2024 NORTHWEST TERRITORIES FOREST HEALTH REPORT

Mandate commitment of the 20th Legislative Assembly

RAPPORT de 2024 SUR LA SANTÉ DES FORÊTS AUX TERRITOIRES DU NORD-OUEST

Engagement du mandat de la 20e Assemblée législative

Government of Northwest Territories
Gouvernement des Territoires du Nord-Ouest

K'áhshó got'ı̨ne xədə k'é hederı ɂedı̨htl'é yerınıwę nı dé dúle.
Dene Kədə́

ʔerıhtł'ís Dëne Sų̈łıné yatı t'a huts'elkër xa beyáyatı theɂą ɂat'e, nuwe ts'ën yółtı.
Dëne Sų̈łıné

Edı gondı dehgáh got'ı̨e zhatıé k'ę́ę́ edatł'éh enahddhę nıde naxets'é edahłí.
Dene Zhatıé

Jii gwandak izhii ginjìk vat'atr'ijąhch'uu zhit yinohthan jì', diits'àt ginohkhìi.
Dinjii Zhu' Ginjik

Uvanittuaq ilitchurisukupku Inuvialuktun, ququaqluta.
Inuvialuktun

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Inuktitut

Hapkua titiqqat pijumagupkit Inuinnaqtun, uvaptinnut hivajarlutit.
Inuinnaqtun

kīspin ki nitawihtīn ē nīhīyawihk ōma ācimōwin, tipwāsinān.
nēhiyawēwin

Tłı̨chǫ yatı k'ę̀ę̀. Dı wegodı newǫ dè, gots'o gonede.
Tłı̨chǫ

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Contents

Background – forest health monitoring program in the Northwest Territories

The forest health monitoring program in the Northwest Territories is carried out by the Government of the Northwest Territories' (GNWT) Department of Environment and Climate Change (ECC). Historically, the program has focused on insect and disease damage. Since 2015, it has expanded to address the uncertainty of forest ecosystem response to a changing climate, including abiotic and biotic disturbances. These are animal damage and environmental effects such as drought, flooding, wind and snow damage, and permafrost-related issues such as slumping, multi-directional tree falling ("drunken forest"). Initially, forest health surveys were conducted by the Canadian Forest Service (CFS) from the 1950s until 1998 when, with continuous assistance from the CFS, the territorial government took over this function. Beginning in 2022, GNWT hired SKOG Forest Health to assist with annual surveys. The program's ongoing adaptation and collaboration ensures the continued monitoring and management of forest health in the face of evolving environmental challenges.

Contexte – Programme de surveillance de la santé des forêts aux Territoires du Nord-Ouest

Le Programme de surveillance de la santé des forêts aux Territoires du Nord-Ouest est dirigé par le ministère de l'Environnement et du Changement climatique (MECC) du gouvernement des Territoires du Nord-Ouest (GTNO). Si le but du programme était principalement d'étudier les dommages causés par les insectes et les maladies, sa portée a toutefois été élargie en 2015 pour tenir compte de l'incertitude liée à la réaction des écosystèmes forestiers au changement climatique, notamment aux perturbations abiotiques et biotiques. Ces effets environnementaux comprennent entre autres les sécheresses, les inondations, les dégâts causés par le vent et la neige, ainsi que les problèmes liés au pergélisol, tels que les affaissements et les chutes d'arbres multidirectionnelles (« forêts ivres »). Les relevés sur la santé des forêts ont été menés par le Service canadien des forêts (SCF) des années 1950 jusqu'en 1998, date à laquelle le GTNO a repris cette tâche, bien que le SCF ait continué d'y participer. Depuis 2022, le GTNO fait appel à SKOG Forest Health pour contribuer aux relevés annuels. Les efforts d'adaptation et de collaboration dans le cadre de ce programme permettent de continuer à surveiller et à gérer la santé de nos forêts, dans un contexte où les défis environnementaux évoluent constamment.

Scope of monitoring

Forest health surveys include an aspen defoliation ground survey in the South Slave and Dehcho Regions and a general ground survey in the South Slave, North Slave, and Dehcho regions in proximity to primary highways as well as an aerial overview survey throughout priority forested areas of the South Slave, North Slave, Dehcho, Sahtu, and Beaufort Delta Regions. Additionally, surveys are conducted for the Parks Canada Agency's (PCA) Wood Buffalo National Park, and Nahanni and Nááts'įhch'oh National Park Reserves under a new joint forest health agreement established between the GNWT Environment and Climate Change (ECC) and Parks Canada. Due to the immense size of the forested land in the NWT, nearly 800,000 km2 (80 million (M) hectares (ha), it is necessary to prioritize areas surveyed annually, which, under optimum flying/visibility conditions, is approx. 12-14 M ha, only 15% of the total forest land area in the NWT. Traditionally, areas occupied by mature spruce forests have been considered a priority because of their significance as the preferred host for the most damaging insect pest in the NWT – spruce budworm (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, Martin Hills and Ebbutt Hills.

Forest disturbance agents and damage

Forest health issues in the NWT are caused by biotic factors, such as insect pests, diseases, animal damage, and abiotic factors such as wind events, snow, hail, flooding, and drought leading to partial and complete tree defoliation and eventually mortality. Insect pests which feed on leaves and needles of trees on an annual basis are called defoliators. These infestations normally do not kill trees immediately. A significant loss of leaves or needles results in decreased growth, increased susceptibility to attack by other insects and pathogens, and eventually, mortality. In the case of spruce budworm, it takes as long as 5-7 years of consecutive severe defoliation to kill a tree. Yet other defoliators, such as aspen serpentine leafminer, usually inhibit tree growth and weaken a tree without killing it. Because defoliation can occur over several years in the same areas, the reported area for defoliators is unique for each year. Some diseases/pathogens can also cause defoliation (e.g. spruce needle rust); therefore, areas affected by these agents are also unique for each year. Common defoliators in the NWT are spruce budworm, aspen serpentine leafminer, forest tent caterpillar, large aspen tortrix, aspen two leaf tier, leaf rollers, willow blotch leaf miner, and birch leafminers.

Damage caused by bark beetles typically results in tree mortality. Numbers reported for these agents represent the status of areas (tree stands) and the percentage (%) of tree mortality. Often, pests in a larger group or concentration, rather than a singular attack is responsible for tree mortality. The most common insect pests causing tree mortality in NWT are western balsam bark beetle, spruce beetle, eastern larch beetle, and white spotted sawyer beetle (pest complex). Abiotic disturbances such as flooding, wind damage, or drought are also commonly associated with tree mortality in the NWT.

Methods

The forest health monitoring program is comprised of an aspen defoliation ground survey, general ground surveys, aerial overview surveys, western spruce budworm and mountain pine beetle pheromone trapping, and public reporting. Aspen defoliation surveys are targeted ground surveys that focus on detecting and assessing damage caused by defoliators in roadside aspen and poplar forests. Defoliators often include various leaf beetles, leaf miners, leaf-tiers, leaf-rollers, and free-feeding caterpillars. The aspen defoliation survey is usually conducted in early- to mid-June, aiming to catch late instar larvae and pupae, pupae, or even adults for easier identification of primary defoliators and determining their population status and severity. This timing is highly variable from year to year depending on weather conditions.

General ground surveys are non-systematic reconnaissance surveys but are much broader than the aspen defoliation survey, investigating observed issues and conducting random spot-checks on all trees and shrubs. General ground surveys are usually conducted in early-to mid-July and include ground investigations of observed issues and random spot-checks of trees and shrubs. In normal visibility conditions during regular years, survey coverage is performed within 1000 m each side of the roads, and 10 km each side of the aerial survey routes. Both the general ground survey and aspen defoliation surveys use a variety of methods and techniques to detect and diagnose forest health issues, including “tree-beating” for defoliators, netting, pole-pruners, bark beetle sampling, and collections. Most damaging agents are identified in the field and later in the office, except when exceedingly difficult, they are sent to a taxonomic specialist at the NRCan-CFS Northern Forestry Centre in Edmonton for identification support.

An aerial overview survey is the primary survey conducted when monitoring forest health annually. Not only does it provide a solid understanding of current conditions across the landscape, but also provides valuable information on population dynamics, impacts, and changes occurring over time. Aerial overview surveys are usually conducted in mid- to late-July in a small fixed-wing aircraft such as a Cessna 206 (Figure 1). A helicopter is used occasionally when ground verification is required in areas with limited road or water access.

All forest health issues observed during ground and aerial surveys are mapped digitally as polygons using a tablet with ESRI Arc Pad 10 software as an ESRI shape file, adhering to GNWT forest health data standards. Observations recorded capture the year the survey was conducted, causal agent (the biotic or abiotic issue observed), severity as the class rating for the percent damage observed, the forest plant species affected, the area of the observation in hectares, and the NWT region or National Park where the damage was observed. When necessary, comments are also recorded in the spatial data to add context to specific observations. The damage severity rating (Table 1) is either based on the percent of affected foliage in the initial stages of forest damage or the stand's tree mortality percentage in the final stages of the damage. Smaller areas consisting of a few trees are recorded as points. Data recorded in the shapefile are classed as Nil, Light, Moderate, or Severe with different numerical thresholds depending on the type of forest health issue recorded, mortality or defoliation. Georeferenced photos are presented as a catalogue of folders with each containing a KML file of the georeferenced photos. Aerial observations are calibrated and, in the areas with limited visibility or hazardous conditions, supported by observations from ground surveys.

Figure 1. Refuelling the survey plane, Simpson Air GGHU Cessna 206, in Inuvik 2024.

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

Severity class	Mortality (% of trees killed)	Defoliation (% of current-year foliage affected)
Nil	0	0
Light (L)	<10	<30
Moderate (M)	10-30	30-70
Severe (S)	>30	>70

Pheromone traps are used to detect both pruce budworm. Each trap contains a pheromone lure to attract male moths, and an insecticide strip to kill trapped insects. Five mountain pine beetle pheromone trapping locations were established in the southern NWT along Highway 1, from the Alberta border to Enterprise and two locations between Enterprise and Jean Marie River (Fig. 2). Most mountain pine beetle trapping sites were damaged during the 2023-2024 wildfire seasons and will be re-established if any substantial growth in presence of this insect is reported for Alberta or British Columbia. Mountain pine beetle has not been detected in the NWT for several years. 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. Four pheromone trap locations were established and are active along the Arctic Red River, Peel River, and the upper Delta: the Peel River, Peel Channel, Arctic Red River, and Husky Channel locations. Each site contains three traps established roughly 50m apart. The container-type traps are deployed from mid-June to mid-August (Fig. 2) using rotary wing. When traps are collected in August, the SBW moths are separated from other insects that may have been caught, and then counted, enabling ECC to track whether populations are stable, increasing or decreasing.

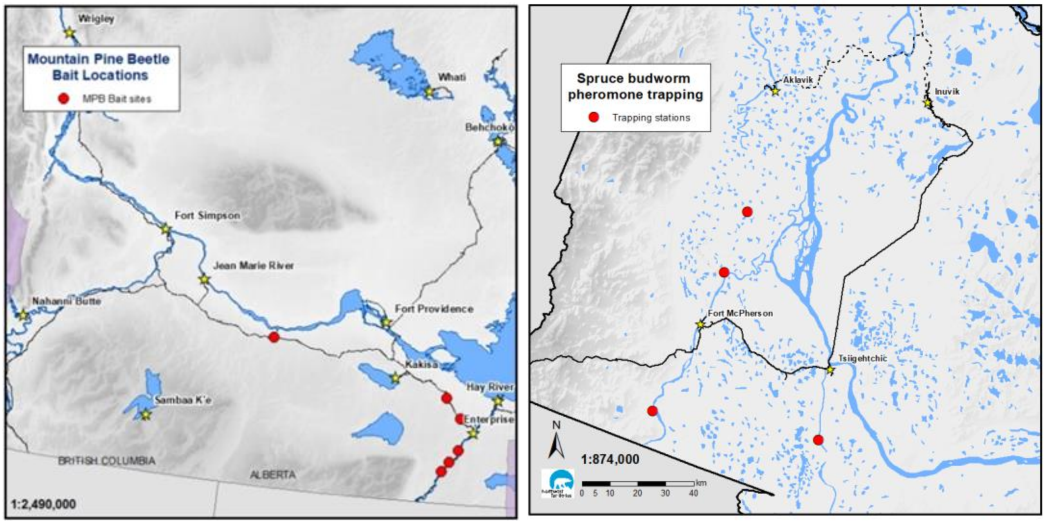

Figure 2. Pheromone trapping locations for mountain pine beetle in the South Slave and Dehcho Regions (left) and spruce budworm in the Inuvik Region (right)

Public sightings, inquiries with photos of various insect and disease disturbances from communities across the NWT, and regional reports are important because they not only help corroborate aerial survey observations, but often help direct ground surveys. All GNWT workers, Renewable Resource Officers, Forest Officers, and the general public are encouraged to report any forest health issues that draw their attention. Information, photos and reporting can be submitted to an ECC Regional Wildlife and Forestry Office. Visit ECC's website (https://www.gov.nt.ca/ecc/en/regional-offices) for more information.

