MINISTRY OF FORESTS

Selkirk Natural Resource District

Kootenay Lake TSA
Forest Health Strategy 2022-23

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June ??, 2023

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July 31, 2023
Date

Douglas-fir beetle

Wood Borer attacked Spruce in Creston

IBM checks in Yahk

Cover Photo: Courtesy of Marnie Duthie-Holt – IBM Fall & Burn Yahk

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

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 Kootenay Lake 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 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. Kootenay Lake TSA 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 current TSR4 analysis report identifies the total area of the TSA as 1,240,878 hectares, of which 675,024 hectares are Crown forested land, and 169,227 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.

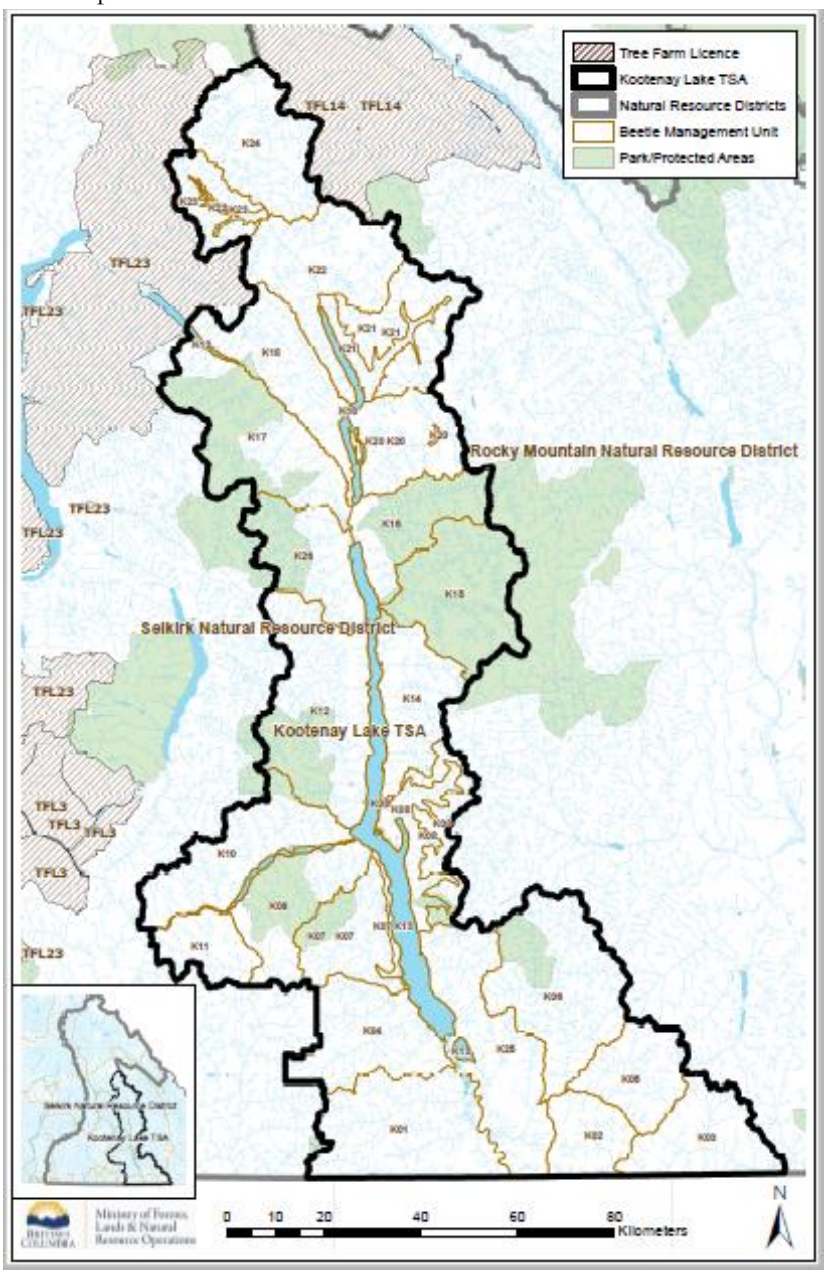

Figure 1: Kootenay Lake TSA.

