forest health factors are ranked, only the more significant pests. The following table covers the major forest health agents which can potentially impact the timber supply.

Table 3: Ranking of Forest Health agents by potential impact on forest management activities in the Kootenay Lake TSA

FH Factor	Very High	High	Moderate	Low
Defoliators		Western Spruce Budworm Western hemlock looper		Aspen Serpentine Leaf Miner
Diseases	Armillaria root disease		White pine blister rust	Dothistroma, Hard pine rusts (Western gall rust, Stalactiform blister rust & Comandra blister rust)
Insects	Douglas-fir beetle, Spruce beetle Mountain pine beetle, Western balsam bark beetle			Spruce weevil
Mammals			Bear & other animals	
Abiotic Factors	Fire	Windthrow Drought		

5. Description of the Priority Forest Health agent status

Table 4 provides an overview of the activity status of some of the priority forest health agents which were reported during the 2018 and 2019 provincial aerial overview survey (AOS). Note that spot tree counts have been incorporated into the severe category of damage based on a fraction of a hectare per spot. Priority ranking is based on risk of current and future non-recoverable losses. The three Priority 1's represent the largest current losses of higher value timber species over the last 2 years and the four bark beetles have the potential to cause further losses if not managed/ harvested in a timely fashion.

Table 4: 2018 & 2019 Kootenay Lake TSA significant Forest Health damaging agents based on Aerial Overview Survey data

Forest health agents	2019 Affected Area (ha)	2018 Affected Area (ha)	Trend	Current Impact on Timber Supply	TSA Priority
Douglas-fir beetle	1,024 ha	703 ha	Significant Increase	Very High	1
Mountain pine beetle	3,586 ha	3,560 ha	Static	Very High	1

Western balsam bark beetle	8,541 ha	5583 ha	Significant Increase	Very High	2
Fire & Post Fire	360 ha	12,559 ha	Significant Decrease	High	1
Spruce bark beetle	1,110 ha	227 ha	Significant Increase	Low	2
Hemlock Looper	298 ha	0 ha	Significant Increase	Low	3
Aspen Serpentine Leaf Miner	6,050 ha	5901 ha	Static	Low	n/a
Birch Leaf Miner	786 ha	321 ha	Slight Increase	Very Low	n/a
Animal damage (Bear)	55 ha	92 ha	Slight Decrease	Low	3
Windthrow	0 ha	58 ha	Slight Decrease	Very Low	2
Western Pine Beetle	13 ha	17 ha	Static	Nil	n/a
Cedar Flagging	1220 ha	0 ha	Significant Increase - New	Very Low	n/a
Larch needle blight / cast	189 ha	655 ha	Significant Decrease	Nil	n/a
Flooding	0 ha	67 ha	Slight Increase	Very Low	n/a
Drought	296 ha	1288 ha	Significant Increase	Low	n/a
Slides	8 ha	28 ha	Static	Very Low	3

5.1. Mountain Pine beetle IBM (*Dendroctonus ponderosae*)

The area of current mountain pine beetle infestation remains high and has increased by 26 ha from 2018. Approximately 75% of the area affected was surveyed as low and moderate severity with the balance as trace and severe which is a general slight increase in severity over 2018. Approximately 16% of the affected area is within the operable land base. Mountain pine beetle has been active in the Kootenay Lake TSA since 2001 and activity has been generally declining since 2006 when volume losses peaked likely due to much of the concentrated Pli stands having been already attacked and/or harvested. Pli currently represents about 10% of the standing inventory.

There are 51,269 ha of susceptible (>33 rating) forest types to Mountain Pine beetle in the Kootenay Lake TSA based on a 2014 BMU analysis. Ten of the TSA BMUs have area with greater than one thousand hectares of susceptible Pli (>33%) and 80% of the pine volume (THLB) is located in 6 landscape units in the Southeast corner of the TSA. Of these 6 LUs/ BMUs only 3 are still under Suppression (K02, K03 and K05). Figure 2 displays those higher risk BMUs and indicates that most of the higher risk area is in the SE of the TSA in the vicinity of Creston and Yahk.

Extensive mountain pine beetle ground surveys, single tree treatments and harvesting of infested and susceptible areas have been carried out in Kootenay Lake TSA since 2005. All suppression efforts have been directed to three suppression BMUs (K02, K02 and K05), the table below provide an overview of the suppression efforts completed since 2006. The peak of the mountain pine beetle outbreak occurred in 2008/09 in the Kootenay Lake TSA and population levels have been declining ever since to the current endemic level.

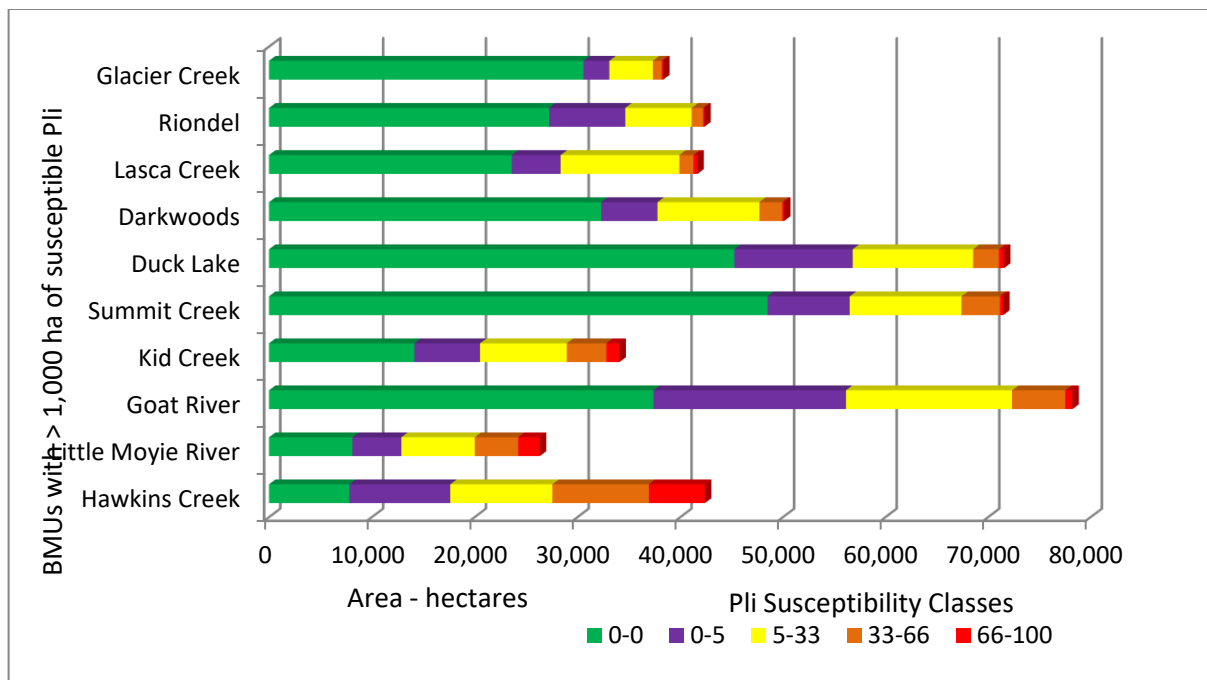


Figure 2: Kootenay Lake TSA BMUs with greater than 1,000 hectares of moderate and high susceptibility class as of 2015 ranked from lowest to highest area top to bottom.

