NWT FOREST HEALTH

2020 REPORT

Government of
Northwest Territories

Contents

Report prepared in partnership with the Natural Resources Canada – Canadian Forest Service

Cover photo: Healthy birch stands (rich green) and defoliated aspen (silvery light green) as observed near Little Doctor Lake, Dehcho.

1. Forest Health Program in the Northwest Territories

Background

The Department of Environment and Natural Resources (ENR) is responsible for monitoring forest health conditions across the Northwest Territories (NWT) to ensure the forest has the capacity for renewal after a wide range of disturbances, and is able to retain its ecological resiliency while meeting the current and future needs of NWT residents. Historically, the focus of the forest health program has been on monitoring insect and disease impacts in NWT forests. In addition, since 2015, the Forest Management Division (FMD) has been recording abiotic disturbances (disturbances caused by non-living factors) to address the uncertainty of forest ecosystem response to a changing climate. Examples of abiotic disturbances recorded during monitoring surveys include: drought symptoms (reddening of foliage, sun scalding scars, stunted and gnarled foliage), flooding, wind and snow damage, land slumps and permafrost related disturbance (i.e. “drunken forest” phenomenon). General decline of some tree species is also tracked as an important sign of changing growth conditions caused for example by climate change. In cases where a biotic agent cannot be identified, changes are considered to be of abiotic origin.

Historically, surveys were conducted by the Canadian Forest Service (CFS) from the 1950’s until 1998 when the Government of the Northwest Territories took on the surveying role. Since 2009, annual forest health surveys have been conducted by ENR staff, assisted by the Canadian Forest Service. In 2020, the aerial surveys were conducted by Jakub Olesinski (ENR). Brent Starling, a Forest Officer from ENR’s South Slave Region, also participated in a regional survey.

In 2020, only the South Slave Region and the southern part of the Dehcho Region were surveyed due to COVID 19 restrictions. The aerial survey followed typical routes in these areas (Fig. 1).

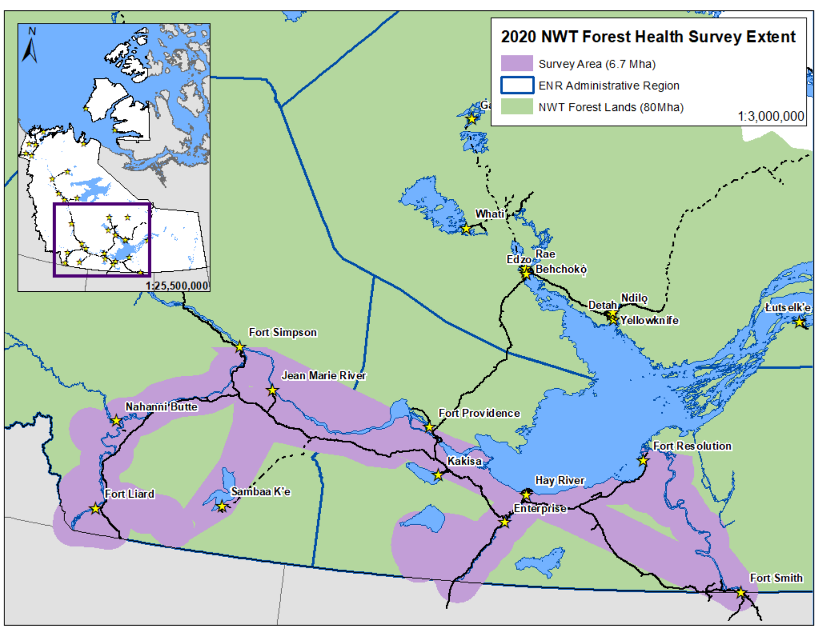


Figure 1: NWT Forest Health monitoring extent in 2020. Only the South Slave Region and the southern part of the Dehcho were surveyed due to COVID-19 restrictions. The estimated total area surveyed was 6.7 million hectares.

Monitoring scope

Forested land in the NWT encompasses nearly 800,000 km^2, larger than any European country excepting Russia. Given the vast geographic area, it is necessary to prioritize areas surveyed annually. Traditionally, areas occupied by mature spruce forests have been a priority because of their significance as the preferred host for the most serious insect pest in the NWT – Spruce Budworm (*Choristoneura fumiferana*) (SBW). These areas extend along major rivers and waterways, including the Mackenzie, Liard and Slave Rivers and their main tributaries, as well as the foothills of the Mackenzie Mountains and slopes of the Cameron Hills, Marten Hills and Ebbutt Hills.

Methods

Aerial detection and coverage

Monitoring is mostly conducted through aerial detection mapping using small planes such as Cessna 206. A helicopter is used when ground verification is required in areas with limited road or water access. Disturbed areas are digitally mapped using a tablet with ESRI Arc Pad 10 software. Insect and disease agents are usually identified on site. However, in some cases, samples are collected and taxonomic identifications are made at the CFS Northern Forestry Centre lab in Edmonton.

The total area covered by surveys varies slightly each year due to visibility. Under optimum flying conditions, approximately 23.8 million hectares are covered, which represents about 30% of the total forested land area in the NWT. In 2020, due to COVID-19 restrictions, only approximately 2,600 km of forest health survey routes were flown in the southern part of the territory, covering approx. 6.7 million hectares (8% of the total forest land area).

Severity of defoliation and damage is also recorded during aerial surveys as an attribute associated with spatial data. Severity expresses the degree of foliage affected, or amount of mortality present in a stand, caused by the particular pest or damaging agent. In the case of defoliators or abiotic foliar damage, severity class is assessed visually as a percentage of current growth affected (Table 1), whereas with mortality agents such as bark beetles or abiotic factors, severity represents the percent of trees affected within a stand. Mortality can also result from moderate to severe defoliation reoccurring over several years, which is especially likely with spruce budworm. Other defoliators, like aspen serpentine leafminer or willow blotch leafminer, are rarely the sole cause of tree mortality despite the severe damage they cause each year. The ramifications of the severity of defoliation are described below when discussing each particular pest agent.

Table 1: Defoliation severity classes and mortality severity classes used by FMD

Defoliation severity class	% of current growth defoliated (conifer)	% of current growth defoliated (broadleaf)
Light (L)	<30	<30
Moderate (M)	30-50	30-70
Severe (S)	>50	>70
Mortality severity class	**% of trees affected within a stand**	
Light (L)	<=10	
Moderate (M)	10-50	
Severe (S)	>50	

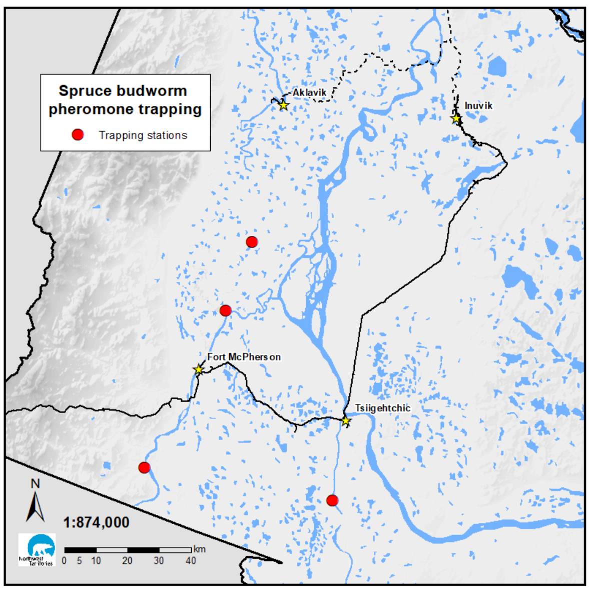
Ground surveys

Ground surveys along major NWT highways are usually conducted on an annual basis. These surveys play an important role as they are often the only opportunity to confirm the presence of suspected pest agents on the ground. Ground surveys also provide opportunities for collecting samples and discovering new and emerging factors affecting forest health, often not discernable from the air. Ground surveys were not conducted in 2020 due to operational limitations caused by COVID restrictions.