Table 1 shows the BMU names and associated codes 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 9 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 Total Volume (m^3) by Species Composition 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 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 %
Douglas-fir	8,208,583	1,832,991	581,530	106,418	21,292	**10,750,813**	**23.6%**
Western Larch	5,561,876	2,733,516	578,908	230,269	33,582	**9,138,151**	**20.0%**
Lodgepole pine	5,181,919	1,220,148	759,108	193,996	37,641	**7,392,812**	**16.2%**
Spruce	2,855,324	1,936,285	671,017	184,467	36,883	**5,683,976**	**12.5%**
Western Hemlock	3,927,394	1,007,603	311,590	99,842	13,412	**5,359,841**	**11.7%**
Sub-alpine fir	2,563,228	1,154,098	370,207	198,970	30,403	**4,316,906**	**9.5%**
Cedar	664,398	879,119	324,707	129,691	17,412	**2,015,327**	**4.4%**
Aspen	75,924	84,432	50,972	32,046	12,328	**255,702**	**0.6%**
Ponderosa pine	36,709	84,133	40,613	14,975	2,564	**178,994**	**0.4%**
Birch	19,771	57,165	46,788	34,165	17,786	**175,674**	**0.4%**
Grand fir	17,551	50,844	32,363	19,885	6,318	**126,961**	**0.3%**
Cottonwood	74,627	12,548	17,464	7,485	7,420	**119,544**	**0.3%**
White pine	1,801	16,928	26,233	22,100	15,197	**82,258**	**0.2%**
Alpine larch	4,868	1,824	6,088	622	46	**13,448**	**0.0%**
Whitebark pine	24	2,420	3,089	73	303	**5,908**	**0.0%**
Total						**45,616,315**	

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, Western larch, Lodgepole pine, Spruce and Western Hemlock (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://www2.gov.bc.ca/gov/content/industry/crown-land-water/land-use-planning/regions/kootenay-boundary/kootenay-boundary-rlup

3.1. Previous Forest Health Strategies in the Kootenay Lake TSA

The last forest health strategy was completed in 2022. No updates have occurred with regards to the BMU strategies for many years and none this year. Post fire salvage and IBD management remain significant issues at this time.

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:

Ranking	***Predicted potential damage loss per year (ha)***
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 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 2020 and 2021 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 represents the largest current losses of higher value timber species over the last few years and the four bark beetles have the potential to cause further losses if not managed/ harvested int a timely fashion.

Table 4: 2021 & 2022 Kootenay Lake TSA significant Forest Health damaging agents based on Aerial Overview Survey data.

Forest health agents	2022 Affected Area (ha)	2021 Affected Area (ha)	Trend	Current Impact on Timber Supply	TSA Priority
Fire & Post Fire	4,957	16,333	Significant Decrease	Very High	**1**
Douglas-fir beetle	1587	2071	Slight Decrease	Very High	**1**
Mountain pine beetle	420	1,481	Significant Decrease	High	1
Western balsam bark beetle	3292	3,674	Slight Decrease	Very High	2
Spruce bark beetle	661	627	Slight Increase	Low	2
Drought	0	2,521	Significant Decrease	Moderate	3
Hemlock Looper	4377	971	Significant Increase	Low	2
Aspen Serpentine Leaf Miner	30	3,306	Significant Decrease	Low	n/a
Birch Leaf Miner	0	20	Not Observed	Very Low	n/a
Dothistroma needle blight	0	0	Not Observed	Very Low	3
Animal damage (Bear)	0	37	Slight Decrease	Low	3
Windthrow	36	15	Slight Increase	Very Low	2
Western Pine Beetle	<1	0	Static	Nil	n/a
Cedar Flagging	5744	0	Static	Very Low	n/a
Larch casebearer	0	24	Not observed	Nil	n/a
Larch needle blight / cast	1155	492	Significant Increase	Nil	n/a
Flooding	0	18	Not Observed	Very Low	n/a

5.1 BARK BEETLES

Douglas-fir beetle IBD (*Dendroctonus pseudotsugae)*

The IBD affected area in 2022 is a 25% decrease from the previous year. Severity was primarily Light, with most of the balance in both Trace and Moderate. **Areas of known significant attack in 2022 include: drainages around Ymir, West Arm from East end(Coffee Ck) to Slocan Junction (Rover Ck) although IBD attack seems to be occurring everywhere.** 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. 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.

Recent harvest of IBD polygons has not been significant in the last few years. **Ideally, Licencee response in suppression BMUs should be targeting harvest of at least 70% of the previous year's attack within 1 to 2 years.**

Four areas of Kootenay Lake TSA were detailed flown for IBD (see Figure 2). finding a total of 273 spots with 1762 red trees plus 4 small polygons totalling 20.7 ha with attack severity between 10 and 30%.