Over the past 19 years Kootenay Lake TSA licencees responded to the beetle population with targeted harvesting from 1999 to 2006 with declining harvest of killed volume since 2007 (see Section 12 Non-Recoverable Losses). Table 5 below shows recent harvest of IBM polygons is minimal to date and with the declining incidence there have been fewer concentrated IBM attack areas to be harvested. An ideal response would be 50% or greater within 1 year with most of the BMUS in holding action strategy.

Table 5: 2017-19 IBM Aerial Overview Survey polygon area and completed/ planned harvest to date

2017-19 IBM AOS Polygon Area and Polygon Harvest Area							
Year	Total AOS Polygon Area (ha)	Operable AOS Polygon Area (ha)	Harvested Area as of Winter 2019-20	Planned Harvest Area as of Winter 2019-20	Harvested % of Operable as of Winter 2019-20	Planned Harvest % of Operable as of Winter 2019-20	Total Current and Future Harvest %
2017	2902.7	483.1	7.6	0	0%	1.7%	1.6%
2018	3544.4	414.6	0	0.8	0%	0.2%	0.2%
2019	3508.6	559.4	0	0	0%	0%	0%

A significant amount of resources have been expended managing IBM in the Yahk area BMUs over the last many years as noted in part in Table 6. IBM detection and treatment has been declining over the last several years with declining beetle populations in the area. The single tree fall and burn treatments and Licencee targeted harvesting of attacked or susceptible stands has been likely been instrumental in reducing IBM levels in this area to a significantly lower level. **Continued harvest of susceptible stands and any identified polygons of attack to reduce non recoverable losses is the recommended strategy.**

Table 6: Historical IBM (IBW) treatments in the Yahk Area 3 BMUs 2014-2020 and IBD near Nelson in 2016 -2019

Fiscal Year	Area Ground Surveyed	# of trees felled & burned (treated)
2014/15	1360 IBM points & 5.9 ha	880 trees
2015/16	814 IBM points	693 trees
2016/17	621 points (IBM) & 16 points (IBD)	184 trees (IBM/IBW) & 34 trees (IBD)
2017/18	216 points (IBM) & 16 points (IBD)	180 trees (IBM/IBW) & 109 trees (IBD)
2018/19	297 IBM points	333 IBM/IBW trees & 6 IBD trees
2019/20	187 IBM points	627 trees

Future Trends

The “BC MPB Model (2015) projection of the Current Mountain Pine Beetle Outbreak” previously estimated that less pine will be killed than originally thought but the impact on Kootenay Lake TSA is still significant and had projected that IBM attack will continue to increase.

The total Pli volume killed from 1999 to 2019 from Mountain Pine Beetle has been calculated at 5,531,648 cubic metres based on the Aerial Overview Survey data within the Crown Forest Land Base.

5.2. Douglas-fir beetle IBD (*Dendroctonus pseudotsugae*)

The IBD affected area in 2019 is a 50% increase from the previous year, however volume estimates are double within both the Crown Forest Land Base (CFLB) and Timber Harvesting Land Base (THLB). Severity was primarily Light and Moderate, with a small amount of area in Trace and Severe. Areas of known significant attack in 2019 include: Sanca/Akokli Creeks East side of Kootenay lake, West Arm Area (especially north shore) from Queen’s Bay to Slocan Junction (north and south shores), Queen’s Bay to Kaslo, Ymir, Duncan Lake, Argenta/Johnson’s Landing and Crawford Bay. The IBD outbreaks have likely been fueled largely by localized windthrow events, wildfires by creating scorched/ stressed Douglas-fir trees in the light to moderate intensity wildfire areas and more recently by repeated drought conditions.

There are 93,815 ha of susceptible (>20 rating) forest types to IBD in the Kootenay Lake TSA based on a 2014 BMU analysis and Douglas-fir is a dominant tree species in this TSA and leading species by volume. BMUs with greater than 2,500 hectares of susceptible stands are shown in Figure 3. In addition, inventory data indicates many of the stands in the TSA are approaching age and diameter threshold which will make them more susceptible to attack from bark beetles. The Douglas-fir beetle has the potential to significantly impact the Kootenay Lake TSA timber supply. Therefore, the management of IBD and Douglas-fir leading stands remain a priority. **Trap tree and/ or funnel trap programs and monitoring post-harvest slash and monitoring blowdown in recently harvested blocks and removing or burning any slash are recommended beneficial practices to minimize future losses.** Additional good practice includes harvesting fired damaged trees and adjacent stressed trees to reduce IBD population increases. This may be even more critical for small tenure holders – Woodlots primarily and Community Forests.