2024 Survey Conditions and Coverage

The 2024 NWT forest health surveys included an aspen defoliation survey in the Dehcho and South Slave regions during June 3-10 and aerial and general ground surveys between July 3 and 30. Aerial and ground surveys were also completed for Wood Buffalo National Park, and an aerial survey for Nahanni and Náátsʼįhchʼoh National Park Reserves. The aspen defoliation survey included 44 aspen and poplar sites, the general ground survey covered 150 sites, and aerial overview survey covered 0.1 M ha, 0.1 M ha, and 4.1 M ha in the NWT respectively, totaling 4.3 M ha. The area surveyed also included 0.6 M ha in the Alberta portion of WBNP and Alberta, Yukon, and British Columbia cross-border areas. Although visibility conditions were generally better compared with those in 2023 and survey routes remained the same as in previous years (Figure 3), several areas were missed during aerial surveys including Camsell Bend and the North Nahanni area of the Mackenzie, the Moose Ponds area of Náátsʼįhchʼoh National Park Reserve, the Cameron Hills, Tathlina and Kakisa Lakes, the lower half of the Hay River to the Alberta border, and the Fort Resolution area (Fig 4). The Trout Lake portion of the Dehcho route was not cancelled but was removed from the surveys due to much of that route being burned. Also, due to visibility issues, survey coverage was calculated by buffering each side of the roads by 0.3 km instead of 1 km as was done in regular years, and each side of the aerial survey routes by 3 km instead of 10 km. As a result, only 4.3 M ha were surveyed in NWT in total—one third of that in the regular year—representing five percent of the NWT forested area.

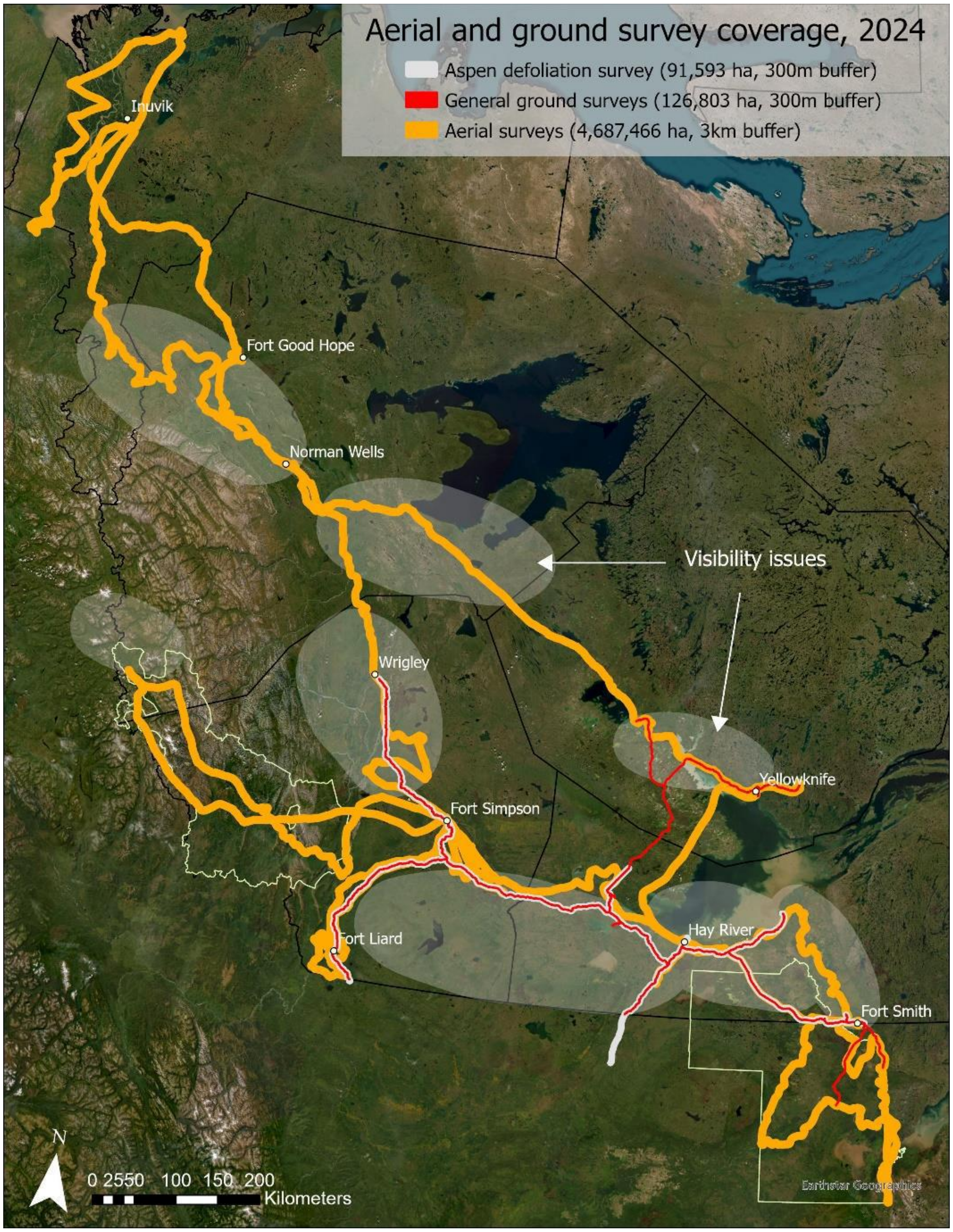

Figure 3. 2024 NWT Aerial and Ground Survey routes and estimated coverage (4.3 M ha), including the Alberta portion of WBNP and Alberta, Yukon, and British Columbia cross-border areas (0.6 M ha)

Figure 4. Survey to Cameron Hills cancelled due to low clouds and heavy smoke, 2024

2024 NWT forest health survey results

Summary

The 2024 NWT Forest Health Survey was, like the previous year, heavily affected by wildfire smoke, primarily through reduced visibility. This led to a decrease in the observation zone on each side of the survey route from 1 km to 0.3 km for ground surveys, and from 10 km to 3 km for aerial surveys. As a result, 4.29 M ha—one-third of the regular survey area—was effectively assessed in 2024. Due to this, as well as a general reduction in forest pests, including aspen and spruce budworm defoliation, only 0.65 M ha were observed to be impacted by 41 forest health issues, which is substantially less compared with 1.12 M ha in 2023 and 3.10 M ha in 2022.

Damage from aspen serpentine leafminer *(Phyllocnistis populiella)* decreased from 1.04 M ha in 2022 to 0.30 M ha in 2024 and combined damage from eastern spruce budworm

(Choristoneura fumiferana) and spruce coneworm *(Dioryctria reniculelloides)* decreased from 1.38 M ha in 2022 to only 0.08 M ha in 2024. At the same time, a new outbreak of the large aspen tortrix *(Choristoneura conflictana)* infestation (0.01 M ha) and an increase in spruce coneworm damage (0.004 M ha) were observed. Damage from willow blotch leafminer *(Micruapteryx salcifoliella)* declined from 0.10 M ha in 2018 to 0.03 M ha in 2023 and 0.01 M ha in 2024. Several other minor or unsubstantiated damage agents, each with an area of damage of < 1,000 ha, were also mapped. These included unknown bark beetles and wood borers, jack pine resin midge *(Cecidomyia resinicola)*, western balsam bark beetle *(Dryocoetes confusus)*, yellow-headed spruce sawfly *(Pikonema alaskensis)*, western gall rust *(Endocronartium harknessii)*, and Diplodia canker *(Diplodia tumefaciens)*. Wind, bison, porcupine, squirrel, and beaver damage were also noted to have minimal impacts this year compared with other disturbances. Aspen running canker *(Neodothiora populina)* is a newly confirmed aggressive disease in the NWT which may become more prevalent in the future; close monitoring of this disease is warranted during future surveys.

While the 2024 survey revealed a general decrease in forest insect and disease damage, drought is a major issue in all five regions, especially in the Dehcho, South Slave, and North Slave. Drought creates water stress in plants which reduces the forest's resistance to insects and diseases, and substantially elevates the probability, danger, and behaviour of wildland fire. Several droughts have occurred in the NWT in the past 30 years; however, the current drought is an exceptional event that will have substantial impacts on forest health and will become more apparent in the coming years. Moderate drought conditions started in June 2022 and persisted in 2023 and 2024, and continue in 2025. In total, approximately 0.02 M ha of drought and drought-related stress and damage were observed in 2024, but the real extent of drought damage may be much more substantial.

According to the Canadian Drought Monitor as of December 31, 2024, approximately 40% of the NWT is still affected by abnormally dry to severe and even extreme drought conditions. The extent and magnitude of the current drought in the NWT and its long-term effects on the northern forest ecosystem require the development of more effective and accurate satellite-based remote sensing drought and forest health monitoring tools. These tools would better inform operational and strategic decisions in forest and wildfire management across the territory.

Summary table

In total, approximately 0.62 M ha of damage from 41 forest health issues in the NWT were recorded during the 2024 aerial and ground surveys (Table 2). This represents roughly half of the 1.2 million hectares mapped in 2023. The decrease is mainly due to a general decline in forest pests, including a substantial decline in eastern spruce budworm and aspen serpentine leafminer. An additional 10,000 hectares of issues were recorded in cross-border areas within Alberta, British Columbia, and the Yukon territory, which are not shown in the table below.

Table 2. 2024 Forest health conditions summary (thousands ha)

Damaging Agent	Per NWT Region, Detected Area of Damage (thousands Ha)								
	Dehcho	South Slave	North Slave	Sahtu	Beaufort-Delta	NNP	WBNP-AB	WBNP-NT	Grand Total
Aspen serpentine leafminer	224.1	38.7	0.1	3.3		3.9	22.2	5.2	297.5
Eastern spruce budworm	71.9	2.7	0.01	0.8	4.3		5.5	0.2	85.4
Unknown stress - drought-related	29.9	9.3	0.1	13.7	6.1	0.6	0.01	0.1	59.7
Unknown drought-related stress and mortality -	5.6	2.9	9.7	38.4	1.0			0.1	57.7
High water table stress	12.6	0.7	0.2	6.2	8.9		0.4		28.9
Drought stress	7.7	5.5	0.9	2.8	0.08	3.8	0.3	2.6	23.8
Aspen decline	17.7	0.8	0.1	0.5		0.5	3.9		23.4
Flooding mortality	3.9	17.5	0.5	0.4	0.6	0.03	0.4	0.01	23.4
Drought stress and mortality	9.3	3.7	5.5		0.03	0.2		3.8	22.5
Large aspen tortrix	11.6								11.6
Willow blotch leafminer	4.7	1.2	0.1	1.1	0.01	0.06	0.2	0.03	7.3
Spruce coneworm		4.0	0.3				0.8	0.3	5.3
SBW-caused mortality with drought				1.9	0.5	0.3			2.7
Wind damage, bent and broken tops				1.1					1.1
Hail damage	1.0								1.0
Permafrost slumping	0.3			0.2	0.2	0.06			0.7
Lodgepole pine dwarf mistletoe							0.4		0.4
Western balsam bark beetle	0.3								0.3
Western gall rust	0.1	0.01					0.03	0.1	0.3
Blowdown						0.06	0.2		0.2
Poplar decline						0.2			0.2
Venturia leaf blight		0.1					0.1		0.2