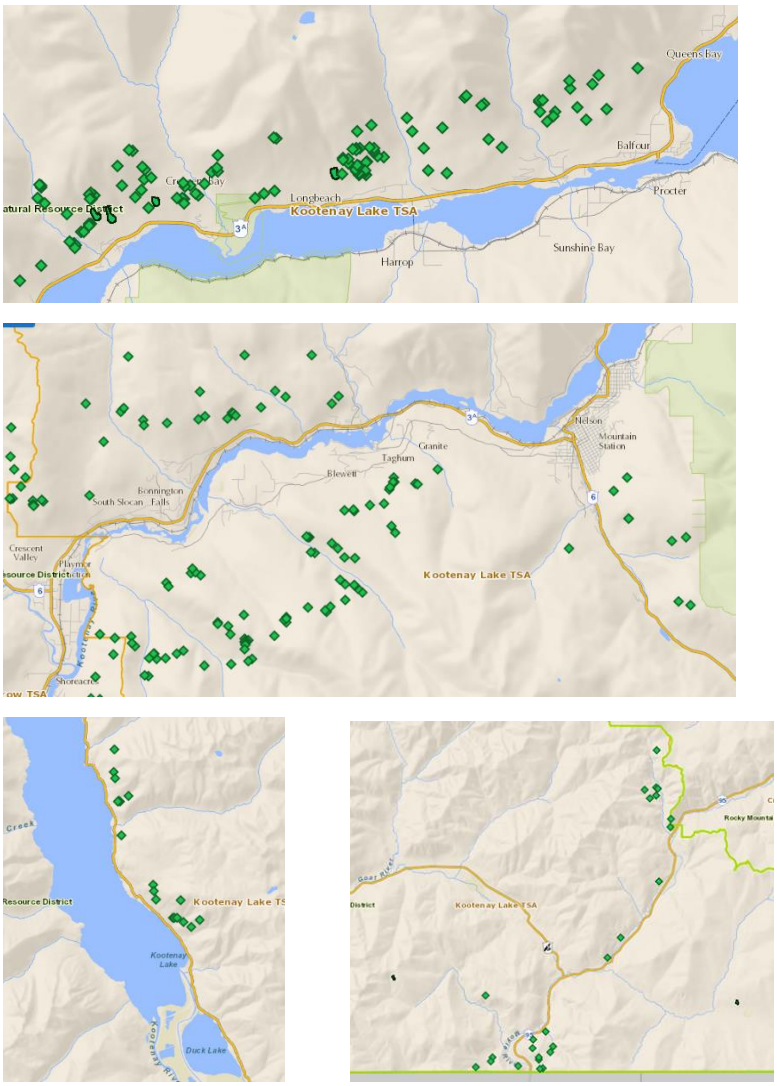

Figure 2. 2022 detailed IBD locations – Spots and polygons.

Mountain Pine beetle IBM (*Dendroctonus ponderosae*)

The area of current mountain pine beetle infestation has decreased to 420 ha in 2022 from 1481 ha in 2021. Most of the area affected was surveyed as and roughly evenly distributed as Trace, Low and Moderate severity. **General areas with higher levels of attack include: Yahk/ Hawkins and Corn Ck (East of Creston).** 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 11% of the standing inventory greater than 60 years old.

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. 3 LUs/ BMUs in and around Yahk are still under Suppression (K02, K03 and K05).

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). An ideal response would be harvesting 50% or greater of attacked areas within 1 to 2 years.

Significant resources have been expended managing IBM in the Yahk area BMUs over the last many years as noted in part in Table 5. IBM population appears to be rising somewhat based on the number of trees burned and surveys completed. 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 5: Historical IBM (IBW) treatments in the Yahk Area 3 BMUs 2014-2023 and IBD near Nelson in 2016 -2020

Fiscal Year	Area Ground Surveyed	# of trees felled & burned (treated)
2014/15	1360 IBM ground probes & 5.9 ha	880 trees
2015/16	814 IBM ground probes	693 trees
2016/17	621 ground probes (IBM) & 16 points (IBD)	184 trees (IBM/IBW) & 34 trees (IBD)
2017/18	216 ground probes (IBM) & 16 points (IBD)	180 trees (IBM/IBW) & 109 trees (IBD)
2018/19	297 IBM ground probes	333 IBM/IBW trees & 6 IBD trees
2019/20	187 IBM ground probes	627 trees
2020/21	254 IBM ground probes	768 trees
2021/22	280 IBM ground probes	722 trees
2022/23	286 IBM ground probes	1073 trees

Spruce bark beetle IBS (*Dendroctonus rufipennis*)

Spruce beetle attack increased slightly to 661 ha in 2022 from 627 hectares in 2021. Most of the identified area is within Moderate severity and the balance within Light. Most of the attack area is outside the THLB and within Provincial Parks - Purcell Wilderness Conservancy Park. 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 and based on a review of the inventory in 2021 Sx makes up 18% of the volume over 60 years old.

