Forest Health Conditions in Ontario 2021

Ministry of Northern Development, Mines, Natural Resources and Forestry

Ontario

Forest Health Conditions in Ontario 2021

Compiled by Ontario Ministry of Northern Development, Mines, Natural Resources and Forestry, Science and Research Branch.

Cover image: Forest health monitoring staff examining beech tree for signs of beech bark disease. Stock photo.

Printed in Ontario, Canada

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ISBN 978-1-4868-5876-7 (pdf)
ISSN 1913-617X (online)

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Sommaire

État de santé des forêts 2021

En 2021, le réchauffement des températures et un printemps chaud et sec peuvent avoir influencé les populations d'insectes nuisibles. Parmi les événements météorologiques notables figurent les tornades dans le sud et l'incidence accrue des incendies de forêt, surtout dans le nord-ouest de l'Ontario.

Principaux insectes nuisibles et zones où les feuilles et les aiguilles des arbres ont été consommées :

- La tordeuse de pin gris est restée présente dans le nord-ouest, mais a touché moins de zones qu'en 2020;
- La tordeuse des bourgeons de l'épinette est restée présente dans le nord-est, les zones touchées ayant presque triplé par rapport à 2020;
- La livrée des forêts a causé des dommages minimes, et elle n'a fait l'objet d'une cartographie aérienne que dans le nord-est;
- La spongieuse a continué d'augmenter dans le sud et le centre de l'Ontario, avec un nombre record de zones touchées pour la province;
- La tordeuse du tremble a diminué et se trouvait principalement dans le nord-est.

Nous avons continué de surveiller la maladie corticale du hêtre, qui est une combinaison d'un insecte envahissant (cochenille du hêtre) et d'un champignon à tige envahissant. Nous avons enregistré de nouveaux emplacements dans le nord-est.

La maladie de la feuille du hêtre a été confirmée dans le district de Peterborough, ce qui en étend l'aire de répartition. De nouveaux emplacements ont également été détectés dans les districts de Guelph et d'Aylmer. Après avoir confirmé qu'un nématode en est l'agent causal, les chercheurs étudient maintenant son mode de propagation.

De nouvelles occurrences de l'agrile du frêne envahissant ont été signalées dans la zone de quarantaine dans les districts de Pembroke, Kemptville et Parry Sound.

La fumée des feux de forêt, qui a recouvert une grande partie du nord pendant de longues périodes et ainsi nui aux observations aériennes, surtout dans le nord-ouest, a fait partie des difficultés rencontrées cette année. Le personnel de terrain a continué de travailler de façon sécuritaire en appliquant les protocoles liés à la COVID-19.

Introduction

Forest health monitoring in Ontario is conducted by the Ontario Ministry of Northern Development, Mines, Natural Resources and Forestry (NDMNRF).

The annual forest health monitoring program has five components:

- Aerial mapping of major forest disturbances to quantify the extent and severity (e.g., insect outbreaks, weather events, decline, and disease damage)
- Biomonitoring through the collection of insect and disease samples to track occurrence, changes in range or host species attacked, or changes in abundance
- Conducting special surveys for pests of interests, particularly invasive species or pests affecting high value trees, such as plantations or seed orchards
- Conducting or supporting research projects in forest entomology, pathology, or weather effects
- Establishing and surveying temporary and permanent sample plots to monitor health of select forest ecosystems

Forest health monitoring in Ontario includes documenting the occurrence of biotic (e.g., insects, disease) and abiotic (e.g., snow and drought damage) disturbances and events. All forested area in the province, regardless of ownership, is monitored and reported on each year.

In 2021, insect diagnostics were executed through a partnership among NDMNRF, the Canadian Forest Service (CFS), and the Invasive Species Centre (ISC). Samples collected by forest health monitoring program staff were identified by the ISC. The CFS provided laboratory space and access to its historical insect reference collection. Disease samples were identified at the NDMNRF's Ontario Forest Research Institute (OFRI).

Maps, tables, and graphs were produced from aerial surveys of major forest disturbances. Results from the annual monitoring program were reported provincially as part of the NDMNRF's Science Insights seminar series and nationally at the Forest Pest Management Forum (virtually) and are described in more detail in this report.

Weather patterns

Weather affects the growth, phenology (timing of life cycle stages), dispersal, and survival of forest insects. Forest pathogens, especially leaf diseases and needle cast fungi, can be more common during wet or humid periods. Also, extreme weather events such as drought, snowfall, flooding, tornadoes, microbursts, frost, freezing, scorch, and rapid temperature fluctuations can affect tree health, causing foliage or twig death, or tree decline and mortality.

In the first four months of 2021, temperatures were warmer than normal (based on 30 year averages), setting records in all three administrative regions (northwest, northeast, southern). April was very warm, with daily temperature fluctuations ranging from -12 °C to +16 °C. Precipitation varied across the province but was generally below normal, particularly in the northwest and southern regions. By the end of March, most of Southern Region had no snow on the ground and northern regions had less than 20 cm.

The next four months were slightly warmer than normal, with wide temperature swings. May was very dry in southern and northwest regions but the Northeast Region had slightly above normal levels of precipitation due to a three-day rain event in the third week of May. The hot dry days in May might have contributed to the persistence of young LDD moth larvae, and the warmer and wetter than normal days, which are conducive to LDD moth pathogens such as the fungus *Entomaphaga mamaiga*, didn't occur until June and July in Southern Region. Drier weather returned to Southern Region in August. In the northern regions, precipitation levels varied through the summer months. In Northwest Region, precipitation was below normal in June and July and above normal in August. These dry months exacerbated fire conditions in the region. In Northeast Region, precipitation levels were close to normal in June but lower than normal in July and August.

