BRITISH COLUMBIA
Ministry of Forests

B.C.'s Bark Beetle Strategy 2024-2027

Bark Beetle Strategy 2024-2027

Executive Summary

Current and future impacts of bark beetles range from high to extreme and are exacerbated by ongoing forest ecosystem stress from climate change. This 3-year strategy outlines the provincial bark beetle management goals and objectives for the major bark beetles: mountain pine beetle, spruce beetle, Douglas-fir beetle, and western balsam bark beetle.

Although bark beetle populations are high in parts of the province, affecting over 203 million hectares in 2023, there are no landscape-level outbreaks at present. This 3-year strategy is dedicated to understanding the lessons learned from previous outbreaks, solidifying and expanding tools and tactics for bark beetle management, and anticipating and preparing for future outbreaks. These goals are broken down into 4 major objectives:

1) focused management investment to maximize economic, social, and ecological benefit using Beetle Management Units,
2) facilitate and direct effective tactical planning: data collection, bark beetle population mitigation, monitoring, and reporting,
3) continuously improve tools and tactics for bark beetle management, and
4) develop and prepare bark beetle outbreak management policy, protocols, and infrastructure.

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Why do we need a bark beetle strategy?

Over the past three decades, western Canada experienced multiple large outbreaks of native bark beetles. The mountain pine beetle (IBM), *Dendroctonus ponderosae*, outbreak affected approximately *20 million hectares* of forests in British Columbia (BC) between 2000 and 2020. In addition to mountain pine beetle, more recent trends show widespread and concerning surges in bark beetle populations for spruce beetle (IBS), *Dendroctonus rufipennis*, Douglas-fir beetle (IBD), *Dendroctonus pseudotsugae*, and western balsam bark beetle (IBW), *Dryocoetes confusus* (*Figure 1*). Spruce beetle has affected approximately *1.7 million hectares* mainly in northern BC since 2010, and western balsam bark beetle affects over *2 million hectares per year* (in a chronic, spatially disperse infestation pattern) since 2014. As naturally occurring forest disturbances, bark beetle outbreaks can result in increased ecosystem diversity and resilience, but they can also have far-reaching impacts for forest values such as timber, carbon sequestration, recreation, fish and wildlife, watershed management, range, landscape values and aesthetics, cultural heritage, and old growth forest ecosystems.

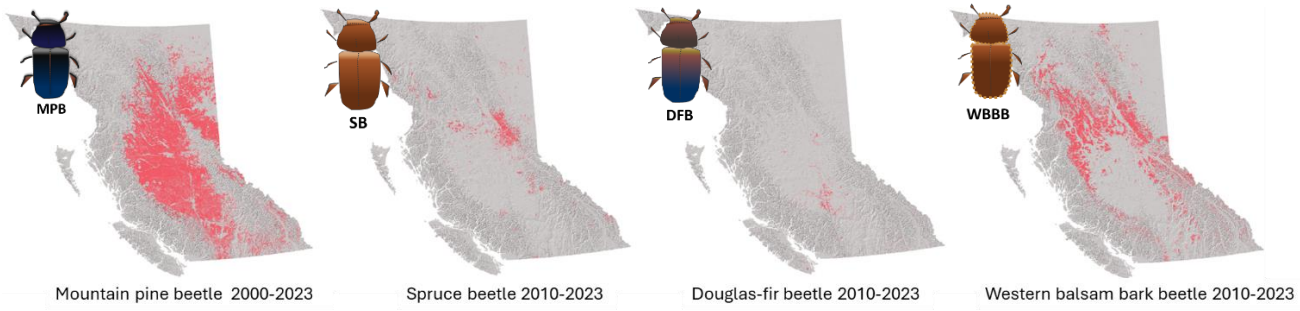

Figure 1 – Cumulative impact areas for the major bark beetles in British Columbia: mountain pine beetle (MPB), spruce beetle (SB), Douglas-fir beetle (DFB), and western balsam bark beetle (WBBB).

Figure 2 places the major insect species and groups into a climate risk framework – unlike many of the risks associated with climate change, outbreaks or large population "pulses" of bark beetles are a certainty. The estimated impacts of bark beetles range from high to extreme, cumulatively having severe impacts on BC's forest ecosystems.

A proactive bark beetle response is crucial.