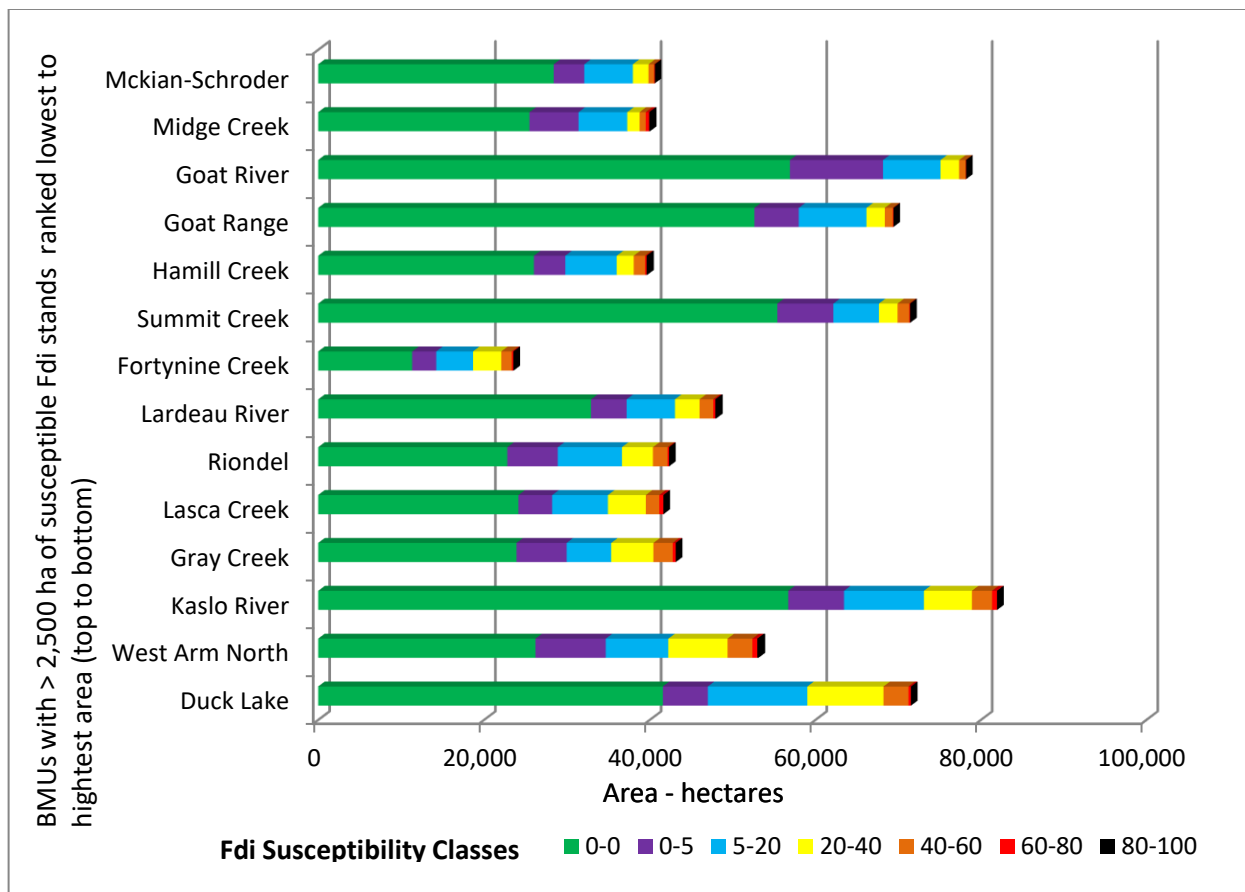


Figure 3: Douglas-fir beetle susceptibility rating for Kootenay Lake TSA BMUs with > 2,500 ha of moderate or greater area as of 2015 ranked from lowest to highest area top to bottom.

The 2017 to 2019 harvest of IBD polygons has not been significant to date as seen in Table 7. The planned and actual harvest amounts of AOS IBD polygons ranges from 4.6 to 13.8% over the three years. **Licencee response in suppression BMUs should be targeting harvest of at least 70% of the previous year's attack within 1 to 2 years.**

Table 7: 2017-19 IBD Aerial Overview Survey polygon area and completed/ planned harvest to date

2017-19 IBD AOS Polygon % and Harvest Area							
Year	Total AOS Polygon Area (ha)	Operable AOS Polygon Area (ha)	Harvested Area as of Winter 2019-20	Planned Harvest Area as of Winter 2019-20	Harvested % of Operable as of Winter 2019-20	Planned Harvest % of Operable as of Winter 2019-20	Total Current and Future Harvest %
2017	373.0	273.7	0	12.6	0.0%	4.6%	4.6%
2018	703.4	281.1	2.4	36.2	0.9%	12.9%	13.8%
2019	980.9	541.1	0	26.7	0.0%	4.9%	4.9%

5.3. Spruce bark beetle IBS (*Dendroctonus rufipennis*)

Spruce beetle attack increased significantly to 1110 hectares in 2019 (primarily within Moderate and Severe severity classes) from 227 ha in 2018. Most of the attack area is outside the THLB and within Provincial Parks. Only 73 ha of the 2019 total area is outside of Parks and of that only 37 ha is

within Operable ground. Licencees with operating areas adjacent to current outbreaks in Provincial Parks should be considering harvesting plans if IBS spreads outside the Parks.

There are 149,811 ha of susceptible (>20 rating) forest types to Spruce beetle in the Kootenay Lake TSA based on a 2014 BMU analysis. The 18 BMUs with greater than 4,000 ha of susceptible Sx area are noted in Figure 4 below in ascending order top to bottom of susceptible area.