Unknown, suspected spruce bark beetle					0.2				0.2
Porcupine/bear	0.01					0.06			0.1
White-spotted sawyer beetle	0.1								0.1
Jack pine resin midge		0.01	0.004					0.04	0.1
Bison damage			0.04					0.02	0.1
Squirrel damage	0.002		0.06						0.1
Slide						0.04			0.04
Beaver damage		0.03							0.03
Aspen two-leaf tier, (Enargia sp.)							0.03		0.03
Comandra blister rust			0.02						0.02
Poplar twig gall fly			0.02						0.02
Potato gall midge, (Rabdophaga salicisbatatus)		0.01							0.01
Snow / ice damage						0.01			0.01
Yellow-headed spruce sawfly		0.0001	0.004						0.004
Aster yellows phytoplasma brooms on willow		0.003							0.003
Diplodia cankers, (Diplodia tumefaciens)		0.001						0.001	0.002
Folded-leaf aspen sawfly, (Euura sp.)			0.002						0.002
Hare damage		0.001							0.001
Roadsalt damage, calcium chloride			0.0005						0.0005
Grand Total	400.6	87.1	17.6	70.3	21.9	9.9	34.4	12.4	654.2

1. Insects

Aspen serpentine leafminer

Aspen defoliation ground surveys conducted in 2024 assessed trembling aspen and balsam poplar stands where accessible. The most spatially substantial aspen or poplar damage recorded throughout the NWT was the aspen serpentine leafminer *(Phyllocnistis populiella)* (Figure 5 and 6), which was reported to decrease to just 0.28 M ha across the NWT (excluding the Alberta portion of WBNP) in 2024 (see Table 2) from 0.45 M ha in 2023 and 1.04 M ha in 2022 (Figure 7). This decrease is caused by the general decline in forest pests in 2024, but to some degree, is the result of poor visibility caused by wildfire smoke which limited detection and forced route changes. Most of the reported area was affected by moderate leaf mining damage, of which 75% was mapped in the Dehcho. Other hotspots where substantial light to severe damage occurred were the Fort Providence, Fort Smith, and WBNP areas. Overall, populations decreased by 74% by area from 2022 levels. Ground surveys revealed that some larval mortality (Figure 6) occurred in the early summer, possibly due to a late spring frost, parasites, or disease. Since the aspen serpentine leafminer has two generations a summer, the amount of mortality observed did not affect populations.

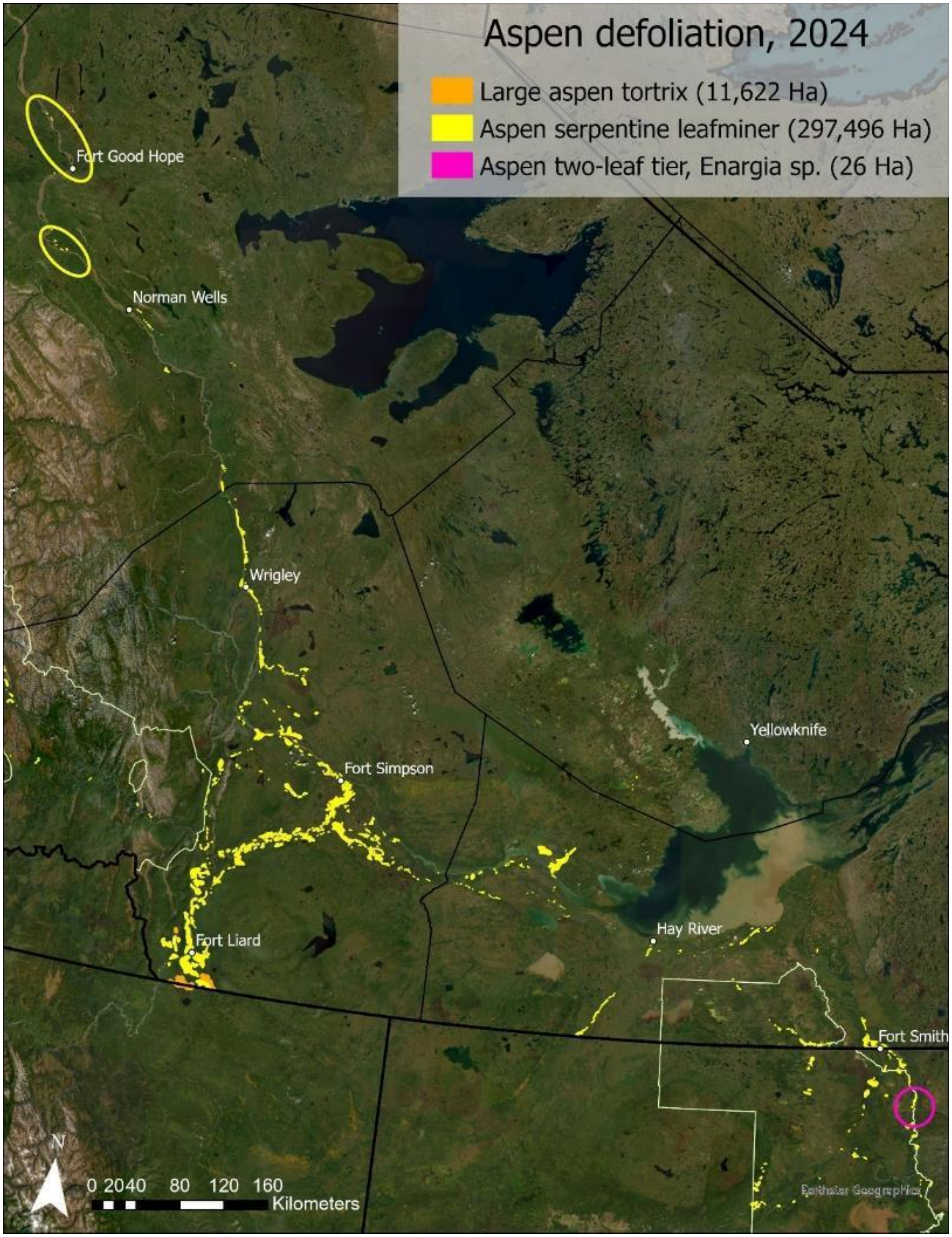

Figure 5. 2024 NWT Aspen defoliation survey spot check locations and damage, including the Alberta portion of WBNP and Alberta, Yukon, and British Columbia cross-border areas

Figure 6. Aspen serpentine leafminer larvae mortality in the South Slave, Hwy 5 near Klewi river, 2024

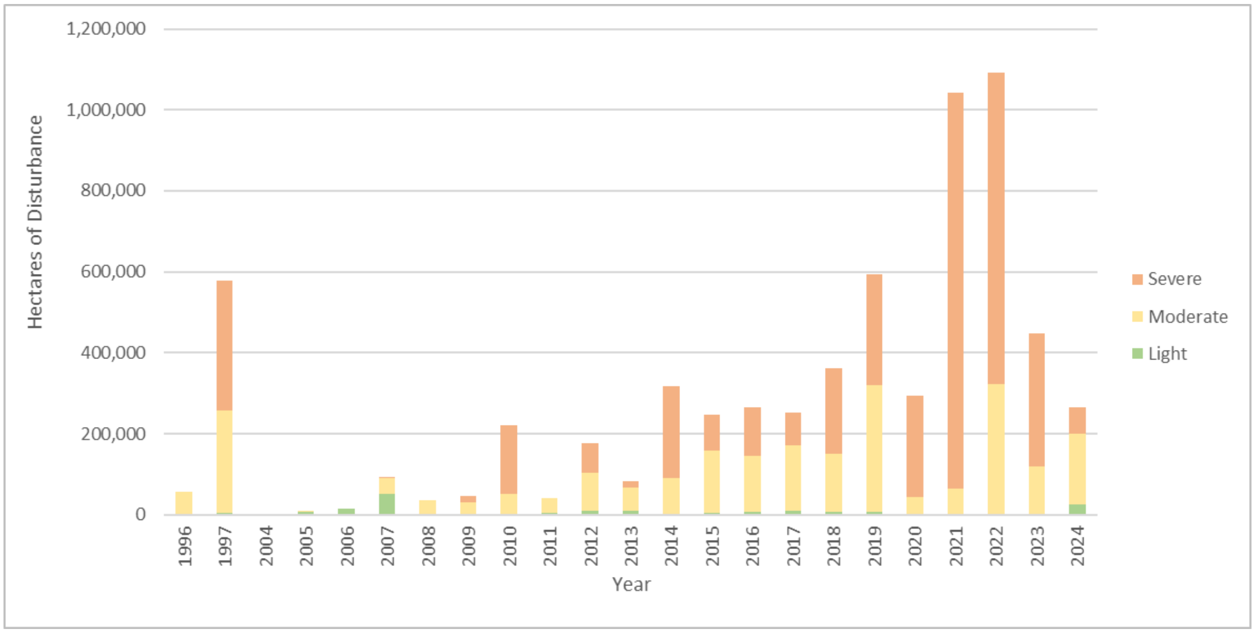

Figure 7. Temporal dynamics of Aspen Serpentine Leafminer defoliation; 0.28 M ha in the NWT (excluding the Alberta portion of WBNP) in 2024

Large aspen tortrix and forest tent caterpillar

A new event, which is also responsible for aspen and poplar defoliation, is a small outbreak of large aspen tortrix (*Choristoneura conflictana*) occurring along the BC border south of Fort Liard, affecting young and mature aspen stands in the area (Fig. 8-10). Approximately 11.6 thousand ha of moderate to severe defoliation was recorded on the NWT side of the border, but it extended much further south into BC. In the Fort Liard area, large aspen tortrix and, another aspen defoliator, forest tent caterpillar (*Malacosoma disttria*) (Figure 11), were found only at trace levels. Both pests have a significant impact on aspen vigour and overall health, especially over the length of an outbreak which can last 2-4 years for large aspen tortrix and 4-6 years for forest tent caterpillar. Moderate to severe annual defoliation during an outbreak, accumulated with drought, has an extreme impact on tree health, often causing significant annual decline until the trees eventually die.

In the NWT, the large aspen tortrix and forest tent caterpillar especially, usually follow drought events. During the 1995 drought, a forest tent caterpillar outbreak came up through northern BC into the Liard River valley and ran from 1995-1998. Again, during the 2014 drought, a forest tent caterpillar outbreak expanded up through Alberta affecting the South Slave during 2014-2018. The relationship seems cyclical, as primary defoliators are attracted to weakened trees and favourable weather conditions during droughts. Therefore, under the conditions of the third year of the 2022-2024 drought, these two pests should be closely monitored. The concern for the Dehcho and parts of the South Slave region is that the combined stress from defoliation and drought will result in increased in aspen decline and mortality for several years following the drought.

Figure 8. Large aspen tortrix by Fort Liard, 2024

Figure 9. Large aspen tortrix severe defoliation, Fort Liard, 2024

Figure 10. Large aspen tortrix pupa and defoliation south of Fort Liard, 2024

Figure 11. Trace amounts of forest tent caterpillar larvae found by Fort Liard, 2024

Miscellaneous Aspen- and Poplar-hosted Insects

Aside from the primary aspen and poplar defoliators such as aspen serpentine leafminer, large aspen tortrix, and forest tent caterpillar, only trace amounts of other miscellaneous aspen and poplar-hosted species were found in the Dehcho and South Slave regions. These included the pale-headed aspen leafroller *(Anacampsis niveopulvella)*, the spotted aspen leaf roller, *(Pseudosciaphila duplex)*, and leaf beetles such as the cottonwood leaf beetle *(Chryosmela scripta)* and the aspen leaf beetle *(C. crotchi)*. Other symptoms of aspen defoliators found that are noteworthy included many various leaf gall midges and aphids which all contributed to attacking drought-weakened trees. A small pocket (26 ha) of an aspen two-leaf tier species was recorded within WBNP in the Hay Camp area.

Eastern spruce budworm

South Slave Region

Eastern spruce budworm *(Choristoneura fumiferana)* defoliation in white spruce (Figure 12) substantially declined in all regions of the NWT from 1.38 M ha in 2022 and 0.54 M ha in 2023 to only 0.08 M ha in 2024, all but collapsing in some areas (Figure 13). In the South Slave region, approximately 2.7 thousand ha of mostly light defoliation with some moderate patches were recorded along Hwy 5 and the Slave River north of Fort Smith. This is a substantial decline from 225.1 thousand ha in 2023 and 350.6 thousand ha in 2022. Many stands of white spruce showed a decent recovery from the previous years damage (Figure 14). The larger areas recorded were observed by McConnell Island at the north end of the river, closer to Fort Resolution. Areas mapped in 2022 and 2023 in the Jean River area east of the Resdelta Channel in Slave River Delta, were not surveyed due to heavy smoke and an active fire.