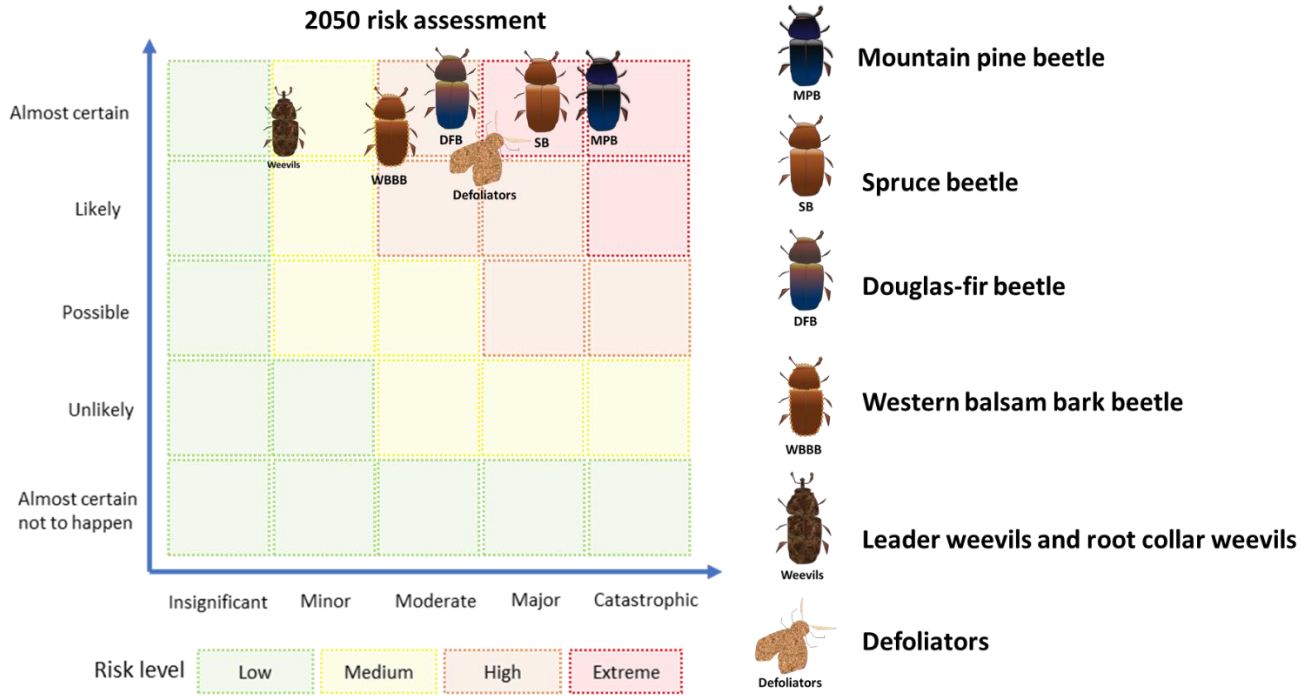

Figure 2 – Risk matrix for major forest health factors in BC developed from expert opinion: mountain pine beetle, spruce beetle, Douglas-fir beetle, western balsam bark beetle, leader weevils and root collar weevils, and defoliators including western spruce budworm, Douglas-fir tussock moth, western hemlock looper, two-year cycle budworm, and black-headed budworm. Outbreaks or pulse populations of each category are almost certain within the next 30 years. The impact varies from high to extreme for bark beetles.

Provincial Bark Beetle Strategy Goals

Having recently experienced an unprecedented mountain pine beetle outbreak and other large-scale infestations, the BC Ministry of Forests must have a proactive, science-based response to endemic populations as well as to future outbreaks.

The goals of this strategy are to:

- understand the lessons learned from previous outbreaks
- solidify and expand tools and tactics for bark beetle management
- anticipate and prepare for future outbreaks

The management of forest health and bark beetles integrates multiple levels of government, industry, the public, and First Nations communities. A proactive, timely and effective provincial bark beetle response must also be connected to, and included in, forest policy, including Modernizing forest policy in British Columbia and A New Future for Old Forests. Like fire, bark beetles are a major forest disturbance agent in BC and globally; they must be at the forefront of forest future planning, including Forest Landscape Planning.