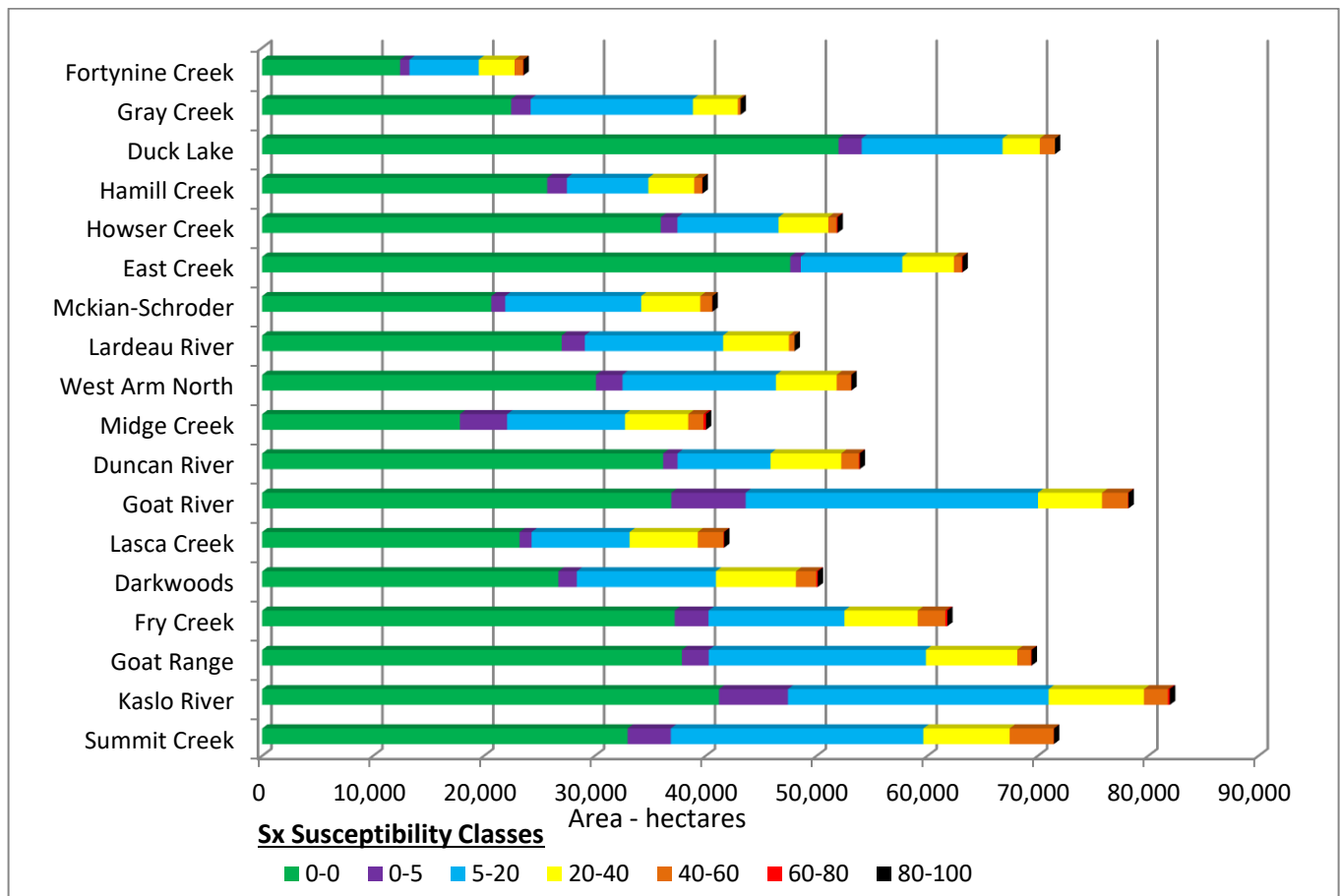


Figure 4: Spruce beetle susceptibility rating (2015) for Kootenay Lake TSA BMUs with > 4,000 hectares of Sx susceptible area, ranked from lowest to highest susceptible area (top to bottom).

Spruce blowdown when identified is a high priority for treatment / harvest. The Bark Beetle Guidebook will guide treatments. Link is as follows:

<http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/beetle/betletoc.htm>

Forest Licence plans and harvest of IBS attacked areas from 2017-2019 is shown in Table 8. The area has been small in the THLB and no area has been harvested to date and no areas were planned for future harvest at the time the data was gathered. All of the 2018 area and 93% of the 2019 area is within the Purcell Wilderness Conservancy Park. Rapid harvest response to any IBS outbreaks on operable THLB area is critical to reduce losses and IBS populations. Current harvest response levels are inadequate for suppression designation and in fact are below holding designation as well. **Given the current low amount of attack in operable areas, harvesting and keeping IBS populations low would be ideal through immediate harvesting, in less than 1 to 2 years.**

Table 8: Spruce Beetle attacked area 2017–2019 compared to area harvested and planned to be harvested.

2017-19 IBS AOS Polygon % and Harvest Area							
Year	Total AOS Polygon Area (ha)	Operable AOS Polygon Area (ha)	Harvested Area as of Winter 2019-20	Planned Harvest Area as of Winter 2019-20	Harvested % of Operable as of Winter 2019-20	Planned Harvest % of Operable as of Winter 2019-20	Total Current and Future Harvest %
2017	381	101.8	0	0	0%	0.0%	0%
2018	227.3	0	0	0	0%	0.0%	0%
2019	1109.7	37.0	0	0	0%	0.0%	0%

5.4. Windthrow NW

Windthrow is a concern especially when located in Douglas-fir and spruce dominated stand types. Smaller Areas of windthrow are not picked up by the AOS survey typically. Historically, Spruce 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 serious if not managed in a timely fashion. No blowdown was detected in 2019 with 50.6 ha in 2018 and 10 ha in 2017. Approximately two thirds of the blowdown areas are in Low to Moderate hazard Fdi stands.

2017-19 NW AOS Polygon % and Harvest Area							
Year	Total AOS Polygon Area (ha)	Operable AOS Polygon Area (ha)	Harvested Area as of Winter 2017-18	Planned Harvest Area as of Winter 2017-18	Harvested % of Operable as of Winter 2017-18	Planned Harvest % of Operable as of Winter 2017-18	Total Current and Future Harvest %
2017	10.0	10.0	0	0	0%	0%	0%
2018	57.5	50.6	0	0	0%	0%	0%
2019	0	0	0	0	NA	NA	NA

5.5. Armillaria Root Disease DRA (*Armillaria ostoyae*)

Armillaria (DRA) root disease has been identified as a significant issue throughout the TSA. No areas were noted in the AOS the last 2 years because the AOS is not effective for detecting the vast majority of root disease impact. Management of Armillaria and other root diseases in the TSA is

recommended to follow the “[Managing Root Disease in BC](#)” guide published by FLNRORD (2018). Guide, recently published, and a copy has been placed on the FTP site at the following link:

Stocking Standards for Free Growing Stands are contained in each licensee’s Forest Stewardship Plan and have been developed to address this disease. Harvested ICH stands of a suitable nature should be considered for stump removal treatments post-harvest to reduce DRA levels. Treatment of stands other than the ICH should be assessed for DRA levels or only after discussions with FLNRO Regional Pathologist. 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 vigor when competing deciduous broadleaves have a less extensive root network.

Young plantations with Armillaria 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.

No area was treated with stump removal in 2019 based on a June, 2020 RESULTS report, Only 33.5 ha were treated with a stump removal in 2018. Few Licensees appear to be conducting stump removal treatments even though a significant portion of the TSA is covered by ICH BEC subzones that are considered highly susceptible to DRA. RESULTS data for 2011 to 2017 shows only 4.4 ha of area were treated and this area was completed in 2011. This number seems far too low given the high % of ICH stands in Kootenay Lake TSA and it is **recommended that all Licensees should be considering stump removal treatments in high risk areas where feasible.**

5.6. Western Balsam bark beetle IBB (*Dryocoetes confuses*)

There are significant areas of subalpine fir leading forest stands in the Kootenay Lake TSA that are susceptible to western balsam bark beetle. Western balsam bark beetle has been chronically causing mortality over many years. 2019 saw another significant increase of approximately 50% more area affected at 8,541 ha compared to 2018 when 5583 ha was observed. Similar to 2018, attack severity for 2019 were primarily in the Trace and Light attack categories with a very small amount of area in Moderate and Severe. Direct control action on that insect is very difficult due to its attack dynamics and the scattered distribution of the stands.

5.7 Fire and Post Fire NB & NBP

2019 Fire affected area was significantly less at only 360 ha due to the wetter summer and fewer fires. This compares to 12,559 ha in 2018 and 11,233 ha in 2017. There were no volume losses in the THLB for 2019 compared to significant losses the two previous years. **Fire damaged stands should be considered for immediate salvage to reduce future damaging agents such as Douglas-fir bark beetle Spruce bark beetle and to reduce non-recoverable losses. Harvest within a year of damage is recommended for wood quality and reduction of other pests.**

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

2019 saw a significant decrease to 189 ha affected from 655 ha in 2018. These diseases infected Western larch of all ages. Defoliation by these diseases may cause minor growth reduction in large trees and young trees may be killed. Area affected varies annually. No significant impact on the TSA is expected at this point and no management is proposed except continuous monitoring of the occurrence. These diseases are reliant on extended cool wet conditions in spring to early summer seasons.

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

The hard pine rusts are a minor to moderate concern in the Kootenay TSA. They are restricted to lodgepole and ponderosa pine. These diseases are not typically noted from Aerial flights due to the nature of the disease expression and timing of the flights. The loss impact on the TSA is unclear but will impact the future rotation to some degree with timber mortality and quality losses. Stocking standards have been designed to mitigate this pest. Future stocking standard modifications may be considered as well. Careful thought should be given to Pli deployment, especially in most ICH sites.