Pheromone trapping

Pheromones are used to detect both mountain pine beetle and spruce budworm. Mountain pine beetle is detected using a dispersal baiting method. Five baiting locations were established in the southern NWT. Three locations were established along the Highway 1 corridor (Alberta border to Enterprise), and two locations were established between Enterprise and Jean Marie River (Fig. 2).

The spruce budworm pheromone trapping program was active across the territory in 1997-2012, and in the Beaufort Delta Region it has been active again since 2017. The regional forestry staff deploys traps in historical trapping locations along the Arctic Red River, Peel River and the upper Delta. There are currently four active trapping locations with three traps at each site. The Unitrap container type traps are deployed from mid-June to mid-August (Fig 2) using rotary wing. Each trap contains a pheromone lure to attract male moths, and an insecticide strip to kill trapped moths. When traps are collected in August, the SBW moths are separated from other insects that may have been caught, and then counted. Moth count results are sent to the Ecosystem Forester.



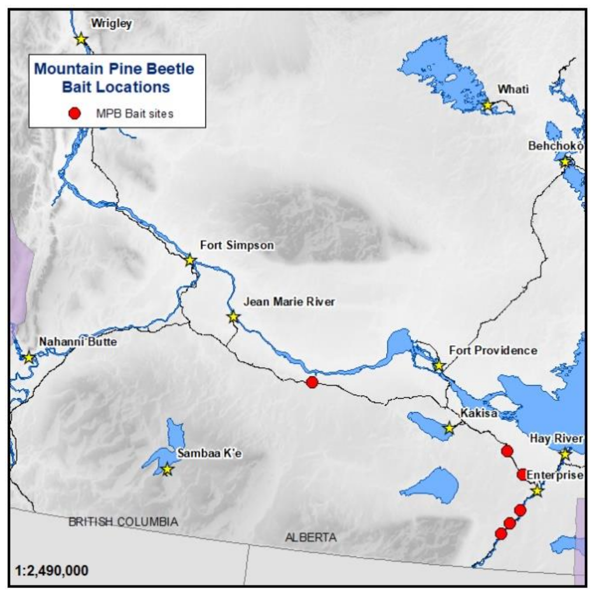


Figure 2: Pheromone trapping locations for spruce budworm in the Inuvik Region (left) and baiting locations for mountain pine beetle in the South Slave and Dehcho Regions (right)

Public reports

Public sightings and regional reports are an important addition to the existing body of knowledge. Renewable Resource Officers, Forest Officers and the general public are encouraged to report any forest health issues that draw their attention. Each year, FMD receives inquiries with photos of various insect and disease disturbances from communities across the NWT. Public reports are important because they not only help corroborate aerial survey observations, but often help direct ground surveys.

Survey schedule

Aerial surveys are flown in the second half of July when the spruce budworm defoliation is usually most evident. Any other disturbances visible from the air are also recorded during this main pan-territorial survey. Additional surveys targeting specific pests are flown as required. Because of low fire activity in 2020, all surveys were done using a fire contract helicopter.

Dates of the 2020 surveys:

- July 15 – South Slave aerial survey using rotary wing
- July 17 – Dehcho aerial survey using rotary wing
- Aug 16 – additional aerial survey in the Liard Valley

2. Climate and wildfire conditions

Climate

The winter of 2019-2020 (December-March) was affected by well below seasonal precipitation across all of the NWT. Most areas noted only 60% of normal precipitation, or less through the period. Unusually cold conditions in April followed with well-above normal snowpacks still present on April 15. A strong Arctic Vortex kept unusually cold (but dry) conditions for much of May which led to delayed loss of snow in many areas. The 2020 summer temperatures were close to long-time averages; however, heavy precipitation persisted in the southern parts of the territory through much of the season.

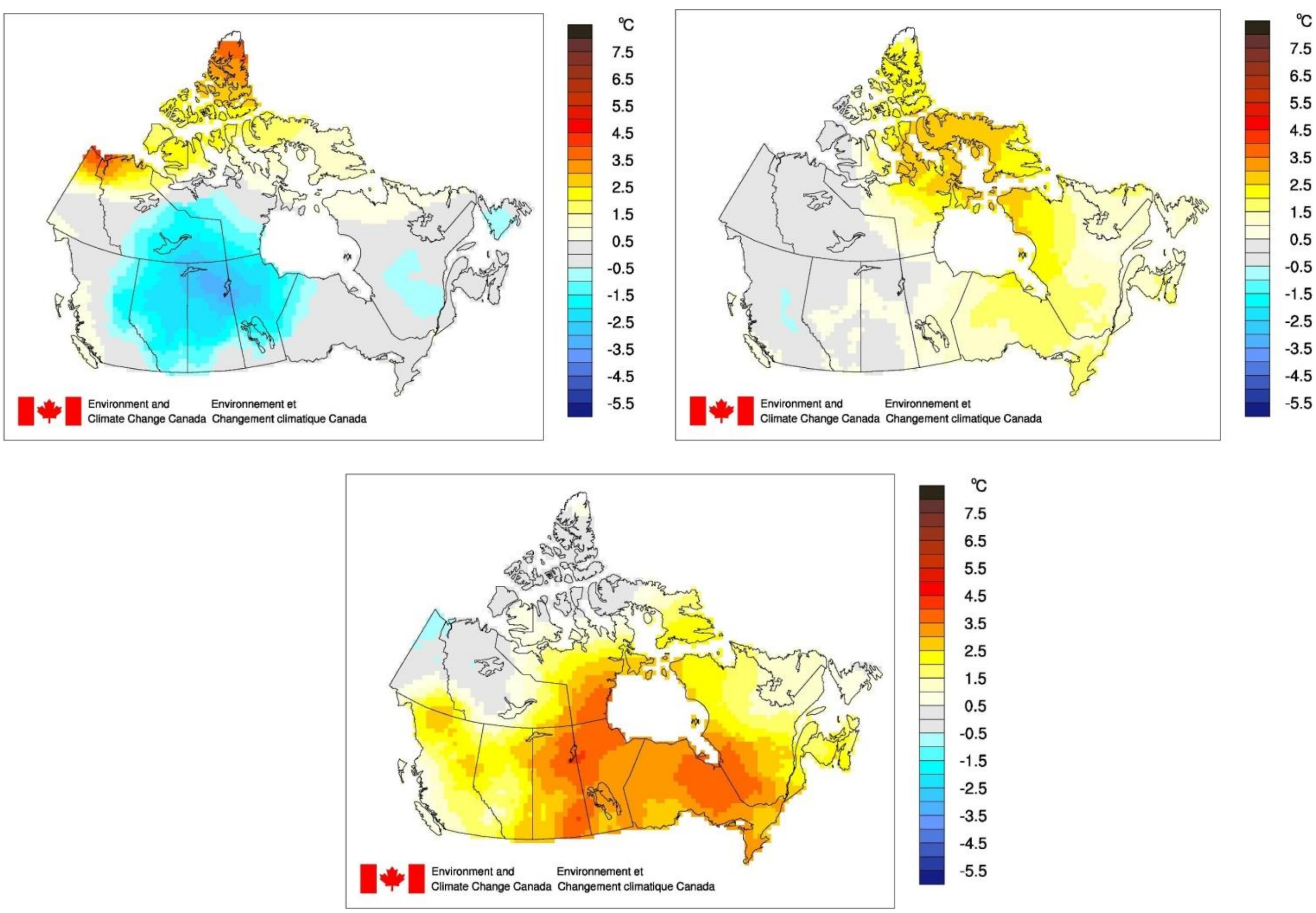


Figure 3. Temperature departures from normal in spring 2020 (top left), summer 2020 (top right), and winter 2019-20 (bottom)

The NWT experienced extremely wet conditions through most of the growing season. Total rainfall during July and August was near and over 200% of normal precipitation across the southern NWT (Fig. 4). Hay River and Fort Smith received over 100 mm of rainfall in two consecutive months which is an extremely rare occurrence in the NWT. Another important climatic factor that shaped the dynamics of insect pest activity in 2020 was the abnormally slow start to the growing season with snow on the ground persisting well into May. Leaf flush occurred as late as June 15 in the South Slave.