Some extreme weather events, including several tornados, occurred during the summer. Towards the end of May, two wind events occurred in Northeast Region; one was an unconfirmed tornado north of Gogama and another was a confirmed tornado (preliminary classification of EF-2 on the Enhanced Fujita (EF) scale) east of Chapleau near Little Antler Lake. In June, two tornados were reported by the Northern Tornadoes Project (NTP), one in Northwest Region on June 23 near the Sioux Lookout airport and the other in Southern Region on June 26 near Chatsworth. In July, 11 tornados were reported in Southern Region. On July 13, NTP confirmed a tornado in Penetanguishene, one northeast of Tasso Lake near Huntsville and another in Beachburg near the Ottawa River Valley. On July 15, six tornados were reported. The worst hit area was in Barrie where a preliminary rating of EF-2 resulted in winds estimated at up to 210 km per hour. Other areas with a reported tornado rating of EF-2 included Little Britain, Lorneville, Dwight, Lake Traverse, and Sunbeam Lake. On July 20, an EF-0 tornado was reported at Whitestone Lake north of Parry Sound near Dunchurch, with winds estimated at 115 km per hour. On July 24, three EF-0 tornadoes and one EF-1 tornado occurred in Southern Region. The three EF-0 tornadoes happened near Bayfield, Thornbury, and Windsor and the EF-1 tornado was near Leamington.

In 2021, the last four months were warmer than normal in Ontario, especially October. In Northwest Region, several consecutive days were above 20 °C in October. In December, temperatures in northeast and southern regions were well above normal as the month was among the top five warmest Decembers on record for the province. Overall, fall precipitation was close to normal across the province. Northwest Region had dry spells in September, October, and November but a wet December. Precipitation in Southern Region was higher than normal in October and November and closer to normal for November and December. In Northeast Region, precipitation was above normal in September and December and below normal in October and November.

In September, several tornadoes occurred in Southern Region. On September 7, tornadoes with an EF-2 rating

were recorded in Kingsbridge on the east side of Lake Huron and between Harriston and Kenilworth. Two other tornadoes (EF-0) were recorded near Vaughn and Kuhryville (north of Stratford). Farther west, an EF-0 tornado touched down in Port Elgin and an EF-1 was recorded in Southampton. On September 12, EF-1 tornadoes were observed in Parkhill (south of Grand Bend) and Ailsa Craig. As well, a microburst with maximum speeds of 120 km per hour was reported south of London near Belmont.

Extreme weather and abiotic events

With warmer temperatures and drier than normal conditions in spring 2021, early season defoliators such as LDD moth, jack pine budworm, and spruce budworm thrived in the province. The area of moderate to severe defoliation from these four insects totalled 3,428,547 ha.

In 2021, 1,198 forest fires were recorded in Ontario, a large increase from the 607 recorded in 2020. A new annual record for hectares burned in the province was set in 2021 with 793,325 ha. Most of these fires were in Northwest Region in areas where blowdown, snow damage, insect infestations, or disease had killed or damaged trees in recent years. These fires affected aerial mapping of forest disturbances, particularly in Northwest Region where smoke impeded visibility in some areas.

The area of blowdown decreased from 8,490 ha in 2020 to 704 ha in 2021 — the least area recorded in the province since 2004 when 104 ha were aerially mapped. Most of the 2021 blowdown was in Northeast Region, with small areas documented in northwest and southern regions. Due to COVID-19 restrictions, aerial mapping was focused on known areas of major forest disturbances so some blowdown in remote areas may not have been detected.

Insect infestations

The area of moderate to severe LDD moth defoliation increased from 569,384 ha in 2020 to 1,779,744 ha in 2021, the most ever recorded in Ontario. A total of 9,101 ha of light defoliation were also mapped, all in Southern Region. Most (1,703,827 ha) of the moderate to severe defoliation was aerially mapped in Southern Region, with the remainder (75,916 ha) mapped in Northeast Region. All districts in Southern Region had some LDD moth defoliation. All 10 districts had increased areas of moderate to severe LDD moth defoliation in 2021, with a new area recorded in Algonquin Provincial Park — its first during the current outbreak. Almost 70% of the moderate to severe LDD moth defoliation in Southern Region was in four districts: Peterborough (374,313 ha), Bancroft (371,806 ha), Kemptville (226,362 ha), and Midhurst (176,264 ha). The light defoliation was mainly on the edges of moderate to severe defoliation, with most of it recorded in Pembroke District (5,605 ha).

Varying levels of LDD moth pathogens, such as *Entomophaga maimaiga* and NPV (nuclear polyhedrosis virus), were noted in Southern Region. Moderate to high levels of egg parasitism were evident in Aylmer and Guelph districts where LDD moth defoliation has been recorded for the past four years. The LDD moth defoliation forecast

surveys in six districts in Southern Region projected severe defoliation for 2022 in 12 of the 16 locations surveyed, moderate defoliation in four, and light defoliation in one (Midhurst District). In Northeast Region, most of the moderate to severe defoliation was recorded in Sudbury District (68,875 ha) in and around the City of Greater Sudbury where the last outbreak of LDD moth occurred in 2014. For the second consecutive year, moderate to severe LDD moth defoliation was aerially mapped in North Bay and Sault Ste. Marie districts, with slightly higher area recorded than in 2020. For the first time, a small area of moderate to severe LDD moth defoliation was mapped in Kirkland Lake District in 2021.

For the second consecutive year, moderate to severe defoliation by jack pine budworm decreased from 1,001,269 ha in 2019 to 929,763 ha in 2020 to 346,266 ha. Most of the defoliation was in Northwest Region, with a small area in Northeast Region. The decrease in defoliation in Northwest Region was recorded in Dryden, Kenora, and Sioux Lookout districts with no defoliation recorded in Red Lake District. Moderate to severe defoliation increased considerably in Thunder Bay District, slightly in Fort Frances District, and new areas of defoliation were mapped in Nipigon District. In 2021, some (1,172 ha) jack pine budworm-caused mortality was recorded in Northwest Region. Most of this mortality was in Dryden District (828 ha), with smaller amounts in Sioux Lookout (212 ha) and Nipigon (131 ha) districts. In Northeast Region, 137 ha of moderate to severe jack pine budworm defoliation were recorded in 2021, all in Sudbury District in the Town of Espanola.