5.10 Lophodermella Needle Cast DFO (*Lophodermella concolor*) & Dothistroma Needle Blight DFS (*Dothistroma septosporum*)

Both Lophodermella and Dothistroma were not detected in the last many years. They typically affect young pine stands and can cause serious defoliation typically during moist summer years. Growth reductions and mortality may result after repeated epidemics. Both are often associated with over planting of Lodgepole pine in ICH sites or planting offsite seedlots of Pli. Careful thought should be given to its deployment in most ICH sites and this has been reflected in the DSE default stocking standards.

5.11 Various deciduous diseases and pests

There was a slight increase in observed Aspen leaf miner & and an approximate doubling of Birch leaf miner attacked area. The impact of these pests and diseases on the TSA is not 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 Kootenay Lake TSA over the last many years, possibly related to climate change or weather patterns, supports this recommendation.

5.12 Animal Damage - Bear AB

Bear damage appears to have decreased slightly to 55 ha in 2019 compared to 92 ha in 2018. Mortality often appears to be on younger single trees rather than widespread areas and some But to be detected on the AOS it would be significant damage within an opening or strata. Potential solutions to manage animal damage and in particular bear damage might include species diversity at time of planting, less Lodgepole pine, and perhaps higher planting density as well.

5.13 Western Spruce Budworm IDW (*Choristoneura occidentalis*)

IDW has not been detected in the last 5 years in the TSA. Detection, prediction and treatment of defoliators remain the responsibility of the Kootenay Boundary Regional staff. More specific information on the defoliator program can be obtained from them and in the Defoliator Management Guidebook (1995). 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 which attempt to regenerate a younger layer under an established canopy. Future management may include a spray program by the Province if the outbreak is significant enough and funds available.

5.14 Western Hemlock Looper IDL (*Lambdina fiscellaria lugubrosa*)

Looper was observed over 298 ha in 2019 after five years in of no attack. Most of the Severity was Light and Moderate and a small area of Severe. Attack was located in the Westfall River Drainage and Retallack area. The current management strategy is to monitor and if necessary, consider spraying with Btk. Monitoring is through the aerial overview survey and ground sampling carried out at the Regional level. While not significant at this time, an outbreak would impact short term timber supply of host species. The preferred host of the looper is western hemlock followed by interior spruce, Douglas-fir and western red cedar and it is found primarily in mature and over mature hemlock and hemlock-cedar stands.

5.15 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 Kootenay Lake TSA. In Kootenay Lake TSA, it is the #1 insect/disease factor in stands younger than 40 years (SDM). The availability of disease-resistant white pine makes it possible to ensure this valuable timber species can be 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. Forest Licencees are encouraged to consider planting rust resistant seedlots.

5.16 Whitebark Pine Decline

Whitebark pine (*P. albicaulis*) often occurs within harvest units at elevations above 1600 meters. Whitebark pine mortality causes are primarily white pine blister rust and mountain pine beetle. To a lesser 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 species for its very large seeds.

The cutting or damaging of whitebark pine should be strictly avoided. Whitebark pine stands, especially those with many cone-bearing trees and in good health, 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 survivorship by reducing competition and providing seed regeneration habitat.

5.17 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.

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, 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 before in regards to thinning birch and other deciduous brush. Early treatments may be an option to reduce DRA issues before root spread on deciduous becomes too large.

5.18 Hot Droughts NDM

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. Drought damage observed in the AOS decreased from 1288 ha 2018 to 296 ha in 2019. This drop was likely due to the moister weather over the 2019 growing season. Most of the area was in Light Severity class and a small amount of Moderate severity and the cause was likely a result of the 2 previous years of drought. Drought mortality may not become evident until the year following as well. 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.. 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.

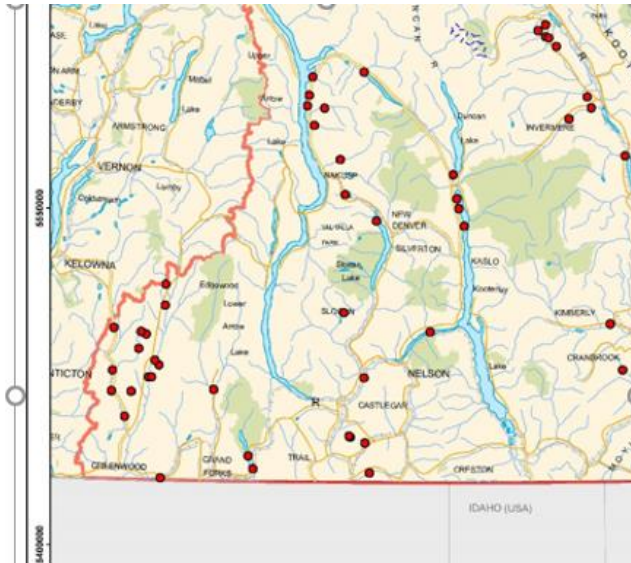
5.19 Laminated Root Disease DRL

This disease, caused by *Phellinus sulphurascens*, primarily infects Douglas-fir, grand fir, subalpine fir, and mountain hemlock. A separate laminated root disease (*Phellinus weirii*) is known to cause butt rot on western red-cedar but is not known to be a major mortality agent. The incidence of *P. sulphurascens* can be especially impacting on second & third-growth Douglas-fir plantations. Windthrow, decay, and mortality can be locally significant, especially in moist ICH subzones. Douglas-fir bark beetle may prefer infected trees. Management is recommended to follow the “[Managing Root Disease in BC](#)” guide published by FLNRORD (2018). Stocking Standards for Free Growing Stands are contained in each licensee's Forest Stewardship Plan and have been developed to address this disease.

5.20 Invasive Species – Gypsy moth (*Lymantria dispar dispar*)

The Ministry of Forests, Lands, Natural Resource Operations and Rural Development (MFLNRORD), Canadian Food Inspection Agency (CFIA), and Canadian Forest Service (CFS) cooperatively monitor for the occurrence of European gypsy 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 2). In 2018, three moths were trapped at a site near Castlegar. A delamination grid of an additional 43 traps per square mile were deployed in 2019, with a total of 13 moths caught in 5 traps (one trap caught 9 moths, and 4 traps caught singles). The Pass Creek Area was sprayed 3 times in May-June 2020 with Btk to

Figure 1. Selected Kootenay Boundary Regional Gypsy moth pheromone trap placements.



5.21 Invasive Species – Balsam woolly adelgid (*Adelges piceae*)

Balsam woolly adelgid 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.