Total and Percent of Normal Precipitation: July and August 2020		July	August	Total Summer Rainfall	% of Normal Summer 2020
Fort Smith A	Actual	111.6	117.6	229.2	210
	Average	*54.5*	*54.5*	*109.0*	
Hay River A	Actual	102.2	108.2	210.4	207
	Average	*43.0*	*58.7*	*101.7*	
Sweetgrass (WBNP)	Actual	111.2	103.3	214.5	182
	Average	*67.4*	*50.2*	*117.6*	
Yellowknife A	Actual	97.6	67.4	165.0	206
	Average	*40.8*	*39.3*	*80.1*	
Fort Simpson A	Actual	120.2	87.2	207.4	169
	Average	*61.1*	*61.4*	*122.5*	
Fort Liard (WJL)	Actual	67.1	141.6	208.7	150
	Average	*83.4*	*55.3*	*138.7*	
Norman Wells A	Actual	42.5	38.7	81.2	97
	Average	*41.8*	*41.8*	*83.6*	
Inuvik Climate	Actual	54.7	16.5	71.2	96
	Average	*35.0*	*39.4*	*74.4*	

Figure 4. Total and percent of normal precipitation for July and August. Source: 2020 Fire Weather Report.

Wildfire activity

Due to overall wet conditions, the 2020 fire season was one of the least active seasons in the last 30 years with only 21,000 hectares burned compared to a 30-year average of 634,000 ha. Given the current technology used to detect wildfire and determine total hectares burned, the statistics for the past three consecutive fire seasons (2018, 2019, and 2020) are remarkably low, with all three seasons ranking amongst the top 25 least active of the past 71 years. Perhaps even more notable is that four years since 2000 have ranked amongst the top 15 slowest of all-time in terms of ignition, despite the fact that climate change has been impacting northern climates at an accelerated rate, with high-latitude regions warming, on average, twice as fast as the rest of the world. It is unknown at this time whether or not the lower fire occurrence in the NWT is a consequence of climate change or if these trends are just short-term deviances.

It is suspected that the combination of damp and cool conditions and late spring caused an overall decline in insect pest activity observed in the south of the territory in 2020.

3. Overview of forest health conditions

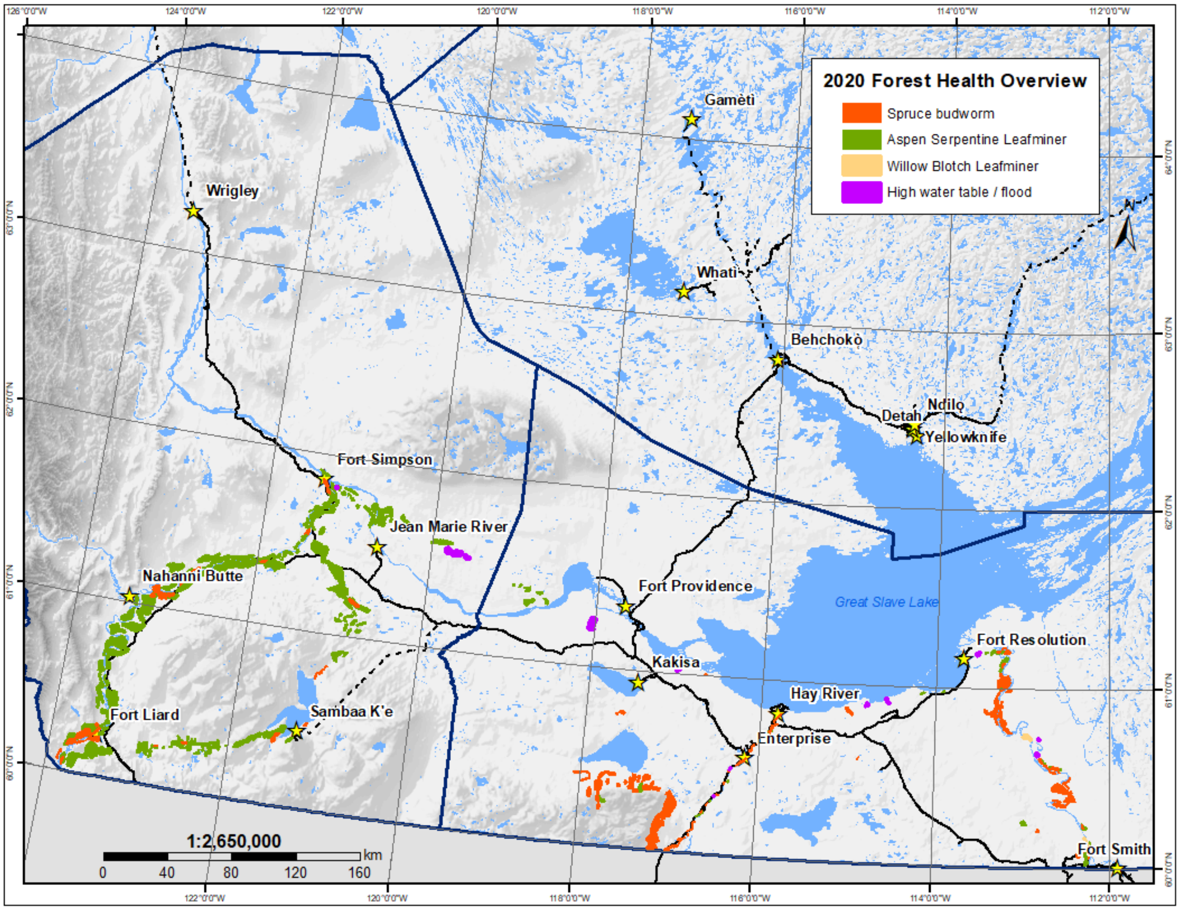


Figure 5: Overview of NWT forest health conditions in 2020

Since the 2020 surveys were conducted only in the South Slave and the southern parts of the Dehcho Region, relative differences comparing to the 2019 results were calculated for the same survey area. In 2020, approximately 422,000 ha (6.3% of the total surveyed area) were affected by insect and abiotic disturbances (flooding and high water table), marking a 44% decline compared to the comparable survey area in 2019. All major pests observed in 2019 continued to affect the NWT forests but their ranges and severity of impact were generally reduced compared to the previous year. There was a slight decline of Spruce Budworm (SBW) defoliation in the survey area (12% decrease) especially in the Dehcho Region where defoliation may have been underestimated due to heavy precipitation occurring in the region before the survey. Increases in defoliation were noted along the Slave, and Hay Rivers, and in the Cameron Hills area (South Slave). Willow Blotch Leafminer (WBL) declined by 85% and was observed only along the Slave River. This dramatic drop was likely due to the delayed development of WBL which became active later than usual. As a result, much of the defoliation could have been missed during the survey. If a wet cool summer pattern becomes more frequent in the future, the main aerial survey may have to be rescheduled to a later date to capture the full extent of defoliation. Alternatively, an additional, willow dedicated survey may have to be flown in August.

As in the previous year, the most notable abiotic disturbance in 2020 was tree stress and mortality caused by high water table and flooding.