In late September 2021, jack pine budworm defoliation was forecast based on surveys of the number of overwintering jack pine budworm larvae on tree branches in northwest and northeast regions. In all, 22 locations were surveyed, 17 in Northwest Region in Dryden and Thunder Bay districts and five in Northeast Region. Results indicated that moderate levels of defoliation are forecast at seven locations in Dryden District and two locations in Thunder Bay District in 2022. Light defoliation is forecast for the remaining six locations in Dryden District and one location in Thunder Bay District. In Northeast Region, jack pine budworm defoliation forecast for 2022 is light for all survey locations.

The area of moderate to severe spruce budworm defoliation increased from 442,426 ha in 2020 to 1,302,537 ha in 2021. Area defoliated increased in Northeast Region but decreased in Southern Region relative to 2020. In Northeast Region, spruce budworm defoliation was aerially mapped in all nine districts in 2021. Areas of moderate to severe defoliation increased in all districts except Sault Ste. Marie, where it decreased slightly. The largest areas of defoliation were in Cochrane, Timmins, Sudbury, Kirkland Lake, and Chapleau districts. Increases in area of defoliation were less in Hearst, Wawa, and North Bay districts. Also mapped were 31,673 ha of tree mortality caused by spruce budworm in Northeast Region in 2021. Most of this mortality was mapped in North Bay (19,748 ha) and Chapleau (7,563 ha) districts, with the remainder dispersed among Sudbury, Timmins, Hearst, Kirkland Lake, and Cochrane districts. In Southern Region, moderate to severe spruce budworm defoliation was only mapped in Parry Sound District, decreasing from 6,869 ha in 2020 to 348 ha in 2021. Tree mortality was also observed in Southern Region in Balsam Lake Provincial Park, Peterborough District, but not aerially mapped as the mortality was sporadic, affecting few trees.

In October 2021, spruce budworm defoliation was forecast in Northeast Region based on surveys of the number of overwintering larvae on tree branches. A total of 36 locations were surveyed in Cochrane, Timmins, Hearst, Chapleau, Sudbury, and North Bay districts. Results indicated that severe defoliation would persist at 20 of these locations in 2022, with 11 locations forecast to have moderate defoliation and five locations to have light defoliation.

In 2021, 36,926 ha of moderate to severe forest tent caterpillar defoliation were recorded in Ontario after a total collapse in 2020. All this defoliation was aerially mapped in Northeast Region. Most of the defoliation was in Hearst District (26,041 ha), with smaller areas in Sudbury, Cochrane, and Timmins districts, and minimal area in Chapleau District.

Moderate to severe defoliation by large aspen tortrix decreased from 22,759 ha in 2020 to 5,486 ha in 2021. Almost all the defoliation was aerially mapped in Kirkland Lake District (5,354 ha) with a small area in North Bay District (132 ha).

After an absence of cedar leaf miner defoliation in 2020, moderate to severe defoliation reappeared in 2021 with 12,636 ha mapped in Southern Region. Most of the defoliation was in Pembroke District (9,294 ha) with the remainder in Kemptville District (3,342 ha).

Several other insects caused localized defoliation or damage in various parts of Ontario. These occurrences did not develop into provincially significant areas of defoliation but do contribute to overall effects on forest health.

Forest pathogens and tree decline

Most tree pathogens do not cause symptoms over areas large enough to be aerially mapped, except when the damage is severe. Leaf spot was observed in localized areas during ground surveys in northeast and southern regions. Several softwood needle blights were observed in Southern Region, including brown spot, dothistroma or red band, and rhizosphaera. The warmer, wetter weather in the summer may have contributed to localized infections. Damage was not widespread or aerially mapped but occurrences were noted during ground surveys in several districts. Several different types of leaf spot were observed on hardwoods in northeast and southern regions. Septoria leaf spot of white birch, trembling aspen, and balsam poplar were more common in late summer in Northeast Region while Southern Region had localized infections of leaf spot of ash and tar spot on maples.

Oak decline was aerially mapped in northeast and southern regions in 2021. The oak decline in Northeast Region was a continuation of the red oak decline observed in 2020 in Sudbury District. The decline is attributed to several factors including severe forest tent caterpillar defoliation, drought-like conditions, poor site, and a frost event. As a result, wood borers and armillaria root rot have established, causing whole tree mortality and decline. In Southern Region, oak stands in Parry Sound District were in decline due to several consecutive years of forest tent caterpillar and LDD moth defoliation.

Beech leaf disease was first reported in Ohio in 2012 and in 2017 symptoms were confirmed in Aylmer District. Since then, beech leaf disease has also been confirmed in Guelph and Aurora districts. During 2018 and 2019, ministry forest health experts worked with AgCanada and U.S. researchers to describe the nematode found in symptomatic leaves and reproduce symptoms in beech using solutions containing the nematode. They also determined how the nematode overwinters and the types of tissues that are infected during the growing season. Knowing the causal agent, they plan to investigate how the nematode is being spread locally and regionally. In 2021, beech leaf disease was confirmed in Peterborough District expanding the range of this disease. New locations were also detected in Guelph and Aylmer districts.

Invasive species

Emerald ash borer is an invasive insect that is regulated by the Canadian Food Inspection Agency (CFIA). As of June 30, 2016, the area regulated to control emerald ash borer in Ontario includes Southern Region and the southern part of Northeast Region, south of Montreal River, which is at the northern end of Sault Ste. Marie District. The City of Thunder Bay in Northwest Region is also regulated for this borer. In 2021, 610 ha of ash decline caused by emerald ash borer was aerially mapped in the southern part of Northeast Region in Sudbury and Sault Ste. Marie districts, all in the quarantined area. During ground surveys, new occurrences were found in the quarantined area in Pembroke, Kemptville, and Parry Sound districts in Southern Region.

In 2021, new occurrences of beech bark disease were observed in Northeast Region and laboratory diagnostics confirmed infections in known areas of beech bark disease in Southern Region.