Provincial Bark Beetle Strategy Objectives

The updated Provincial Bark Beetle Strategy is based on the fundamental elements of bark beetle-host interactions under a changing climate, ecologically informed management tactics, and landscape-level planning. Part of this strategy is to define effective Bark Beetle Management Units (BMU) at the landscape level for each of the major bark beetles. The BMU designations will identify key geographic areas where management tactics will be effective and define areas where natural bark beetle disturbances should function independently of human intervention or management. This strategy describes the development of the forest health program for bark beetles, and how to prepare emergency management protocols for new major bark beetle outbreaks before they occur. The objectives of this provincial bark beetle strategy are to:

1. focus bark beetle management investment to maximize economic, social, and ecological benefit using BMUs
2. assign and facilitate effective tactical planning: data collection, bark beetle population mitigation, monitoring, and reporting
3. continuously improve tools and tactics for bark beetle management
4. prepare bark beetle outbreak management protocols and infrastructure

Objective 1: Designate BMUs to maximize economic, social, and ecological benefits

BMU designations are a tool used to identify high-risk areas for early intervention and mitigation, to identify susceptible areas that are good candidates for proactive management, or to identify areas that need minimal intervention or management. BMUs are designated using host susceptibility, ecological, and operational parameters. Annual bark beetle detection data is then overlaid to prioritize mitigation actions, to effectively allocate limited provincial resources, and to report on annual progress.

Objective 1.1 – Annual BMU designations

BMU designations will be updated and published annually based on data from the most current Aerial Overview Survey data, detailed aerial surveys, ground surveys, host susceptibility mapping, and climate change risk assessment. By 2027, default BMU designations will be assigned automatically to landscape units using a data pipeline script currently under development. The default BMU designations can subsequently be updated by forest health specialists, if needed. Timely beetle management unit designation is essential for effective tool use and tactical planning; beetle management unit designations will be completed annually by March 31st.

Bark beetle population dynamics and terms for BMU designation

Biological processes underpin bark beetle outbreak dynamics. The major bark beetles follow a generalized series of population phases (*Figure 3*). The number of infested trees increases as the insect populations move from endemic populations to incipient-epidemic populations then, after breaching a threshold number of trees, move into epidemic populations, before falling into a post-epidemic phase where population return to endemic levels. BMU strategies are tied to population dynamics because the timing and effectiveness of operational tactics changes with each population phase.