Table 2: Summary of areas affected by biotic and abiotic agents across the administrative regions of the NWT based on the area surveyed. The * indicates tree mortality associated with the agent.

Area affected (ha)	Dehcho	Beaufort Delta	North Slave	Sahtu	South Slave	Grand Total
Biotic disturbances	**298,322**				**104,449**	**402,771**
Aspen serpentine leafminer	270,341				22,587	**292,928**
Spruce budworm	27,583				80,176	**107,759**
Willow blotch leafminer	0				1,686	**1,686**
White-spotted sawyer beetle*	398		**NOT SURVEYED IN 2020**		0	**398**
Abiotic disturbances	**15,228**				**5,774**	**21,002**
High water table	4,187				4,213	**8,400**
Flooding*					1,561	**1,561**
Slumping	21					**21**
Aspen decline	9,053					**9,053**
Black spruce decline	1,967					**1,967**
Grand Total	**313,550**				**110,223**	**423,773**

4. Insect pest activity

Spruce budworm (*Choristoneura fumiferana*) – SBW

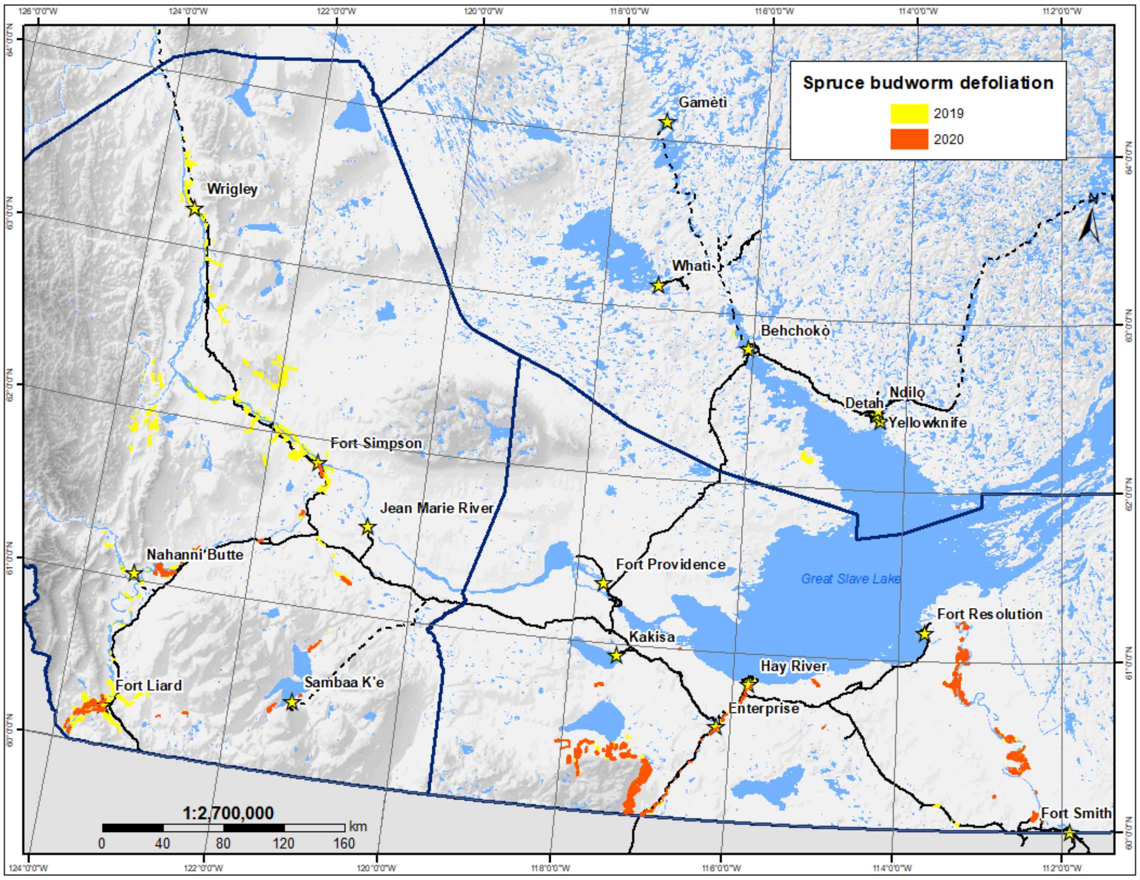


Figure 6: Overview of spruce budworm activity in the NWT in 2019-2020. Areas north of Fort Simpson in the Dehcho were not surveyed in 2020.

The general population dynamics for SBW over the last decade were fairly stable in 2010-2014 (Fig. 7). In 2015-2019, SBW population levels were gradually increasing, especially in the Dehcho Region peaking in 2018, but started to decline at the end of the decade. In 2020, further declines of SBW in the Dehcho were observed (70% decrease compared to the same survey area in 2019); however, the outbreak in the South Slave that was previously observed in 2019 was observed to expand (66% increase compared to the same survey area in 2019). The most significant increases were noted mostly along the eastern and northern slopes of the Cameron Hills, along the Hay River and within the community itself, and along the Slave River. Most of the defoliation in the South Slave was classified as moderate with some severe patches in the Cameron Hills (Fig. 6).

It is possible the detection of defoliation in the Dehcho was affected by heavy prolonged precipitation experienced in the region throughout much of June and July. Heavy rains tend to wash the dead foliage away from treetops making a defoliation aerial assessment difficult, and thus may result in underestimation. The 2021 survey should help to further determine trends of SBW populations in the region.

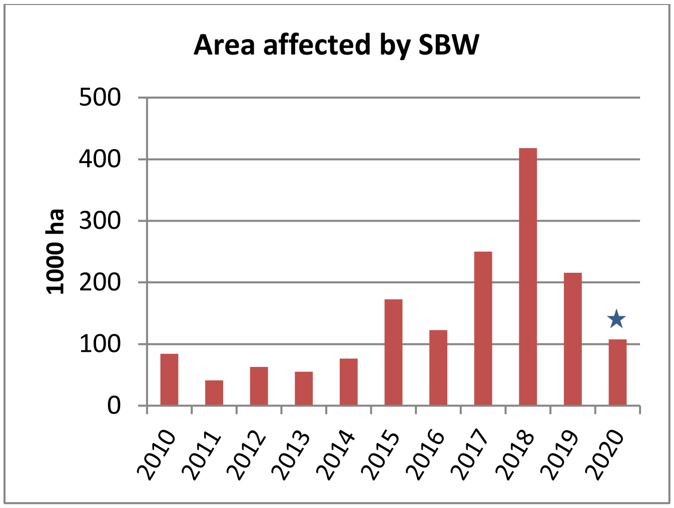


Figure 7: Area affected by spruce budworm defoliation in the NWT over the last decade. The star over the 2020 data indicates that only the South Slave and the southern Dehcho Region information was collected.

Beaufort Delta

A pheromone trapping program continued in the Beaufort Delta Region in 2020. Due to COVID-19, delivery of pheromone traps required for the program was delayed, and traps were only set up from July 16 to Aug 17. Despite a relatively short period of trap activity, the count results from the Arctic Red indicated continuation of the outbreak in this area, while the Peel River counts indicate the outbreak in this area has collapsed and the SBW population is close to the endemic (baseline) level. The Husky and Peel Channel traps both continued to have counts indicative of endemic populations i.e. maintained at baseline low levels (Table 3, Fig. 8).

COORDINATES	SITE	TREE	COUNT
67.213232 N	1 Arctic Red	1	351
133.630127 W	2 Arctic Red	2	461
	3 Arctic Red	3	N/A trap damaged
67.115448 N	2 Peel River	1	66
134.999134 W	3 Peel River	2	33
	4 Peel River	3	52
67.616253 N	3 Husky	1	N/A trap damaged
134.856515 W	4 Husky	2	14
	5 Husky	3	23
67.823584 N	4 Peel Channel	1	11
134.856215 W	5 Peel Channel	2	4
	6 Peel Channel	3	2

Table 3: 2020 SBW Pheromone trapping results from the Beaufort Delta Region.