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

Previous FH strategies have shown that the area attack by IBS in the THLB has been small and no area had been harvested to date and no areas were planned for future harvest at the time the data was gathered. Rapid harvest response to any IBS outbreaks on operable THLB area is critical to reduce losses and IBS populations. Past harvest response levels have been 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.**

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. There was a slight decrease in 2022 to 3,292 ha 3,675 ha in 2021. Severity of attack was primarily in the Trace with a smaller amount in Light. Direct control action on that insect is very difficult due to its attack dynamics and the scattered distribution of the stands.

5.2 DEFOLIATORS

Western Spruce Budworm IDW (*Choristoneura occidentalis)*

IDW has not been detected in the last 8 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 managment may include a spray program by the Province if the outbreak is significant enough and funds available.

Western Hemlock Looper IDL (*Lambdina fiscellaria lugubrosa)*

Looper increased significantly in 2022 to 4,377 ha from 971 ha in 2021. Most of the Severity was Moderate and Light and a small amount in Severe. **Attack was located in the following areas: Crawford/ Grey Ck drainages, Duncan Lake Area , Trout Lake Area, Coffee Ck and Kokanee Ck.** 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.

Larch casebearer – IDC (*Coleophora laricella*)

Larch casebearer was not observed for the in 2022 after 2 years of a small amount of attack. Larch are relatively resistant to the effects of defoliation. However, after 5 years of severe defoliation, annual terminal and radial growth may be seriously affected.

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.

5.3 OTHER INSECTS

Spruce Weevil -IWS (*Pissodes strobi*)

Spruce weevil is an insect that will repeatedly attack and damage the leader of spruce trees, causing poor form and reduced growth. It is not typically noted by the AOS. Spruce weevil is currently a medium to low priority issue overall, but in plantations that contain a large proportion of spruce seedlings; it is a medium to high priority. Risk increases with increasing growth degree days so lower elevation planting of spruce is at greater risk of attack and severe plantation damage. One strategy for this insect is to ensure that there is a good species mix on the site, consider Sx seedlot selection carefully and maintain a relatively high planting density.

Wood Borers

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.

5.4 DISEASES

Amillaria 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 MoF (2018). 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 MoF Regional Pathologist. Because deciduous brush thinning can promote spread of Armillaria, such action should be applied cautiously. 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.

13.4 ha were treated with stump removal in 2022 based on a June 2022 RESULTS report. Few Licencees 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 Licencees should be considering stump removal treatments in high risk areas where feasible.**

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 MoF (2018). Stocking Standards for Free Growing Stands are contained in each licensee's Forest Stewardship Plan and have been developed to address this disease.

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 and in the last 5 years all the Pw planted was rust resistant stock.

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.

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

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

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

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

202s saw the area affected and observed more than double to 1155 ha compared to 492 ha in 2021. The severity of attack observed were both Light and Moderate. Increase in attack likely associated with the cooler wetter spring weather. 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. 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 typically reliant on extended cool wet conditions in spring to early summer seasons.

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.

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

Both Dothistroma and Lophodermella were not detected in 2021. 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.

5.5 Deciduous Pests

Various deciduous diseases and pests

Aspen leaf miner was observed to be30 ha of attack in 2022. The impact of these pests and diseases on the TSA is not significant. No management is planned. 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.

5.6 Abiotic and Animal Damage

Fire and Post Fire NB & NBP

2021 Fire affected area was significantly higher at 16,333 ha. This compares to 1,183 ha in 2020. Most of the fire damaged area appears to be in Provincial Parks and Inoperable areas other than the Akoklex fire. **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.**

Animal Damage - Bear AB

No bear damage was detected in 2022. Mortality often appears to be on younger single trees rather than widespread areas and 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.

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 and only 36 ha were observed for 2022. 1 polygon was observed just west of Duck Lake and the other along Kootenay Lake near Wilson Ck. 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.