Ministry of Agriculture (AGRI) and the Ministry of Forests Lands and Natural Resource Operations and Rural Development (FLNRORD) conducted an occurrence survey for balsam woolly adelgid (BWA) throughout the interior of BC from 2014 to 2018. The objective of the survey was to determine the northern and eastern limits of the current spread of BWA, sampling the primary susceptible tree species, sub-alpine fir from 1,000 to 1,600-meter elevation ranges. It should be noted that much of the province is inaccessible and it is possible that BWA may in fact occur in many of the areas where it was not positively identified. BWA has been confirmed in the Boundary TSA as well as Trail, Nelson and Rossland area and west of the Columbia River, including the dammed Lake Revelstoke, Upper Arrow Lake and Lower Arrow Lake. BWA 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 2018, areas in the Kootenays that were sampled included; Kaslo, Salmo, Creston, Cranbrook, Kimberley, Fernie, Invermere, Golden, Roger's Pass, Glacier National Park and Revelstoke. Any potential samples located were sent to the Canadian National Collection of Insects, Arachnids and Nematodes in Ottawa for identification via the CFIA office in Kelowna. No positive samples were found in the 2018 sampling and even areas with plenty of woolly tufts did not contain adelgids as they had already been preyed upon.

The northern spread appears to be contained below a line that runs approximately from Mica Creek, to Blue River, to Wells Gray Provincial Park and Quesnel.

Table 2. Balsam woolly adelgid occurrence sampling results, 2016-2018 in the Kootenay Boundary Region/ Kootenay Lake TSA.

Location	Result of sampling (positive, negative)	Sample Year
New Denver/ Kalso Pass (Hwy 6)	negative	2018
Archibald FSR (near Salmo)	Negative	2018
Kitchener Road	Wrong species (<i>Pinus</i> sp.)	2018
Whitewater Ski area	Negative	2017
Nelson	Positive	2017

6 Management objectives for priority forest health agents

6.1 Integrated Forest Health Management objectives

The following principle for management objective commonly known as “Integrated Forest Health Management” will be followed for all the priority forest health agents in the Arrow TSA:

1. Know the land base and resource management objectives;
2. Manage from an ecological perspective;
3. Don’t make the situation worse;
4. Practice adaptive management.

The Integrated Forest Health Management is a system that, in the context of specific resource management objectives and knowledge of the associated environment and the biology of the forest health agent and host species, applies all suitable techniques and methods to maintain forest health agent populations at levels below those causing unacceptable damage or mitigates such damage.

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

The following are the management objectives to be implemented for the three main bark beetles in the Kootenay Lake TSA: mountain pine beetle, Douglas-fir beetle and spruce bark 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 the amount of unsalvageable losses due to bark beetles. Target harvesting a minimum of 80% of the area to maintain the suppression strategy for IBD and IBS and 50% of the IBM attacked stands to maintain the current holding action suppression strategy within 12 months of the AOS flight.**
2. Prioritize the forest management to higher hazard forest stands by harvesting or reducing the susceptibility of stands to bark beetles.
3. Limit the amount of non-recoverable losses due to bark beetles;

Definitions:

Sanitation harvesting: harvesting operations specifically designed to maximize the extraction of currently infested or infected stands in order 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.

6.3 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 of 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 m³) 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.

6.4 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 July 1 to September 15 for mountain pine beetle and April 1 through August 31 for Douglas-fir beetle and May 15 through July 15 for spruce beetle:

- 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 least weekly 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/hailed 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 prior to spring break-up/next beetle flight is required.

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 July 1 to Sept. 15 for mountain pine beetle and April 1 through August 31 for Douglas-fir beetle and May 15 through July 15 for spruce beetle:
- 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 or immediately adjacent to **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 licensee. The responsibility to carry out these actions or measures is the responsibility of the licensee.

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 Licensee must carry out activities within the operating area of another Forest Licensee, 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 Kootenay Lake 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 Licensees and other clients	Produce and distribute the Provincial annual forest health overview surveys
Conduct detailed aerial and ground surveys within the Kootenay Lake TSA where deemed appropriate	Conduct defoliator monitoring & aerial treatments for defoliators (ex. spruce budworm Btk spraying)

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 Selkirk Resource District (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, Lands, Natural Resource Operations and Rural Development.

ACTIVITY	FLNRORD	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 (FLNRORD 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	X	
Conduct ground surveys when required to verify incidence and severity of forest health pests	X	X
Conduct aerial overview forest health surveys and report on results (FLNRORD region)	X	
Conduct detailed aerial surveys focusing on suppression beetle management units	X	
Submission of survey and treatment data to FLNRORD		X

7 Provincial Ranking and BMU Strategy for IBM, IBD & IBS

Ranking for the three bark beetles with the highest potential impact on the TSA will be covered in this section: Mountain pine beetle Douglas-fir beetle and Spruce beetle. The three ranking tables below follow the methodology outlined in the Provincial Bark Beetle Strategy and also include the bark beetle Strategy for each BMU. Three of the BMUs for IBM are still in suppression with a ranking of 3 as the recent and current attack levels are down significantly. The IBD BMUs that are listed as high susceptibility vary between a ranking of 3 or 4 depending on recent/ current levels of attack. Low IBD susceptibility BMUs are ranked as 7 or 8. IBS ranking for all the Low susceptible BMUs is ranked at 8 with all but 1 of the high susceptible units ranked as 3. Howser Ck IBS BMU was ranked at 4 based on higher attack levels

Table 9: Mountain pine beetle BMU ranking

BMU #	BMU Name	# green attack	Susceptibility	Provincial Ranking	BMU Strategy
K01	Summit Creek	Unknown	Low	7	Holding
K02	Little Moyie River	Low	High	3	Suppression
K03	Hawkins Creek	Low	High	3	Suppression
K04	Darkwoods	Unknown	Low	8	Holding
K05	Kid Creek	Low	High	3	Suppression
K06	Goat River	Unknown	Low	7	Holding
K07	Midge Creek	Unknown	Low	8	Holding
K08	Gray Creek	Unknown	Low	8	Holding
K09	Lasca Creek	Unknown	Low	8	Holding
K10	West Arm	Unknown	Low	8	Holding
K11	Fortynine Creek	Unknown	Low	8	Holding

K12	Kaslo River	Unknown	Low	8	Holding
K14	Riondel	Unknown	Low	7	Holding
K15	Fry Creek	Unknown	Low	7	Monitor
K16	Hamill Creek	Unknown	Low	7	Holding
K17	Goat Range	Unknown	Low	8	Holding
K18	Lardeau River	Unknown	Low	7	Holding
K20	Glacier Creek	Unknown	Low	7	Holding
K21	Howser Creek	Unknown	Low	8	Holding
K22	East Creek	Unknown	Low	8	Monitor
K23	Westfall River	Unknown	Low	8	Monitor
K24	Duncan River	Unknown	Low	8	Monitor
K25	Duck Lake	Unknown	Low	8	Holding
K26	McKian-Schroeder	Unknown	Low	8	Holding