Pest index — Major forest disturbances

Major forest disturbances occur when an insect, disease, or weather event affects a very large area, is not specific to a region, or has affected more than one region in the past. These disturbances, listed below, are considered of provincial significance.

Pest index — Minor forest disturbances

Minor forest disturbances are identified regionally using forest health surveys. These disturbances, listed below, could have local or regional significance to forest health conditions.

Common name	Scientific name	Type	Page
Yellowheaded spruce sawfly	*Pikonema alaskensis* (Rohwer)	Insect	130
Zimmerman pine moth	*Dioryctria zimmermani* (Grt.)	Insect	131

Pest index — Invasive forest species

Invasive forest species are insects or diseases that are not native to Ontario. Invasive species have the potential or proven ability to have deleterious effects on forest health, tree health, ecosystem functioning, or social and economic values. Invasive species found during forest health monitoring field work in Ontario in 2021 are listed below.

Common name	Scientific name	Type	Page
Beech bark disease	*Neonectria faginata* (Lohman et al.) Castl. & Rossman	Disease	18
Beech scale	*Cryptococcus fagisuga* (Linding.)	Insect	106
Birch leafminer	*Profenusa thomsoni* (Konow)	Insect	109
Emerald ash borer	*Agrilus planipennis* Fairmaire	Insect	38
European fruit lecanium	*Parthenolecanium corni* (Bouché)	Insect	113
Hemlock woolly adelgid	*Adelges tsugae* Annand	Insect	118
Imported willow leaf beetle	*Plagiodera versicolor* (Laich.)	Insect	47
Japanese beetle	*Popillia japonica* Newm	Insect	120
LDD moth	*Lymantria dispar dispar* (L.)	Insect	65
White pine blister rust	*Cronartium ribicola* J. C. Fisch.	Disease	128

Host index

Tree and shrub species mentioned in this report and their scientific names.

Common name	Scientific name
American beech	*Fagus grandifolia* Ehrh.
American elm/white elm	*Ulmus americana* L.
Ash species	*Fraxinus spp.*
Austrian pine	*Pinus nigra*
Balsam fir	*Abies balsamea* (L.) Mill.
Balsam poplar	*Populus balsamifera* L.
Basswood	*Tilia americana* L.
Black ash	*Fraxinus nigra* Marsh.
Black locust	*Robinia pseudoacacia*
Black spruce	*Picea mariana* (Mill.) BSP
Black walnut	*Juglans nigra* L.
Bur oak	*Quercus macrocarpa* Michx.
Eastern hemlock	*Tsuga canadensis* (L.) Carrière
Eastern white cedar	*Thuja occidentalis* L.
Eastern white pine	*Pinus strobus* L.
Green ash	*Fraxinus pennsylvanica* Marshall
Jack pine	*Pinus banksiana* Lamb.
Largetooth aspen	*Populus grandidentata* Michx.
Manitoba maple	*Acer negundo* L.
Norway maple	*Acer platanoides*
Pin cherry	*Prunus pensylvanica* L. f.
Red maple	*Acer rubrum* L.
Red oak	*Quercus rubra* L.
Red pine	*Pinus resinosa* Ait.
Red spruce	*Picea rubens* Sarg.

Common name	Scientific name
Scots pine	*Pinus sylvestris* L.
Silver maple	*Acer saccharinum* L.
Speckled alder	*Alnus incana spp. rugosa* (Du Roi) J. Clausen
Sugar maple	*Acer saccharum* Marsh.
Tamarack/larch	*Larix laricina* (Du Roi) K. Koch
Trembling aspen	*Populus tremuloides* Michx.
Virginia creeper	*Parthenocissus quinquefolia*
White ash	*Fraxinus americana* L.
White birch	*Betula papyrifera* Marsh.
White oak	*Quercus alba* L.
White spruce	*Picea glauca* (Moench) Voss
Wild grape	*Vitis riparia* Michx.
Willow species	*Salix spp.*