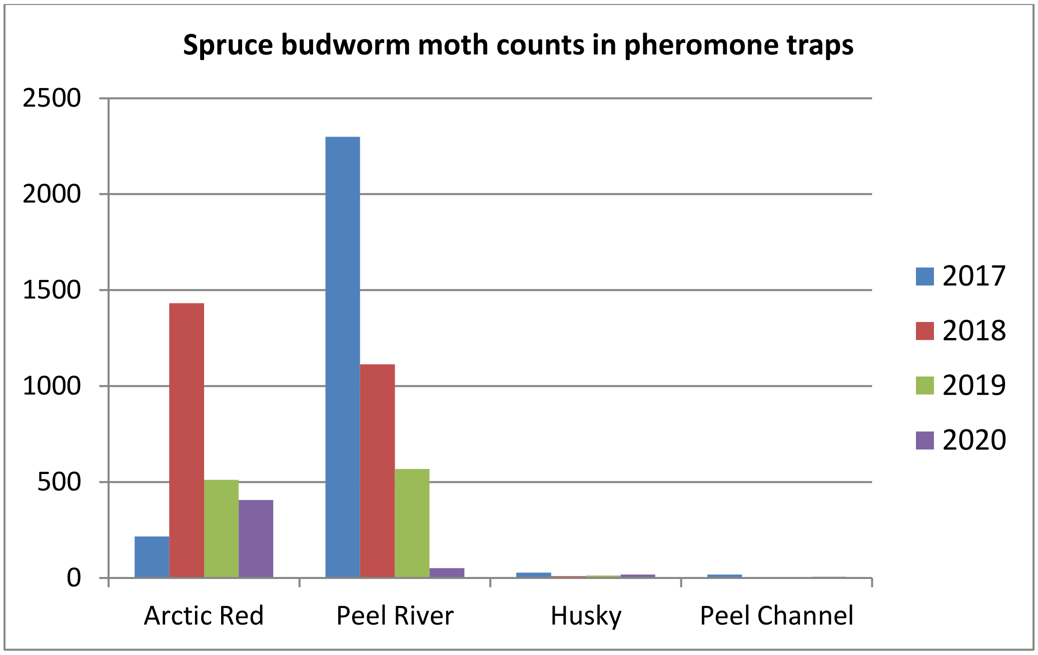


Figure 8. Spruce budworm pheromone trapping results in the Beaufort Delta Region. Each bar is an average count of three traps located at each of the trapping locations. The Husky and Peel Channel trapping sites are located in the southern section of the Mackenzie Delta, while the Arctic Red and Peel River sites are located along the respective rivers south of the delta. Spruce forests growing along the Arctic Red and Peel River are protected from extreme weather exposure by high river banks therefore creating a shelter for the wintering SBW.

Dehcho Region

The SBW population build-up in the southern Dehcho started to occur in 2016 with some trace defoliation observed in many locations along the Liard Highway. In 2017-18, SBW populations in the Dehcho increased significantly but then decreased substantially in 2019 and continued to decrease in 2020. The most significant declines were observed in the Fort Liard area and south of Fort Simpson. A slight increase in affected area was noted around Nahanni Butte (Fig. 9). A few new patches of defoliation were noted in the Sambaa' Ke area both south and north of the lake. Most of the defoliation observed in the Dehcho was moderate with a few light patches.

Heavy precipitation throughout much of June and early July may have washed out the dead foliage from the tree tops which may have contributed to an underestimation of the actual damage. These areas will be re-evaluated during the 2021 surveys.

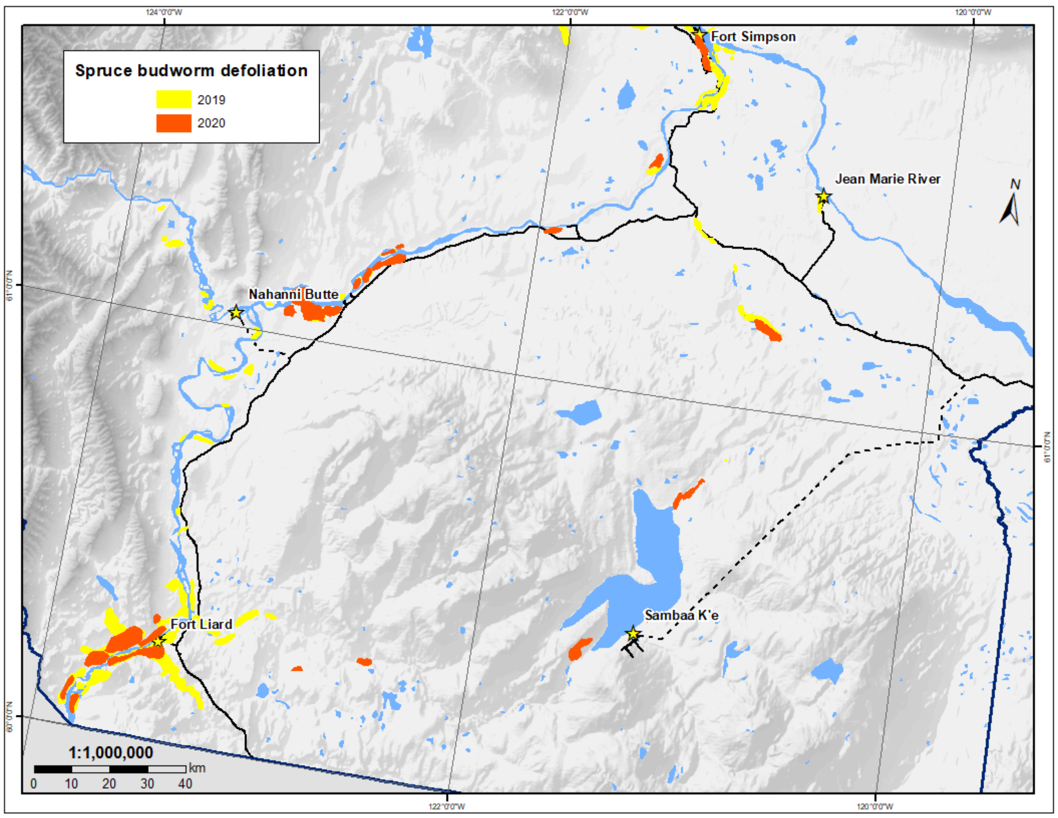


Figure 9: Spruce budworm defoliation extent and severity observed in the Dehcho Region in 2019-2020

South Slave Region

An outbreak of SBW along the Hay River continued in 2020 with severe defoliation observed along the river all the way from the AB border to the mouth. Trees in the community of Hay River were also heavily impacted and were often reported by the public. Overall, there was a 66% increase in defoliated area in the South Slave compared to 2019. The most significant increases were noted in the Cameron Hills area (eastern and northern slopes) and along the Slave River (Fig. 10)