Table 10: Douglas-fir beetle BMU ranking

BMU #	BMU Name	# green attack	Susceptibility	Provincial Ranking	BMU Strategy
K01	Summit Creek	Unknown	Low	8	Suppression
K02	Little Moyie River	Unknown	Low	8	Suppression
K03	Hawkins Creek	Unknown	Low	8	Suppression
K04	Darkwoods	Unknown	Low	8	Suppression
K05	Kid Creek	Unknown	Low	8	Suppression
K06	Goat River	Unknown	Low	8	Suppression
K07	Midge Creek	Unknown	Low	8	Suppression
K08	Gray Creek	Unknown	High	3	Suppression
K09	Lasca Creek	Unknown	High	4	Suppression
K10	West Arm	Unknown	High	4	Suppression
K11	Fortynine Creek	Unknown	High	4	Suppression
K12	Kaslo River	Unknown	High	3	Suppression
K14	Riondel	Unknown	High	3	Suppression
K15	Fry Creek	Unknown	Low	8	Suppression
K16	Hamill Creek	Unknown	Low	7	Suppression
K17	Goat Range	Unknown	Low	8	Suppression
K18	Lardeau River	Unknown	High	3	Suppression
K20	Glacier Creek	Unknown	Low	8	Suppression
K21	Howser Creek	Unknown	Low	8	Suppression
K22	East Creek	Unknown	Low	8	Suppression
K23	Westfall River	Unknown	Low	8	Suppression
K24	Duncan River	Unknown	Low	8	Suppression
K25	Duck Lake	Unknown	High	3	Suppression
K26	McKian-Schroeder	Unknown	Low	8	Suppression

Table 11: Spruce beetle BMU ranking

BMU #	BMU Name	# green attack	Susceptibility	Provincial Ranking	BMU Strategy
K01	Summit Creek	Unknown	High	3	Suppression
K02	Little Moyie River	Unknown	Low	8	Suppression

K03	Hawkins Creek	Unknown	Low	8	Suppression
K04	Darkwoods	Unknown	High	3	Suppression
K05	Kid Creek	Unknown	Low	8	Suppression
K06	Goat River	Unknown	High	3	Suppression
K07	Midge Creek	Unknown	High	3	Suppression
K08	Gray Creek	Unknown	High	3	Suppression
K09	Lasca Creek	Unknown	High	3	Suppression
K10	West Arm	Unknown	High	3	Suppression
K11	Fortynine Creek	Unknown	High	3	Suppression
K12	Kaslo River	Unknown	High	3	Suppression
K14	Riondel	Unknown	Low	8	Suppression
K15	Fry Creek	Unknown	High	3	Monitor
K16	Hamill Creek	Unknown	High	3	Suppression
K17	Goat Range	Unknown	High	3	Suppression
K18	Lardeau River	Unknown	High	3	Suppression
K20	Glacier Creek	Unknown	Low	8	Suppression
K21	Howser Creek	Unknown	High	4	Suppression
K22	East Creek	Unknown	Low	8	Monitor
K23	Westfall River	Unknown	High	3	Suppression
K24	Duncan River	Unknown	High	3	Suppression
K25	Duck Lake	Unknown	Low	8	Suppression
K26	McKian-Schroeder	Unknown	High	3	Suppression

8 Recommended activities to manage IBM, IBD and IBS

8.1 Mountain pine beetle

8.1.1 Harvesting

Harvesting is the most efficient short-term method of managing IBM populations with the intent to prevent timber loss. 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 reducing non-recoverable losses. Failure to address these losses will impact future timber supply determinations negatively. In order to reduce mid-term timber supply impacts harvesting should be targeted at infested stands with significant hazard where feasible.

8.1.2 Pheromone Use

None planned at this time.

8.1.3 Single tree treatment and other treatments

Fall and burn activities are currently planned for 2020-21 in the Yahk Area – Hawkins, Little Moyie & Kid BMUs to maintain low incidence level of IBM.

8.1.4 Detailed Flight and Ground Surveys

A detailed aerial survey will be completed on most of the area within the 3 BMUs in the Yahk Area – Hawkins, Little Moyie & Kid followed by ground surveys at points selected for probable fall and burn opportunities.

8.2 Douglas-fir beetle

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. Trap trees;
2. Anti-aggregation pheromones (MCH);
3. Traps trees and (MCH); and
4. Clean harvesting practices.

8.2.1 Harvesting

Timber harvesting in infested (1st priority) and red/grey attack (2nd priority) and un-infested stands (3rd priority) with high hazard and stress factors such as nearby windthrow, fire damage for example 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.

8.2.2 Pheromone Use

Pheromone use is planned for use with IBD funnel trapping projects under Land Based Investment Funding works through Selkirk Resource District and is covered by the Southern Interior Region Pest Management Plan. At this time, DSE plans to deploy funnel trap at various site from Meadow Creek in North and southwest to the West Arm area and south to Creston in selected higher activity areas.

http://www.for.gov.bc.ca/rsi/ForestHealth/PDF/PMP_2013-2017_FH_Southern_Interior_Feb_19_2013.pdf.

2019 IBD District funded funnel trapping in Kootenay Lake captured 404,000 Douglas fir bark beetles over 21 sites. In 2018, 799,000 were captured on 39 sites and in 2017, 467,000 beetles were captured on 38 sites.

8.2.3 Single tree treatment and other treatments

No completed or planned single tree treatments at this time.

8.2.4 Detailed Flight and Ground Surveys

The current plan for 2020-21 is to complete a heli detail survey, budget allowing, of selected higher incident and risk areas in Kootenay TSA (excludes CFA areas). Area flown will likely be significantly less than the last several years. Detailed mapping flights were completed for Douglas-fir bark beetle in portions of the TSA in 2019. Ground surveys were not completed in 2019 and are not planned at this time for 2020.

8.3 Spruce beetle

The overall strategy for Spruce beetle (IBS) management is that of suppression/monitor through the use of one or a combination of the following:

1. Trap trees;
2. Clean harvesting practices.

8.2.1 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 suppression strategy objectives and reducing non-recoverable losses. A combination of sanitation and salvage harvesting for Spruce 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 IBS areas or Spruce stands and complete a post-harvest mop-up where necessary.

8.3.2 Pheromone Use

No planned use of pheromones is planned at this time for IBS management.

8.3.3 Single tree treatment and other treatments

No planned single tree treatments at this time.

8.3.4 Detailed Flight and Ground Surveys

The current plan for 2020-21 is to consider a heli detail survey of known higher incident areas, budget allowing, in Kootenay Lake TSA (excludes CFA areas). No Ground surveys currently planned for 2020 or completed in 2019.