Figure 12. Eastern spruce budworm and spruce coneworm defoliation, 2024

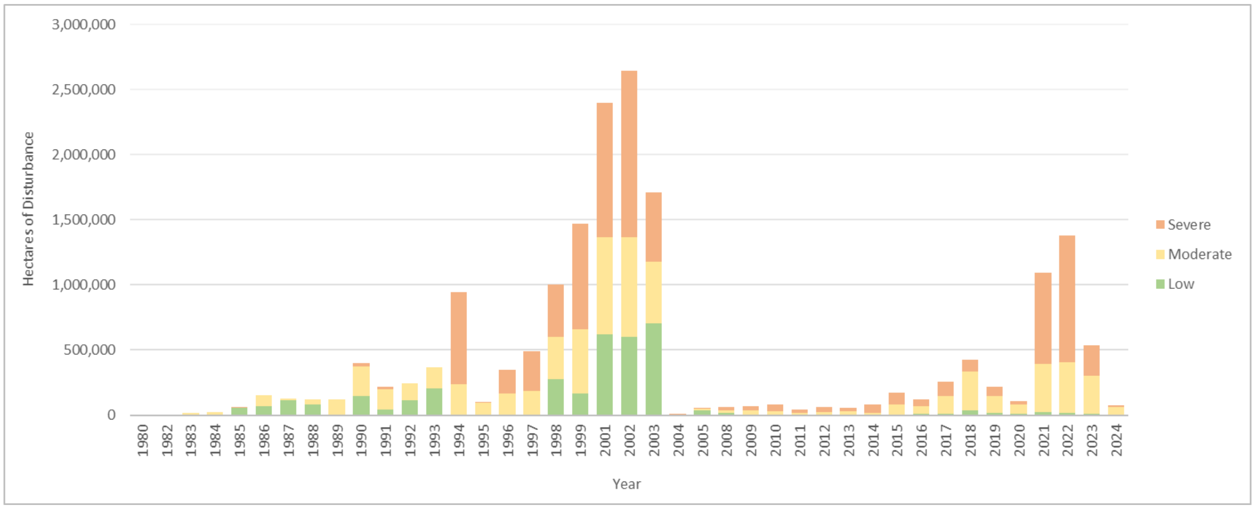

Figure 13. Temporal dynamics of eastern spruce budworm defoliation in white spruce. This damage declined from 1.38 M ha in 2022 and 0.54 M ha in 2023 to only 0.08 M ha in 2024

Figure 14. Decent recovery from spruce budworm defoliation. Hwy 2 near Hay River, 2024

North Slave Region

In the North Slave region, only 9 ha of light defoliation was recorded near Whati. Other defoliation found along the Ingraham Trail was caused by the spruce coneworm. A natural decline in an outbreak occurs when predator, parasite, and pathogen numbers catch up to budworm population levels, or from a weather event like late spring frost, or heavy prolonged rains during late-larval stages. It is possible that the spruce coneworm outbreak also decreased spruce budworm numbers, a natural competitor of the eastern spruce budworm. Again, the main concern now is for areas where continued defoliation and drought may cause an increase in branch, terminal, and tree mortality. This is especially true for the Fort Liard area of the Dehcho region.

Dehcho Region

The Dehcho region had the most defoliation mapped in the NWT, at 71.9 thousand hectares, or 84% of the total recorded (Figure 14), although this represents a substantial decline from the 272.4 thousand hectares in 2023. The Dehcho spruce bud worm outbreak, which was missed last year due to extremely poor visibility from heavy smoke and low clouds, was found to be still causing moderate defoliation along the Liard and Muskeg Rivers. Other patches were also recorded along the Netla and Blackstone Rivers. The concern in the Dehcho is that the current drought will exacerbate spruce budworm-caused mortality in the upcoming years, causing significant branch, terminal, and tree mortality in areas where repeated defoliation occurs. This could add significant fuel loading for potential wildfires, especially in the Fort Liard – Muskeg River areas.

Figure 15. Moderate to severe spruce budworm defoliation, Muskeg River, Fort Liard, 2024

Sahtu Region

In the Sahtu region, only 0.8 thousand ha of moderate defoliation was recorded, far less than the 16.8 thousand ha observed in 2023. Much of the previous year's defoliation mapped along the Ramparts, Hume, and Carcajou Rivers are gone, replaced by a few small, scattered pockets in the Yellow Hills Creek area, and the Ramparts, Hume, and Mackenzie Rivers. Spruce budworm-caused mortality was recorded in white spruce stands in long-running outbreak areas along the Ramparts, Hume, and Carcajou Rivers, some of which were estimated at 40% spruce mortality that have been defoliated by Spruce Budworm for many years and are currently affected by the 2022-24 drought.

Beaufort Delta Region

In the Beaufort Delta region, the area affected by eastern spruce budworm decreased from 7.9 thousand ha in 2023 to 4.3 thousand. It was mapped in the usual areas along the Arctic Red River and just inside the Yukon Territory, where a few small pockets still affect south-facing stands along the Peele River. Though the population persisted in the Arctic Red River valley, it was reduced in severity and extent. Substantial spruce budworm-caused mortality exists in the valley, which has been under annual defoliation for many years. The current ongoing drought is likely contributing to the exacerbation of mortality. Spruce budworm-caused mortality rates of up to 50% were recorded in the areas along the Arctic Red River that have been defoliated for many years. Still, there is little doubt that the mortality in these areas is exacerbated by the 2022-24 drought. A more complete assessment of spruce budworm-caused mortality would require a detailed targeted survey due to the time and extent of the areas to be covered.

Spruce coneworm

Another new pest at outbreak levels showing increasing and significant contribution to white spruce defoliation, the spruce coneworm *(Dioryctria reniculelloides)* was first reported during the 2023 Forest Health Survey (Figure 16-19). Populations of this pest are mixed in with eastern spruce budworm, but unfortunately, both insects cause similar defoliation, which makes defoliation between the two pests nearly impossible to differentiate from a distance. Spruce coneworm is easily missed or mistaken for budworm defoliation during outbreaks. Spruce coneworm is suspected to be native to Canada, though it was only first observed in 1937. It is commonly found alongside eastern spruce budworm feeding on cones, flowers, buds, and needles. The coneworm both feeds alongside and competes with spruce budworm. It can be aggressive and has been known to feed on other phyllophagous larvae, such as the Budworm, when populations are high and food is scarce. Spruce coneworm populations increased during high-yield cone crop years, such as 2022 to 2024, induced by water deficit and high temperature stress throughout northern and western Canada.

Spruce coneworm was recorded in the NWT at 4.6 thousand ha in 2024, causing light defoliation to white spruce in areas of the South and North Slave regions, where the eastern spruce budworm appeared to have collapsed. Ground sampling in both regions revealed that most larvae found were the spruce coneworm. In the South Slave, 4.0 thousand ha were mapped along Hwy 5, and in the Fort Smith, Fort Resolution, and Fort Providence areas and 0.3 thousand ha in the WBNP. In the North Slave region, only 0.3 thousand ha were recorded along the Ingraham Trail by the Yellowknife River, Madeline Lake, and Hidden Lake. The much higher presence of spruce coneworm the South Slave region compared with the North Slave region may suggest a requirement of this species for warmer temperatures. In most cases, defoliation was light, although a few moderate patches were recorded in the Fort Smith area and by the Yellowknife River bridge along the Ingraham Trail north of Yellowknife.

Figure 16. Spruce coneworm, Fort Resolution, 2024

Figure 17. Spruce coneworm pupa and light defoliation, Hwy 5, near Preble Ck, WBNP, 2024

Figure 18. Spruce coneworm larvae (left) and spruce budworm (right),
Hwy 6 near the Little Buffalo River, 2023

Figure 19. Pupae: Spruce coneworm (top) and spruce budworm (bottom), Hwy 2, near Hay River, 2023

Willow blotch leafminer

Mapped areas of willow blotch leafminer *(Micrurapteryx salcifoliella)* damage (Figure 20) in the NWT decreased significantly from 98.0 thousand ha in 2018 and 26.3 thousand ha in 2023 to only 7.1 thousand ha in 2024(Fig. 30 & 32). Severity was also generally low, and much of what would be considered light defoliation went unrecorded during aerial surveys, as it was undetectable from the air. Willow blotch leafminer development appeared to be slower in 2024, so damage manifested later than normal. Likewise, the current drought caused a heavy seed stress crop that blanketed willows across the NWT (Figure 21), hampering the aerial detection of leafminer damage (Fig. 31). Of the total 7.1 thousand ha recorded in 2024, 4.7 thousand ha was mapped in the Dehcho region, 1.2 thousand ha in the South Slave region, and 1.1 thousand ha in the Sahtu region (Figure 22). However, the actual true extent can be much larger in some areas, but not fully registered due to visibility issues, the drought and water stress-induced seed crop, and lighter damage made detection in many cases impossible.

Figure 20 (left). Severe willow blotch leafminer damage, Hwy 1 Bouvier R., 2024

Figure 21. (right) Heavy willow seed production and delayed release throughout the NWT. Ingraham Trail, 2024

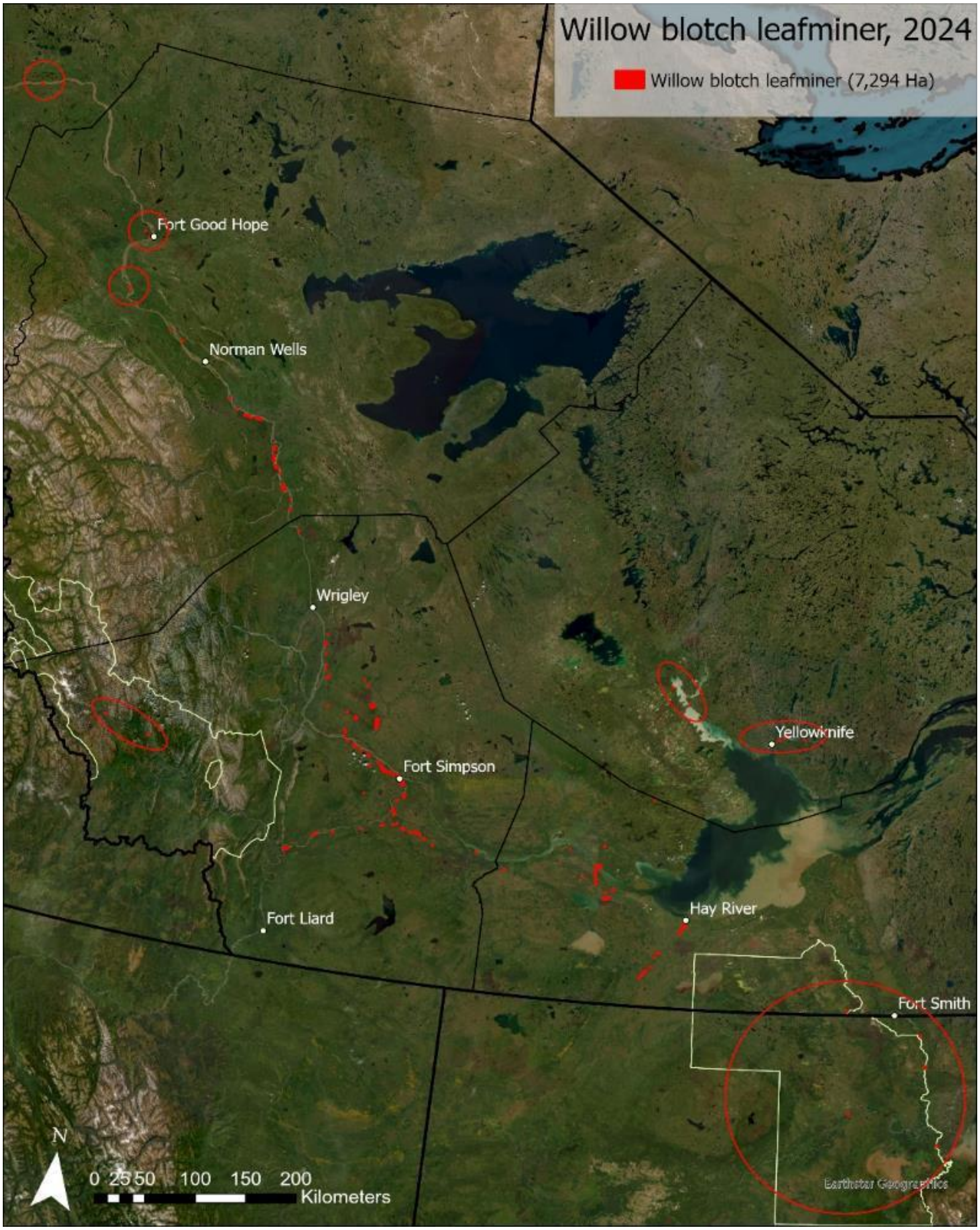

Figure 22. Areas of the willow blotch leafminer recorded in 2024

Other primary insect and disease damage

Compared with the insects causing aspen, poplar, white spruce, and willow defoliation described above—which in general declined in 2024—other primary insect and disease damage in the NWT was spatially insignificant (Figure 23), usually detected on areas less than one thousand hectares, and also showed a declining trend.