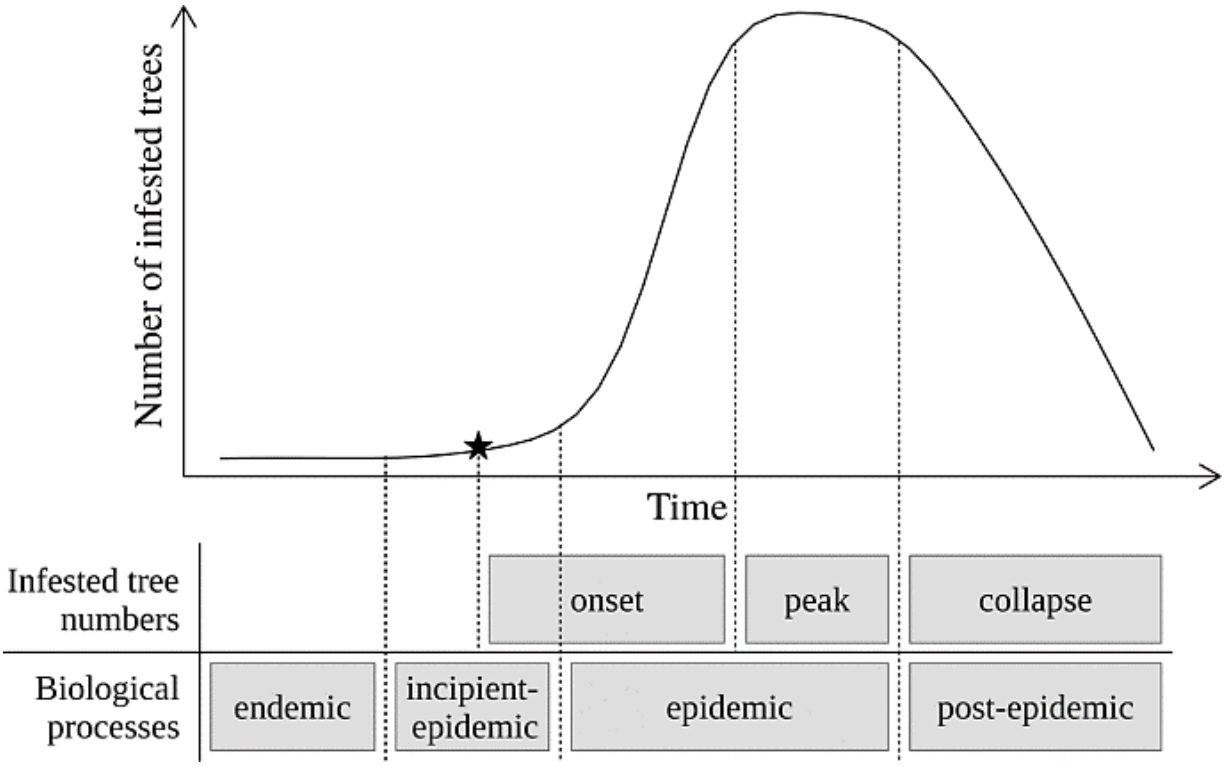

Figure 3 – Biological processes that drive the number of infested trees as a model of bark beetle outbreak dynamics[1].

BMU definitions

A Beetle Management Unit (BMU) is a delineated geographic planning and reporting unit used to guide and assess the effectiveness of operational bark beetle management[2]. Boundaries for BMUs correspond with Landscape Unit (LU) boundaries, a common management unit across the province based on landscape features. Each BMU is assigned a unique designation, with objectives, for managing each bark beetle species using science-based management tactics. The effectiveness of tactics can also be summarized and reported annually for each BMU.

Five BMU designations will be assigned to each landscape unit each year for each major bark beetle. Landscape units may be subdivided as needed. BMU designations defined in *Table 1*.

[1] Kunegel-Lion, M., Lewis, M.A. Factors governing outbreak dynamics in a forest intensively managed for mountain pine beetle. Sci Rep 10, 7601 (2020). https://doi.org/10.1038/s41598-020-63388-8

[2] BMU definitions that were legally established in past Land Use Plans or legal direction (e.g. Cariboo-Chilcotin Regional Land Use Plan) supersede the definitions in this strategy.

Table 1 – Summary of the five Beetle Management Unit (BMU) designations, the associated bark beetle population phase, the BMU definition, and objectives.

BMU designation	Population Phase	BMU definition	BMU Objective
Proactive (P)	Endemic	Proactive management tactics to maintain endemic populations and reduce host susceptibility, and increase forest resilience*	***To prevent beetle populations from establishing in, and expanding to, healthy trees and stands.***
Targeted (T)	Incipient	Aggressive pest reduction tactics where pest populations are building but can still be effectively reduced before more widespread mortality occurs	***Population mitigation to prevent or slow the onset of an outbreak***
Reactive (R)	Epidemic	Large-scale response (tactics) to reduce pest populations and to mitigate widespread bark beetle-caused host tree morality	***To minimize the impacts of an outbreak***
Post-disturbance (PD)	Post-epidemic	Tactics to use dead or dying trees to minimize timber value losses, to regenerate and revitalize post-disturbance areas, or to address post-disturbance hazards (e.g. wildfire)	***To recover timber value, support forest regeneration, and reduce post-disturbance risk factors***
No Action (NA)	Any phase** **Adjacent No Action BMUs should be large enough to allow for the full range of ecosystem processes through time	Applied to designated areas where: • natural disturbances are left unmanaged • values or other management considerations (e.g. wilderness areas, Parks or ecological reserves, culturally significant areas) supersedes that of timber or wood products • management efforts would be ineffective in substantially reducing beetle populations and impacts	***To allow natural disturbance to function without human intervention***

*resilience is defined as the capacity of a system to respond to change while maintaining function, structure and identity, while supporting development.

BMUs and Forest Landscape Plans (FLP)

BMU designations must be evaluated for compatibility with Land Use Plans and with Forest Landscape Plans, where they are available. The BMUs are designated based on available infestation data; tactics that are compatible with Forest Landscape Plan zonation and identified values must be considered to achieve BMU designation objectives.

Objective 1.2 – BMU definitions for western balsam bark beetle

Western balsam bark beetle, although a major and widespread bark beetle in subalpine fir ecosystems, does not follow the outbreak trajectory illustrated in *Figure 3* that is defined for mountain pine beetle, spruce beetle, or Douglas-fir beetle. Therefore, within this three-year strategy, the forest health specialists will develop a new set of BMU designations for "pulse-driven" bark beetle population dynamics, like western balsam bark beetle.

Objective 2: Assign and facilitate effective tactics to achieve BMU objectives: data collection, mitigation, monitoring and reporting.