Major forest disturbances

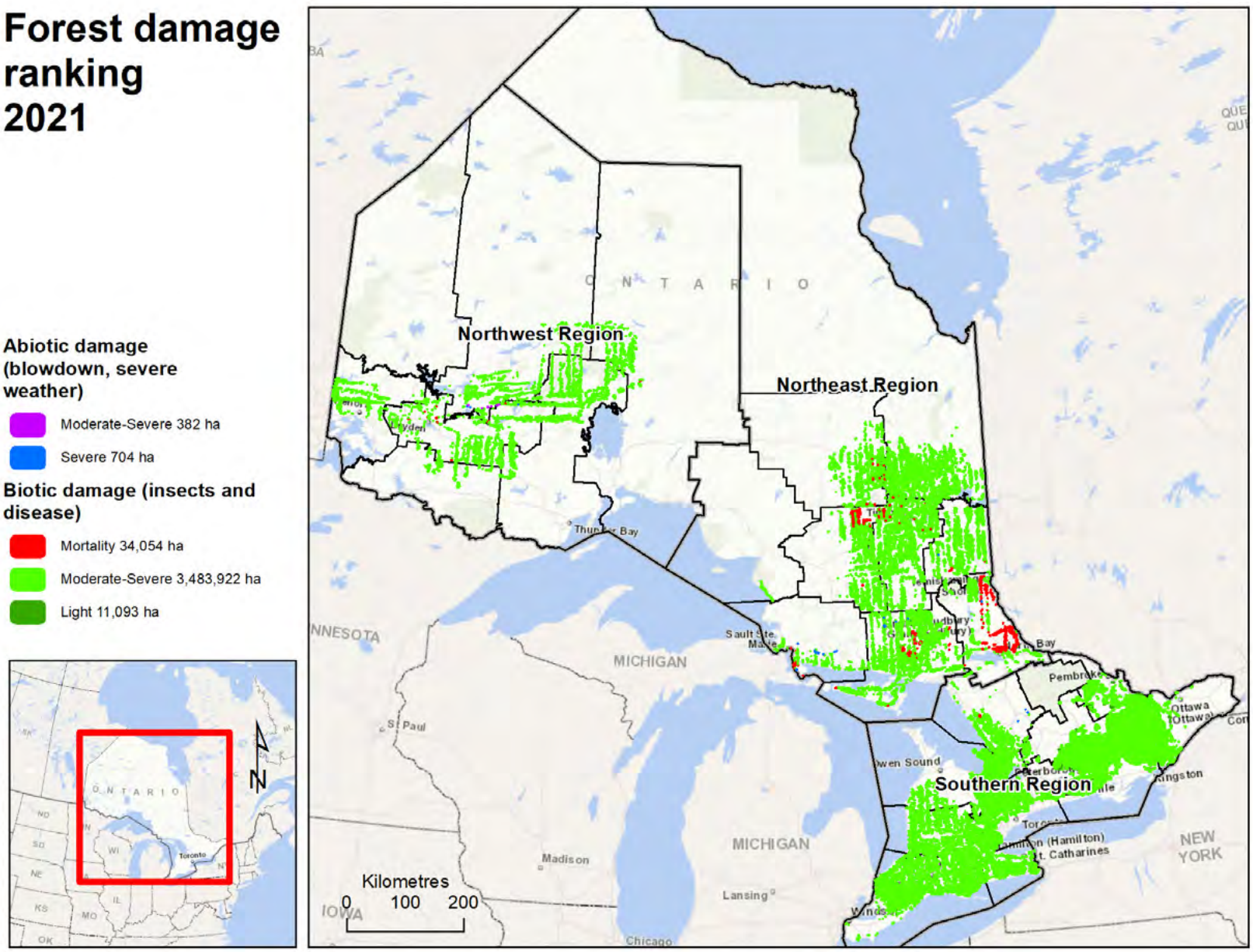
Mapped area

Major forest disturbances are mapped to quantify annual status and support trend analysis. The following table outlines area (in hectares) of mapped defoliation/damage by severity class for major disturbances in 2021.

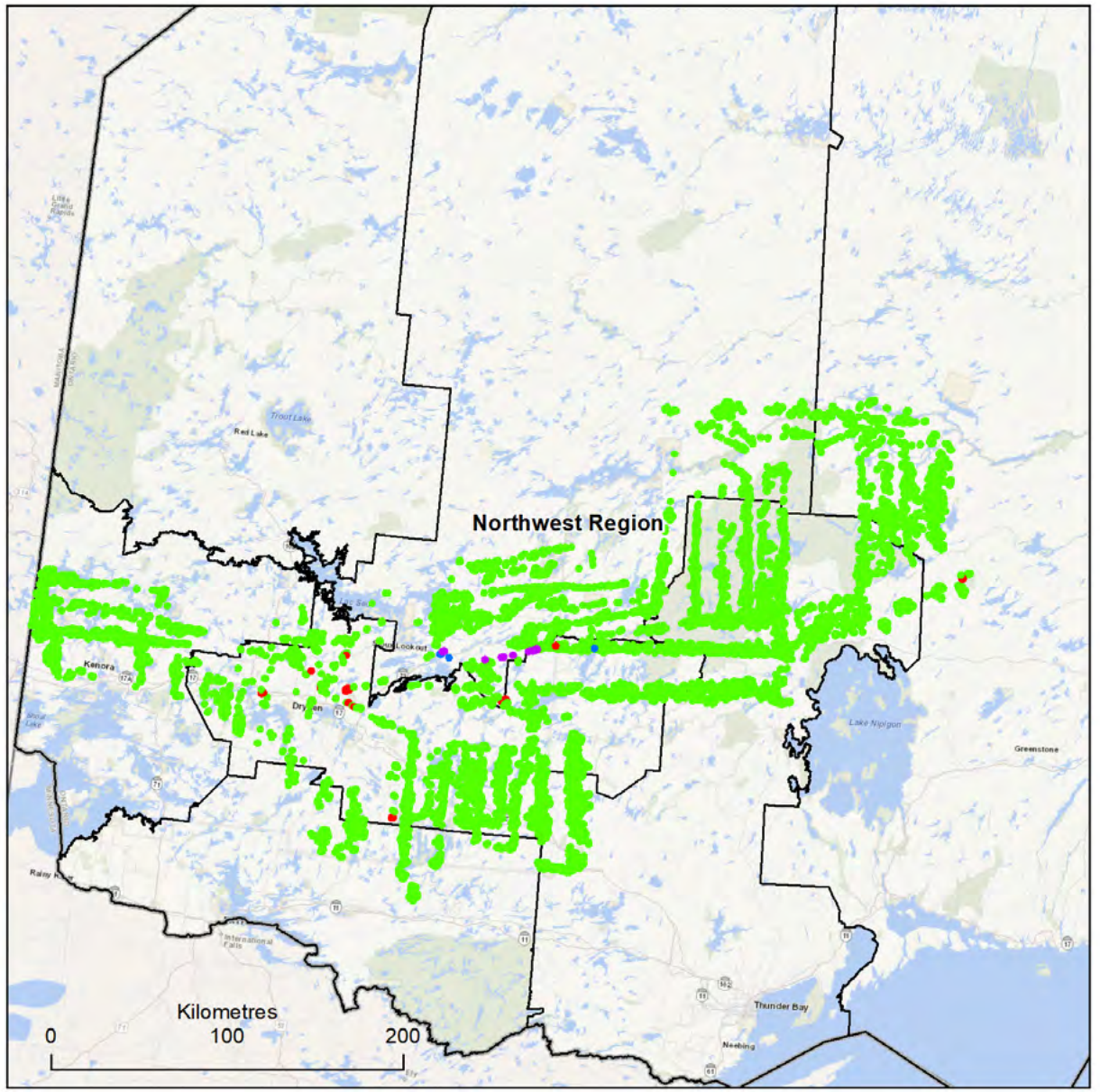
Common name	Light	Moderate to severe	Tree mortality	Total
Blowdown	0	704	NA	704
Brown spot needle blight	0	327	NA	327
Cedar leafminer	1,992	12,636	NA	14,628
Emerald ash borer		610	NA	610
Forest tent caterpillar	0	36,926	NA	36,926
Imported willow leaf beetle	0	14	NA	14
Jack pine budworm	0	346,266	1,172	347,438
Large aspen tortrix	NA	5,486	NA	5,486
LDD moth	9,101	1,779,744	NA	1,788,845
Oak decline	NA	NA	300	300
Spruce budworm	NA	1,302,537	31,673	1,334,210
Whitespotted sawyer beetle	NA	NA	300	300