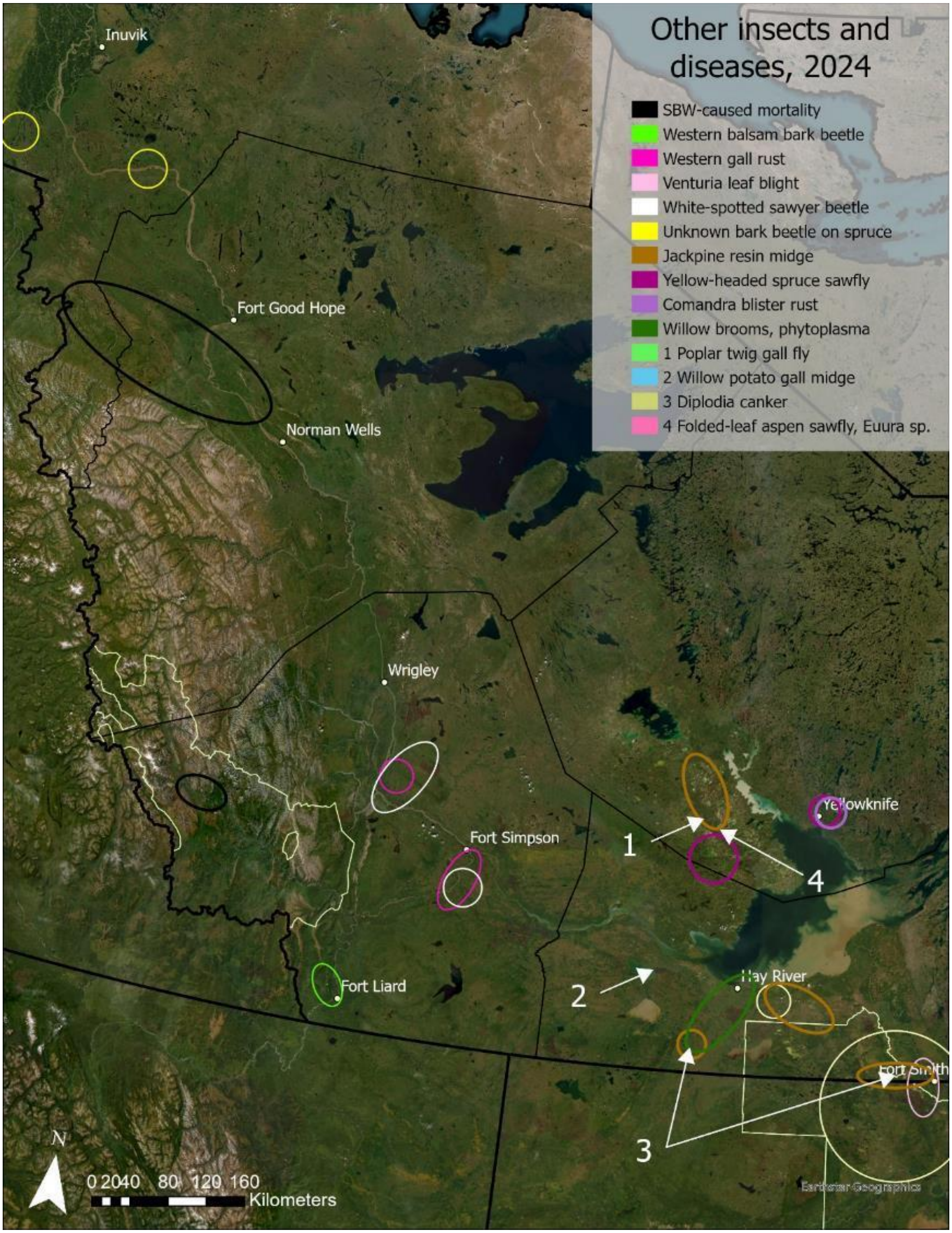

Figure 23. Map of other insects and diseases recorded during aerial and ground surveys, 2024

Western balsam bark beetle

Ongoing mortality of subalpine fir from the western balsam bark beetle has been occurring throughout the mountain ranges in Western Canada for many years. In 2024, approximately 0.3 thousand ha of Subalpine fir mortality from western balsam bark beetle *(Dryocoetes confusus)* was recorded along the west-facing slopes of Mount Cody north of Fort Liard (Figure 23). The mortality rate is typically less than 5% annually, and its pattern is scattered throughout a stand and not in normal bark beetle pockets. Subalpine fir trees are known for longer than normal needle retention, so when trees turn often within the same year of attack, they will remain red for 2 to 3 years. This makes annual detection of extent and severity difficult to achieve, so outbreaks are better assessed over a longer time.

Suspected unknown bark beetle in white spruce

Common bark beetles and wood borers causing mortality in white spruce could include any combination of *Ips perturbatus, Dendroctonus punctatus* or *Dendroctonus rufipennis*, the white-spotted sawyer beetle, and many others. Damage from these suspected/unknown bark beetles detected by aerial survey decreased from 0.6 thousand ha in 2023 to 0.2 thousand ha in 2024. To confirm the agents involved, ground sampling would be required to ascertain the agents involved. Damage to white spruce included four small light patches with less than 10% mortality along the Peele River in the Fort McPherson area and three patches along the Mackenzie River roughly 30 km south of Tsiigehtchic (Figure 23).

White-spotted sawyer beetle

A total of approximately 70 ha of jack pine mortality suspected to be caused by the white-spotted sawyer beetle (*Monochamus scutellatus*) was mapped in the Dehcho region near Checkpoint, Fort Simpson, along the Mackenzie River east of Camsell Bend, and in the Ebbutt Hills area (Fig. 23). The damage pattern was consistent with the wood borer as it typically attacks in a scattered fashion, affecting weakened and dying trees.

Jack pine resin midge

The jack pine resin midge (*Cecidomyia resinicola*), continues to cause light to moderate shoot tip mortality in jack pine stands within areas of the South and North Slave regions (Fig. 23). Areas recorded in the two regions were 14 ha and 4 ha, respectively, but given its subtle visual presentation, it is suspected the true areas being affected are much higher. In the NWT, this pest was first observed in 2021 and went undiagnosed until 2023. Damage from jack pine resin midge first is visible as resin droplets at the base of new green shoots (Figure 24 and 25). Larvae feed directly on cambium tissues and live within the droplets, feeding also upon the resin, which eventually is enough to kill the shoots (Figure 26). Tip mortality can be as high as 75% during outbreaks; however, the midge rarely causes tree mortality. It is suspected that when severe populations are combined with severe droughts, tip mortality in very young regeneration will increase. The jack pine resin midge symptoms can look like the symptoms from other damaging agents such as a drought condition, western gall or blister rust, squirrel damage, and blights. This makes detection and mapping of infested areas difficult often requiring substantial ground surveys to detect the full extent.

Figure 24. (left) Jack pine Resin Midge larvae, Buffalo River, Hwy 5, South Slave region 2024

Figure 25. (right) Jack pine Resin Midge exit holes from resin. McNally Creek, Hwy 1, 2024

Figure 26. (left) Jack pine Resin Midge damage near Angus Tower, Hwy 5, 2024

Poplar twig gall fly

Twig galls on poplar and aspen formed by the poplar twig gall fly (*Euhexomyza schineri*) during the feeding process of maggots can cause branch mortality and the development of multiple new leaders over time. This damage was observed in 2024 on several young, roadside aspen regeneration stands in the North Slave region along Hwy 3 just south of the Hwy 9 junction (Figure 23), totalling 17 ha. A few additional observations—too small to warrant mapping—were found in the South Slave region along Hwy 5 near Nyarling Creek (Figure 27).

Figure 27. poplar twig gall fly damage, Hwy 5 near Nyarling Creek, WBNP, 2024

Yellow-headed spruce sawfly

Preferred host for yellow-headed spruce sawfly (*Pikonema aaskensis*), are young, open-grown spruce trees and damage can be quite severe. Since it feeds gregariously on both current and older growth, it can cause leader and tree mortality when repeated annually. Only 4 ha of tellow-headed spruce sawfly, damage was mapped in 2024 (Fig. 33). One small solitary patch, roughly 0.1 ha in size, was recorded along Hwy 3 by Chan Lake in the South Slave region. Other larger patches, totalling 3.8 ha, were found along Hwy 3 in the North Slave region and along the Ingraham Trail (Fig. 38).

Figure 28. Yellow-headed spruce sawfly larvae, Chan Lake, Hwy 3, 2024

Potato gall midge on willow

The suspected potato gall midge (*Rabdophaga salicisbatatus*), caused moderate damage to willow stems in a small area totalling roughly 13 ha along the Kakisa Lake Road in the South Slave region (Figure 23 and 29). Stem galls were also found in the North Slave region just south of the junction of Hwy 3 and 9. The galls form from a biochemical reaction to the eggs being laid in the stem by adults, and hatched larvae feeding on tissue. The galls cause no significant health issues for the willows, even when numerous from high populations.

Figure 29. Stem galls from the potato gall midge on willow, Kakisa, 2024

2. Primary disease damage

Western gall rust

Larger roadside areas of light infections and branch gall mortality of jack pine branches and some stems by western gall rust (*Endocronartium harknessii*) were recorded during ground surveys on 76 ha along Hwy 1 near Fort Simpson, and north of the Wrigley ferry location in the Dehcho region and on another 10 ha in the South Slave region along Hwy 5 west of Buffalo River and by the Little Buffalo River South Slave regions (Figure 23). Several other pockets of western gall rust-infected branches were also recorded along Hwy 5 in WBNP. Western gall rust is a fungal disease and is commonly found on jack pine branches and stems throughout the range of jack pine in the NWT. The galls formed due to the rust infections (Figure 30) stimulate abnormal tissue growth that helps protect the rust from the tree's defences, restricting water and nutrient flow. This weakens trees, causing significant growth loss. Branch and stem infections can lead to tree mortality, especially when combined with drought.

Figure 30. Western gall rust branch infection, Hwy 5 Little Buffalo R., 2024

Comandra gall rust

In the North Slave region, only 17 ha of comandra blister rust, cronartium comandrae, was recorded along the Ingraham Trail (Fig. 41). This fungal disease causes similar branch and stem galls as Western gall rust, though the gall shape is more oblong and elongated, rather than round. The impact on trees is also similar and can cause branch and stem mortality. Both species are commonly found on branches and stems throughout the range of Jack pine in the NWT. The western gall rust forms round globular galls (Figure 30), while comandra gall rust causes elongated swelling (Figure 31). For both species, the gall formation process and the consequent restricted water and nutrient flow weaken trees, causing significant growth loss and can result in tree mortality, especially during drought.

Figure 31 . Comandra blister rust branch infection, Ingraham Trail, 2024

Venturia leaf blight

Roughly 100 ha of damage by another fungal disease, venturia leaf blight, occurred at light levels in the South Slave region near Fort Smith along the Thebacha Campground Road (Figure 23) along roadside aspen regeneration. Two species fall under this common name, Venturia macularis, which infects aspen (Foigure 32), and Venturia populina, which infects poplar. Both species were observed in many locations throughout the Dehcho and South Slave regions; however, most infections were not large enough to map.