There is a wealth of bark beetle information available from forest health specialists. This information needs to be catalogued, organized, reviewed, centralized, and formatted for end-user consumption. It must also be consistent, up-to-date, science-based, and digestible.

Objective 2.1 – Bark Beetle Portal and Data Hub

The bark beetle portal and data hub will create a user-friendly online GIS-based regional "one-stop shop" tool for bark beetles data storage, collection, visualization, and reporting. The portals will be serviced by a larger data hub that will collate and store bark beetle data collected from aerial surveys and ground surveys as well as track new infestation centres treatments and monitoring efforts by government, and where possible, by licensees, by other stakeholders and by rightsholders. As new remote sensing tools and predictive models are developed, they will be made available for use by portal users. This empowers district forest health staff, regional specialists, licensees, First Nations and other end-users to track bark beetle infestations and management over time. This will decrease reaction time for management activities and increases transparency of communication among government, industry, communities, and First Nations.

Objective 2.2 – Updated training and resources

Requirements (Table 2) for bark beetle management in regional programs will be updated and aligned with BMU designations as needed. These requirements will be in place for each region and available on the forest health website or within the bark beetle portal.

Table 2 – Recommended regional information sources for beetle management unit designation and tactical planning.

Regional resources for BMU designation	Information collection window
• Provincial Annual Aerial Overview Survey (AOS)	July to November
• Helicopter or Detailed Aerial Overview Surveys (DAOS)	May-June and August to October
• Ground surveys	Post- beetle flight August to February
• Regional forest health strategy	Periodically (1-3 years)
• Operational guidance	As required
• Forest health legislation and policy	Periodically
• Forest Landscape Plan	As required
• Bark beetle portal access and reporting	Continual

Objective 2.3 – Annual Operating Plans

Each year, regions and districts will identify appropriate strategies and tactics for each BMU designation. Annual operating plan structure and detail will be tailored to the needs of each region (e.g. this can be a

regional strategy, district, or timber supply area (TSA) strategy / annual operating plan). These plans must be developed in collaboration with local stakeholders (e.g., forest licensees) and rightsholders to address BMU designations and goals each year, report on the tactics used, and assess the efficacy of bark beetle management. Appendix I outlines some of the major recommended tactics by BMU with critical dates for each of the four major bark beetles. Annual operating plans can be posted and tracked on the regional bark beetle portal.

Objective 3: Continuously improve tools and tactics for bark beetle management

Objective 3 includes 5 components that support the continuous improvement of the tools and tactics used for bark beetle management and that will support the annual development of regional and district operating plans.

Objective 3.1 – Update the bark beetle management tools and website

A list of essential bark beetle guidance and tools are listed in order of priority in the table below. These tools will be the focus of this strategy until 2027.

Table 3 – The priority forest health tools for bark beetle detection, monitoring, survey and management. Green highlighting indicates the tools that are under active review and development.

Tool	Priority	Tool description	Existing?	Timeline
1	High	Updated Bark Beetle FPC Guidebook	Yes – update	2 years
2	High	Bark beetle susceptibility mapping - spruce and fir	Yes – update	2 months
3	High	Bark beetle susceptibility mapping - pine	Yes – update	2 months
4	High	Integrated climate change forest health modeling	No	3 years
5	High	Bark beetle portals - Regional to Provincial	Yes – started	1 year
6	High	Eruptive pest monitoring	No	-
7	Med	Update the forest health website for bark beetles	Yes – update	1 year
8	Med	Online training courses/material for 4 bark beetles	No	1 year/ course
9	Med	Consistent survey methods for bark beetles	Yes – started	2 years
10	Med	Operational guidance updates – funnel traps, trap trees, single tree treatments etc.	Yes - update	1.5 years

Objective 3.2 - Consistent bark beetle data collection for the bark beetle portal

When the provincial and regional portals are completed, mobile device applications will also be developed to support ground and helicopter surveys. Data collection on standardized mobile applications allow for almost immediate population of the portals with field data. In addition, surveyors can upload pictures and comments on the portal sites in almost real time. The data consistency and time savings will increase survey efficiency.

Objective 3.3 – Integrate climate change into future modeling for bark beetles

A forest health Research Climatologist position reporting to the Director, Provincial Bark Beetle Response and working with the Future Forests Ecosytem Centre (FFEC) will use existing forest health datasets (e.g AOS, VRI, eCAS) and new technologies (e.g. remote sensing satellite data and BioSIM modeling output) to develop tools to better understand, predict, and manage bark beetles under changing climate scenarios. These new technologies will be integrated into the bark beetle portal system as they are developed.