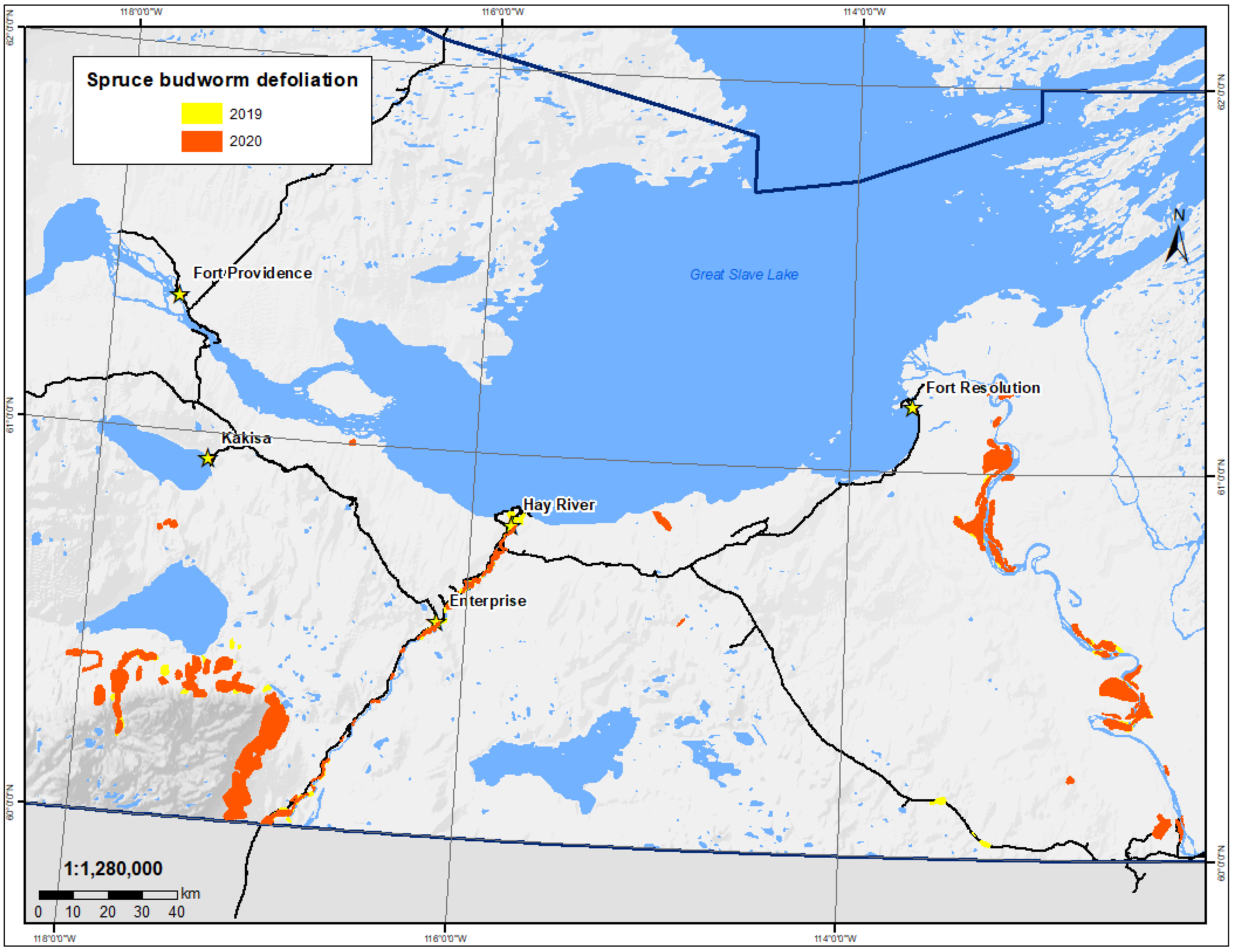


Figure 10: Spruce budworm defoliation extent and severity in the South Slave Region in 2019-2020.

Aspen defoliators

Aspen serpentine leafminer (*Phyllocnistis populiella*) – ASL

Aspen serpentine leafminer (ASL) continues to be one of the most prevalent insect pests in the NWT. The extent of ASL generally matches the current aspen range in the NWT, making it one of the most “successful” pests in the North. However, in 2020, the area affected by ASL defoliation declined throughout the survey area. In the Dehcho, approximately 270,000 ha were affected which is a 55% decrease compared to 2019. In the South Slave, the defoliated area was 22,587 ha which is a 63% decrease compared to 2019.

Overall, the south west of NWT (Dehcho) was significantly more affected by ASL than the south east (South Slave, Fig. 11). This difference could be a result of more favorable spring weather conditions in the Dehcho which is usually the warmest region in the territory. Late spring and a cool wet summer in the South Slave may have contributed to a delayed development of ASL larvae and thus lower activity in this region.

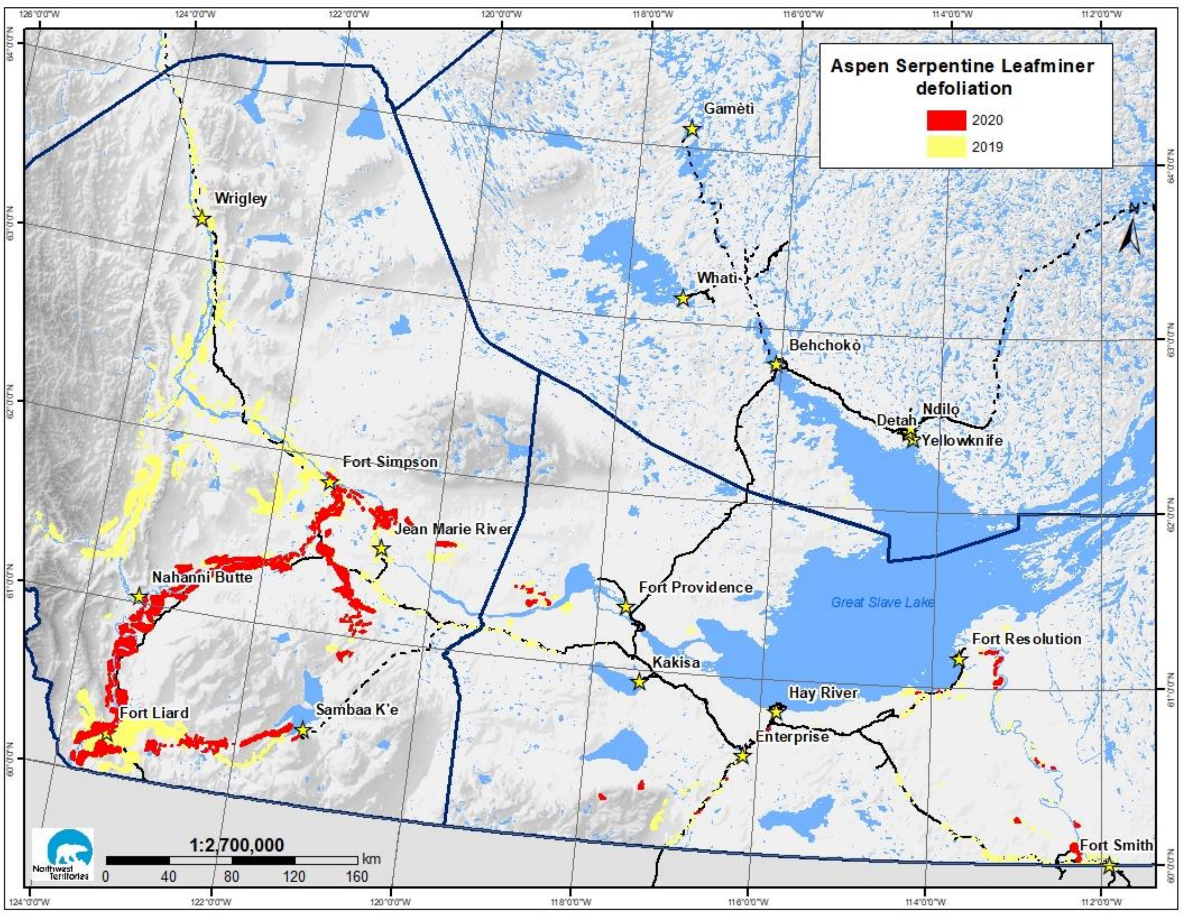


Figure 11. Aspen serpentine leafminer defoliation observed in 2019-2020. Southwestern NWT was more affected by ASL than the southeastern parts.