Major forest disturbances maps

Provincial overview



Northwest Region Forest damage ranking 2021



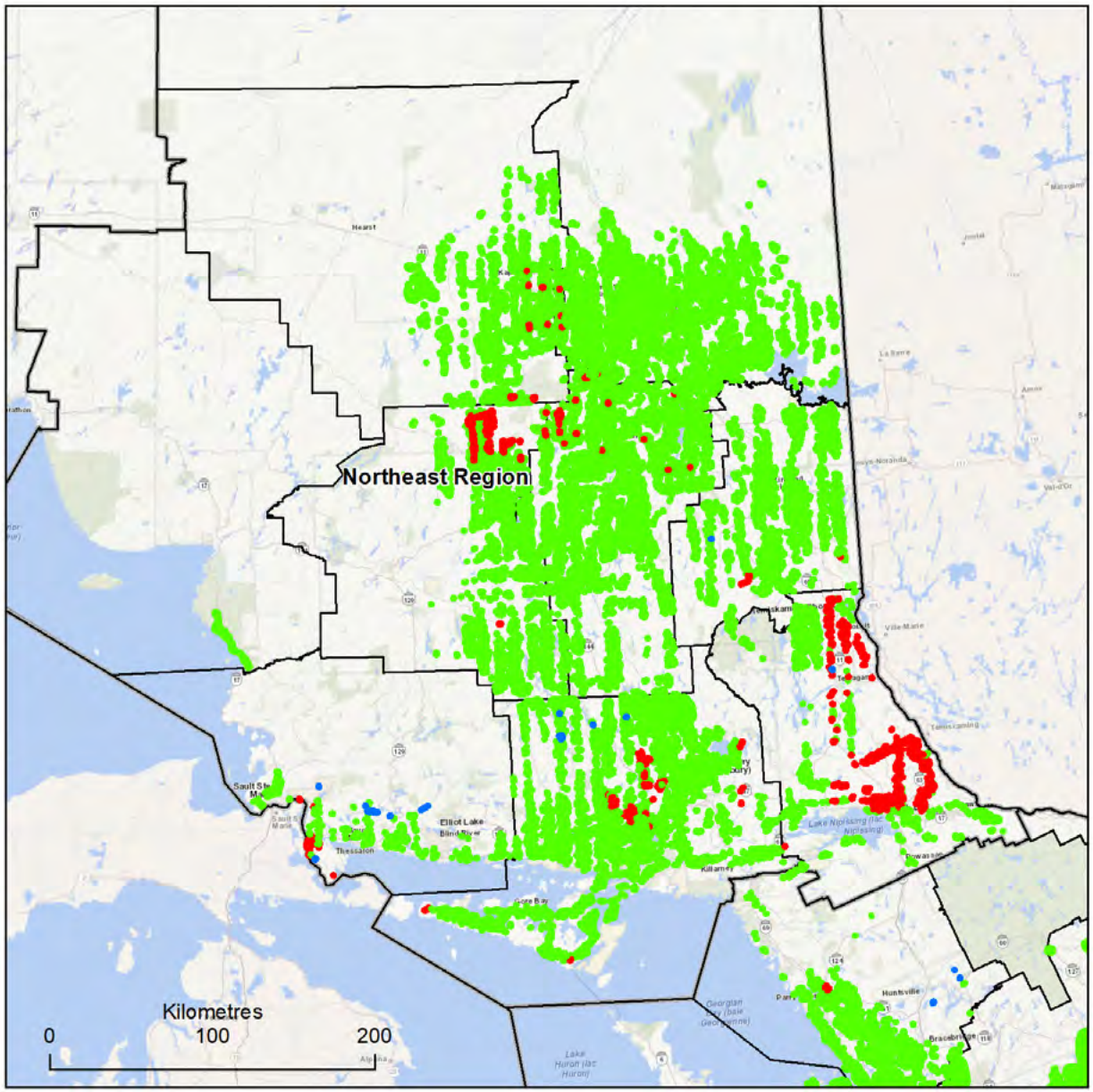
Abiotic damage (blowdown, severe weather)

- Moderate-Severe 382 ha
- Severe 37 ha

Biotic damage (insects and disease)

- Mortality 1,172 ha
- Moderate-Severe 346,129 ha

Northeast Region Forest damage ranking 2021



Abiotic damage (blowdown, severe weather)