Objective 3.4 - Foundational science network and communication

Forest health program specialists excel at investigating and publishing sound scientific information. A provincial bark beetle response must include relevant connections with, and contributions to, current research and approaches to bark beetle management in BC, Canada, North America, and globally. Active contribution and collaboration by the Ministry of Forests entomologists to scientific forums across Canada and the United States is essential. Examples of organizations working and connecting on issues in forest include:

- Canadian Council of Forest Ministers Pest Management Forum
- The USDA Remote Sensing Working Group
- Western Forest Insect Work Conference (WFIWC)
- Natural Resources Canada
- Professional Associations
- International Union of Forest Research Organization (IUFRO)
- Spray Efficacy Research Group-International (SERG-I)
- Bark Beetle Technical Working Group

Objective 3.5 – Research excellence on priority bark beetles

A key part of a provincial bark beetle strategy is to leverage the considerable scientific expertise within the program to address the many unanswered questions in bark beetle management and ecology. The current research priorities include: operational tool development, subalpine fir ecosystem health, predicting dynamics of bark beetles in a warming and uncertain environment, and projects exploring ecosystem restoration, resilience, and reconciliation.

Research theme 1 – operational tool development

In an era of increased frequency and severity of bark beetle infestations, new operational tools are needed to mitigate pest populations from endemic to epidemic phases. One example of this research theme includes a project on the development of lethal trap trees. Lethal trap trees are no longer used as a population control tool for spruce beetles because of concerns over the non-target effects of insecticides. New nontoxic, targeted, inexpensive, and effective genetic technologies are currently being developed (RNA interference [RNAi]) that could be used in place of generalized insecticides in trap trees. This study is designed to test the effectiveness of RNAi for use in lethal traps trees for bark beetles. The is an applied and collaborative research project with to develop the RNAi probes and technique for use in lethal trap trees. This project will inform management practices to reduce the risk of significant predicted disturbances by adding an additional powerful tool for bark beetle management (the largest biotic disturbance agent in the province).

Other operational tools under development include projects such as anti-aggregation pheromone testing for spruce beetle management, SPLAT technology for mountain pine beetle management, enhancement of mountain pine beetle trapping lures. This bark beetle research theme focuses on the continuous improvement of operation tools to improve the effectiveness of bark beetle management.

Research theme 2 - Subalpine fir ecosystems

In light of the mounting evidence of accumulating stress, IBB life cycle adaptations, and increasing threats from non-native pests to subalpine fir ecosystems, forest entomologists in B.C. will collaborate to characterize, prioritize, and develop research initiatives that will provide a better understanding of

these sensitive yet valuable ecosystems. This research will address factors that may contribute to subalpine fir decline, whether biotic, abiotic, natural, or anthropogenic. A series of projects has been initiated in subalpine fir forests throughout the province to 1) improve the hazard-risk system; 2) develop new management strategies for subalpine fir in light of increasing threat from IBB and invasive species such as balsam woolly adelgid (*Adelges piceae*); 3) identify critical biological parameters of IBB and its symbionts to inform climate change modeling using dynamic species distribution models; and 4) characterize the wood quality or 'shelf-life' of IBB-killed trees to project its marketability and timber value. This research will investigate the potential shift in the multitrophic interactions of the bark beetle and its associated organisms in response to changing temperature and moisture regimes. This will enable better understanding of IBB dynamics as well as science-based guidance for management and restoration strategies of impacted stands by incorporating holistic, multi-value perspectives for within these distinctive ecosystems.

Research theme 3 - Predicting dynamics of bark beetles in a warming and uncertain environment

Native forest insects (e.g., some bark beetle species) are expanding their ranges in BC and are becoming invasive pests. Range shifts are arguably the most important outcome of climate change impacts. This is particularly true for forest insects with irruptive dynamics characterized by episodic landscape-scale outbreaks. The mandate of the newly established Future Forest Ecosystems Centre (FFEC) is based on a multi-decadal forecast of ecosystem change that directly informs the Ministry's policy, planning, and practice initiatives. This research theme aligns with the FFEC's mandates and will allow managers to prioritize their harvest, modify stand conditions to reduce susceptibility or directly target existing populations in stands with a high risk of outbreaks. Efficient development and use of data and new technologies must occur to accurately identify, monitor, analyse, and predict forest health factors in uncertain and rapidly changing conditions. In addition, anomalous weather events (like heat waves and windstorms) that can trigger acute forest health outbreaks can be anticipated, and the risks mitigated, by altering management regimes. Incorporating technologies like genomics data with dynamic species distribution models (SDM) can help us predict likelihood of spread for insect pests under climate change. This is especially important in an era where big data analysis is a requirement to ensure land use planning substantively measures ecosystem health to prevent infringement of indigenous rights.