9 Priority Activities in BMUs

The following projects are planned:

- Ongoing detailed monitoring (primarily detailed flights) in higher priority areas.
- Ongoing discussions with Licencees regarding active IBM, IBD and IBS population and fire damage and windthrow in their operating areas and targeting these areas for immediate harvest.
- Ongoing funnel trapping for IBD in selected areas.
- Encouraging Forest Licencees to consider their own funnel trap and trap tree programs.
- IBM ground detection and Fall & Burn in Yahk Area

10 2020-21 Fiscal Year Tactical Plan

The tactical plan will be to continue to monitor forest health agents through the overview survey and IBM, IBD and IBS detailed survey of selected high priority suppression units. Selkirk District is currently planning for another year of IBM ground surveys with Fall and Burn in the Yahk Area and is implementing a funnel trap program for IBD in select areas throughout Kootenay Lake for 2020. Additional opportunities for funnel trapping will be considered on an annual basis based on current attack levels, funding and site feasibility. The primary focus of the funnel trap program is to reduce IBD populations in areas of high risk such as areas of recent fire, blowdown or high IBD incidence.

11 Stocking Standards

Forest health concerns can be a factor in species selection and other aspects of stocking standards. Significant concerns relating to Pli in the ICH in particular rusts, bear damage and other damaging agents exist for this species especially when stands are declared at such a young age due to the fast growing nature of this species. Evidence for this includes FREP SDM surveys in adjacent TSAs and continued research by Alex Woods and David Coates. New BEC and corresponding stocking standards have addressed some of the Pli in ICH concerns.

Licencees 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.

An additional consideration to professionals completing Free Growing (FG) declarations is the age at which plantations are allowed to undergo FG 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. Several other Pli damaging and mortality agents often express themselves at an older age than 9 years and are an added risk factor for future timber supply with early FG declarations.

12 Non-Recoverable Losses (fire, wind, pests, total current AAC comparisons)

The estimated annual forest volume killed by selected Forest Health Factor and not harvested in the Timber Harvesting Land Base (TSLA only), as well as the amount of that killed volume that has been either harvested by the year 2019 is listed below (Table 12). Over the 21 years reported, the volume lost by the significant FH factors represents over **12%** of the AAC. The 21-year average annual of Volume Killed and harvested is 14% and 2013 was the last year that the TSA met or exceeded this value. Ideally Licencees should target more of the AOS polygon area for harvest and within a faster timeframe to reduce losses and beetle population growth which contribute to more future losses.

Table 12: 1999-2019 THLB volume killed and not harvested and total killed volume harvested by selected Forest Health factors.

Annual Volume (m3) Killed on the THLB and Not Harvested as of 2019 -- Kootenay Lake TSA									Harvested Volume & %	
Year	IBM	Fire	IBD	IBB	Wind throw	Drought	IBS	Grand Total*	THLB NRL Volume Harvested	% Harvested as % of Total
1999	6,045	18	8,350	-	8,568	289	374	16,038	5,865	27%
2000	6,491	1,174	18,441	109	1,393	-	-	26,215	8,852	25%
2001	20,752	156	13,774	141	271	-	-	34,823	8,313	19%
2002	30,811	-	1,090	-	-	-	-	31,901	5,858	16%
2003	48,372	-	519	5,113	-	-	46	54,050	10,935	17%
2004	91,704	10,346	-	390	-	-	177	102,617	19,243	16%
2005	171,784	11,945	251	2,034	-	-	-	186,014	43,156	19%
2006	278,467	3,739	828	851	753	-	-	283,885	62,053	18%
2007	158,641	50,014	178	527	2,294	-	-	209,360	29,284	12%
2008	231,491	11,478	1,897	18	1,109	-	-	244,884	34,127	12%
2009	130,360	-	836	1	1,550	-	-	131,197	16,232	11%
2010	98,101	403	3,857	12	6,430	-	-	102,373	12,485	11%
2011	36,441	-	2,655	319	-	-	-	40,483	5,290	12%
2012	24,332	728	710	49	2,558	-	-	25,819	7,360	22%
2013	13,320	530	884	-	525	-	-	14,734	3,239	18%
2014	11,614	1,383	5,051	13	368	-	-	18,061	2,167	11%
2015	6,165	39,534	2,900	90	-	-	-	48,777	5,302	10%
2016	8,573	326	10,164	257	110	-	205	19,673	1,554	7%
2017	14,411	19,728	5,223	-	458	3,242	41	42,195	1,716	4%

Annual Volume (m3) Killed on the THLB and Not Harvested as of 2019 -- Kootenay Lake TSA									Harvested Volume & %	
Year	IBM	Fire	IBD	IBB	Wind throw	Drought	IBS	Grand Total*	THLB NRL Volume Harvested	% Harvested as % of Total
2018	1,658	114,101	6,909	622	3,941	2,865	-	127,057	11,204	8%
2019	3,827	-	14,017	665	-	1,836	17	20,437	0	0%
Totals	1,393,360	303,627	92,106	14,683	30,328	8,232	860	1,780,593	335,688	14%
Change from previous year	-234,483	-38,474	+6,248	-3,472		+1,548	+19	-120,336	-41,453	-2%

*Includes minor volume losses from FH Factors not listed in the table

The reduction (or increases) in losses from the 2018 data is presumably due to harvesting of previously damaged areas, changes in TSA THLB boundaries and/ or refinements in data analysis.

The historical Kootenay Lake TSA AAC (excludes Area based tenures – CFAs and WLs) from 1999 to present is listed in Table 13. Total NRLs over the last 21 years represents almost 3 years of AAC for the TSA.

Table 13: Historical Kootenay Lake TSA AAC

Year	Volume m3
1999-2001	700,000*
2001-2010	681,300
2011- Present	640,000
21 Year Total	14,673,000

*May include Woodlot volume

13 Conclusion

This Forest Health Strategy provides strategic direction for the licensees and FLNRORD in the Selkirk Natural Resource District – Kootenay Lake TSA. Specific practices conducted by each licensee should fall within the strategic direction provided within this document. There are significant concerns on the spread and ongoing non-recoverable losses as a result of the 4 bark beetles – Douglas-fir Beetle, Mountain Pine Beetle, Western Balsam Beetle and Spruce Beetle and fire damaged stands and the necessity to address these through harvest and other active management tools to reduce NRLs in the present and future.

Periodic review of the Forest Health Strategy will allow adaptive management principles to be used. The plan is to review it on an annual basis will ensure forest managers regularly turn their minds to other potential sources of damage or risk to the forest.

The active co-operation of licensees and FLNRORD 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.

14 Information Links

Report: 2019 Overview of Forest Health Conditions in Southern British Columbia

https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/forest-health/forest-health-docs/2019_south_area_forest_health_conditions_report.pdf

Provincial Forest Health Strategy 2013-2017

<https://www.for.gov.bc.ca/hfp/health/Strategy/Forest%20Health%20Strategy.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

2018 and earlier Annual Overview Surveys. (fixed wing based aerial mapping of all visible forest pests).

http://www.for.gov.bc.ca/ftp/HFP/external/lpublish/Aerial_Overview/

2018 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/lpublish/Forest%20Health/Detailed%20and%20Aerial%20Overview%20flight%20data/>