Figure 32. Venturia macularis infecting aspen near Wrigley, 2024

Diplodia canker

Areas of aspen trees infected with a fungal disease diplodia canker (*Diplodia tumefaciens)* of approximately one hectare in size were recorded north of the Alberta border along Hwy 1 near Swede Creek and in the Little Buffalo Falls area of the WBNP in the South Slave region (Figure 23). Diplodia canker causes a significant reduction in water and nutrient flow within the tree which reduces tree vigor eventually leading to tree mortality. Diplodia canker weakens the tree, thereby exposing it to further attack from other pathogens and insects. This occurring during periods of drought will significantly increase the risk of decline and mortality.

Figure 33. Aspen tree infected with Diplodia canker, Little Buffalo Falls, WBNP, 2024

Aspen running canker

The aspen running canker (*Neodothiora populina*) has been newly discovered in the NWT in two locations by Wilfrid Laurier University (WLU) field crews and in one location by NWT Forest Health Surveys during the 2024 field season. The WLU observations were found in a remote area near the junction of Hwy 1 and 3, and the junction of Hwy 3 and 9 and the NWT forest health survey observation consisted of 3 trees with visible symptoms south of Enterprise near Swede Creek (Figure 34). The extent of this new disease in the NWT is unknown. Given recent discussions with Alaskan and WLU researchers, confidence is high that observation is aspen running canker.

Figure 34. 2024 Aspen running canker observations in the NWT (WLU and NWT, 2024)

The aspen running canker, caused by the novel fungal pathogen (*Neodothiora populina)* (Figures 35-37), is an aggressive, fast-spreading disease that poses a significant threat to trembling aspen forests across northern boreal and taiga regions. It has already caused substantial damage in Alaska where it was first discovered and has recently been found in several areas of the Yukon. There is the potential for this disease to cause widespread mortality in aspen-dominated and mixedwood forests of the NWT and northern Alberta affecting stand composition, succession, and biodiversity. Researchers suspect the pathogen is both symptomatic and asymptomatic and that, though has not been documented in the NWT before, it may be native due to its remote and widespread occurrence, frequently being found far from roads and populated areas. It is possible that the spread of the disease is caused by drought combined with ongoing aspen serpentine leafminer outbreaks, which have made host susceptibility and environmental conditions ideal for spread of the disease. Therefore, close monitoring of this emerging forest health issue should be insured.

Figure 35. Aspen running canker in the Yukon (Mackenzie mihorean, WLU)

Figure 36. Exposing ARC ARC-infected phloem and cambium layers of the tree bark Yukon, Mackenzie Mihorean, WLU

Figure 37. ARC pycnidia fruiting bodies on canker, (Mackenzie Mihorean, WLU)

3. Abiotic and animal damage

Abiotic damages in the NWT in 2024 included blowdown, hail and snow damage, wind damage, slide damage, permafrost slumping, flooding, and drought. Animal damage to trees was caused by several animal species, the more common being bison, porcupine, woodpecker, hare, squirrels, and voles (Figure 38). Most damage is incidental and not severe, however, in some cases high populations and activity can significantly impact small areas.

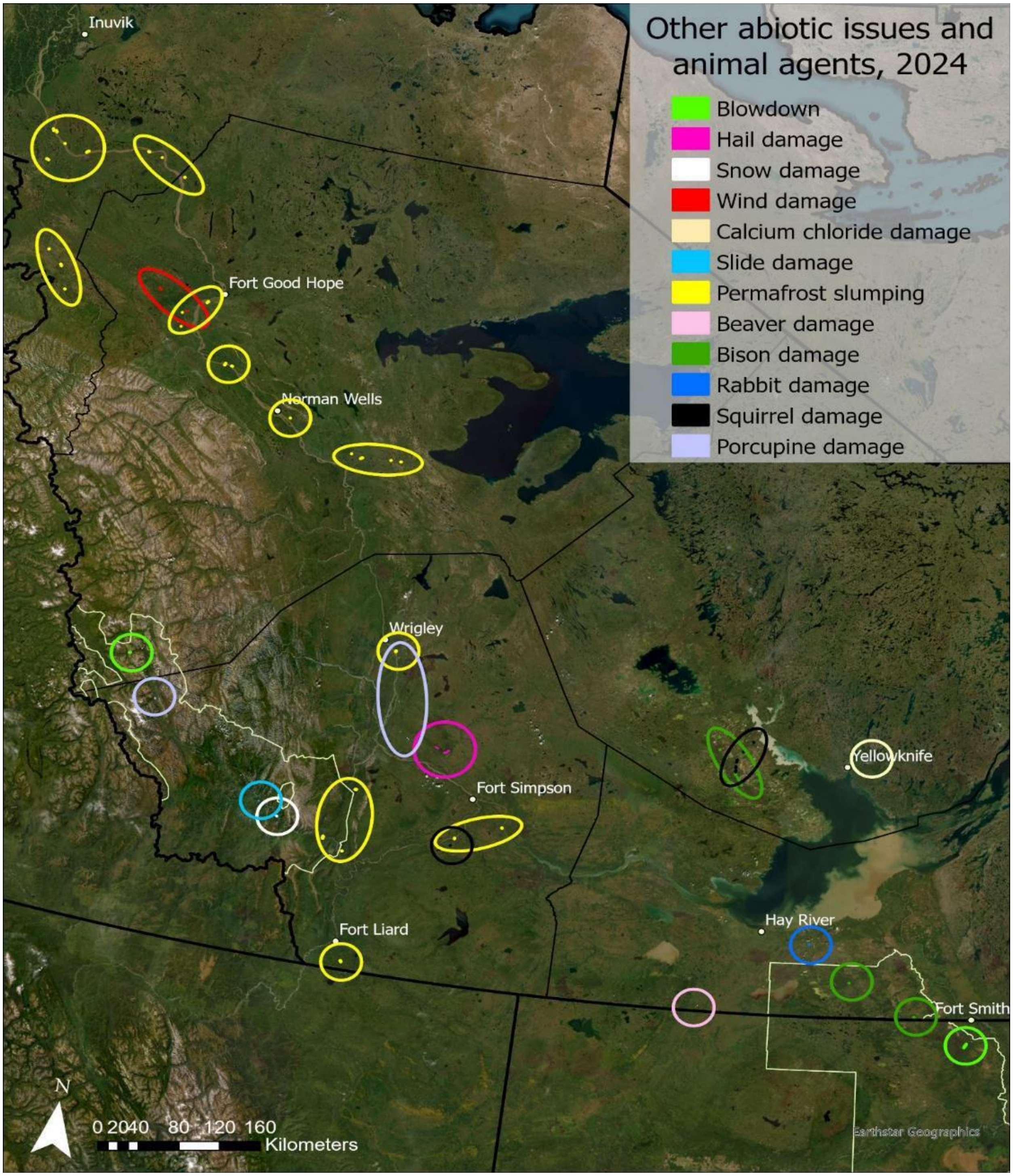

Figure 38. Map of other abiotic issues and animal damage, 2024

Storm wind and hail damage

A severe thunderstorm blew through the Dehcho region northwest of Fort Simpson on July 8th causing severe hail and wind damage to forests along the southeast-facing slopes of the Ebbutt Hills. The storm affected approximately 862 ha of Aspen and Spruce forests in the area which was recorded in four patches along the hills (Fig38 and 39). Damage observed consisted of foliar, twig, and branch damage, including broken tops. Elsewhere in the Sahtu region, 1.1 thousand ha of 2023 storm-damaged bent and broken spruce trees that were missed during 2023 surveys due to visibility issues, were recorded in 2024. This damage occurred west and southwest of Fort Good Hope along the Ramparts and Hume Rivers.

Figure 39. Threatening cloud formations during a July 8 severe storm that caused hail and wind damage to Ebbutt Hills, July 8, 2024. Photo credit: Lena Aronyk, Simpson Air

Permafrost slumping

In 2024, a total of 0.74 thousand ha of permafrost slumping damage was mapped in the NWT, of which 0.3 thousand ha were recorded in the Dehcho, 0.2 thousand ha in the Sahtu, 0.18 thousand ha in the Beaufort Delta region, and 0.06 thousand ha in Nahanni National Park Reserve (Fig. 38). Permafrost melt has been causing ongoing issues to Hwy 1 and the Smith Creek bridge, located roughly 8.5 km south of Wrigley. Permafrost melting started along the southern creek slopes a few years ago and has progressed destabilizing the terrain and warping the road and bridge approach (Figure 40).

Permafrost thaw-slumping events in the NWT typically occur along riverbanks, elevated lake shores, or on the slopes of hills and plateaus. Slumping mapped annually during aerial surveys is incidental but often included when forested areas are affected. Those mapped annually mostly consist of new or expanding events, however older events are also recorded if believed to have been missed in the past. Slumps are more common in higher latitudes due to the increased frequency of permafrost areas.

Figure 40. Permafrost slumping affecting the Wrigley Hwy and Smith Creek area, 2024

Bison damage

Approximately 44 ha of bison damage were recorded in the North Slave region in various locations along Hwy 3 and 9. Another 18 ha was recorded in the South Slave region along Hwy 5 in WBNP (Figure 41 and 42). Species affected are most often young jack pine, however, in WBNP many young aspen were not rubbed but pushed over by young bulls (Figure 42). Though black bears can also topple young aspen, the evidence concluded bison due to the scratches along the stems were not claw marks, and bison scat was present.

Figure 41. Bison rub mortality to young jack pine. Hwy 3, 2024

Figure 42. Bison - felled aspen trees,
along Hwy 5 near Nyarling River, 2024

Porcupine

Porcupines caused light mortality in several jack pine stands along the Wrigley Road (Hwy 1) in the Dehcho in 2024 (Figure 43). Damage was recorded in several small patches totalling 15 ha. An additional, 57 ha of pine mortality, suspected of being caused by porcupine or possibly bear, was mapped in the Nahanni National Park Reserve.

Figure 43. Porcupine damage, Willowlake River, Hwy 1, 2024

Squirrel

Several areas of heavy jack pine branch mortality caused by squirrels' clipping cones, were recorded in the North Slave region in 2024 (Figure 44). Approximately 56 ha of light to moderate damage was recorded in young and mature jack pine along Hwy 3 from 12km south of the Whati Hwy 9 junction to Edzo.

Figure 44. Squirrel cone clipping damage, Hwy 3, 2024

Beaver

Approximately 13 ha of beaver-felled trees were mapped in three separate patches near the Alberta border along Hwy 1 (Figure 45). This is a common occurrence in the NWT, though a nuisance for highway maintenance crews.

Figure 45. Beaver falling aspen, AB border, Hwy 1, 2024

Snowshoe hare

Jack pine mortality caused by the Snowshoe Hare occurred in a 1 ha mapped area just west of the Buffalo River bridge along Hwy 5 in the South Slave region (Figure 46). Hare damage is common in this area and is observed annually.

Figure 46. Snowshoe hare jack pine mortality,
Buffalo River Hwy 5, 2024

Drought

The top forest health issue in 2024 is a third-year continuous stress, decline, and mortality caused by drought and drought-related factors in all regions, especially in the Dehcho, South Slave, and North Slave regions (Figure 47). Drought damage symptoms observed included the yellowing, browning, and reddening of foliage and its margins and tips, stunted foliage, sun-scalded tree branches and stems, branch tips and crown dieback, and tree mortality (Figure 48).

Several moderate and severe droughts have occurred in the NWT in the past 30 years, and the current drought—beginning in June 2022—has been prolonged. According to Agriculture and Agri-Food Canada's Canadian Drought Monitor, moderate drought conditions continued from June 2022, escalating to severe and extreme drought levels by August 2023 (Figure 49-53), and remaining so through summer 2024. During that time, most of the NWT was affected by abnormally dry to severe and extreme drought with 25 - 50% of normal precipitation, and more than 50% of areas receiving less than 25% (Figure 54).

Agriculture and Agri-Food Canada also reported temperatures 2-4°C higher than normal across most of the NWT in July 2024. Water levels throughout the summer were extremely low, as observed in all lakes, ponds, rivers, and creeks during aerial surveys. Since surveys ended in July, it is very unlikely that the true extent of the 2024 drought damage was captured. Conditions would have worsened well into September. The true impact of droughts can take years to manifest, as drought-weakened trees are often not given time to recover before further damage from secondary agents, attracted to the tree's weakened condition.