Cedar Flagging NE & Drought Foliage Damage NDF

A significant amount of area was observed for Cedar Flagging in 2022 – 5,744 ha. Drought foliage damage was noted for a total of 1,227 ha in 2021. Most of the area affected in 2022 was noted as Moderate Severity with lesser amounts in Light then Severe. NE was noted primarily in the Kaslo Area, Narrows Ck and other scattered locations. Cedar flagging is typically a result of hot, dry weather and drought conditions from current and previous years. With the extended late Fall drought in 2022 damage could have been more or higher severity than mapped.

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 oberved in the AOS increased significantly as expected in 2021 to 2,521 ha from 0 ha in 2020. Presumably the extreme heat and lengthy hot weather due to the heat dome was a factor. 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.

5.7 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 3).

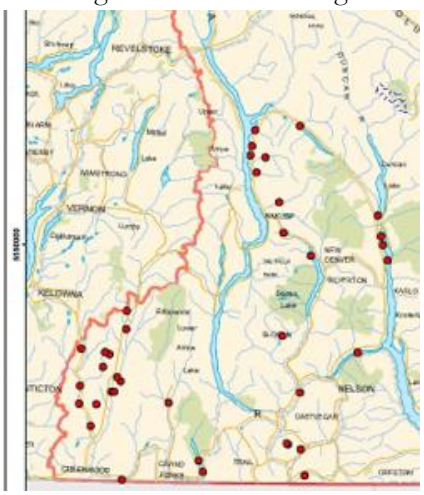

Figure 3. Kootenay Boundary Regional Spongy moth pheromone trap placements.

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.

BWA has been confirmed in the Arrow TSA 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.

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 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 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.

6.4 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/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 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.

6.5 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/*).

6.6 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 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 Licencees 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.

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	***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 (MoF region)	***X***	
Conduct detailed aerial surveys focusing on suppression beetle management units	***X***	
Submission of survey and treatment data to MoF		***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 6: IBM, IBD, IBS BMU rankings

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

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 2023-24 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. 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.

2022 IBD District funded funnel trapping in Kootenay Lake captured 825,290 Douglas-fir bark beetles over 34 sites compared to 2,598,016 beetles over 43 sites in 2021.

IBD Funnel trap capture numbers by Licencee is listed in Table 6. Over 900,000 captured by all participating Licencees and Government and potentially saving over 543 new attacked trees.

TABLE 6: Kootenay Lake IBD Funnel trapping - 2022

Licencee	# of Sites	# of IBD
District	34	825,290
BCTS	8	40,000 (estimate)
Monticola Private lands	5	57,573
Totals	**48**	**922,863**

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 2023-24 is to complete a heli detail survey, budget allowing, of selected higher incident and risk areas in Kootenay TSA (excludes CFA areas). Detailed mapping flights were completed for Douglas-fir bark beetle in portions of the TSA in 2022. Ground surveys were not completed in 2022 and are not planned at this time for 2023.

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 are currently planned.

8.3.4 Detailed Flight and Ground Surveys

The current plan for 2023-24 is to not fly any IBS areas as known attack areas are in Parks. No Ground surveys currently planned for 2023 or completed in 2022.

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 2023-24 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 2023. 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 then 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 (TSA only), as well as the amount of that killed volume that has been either harvested by the year 2019 is listed below (Table 6). 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.

There are no 2020-22 updates to this table as it was not supplied at the time of this report preparation.

Table 6: 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
1999-2009	1,174,918	88,870	46,164	9,184	15,938	289	597	1,320,984	243,918	16%
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%
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%

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

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 10: Historical Kootenay Lake TSA AAC

Year	Annual Volume m3
1999-2001	700,000*
2002-2010	681,300
2011- Present	640,000
24 Year Total	15,911,700

*May include Woodlot volume

13 Conclusion/ Final Comments

This Forest Health Strategy provides strategic direction for the licensees and Ministry of Forests 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, Western Balsam Beetle, Spruce Beetle Mountain Pine 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. Active IBD management is highly recommended in any areas of moderate or higher hazard Douglas-fir risk. Recent Wildfire losses, Western Hemlock Looper and Drought are also significant factors in the last 2 years that are recommended for attention by Licencees, whether for harvest, or reforestation regimes or both. Active IBD management is highly recommended in any areas of moderate or higher hazard Douglas-fir risk. New this last year are wood borers as a primary mortality agent. Wood Borers attack has seen a significant rise based on ground observations and at times was mistaken for IBD from the air.

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 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/2018%20data/AerialOverviewSurvey%202016-2018%20IBM%20IBD%20NW%20NF%20GEOrefPDF%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/