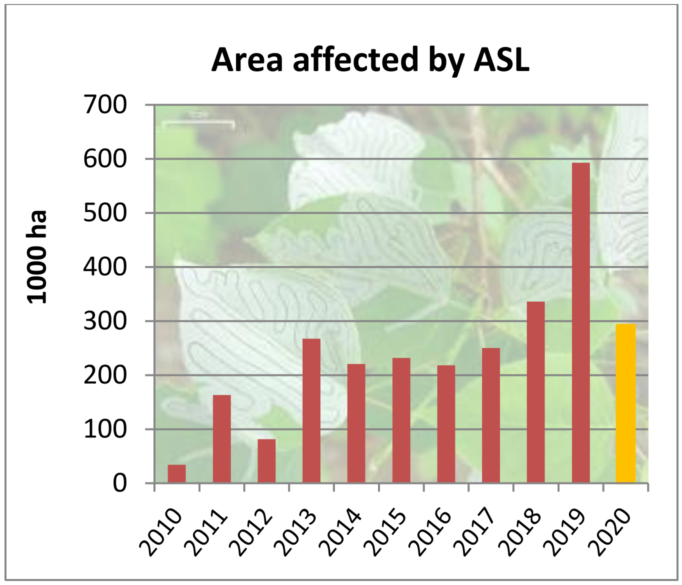


Figure 12. Area defoliated by aspen serpentine leafminer in the NWT in 2010-2020. The 2020 data reflect limited survey area which included only the South Slave and the southern Dehcho regions.

Willow defoliators

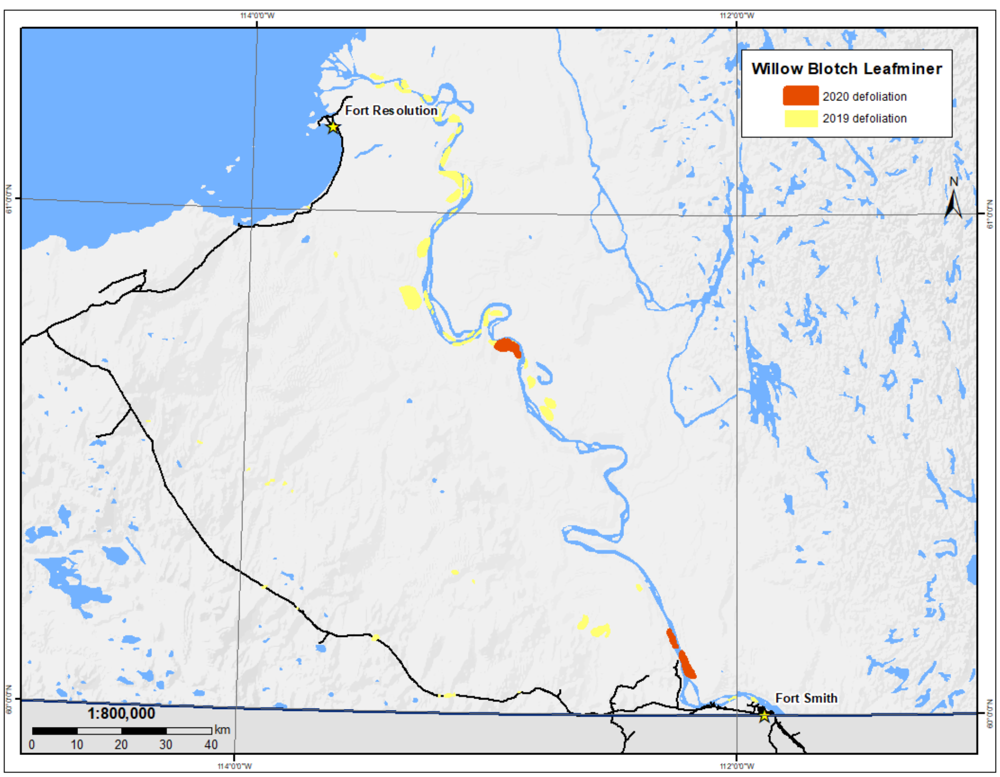


Figure 13: Willow blotch leafminer damage observed in 2019-2020.

Similarly to 2019, willow defoliator development was significantly delayed in 2020. Therefore, defoliation extent was likely underestimated during the time of the survey. Willow blotch leafminer (WBL) defoliation was only significantly detected along the Slave River while there was some negligible disturbance seen in the Dehcho. These observations are likely not fully indicative of actual impacts due to a delayed development and the lack of the ground survey along the Liard highway. No other willow defoliator activity was observed in 2020.

Secondary pests of notable occurrence

- **White-spotted sawyer beetle (*Monochamus scutellatus*) (WSSB) complex** – This was first described in the 2015 Forest Health Report. Drought-stressed mature pine stands near Checkpoint (Dehcho) were attacked by a complex of insects with WSSB being the main pest. Although it is very rare for sawyer beetle to kill healthy green trees, it is believed the weakening caused by drought stress and other secondary damaging agents is sufficient enough to cause trees to succumb. Another spruce leading stand near Jean Marie River was thought to be affected by the WSSB complex as well. The affected area expanded from 767 ha in 2015 to over 2,000 ha in 2016. In 2017, the affected area expanded by 695 ha in the Dehcho. In 2018, WSSB activity was more prevalent in several areas along the highway to Fort Simpson, especially in the Kakisa area. Other new pockets were observed north of Fort Providence. The total affected area mapped in 2018 was 5,047 ha. Tree mortality caused by WSSB is becoming increasingly prominent, regardless of whether the host species is pine or spruce. In 2019-20, over 5100 ha of related disturbance were mapped mostly in the Dehcho (Fig. 14). It is possible that an increase of WSSB may be noticeable along the AB / BC border due to the 2019 Paddle Prairie and Steen River fires in northern Alberta. WSSB populations would be quite certain to increase in these areas and may venture north.

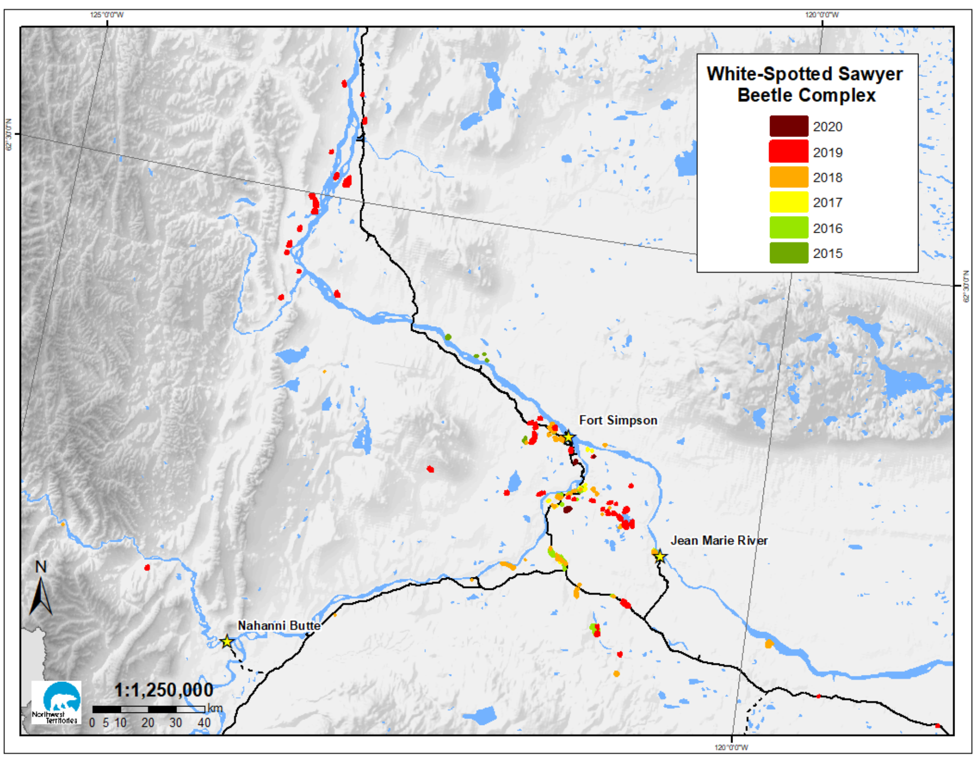


Figure 14. Tree mortality caused by the White-Spotted Sawyer Beetle complex in 2015-2020

Mountain pine beetle (*Dendroctonus ponderosae*)

Mountain pine beetle (MPB), the most damaging insect pest of pine trees in North America, has been monitored in the NWT since 2009. In 2012, the beetle was found in one pine stand just north of the NWT-Alberta border. The affected trees were cut and burned the following spring, and wildfire occurred in this area later in the season, destroying the stand completely. Since then, there has been no recorded presence of MPB in the NWT.