Figure 47. Drought-induced jack pine mortality along the Ingraham Trail, 2024

Figure 48. Jack pine drought mortality and general drought stress affecting multiple species throughout the NWT, 2023

Figure 49. Drought-stress affecting multiple species, Norman Wells, 2023

Figure 50. Drought-stress affecting multiple species, Ingraham Trail near Tibbit Lake, 2023

Figure 51. Drought-induced jack pine mortality, Hwy 1 near McNallie Creek, 2023

Figure 52. Drought-induced jack pine mortality,
Pine Point, south shore of Great Slave Lake, 2023

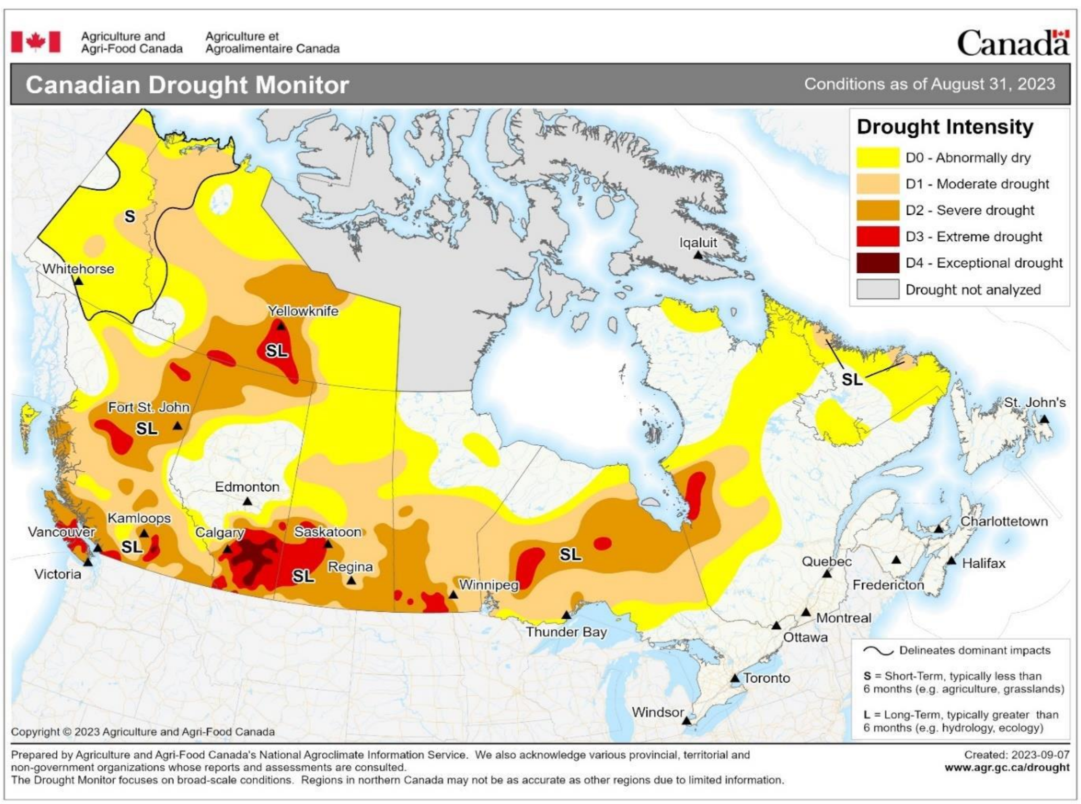

Figure 53. 2023 Drought map of Canada, Agriculture and Agrifood Canada, Aug 31, 2023

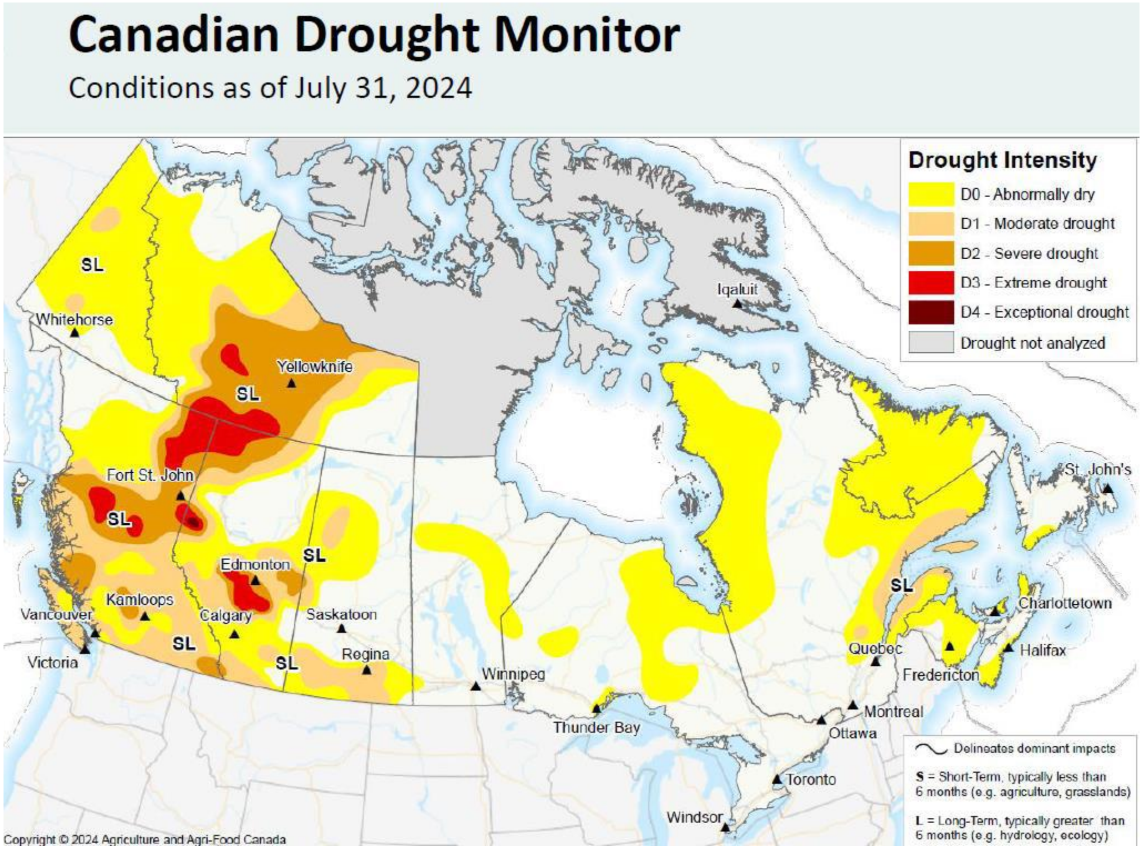

Figure 54. 2024 Drought map of Canada, Agriculture and Agri-food Canada, 31 July 2024

Flooding and high-water tables

Ongoing direct and indirect physiological stress and mortality in the NWT forests are caused by two main large-scale factors: insufficient water (drought) and excess water (flooding and high water tables). Due to either a lack or excess of water in the tree root zone, both factors lead to the same result—initial damage to the root system and, eventually, the whole tree. The symptoms of drought and flooding/high-water table are also the same: yellowing, browning, and reddening of foliage, stunted foliage, branch tips and crown dieback, and tree mortality.

While the lack of water during drought years is well understood, the presence of excess water in some areas with sporadic or continuous permafrost is suspected of being caused by an increase in melting permafrost, exacerbated by much drier and warmer conditions during drought seasons. However, this possible link between drought and flooding needs to be checked experimentally. Most of the flooding damage was likely caused due to substantially raised water tables during abnormally wet 2019-2021 years.

In 2024, 57.7 thousand ha of high water table and 23.4 thousand ha of flooding mortality were recorded across the NWT, which is a substantial increase compared with only 2.0 thousand ha of flooding damage in 2023. The South Slave region has been greatly affected by large-scale 2019-2021 flooding events north of Fort Smith between the Little Buffalo and Slave Rivers and between the Slave and the Taltson Rivers, and in the area north of Fort Providence and Mackenzie Bison Sanctuary (Figure 55). These are massive areas that have resulted in substantial forest mortality.

Figure 55. Flooding mortality, Slave River, 2024

Combined drought and flooding damage

In 2024, out of the 4.29 M ha surveyed within the NWT (Table 1), approximately 0.22 M ha of flooding and drought-related stress and mortality were recorded across all regions (Table 3), which is a substantial increase compared to 0.07 M ha reported in 2023. This includes 0.09 M ha of stress symptoms and another 0.13 M ha of stress symptoms with mortality (Fig. 10). This represents approximately 5% of the surveyed area affected by moderate to extreme drought conditions. However, the real extent of the areas affected by drought and flooding is likely substantially larger. According to the Canadian Drought Monitor (Agriculture and Agri-Food Canada), more than 50% of the NWT was affected by conditions ranging from moderate to severe and extreme drought (Figure 54). The current ongoing drought conditions have put a significant strain on NWT forests and will have an long-term impacts for years to come. This will be especially true for the Dehcho, South Slave, and North Slave regions. Significant physical stress, damage, and mortality to NWT forests were recorded throughout the NWT but were most evident in these regions (Figure 56).

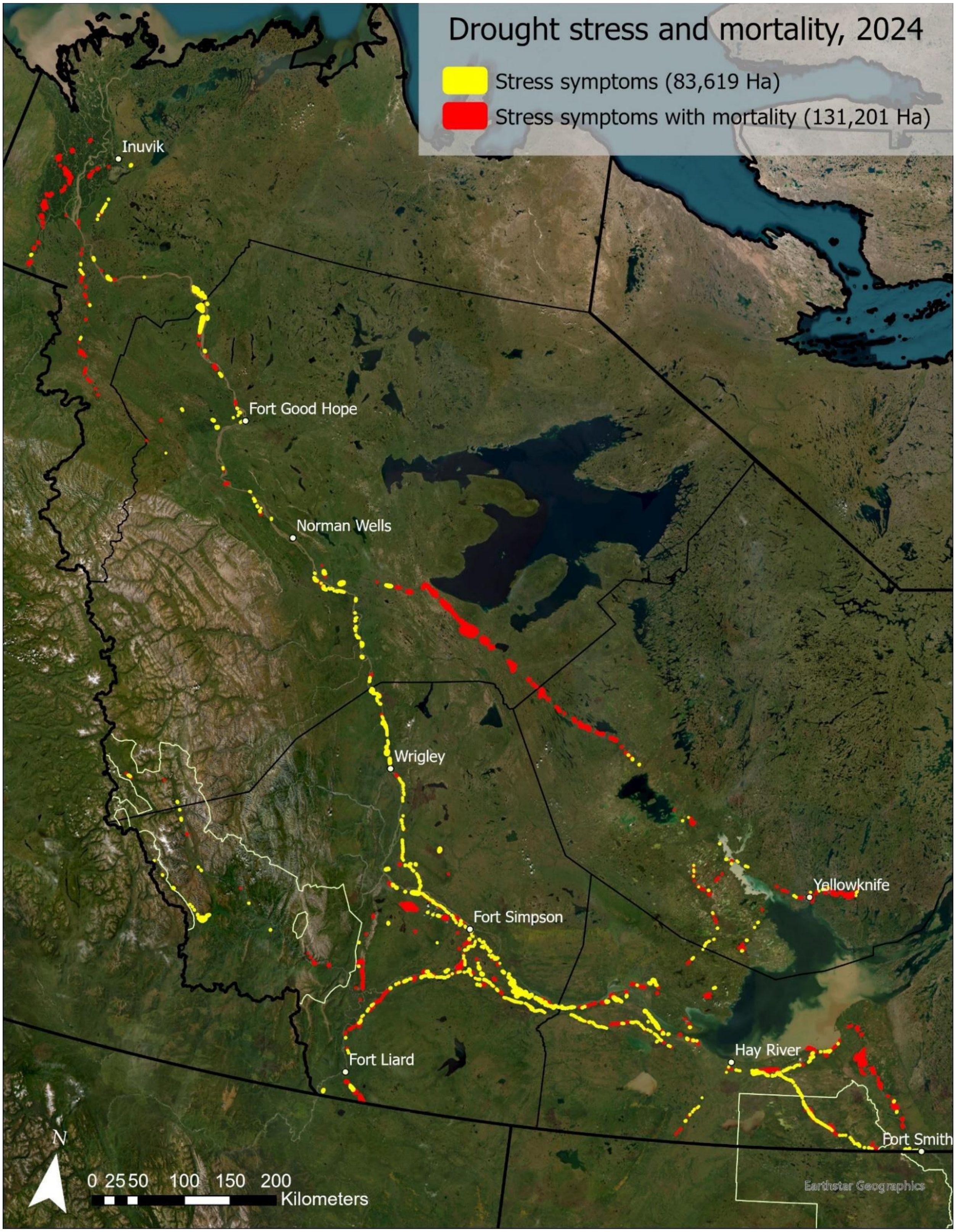

Figure 56. Drought stress and mortality map, 2024

Dehcho Region

The Dehcho region had the highest overall area of drought damage (68.9 thousand ha) recorded in all the NWT, representing approximately 6% of the regional surveyed. Approximately half of the region's total drought damage was classified as stress symptoms, which was easily visible along both the Mackenzie and Liard Highways. Drought-related mortality was also evident along both highways. Larger areas of black spruce decline were recorded west of Fort Simpson and south of Checkpoint toward Fort Liard.