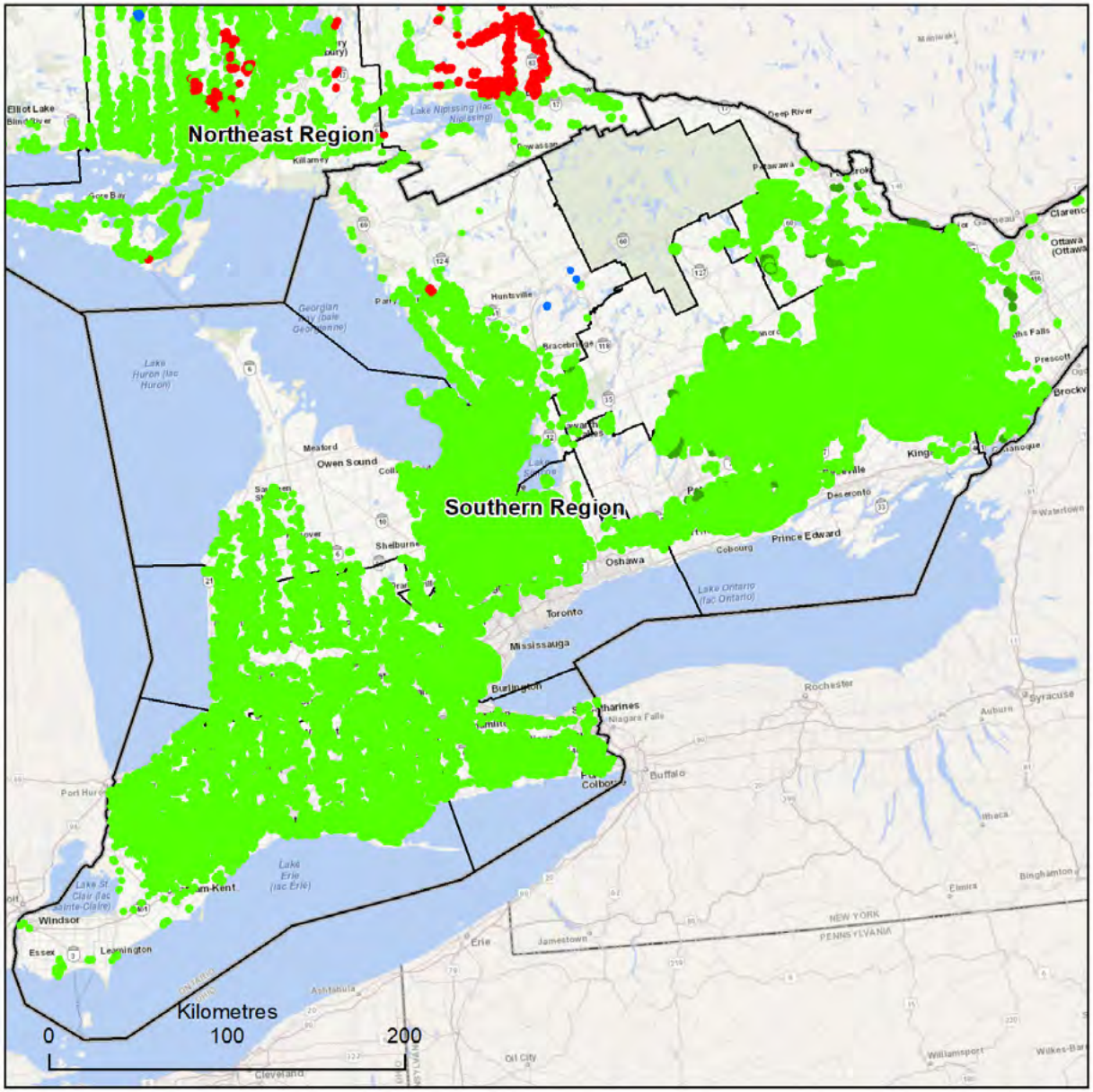
Severe 604 ha

Biotic damage (insects and disease)

Mortality 32,625 ha

Moderate-Severe 1,420,655 ha

Southern Region Forest damage ranking 2021



Abiotic damage (blowdown, severe weather)

- Severe 63 ha

Biotic damage (insects and disease)

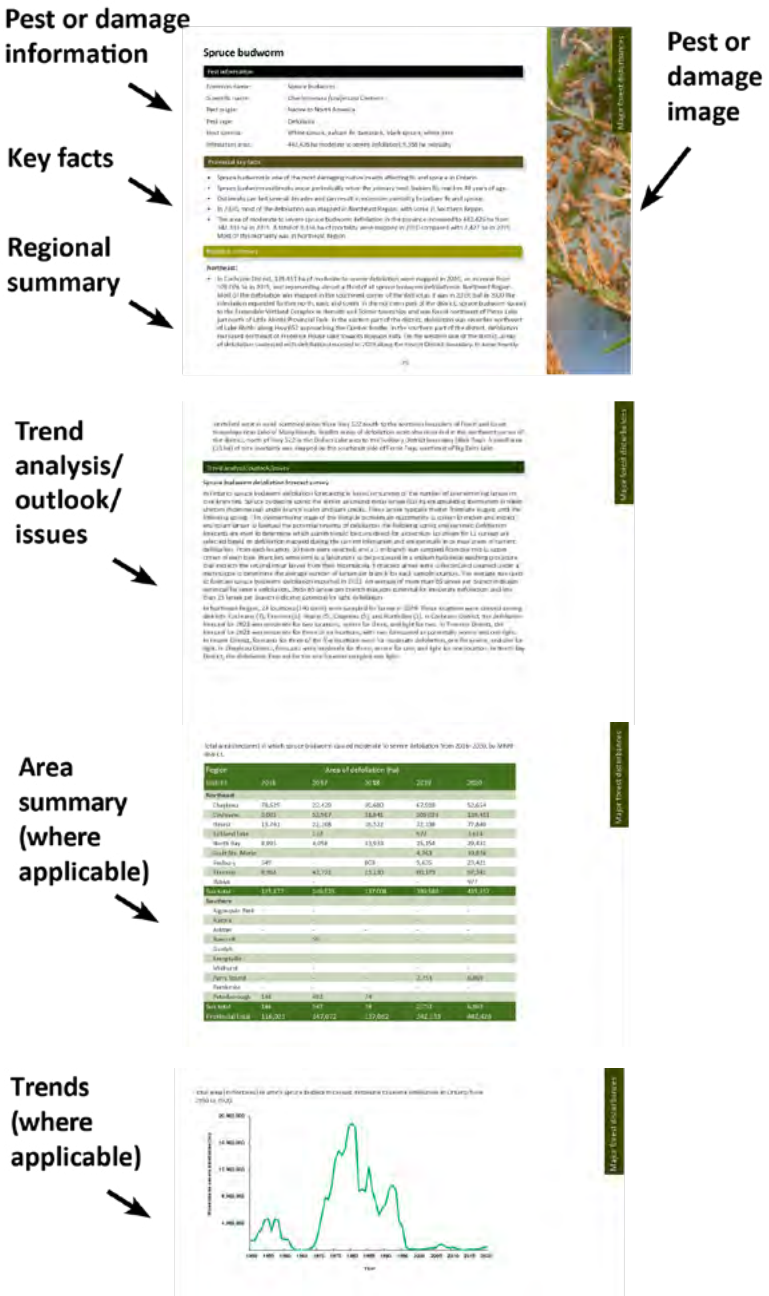
- Mortality 258 ha
- Moderate-Severe 1,717,138 ha
- Light 11,093 ha