The MPB pheromone baiting program was continued in the southern NWT in 2020. Three baiting locations were established along Highway 1 between the NT-AB border and Enterprise, and two between Kakisa and Jean Marie River. Dispersal baiting procedures were used as described in the MPB Monitoring Plan for NWT Pine Forests (2015-2020). No evidence of MPB was recorded in any baiting location in 2020. The pheromone program will continue in 2021.

5. Abiotic disturbances

Abiotic disturbances are damages to trees and/or forest stands caused by physical or environmental factors such as wind, snow, permafrost thaw, moisture stress, etc. As part of our overall forest management response to a changing climate, monitoring for climate-related disturbances has become equally important to monitoring for pests and disease. Direct impacts of climate on forest condition may be subtle and require long-term consistent monitoring over large areas. There is currently little baseline information on abiotic disturbances in the NWT, yet understanding the natural range of variation in the northern boreal forest is essential for inferring climate change impacts. To address this issue, ENR has been recording abiotic disturbances to forests annually since 2015. Information gathered each year is evaluated for any changes in the extent, frequency or patterns and to distinguish new trends.

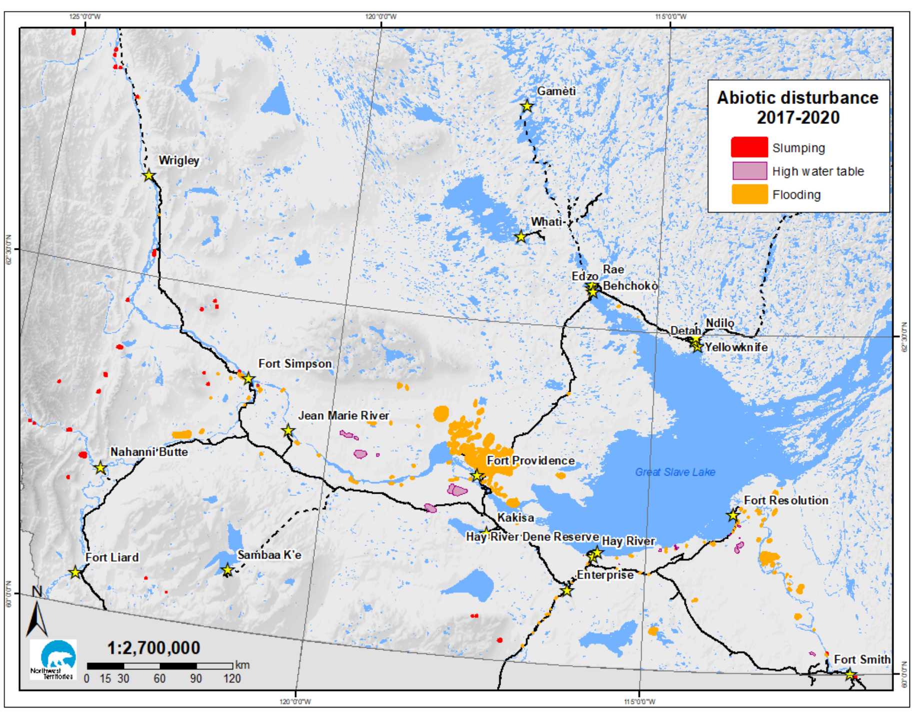


Figure 15. Major abiotic disturbances in 2017-2020 were associated with flooding, high water tables and slumping. The large flooded area north of Fort Providence was mapped in 2017.

Flooding and high water table

Flooding and high water table are examples of water stress which can result in stand mortality. Both share the same symptoms such as yellowing of foliage, and die-off, but the origins are different. Flooding is typically a visual observation of water overflowing from a source (river, pond, swamp), while high water tables are usually associated with groundwater rising from no obvious source. High water table can occur from events such as fires, permafrost thaw, and excessive precipitation. Under this type of stress, tree roots are unable to access oxygen to respire which can cause damage or mortality.

Many areas of flooding were observed in 2020 due to heavy rains. They were especially obvious in the South Slave along the Slave River where over 1500 ha were recorded (Fig.15). Areas with trees stressed by high water table (yellowing needles, mortality) were observed in the corridor between Fort Providence and Jean Marie River (approximately 4100 ha) and between Fort Resolution and Hay River (approximately 4200 ha).

Appendix 1. Photo gallery of insect pests commonly observed in the NWT.

1. Eastern spruce budworm (*Choristoneura fumiferana*)

The damage observed on trees is caused by feeding larvae (bottom). Population monitoring is done by trapping male moths (top) using pheromones. *Photo: nrcan.gc.ca*

Severe defoliation caused by spruce budworm, observed in the Martin Hills, Dehcho. *Photo: GNWT ENR*

2. Aspen serpentine leafminer (*Phyllocnistis populiella*)

Damage observed on trees is caused by larvae mining the internal leaf tissues and leaving whitish snake-like trails on the leaf surface. *Photo: iNaturalist.org, k8thegr8*

Silver-hued leafminer defoliation on aspen contrasts with rich green birch stands in the northern Dehcho.
Photo: GNWT ENR

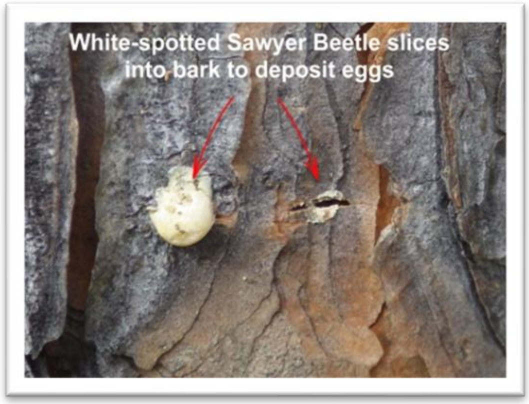
3. Willow Blotch leafminer (*Micrurapteryx salicifoliella*)

Larva is the damaging agent. *Photo: bugguide.net, G. Smiley*

Willow defoliation caused by willow blotch leafminer observed near Mills Lake, western South Slave. *Photo: GNWT ENR*

4. White-spotted Sawyer Beetle (*Monochamus scutellatus)*

Infests mostly dead, fire killed mature pine and spruce. However, when trees are weakened by drought or other environmental stress, it can attack green trees together with other secondary pests such as Pine Engraver (*Ips pini*) and Lodgepole Pine beetle (*Dendroctonus murrayanae*), and even pathogens such as Western Gall Rust (*Endocronartium harknessii*). Photo: Wikipedia.org



White-spotted sawyer beetle and pine engraver larvae found in green-attacked trees weakened by drought.
Photos: NR Can, R.Brett