Included in the total damage mapped was 2.4 thousand ha of pine mortality from an extreme red belt event that occurred along the west-facing pine stands of the Nahanni Range stretching roughly 33 km along the range north of Nahanni Butte (Figure 57). Reviewing high-resolution satellite imagery from 2022 and 2023, it is apparent the event occurred in the late winter or early spring of 2023. It went unnoticed during 2023 surveys because thick smoke blanketed the entire area. Red belt damage typically occurs when warm chinook winds warm the tree, prompting physiological responses to spring, yet the ground and root systems are still frozen. This causes winter desiccation, drying out of the foliage. Jack pine is especially sensitive to the phenomenon, but all species can be affected. Most times up to 10% of jack pine foliage can remain unaffected, and with epicormic growth, trees can often survive. However, it is suspected that the fact this event occurred during a drought, caused severe mortality.

Figure 57. Red belt and drought caused mortality in 2023 along the Nahanni Range, 2024

South Slave Region

In the South Slave region, 39.6 thousand ha of drought-related damage was recorded, which included 23.8 thousand ha of stress and mortality. The total drought damage in this region equalled 8% of the region's surveyed area. Most recorded mortality is attributed to large areas of forest dying due to high water tables along the Slave River (Figure 58) caused from abnormally wet conditions in 2019 to2021. It is highly suspected much more mortality is occurring between the Little Buffalo, Slave, and Taltson Rivers. Other areas along Hwy 5 and 6 had jack pine regeneration and juvenile mortality due to drought, which was recorded. Due to heavy smoke during aerial surveys, the mature jack pine stands along the southern shores of the Great Slave Lake were not assessed, so it is unclear if the drought mortality recorded in these areas in 2023 has gotten worse, or if they were burned in 2023 wildfires.

Figure 58. Flooding mortality along the Slave River is suspected due to wildfire and possibly some permafrost melt, 2024

NWT portion of Wood Buffalo National Park

In the NWT portion of Wood Buffalo National Park, 6.5 thousand ha of drought-related stress and mortality occurred along Hwy 5 between the north park border and Little Buffalo River. This area represents 9% of the survey area in this half of the park. Much of the stress and mortality was caused by insufficient water which affected mainly jack pine, aspen, and poplar.

Figure 62. Drought stress affecting aspen regeneration, Hwy 5 Wood Buffalo National park, 2024

North Slave Region

In the North Slave region, 16.9 thousand ha were recorded, of which 94% consisted of drought-related stress with mortality. This area mapped equals approximately 4% of the North Slave's surveyed area. Much of the mortality included large areas of black spruce decline northwest of Lac La Martre extending to the Sahtu border, and jack pine mortality growing on shield rock and in exposed areas along the Ingraham Trail (Figure 58 and 59). It is extremely likely that mortality exists and is going unsurveyed in the surrounding landscape in both areas. In fact, it is suspected much of the shield in the North and South Slave regions may have experienced similar jack pine mortality including the East Arm of the Great Slave Lake.

Figure 59. Jack pine regeneration drought mortality, Hwy 9. 2024

Figure 58. Drought-stress and mortality affecting jack pine regeneration, Ingraham Trail, 2024

Sahtu Region

The Sahtu region recorded the highest levels of drought-related mortality at 45.0 thousand ha with an additional 16.6 thousand ha of stress symptoms mapped. The total drought damage in this region totalled 61.5 thousand ha, which is 8% of the region's surveyed area. This region's high level of recorded mortality is mainly due to the large areas of black spruce mortality recorded south of Great Bear Lake (Figure 61). Much of that mortality is suspected of being due to past or present high water tables, but this cannot be confirmed without further investigations.

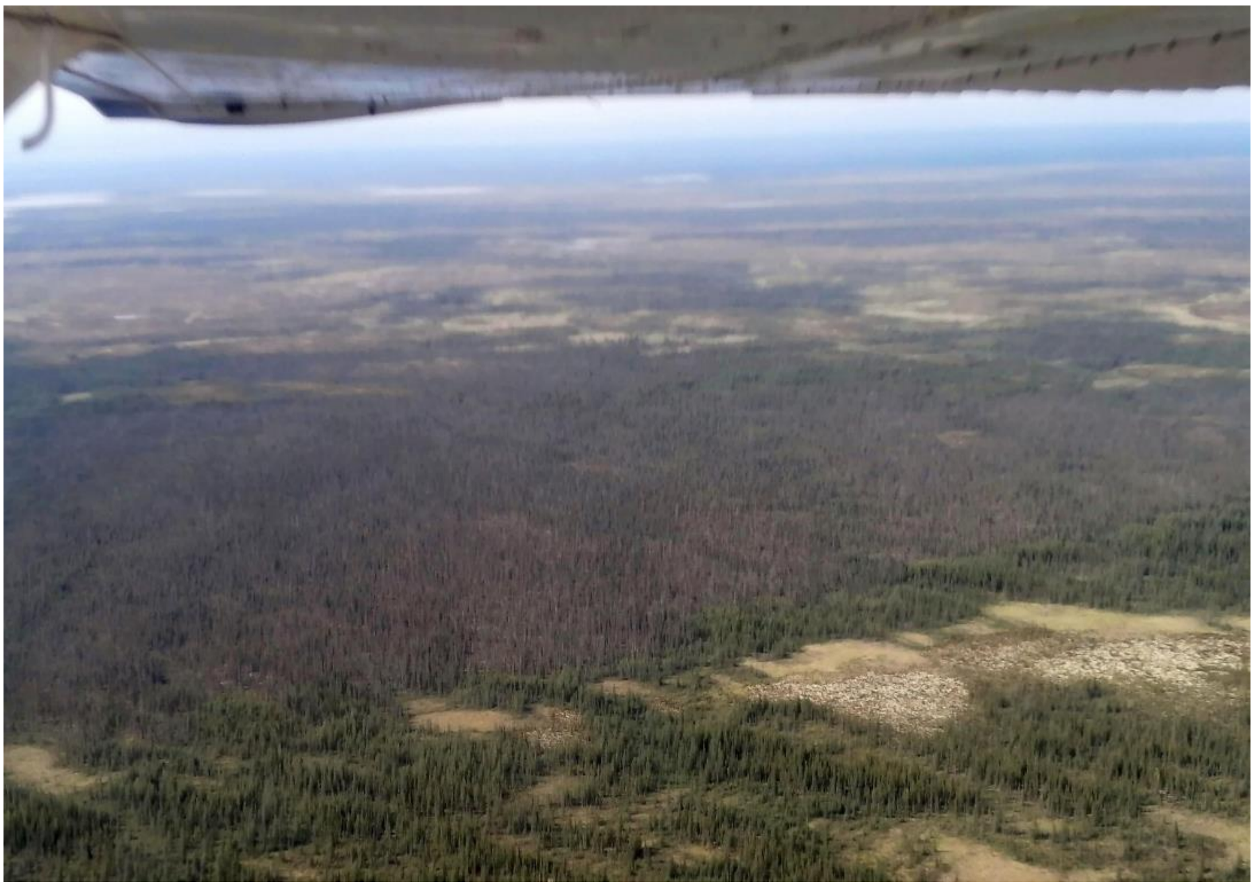

Figure 61. Drought-related mortality south of Great Bear Lake, 2024

Beaufort Delta Region

In the Beaufort Delta region, 16.7 thousand ha were recorded. This represents 2% of the region's surveyed area. Most of the damage (62%) is recorded from spruce mortality in the Mackenzie Delta and willow and spruce mortality along the Arctic Red River. The mortality in the delta is suspected to be caused by high water tables, potentially linked to the development of thermokarst lake. Given the limited coverage of the aerial survey area, it is likely that much more flooding- and drought-related stress and mortality are not being observed and are therefore going unrecorded.

Recommendations

Considering the critical lack of precipitation in 2024 and that up to 40% of the NWT is affected by severe to extreme drought according to the Canadian Drought Monitor at the end of the 2024 season (Figure 54), it is highly likely that drought conditions will continue to worsen during the 2025 season. This suggests there remains a risk of extreme crown fire events similar to those during 2023 and 2024 NWT wildfire seasons. Most of the extremely devastating wildfires in 2014, 2015, 2023, and 2024 were drought-driven. Extreme drought conditions led to significantly reduced moisture content in live and dead vegetation, creating highly flammable conditions that allow fires to ignite and spread rapidly. The proportion of dry matter (fuel) to water (suppressant) in live foliage and twigs—the primary fuel within tree crowns—shifts from 1:1 to 2:1, making crown fuel highly flammable during drought rather than fire-resistant in non-drought seasons. When combined with the existing extremely dry ground litter, grasses, and shrubs, this increase in flammability of live crown fuel substantially raises the likelihood of extreme crown fire events. Fire control during these events can be difficult and, as demonstrated during 2014, 2015, 2023, and 2024, in many cases, impossible. Water sources across the NWT were at record lows in 2024, which also affects the availability of operational water supplies to control and extinguish fires (Figure 62). These extreme conditions of fuel and water availability, coupled with abnormally high wind speeds, air temperatures, and the resulting atmospheric instability and turbulence, can dramatically elevate wildfire hazards and health risks, thereby compromising the safety and health of firefighters and civilians.

Figure 62. Hay River Valley, Enterprise area, 2024 as one of the examples wildfire flame-front jumped over a river valley

Accuracy of operational wildfire modelling systems, essential for the efficiency and safety of forest and wildfire management during extreme wildfire seasons, can be enhanced by developing and using remote sensing tools for drought monitoring and modelling, allowing for more effective resource allocation and mitigation strategies. Although the NWT Forest Health Monitoring Program is considered one of the best in the country given the budget and size of the forested area, the ongoing warming trends and severe droughts are altering northern forest ecosystem dynamics, making current monitoring for issues like drought less effective.

As requested by ECC during the 2023 and 2024 forest health surveys, augmenting the current NWT forest health monitoring program with satellite-based remote sensing techniques should be conducted. Satellite remote sensing tools should be developed to more adequately identify and monitor drought stress and other primary forest health factors, and also to provide more comprehensive and detailed spatial data allowing for 100% spatial coverage across the NWT. These data gaps were also identified in the NWT Climate Change Baseline Report in 2022. Detailed drought monitoring spatial data will greatly improve the accuracy and efficiency of monitoring and will help identify areas where flammability of live crown fuel and correspondingly the probability of the extreme wildfire behaviour is substantially elevated. This information will enhance wildfire behavior prediction models, leading to better decisions in wildfire management, such as fire operations, resource allocation, and evacuation planning.

Among promising satellite remote sensing techniques that can be combined with regular ground and aerial forest health survey are the Normalized Difference Vegetation Index (NDVI), Climate Moisture Index (CMI), Normalized Difference Water Index (NDWI), and other near infrared- and thermal infrared-based remote sensing methods for drought monitoring and modelling. Knowledge of the current general drought conditions captured during regular ground and aerial forest health surveys are key to ensuring proper calibration and accuracy of the remotely sensed and modelled spatial drought data. Additional flight time and ground surveys for quality assurance will be required. Current surveys end in July, but drought symptoms can still develop over the following two months, leading to missed damage and severities, so an extension of surveys into the fall may be required.