An additional project conducted in collaboration with scientists from Natural Resource Canada is focused on the efficacy of pheromone lures targeting endemic and low-density bark beetle populations. This research is planned for mountain pine beetle to enable more accurate population data for integration into both climate and susceptibility models. In addition, this data will better inform predictive models of population dynamics of bark beetles and impending risk of outbreaks.

Research theme 4 – Restoration, Resilience, and Reconciliation

Restoration and resilience of forest ecosystems after disturbance is a high-priority research theme within the forest health program, especially to respond to changing climate conditions. This research theme addresses proactive management approaches toward achieving a defined desired future forest state that incorporates bark beetle disturbance regimes to maintain ecosystem health. This work is planned to be conducted in collaboration with First Nations' vision of health and vibrant future forests.

Objective 4 – Develop a bark beetle emergency response plan

The Director, Bark Beetle Response in collaboration with forest health specialists will develop:

- Definition of thresholds for the declaration of “outbreak” or “emergency” status for the three major eruptive bark beetles: mountain pine beetle, spruce beetle, and Douglas-fir beetle.
- Develop policy guidance and recommendations for the next bark beetle outbreak.

Appendix I

The following tables outline common tactics recommended for each major bark beetle. This is not an exhaustive list, nor a requirement in all circumstances. This is intended as general guidance to plan the timing and implementation of management activities within designated BMUs.

Common tactics for mountain pine beetle by BMU with critical dates

Common Tools and Tactics	*Beetle Management Unit Designation (P, T, R, S, NA)*	*Critical Dates*
Recommended operational training and preparation:		
• ground surveying course	All	August to October
• helicopter surveying course	All	August to October
• tactical guidance review	All	Any time
• forest health legislation and policy review	All	Any time
• bark beetle portal access	All	Any time
• regional forest health strategy review	All	Any time
Assessment and detection		
• Adult flight window	All	June to October
• Funnel trap monitoring network	All	May to September
• Host susceptibility rating and priority management areas	All	Any time
• Aerial Overview Survey (AOS) mapping	All	July to November
• Detailed Aerial Overview Survey (DAOS) mapping	All	June to October
• Satellite imagery	T, R	July to November
• Ground surveys	All	September to March
• Red-green ratio calculation	P, T, R	August to October
• Regional forest health strategy	T, R	Any time
• Regional specialist review	All	Any time
Harvesting		
• Pest reduction harvesting	T, R	September to May
• Post-disturbance harvesting / fibre collection	S	Any time
• High hazard host removal	P, T, R	Any time
• Harvest priority rating	P, T, R, S	Any time
• Retention guidance	P, T, R, S	Any time
Small patch / single tree treatments		
• Fall and burn/peel/remove	T, R	October to May
• Anti-aggregation pheromones	P, T	April to September
• Debarking	T	September to May
• Small patch / single tree harvesting	P, T, R	September to May
• Trap trees deployed	P, T	April to May
• Trap trees removed	All	September to May
Baiting		
• Push-pull tactics	T, R	April to September
Wood hauling and storage		
• Hauling and storage temperature restrictions	T, R	May to September
Development and planning		
• Operational action plans for harvest prioritization	T, R, S	Any time
• Forest health working groups	All	March & November
• Silvicultural working groups	All	Any time

Common tactics for spruce beetle by BMU with critical dates

Common Tools and Tactics	*Beetle Management Unit Designation (P, T, R, S, NA)*	*Critical Dates*
Recommended operational training and preparation:		
• ground surveying course	All	August to October
• helicopter surveying course	All	August to October
• tactical guidance review	All	Any time
• forest health legislation and policy review	All	Any time
• bark beetle portal access	All	Any time
• regional forest health strategy review	All	Any time
Assessment and detection		
• Adult flight window	All	April to September
• Funnel trap monitoring network	All	April to September
• Host susceptibility rating and priority management areas	All	Any time
• Aerial Overview Survey (AOS) mapping	All	July to November
• Detailed Aerial Overview Survey (DAOS) mapping	All	August to October
• Satellite imagery	T, R	July to November
• Ground surveys	All	September to March
• Regional forest health strategy	T, R	Any time
• Regional specialist review	All	Any time
Harvesting		
• Pest reduction harvesting	T, R	September to May
• Post-disturbance harvesting / fibre collection	S	Any time
• High hazard host removal	P, T, R	Any time
• Harvest priority rating	P, T, R, S	Any time
• Retention guidance	P, T, R, S	Any time
Small patch / single tree treatments		
• Fall and burn/peel/remove	T, R	October to May
• Anti-aggregation pheromones	P, T	April to September
• Debarking	T	September to May
• Small patch / single tree harvesting	P, T, R	September to May
• Trap trees deployed	P, T	April to May
• Trap trees removed	All	September to May
Baiting		
• Push-pull tactics	T, R	April to September
Wood hauling and storage		
• Hauling and storage temperature restrictions	T, R	May to September
Development and planning		
• Operational action plans for harvest prioritization	T, R, S	Any time
• Forest health working groups	All	March & November
• Silvicultural working groups	All	Any time

Common tactics for Douglas-fir beetle by BMU with critical dates

Common Tools and Tactics	*Beetle Management Unit Designation (P, T, R, S, NA)*	*Critical Dates*
Recommended operational training and preparation:		
• ground surveying course	All	March to October
• helicopter surveying course	All	March to October
• tactical guidance review	All	Any time
• forest health legislation and policy review	All	Any time
• bark beetle portal access	All	Any time
• regional forest health strategy review	All	Any time
Assessment and detection		
• Adult flight window	All	April to September
• Funnel trap monitoring network	All	April to September
• Host susceptibility rating and priority management areas	All	Any time
• Aerial Overview Survey (AOS) mapping	All	July to November
• Detailed Aerial Overview Survey (DAOS) mapping	All	May-July to October
• Satellite imagery	T, R	July to November
• Ground surveys	P. T, R, S	September to March
• Fire severity mapping	All	September to March
• Regional forest health strategy	T, R	Any time
• Regional specialist review	All	Any time
Harvesting		
• Pest reduction harvesting	T, R	September to May
• Post-disturbance harvesting / fibre collection	S	Any time
• High hazard host removal	P, T, R	Any time
• Harvest priority rating	P, T, R, S	Any time
• Retention guidance	P, T, R, S	Any time
Small patch / single tree treatments		
• Fall and burn/peel/remove	T, R	October to May
• Anti-aggregation pheromones	P, T	April to September
• Debarking	T	September to May
• Small patch / single tree harvesting	P, T, R	September to May
• Trap trees deployed	P, T	March to May
• Trap trees removed	All	September to May
Baiting		
• Push-pull tactics	T, R	April to September
Wood hauling and storage		
• Hauling and storage temperature restrictions	T, R	May to September
Development and planning		
• Operational action plans for harvest prioritization	T, R, S	Any time
• Forest health working groups	All	March & November
• Silvicultural working groups	All	Any time

Common tactics for western balsam bark beetle by BMU with critical dates

Common Tools and Tactics	*Beetle Management Unit Designation (P, T, R, S, NA)*	*Critical Dates*
Recommended operational training and preparation:		
• helicopter surveying course	All	August to October
• tactical guidance review	All	Any time
• forest health legislation and policy review	All	Any time
• bark beetle portal access	All	Any time
• regional forest health strategy review	All	Any time
Assessment and detection		
• Host susceptibility rating and priority management areas	All	Any time
• Aerial Overview Survey (AOS) mapping	All	July to November
• Detailed Aerial Overview Survey (DAOS) mapping	All	August to October
• Satellite imagery	T, R	July to November
• Regional forest health strategy	T, R	Any time
• Regional specialist review	All	Any time
Harvesting		
• Pest reduction harvesting	T, R	September to May
• Post-disturbance harvesting / fibre collection	S	Any time
• High hazard host removal	P, T, R	Any time
• Harvest priority rating	P, T, R, S	Any time
• Retention guidance	P, T, R, S	Any time
Small patch / single tree treatments		
• Small patch / single tree harvesting	P, T, R	September to May
Baiting		
• Push-pull tactics	T, R	April to September
Wood hauling and storage		
• Hauling and storage temperature restrictions	T, R	May to September
Development and planning		
• Operational action plans for harvesting prioritization	T, R, S	Any time
• Forest health working groups	All	March & November
• Silvicultural working groups	All	Any time