Example report

How to read a major disturbance report

Each report summarizes information about an event or disturbance affecting the health of Ontario's forests, including some or all of:

- **Pest/damage information** – basic information about the disturbance, including the type, origin, host species, and area affected that year
- **Key facts** – overview of the disturbance, including provincial scale information about the disturbance, possible effects, and annual activity
- **Regional summary** – regional summaries, outlining more specific information by NDMNRF administrative region (Northwest, Northeast, Southern)
- **Image** – a photo of the disturbance or pest
- **Outlook** – where applicable, an overview of potential future implications and developments for the disturbance
- **Trends** – where applicable, additional information about possible trends
- **Area summary** – where applicable, information about the total area in which the disturbance caused moderate to severe damage from 2017 to 2021 by NDMNRF region and district.



Example map

How to read the maps in this report

For major disturbances, the following spatial information is provided:

- **Damage map** – shows the areas of infestation or damage. Light damage is typically shown in orange, moderate to severe damage in red, and mortality in yellow. Smaller areas are outlined in pink to make them stand out.
- **Image** – photo of the disturbance or pest
- **Legend** – describes map features
- **Extent map** – map of Ontario with the focal area outlined in deep red

Beech bark disease

Pest information

Common name:	Beech bark disease
Scientific name:	*Neonectria faginata* (Lohman, Watson & Ayers) Castl. & Rossman*, N. ditissima* (Tul. & Tul.) Samuels & Rossman
Pest origin:	Invasive – native to Europe
Pest type:	Disease
Host species:	American beech
Infestation area:	Localized

Provincial key facts

- Beech bark disease is the result of an insect-fungal pathogen complex initiated by the infestation of beech scale *(Cryptococcus fagisuga)* on American beech.
- As the insect and fungus become established in a stand, they reduce growth, deform trees, decrease wood quality and mast production, and may cause early tree death.
- Beech bark disease has been identified across the range of beech in Ontario, as far north as St. Joseph Island, Sault Ste. Marie District.
- Three distinct phases of beech bark disease development are evident in Ontario:
    - Advancing front: Beech scale populations have recently colonized unaffected beech trees. Scale infestations combined with other stressors can contribute to beech decline.
    - Killing front: Scale populations build rapidly, and the fungus colonizes trees. The killing front is characterized by high tree mortality.
    - Aftermath forest: The disease has passed through and remains endemic. Large remnant trees continue to decline and young trees become infected, disfigured, and gradually decline.
- Forest health staff continue to monitor and collect information about new occurrences of beech bark disease during general surveys. In 2021, new locations were identified in Northeast Region and the database of confirmed infections in Southern Region was updated.

Regional summary

Northeast

- In North Bay District, beech bark disease was observed on Legrou Lake Road, (East Mills Twp.), South River Road, Rye Road (Nipissing Twp.), and MacBrian's Road (Calvin Twp.). Coalescent cankers were observed in all these areas except MacBrian's Road (Calvin Twp.). Only one tree in each area was observed to have the cankers. Fruiting bodies were observed on Rye Road and MacBrian's Road. Trace to moderate amounts of beech scale were also found on nearby beech trees, primarily on larger diameter stems with few smaller diameter stems affected.

Southern

- In Aylmer District, fruiting bodies and cankers were detected on a single, large diameter beech tree at Hawk Cliff Woods near Port Stanley (Elgin County). Mature beech trees at this location have been declining over several years and as of fall 2021 beech bark disease was confirmed at this location. Moderate to heavy beech scale and severe beech leaf disease symptoms were also observed at Hawk Cliff Woods.
- In Guelph District, old cankers were detected along the bole of two larger diameter trees in an upland forest near the Glanbrook Landfill in the city of Hamilton. Beech scale ranging from trace to light levels as well as trace to moderate beech leaf disease symptoms were detected.
- In Midhurst District, severe beech bark disease symptoms were observed on one large diameter tree south of Kemble (Grey County). No beech scale was observed at this site. West of Holland Centre on Sideroad 20 (Grey County), two large canopy trees were recorded with severe beech bark disease symptoms and moderate levels of beech scale. Fruiting bodies of *Neonectria faginata* were detected on three intermediate trees in Spirit Rock Conservation Area, north of Wiarton in Bruce County. Symptoms were severe.
- In Parry Sound district, moderate to severe beech bark disease was confirmed on Bear Lake Road (east of Dorset), South Crane Lake Road (west of MacTier), Tribble Road (north of Skeleton Lake), and Bon Echo Road (south of Hooton Lake). Beech snap and beech mortality were observed in other trees in the stand. At Bear Lake Road, Tribble Road, and Bon Echo Road, beech bark disease cankers on larger trees were coalescing.

Beech leaf disease

Pest information

Common name:	Beech leaf disease
Scientific name:	NA
Pest origin:	Unknown
Pest type:	Nematode (*Litylenchus crenatae sp. Mccannii*)
Host species:	American beech
Infestation area:	Localized

Provincial key facts

- Beech leaf disease was first identified in the United States in Lake County, Ohio, in 2012 and has since been detected west from southwestern Ontario, east to Connecticut, north to Maine, and south to Virginia. In Ontario, it occurs along the shores of Lake Erie and Lake Ontario.
- Symptoms of beech leaf disease were first confirmed in southern Ontario in 2017 in Aylmer District.
- The primary symptom is striping, or banding, caused by the thickening of leaf tissue between veins. Severely affected leaves have yellowed bands and are coarse and curled. Early leaf drop of severely affected leaves and bud abortion make tree crowns appear thin.
- It is not known if the nematode is the sole causal agent or part of a disease complex.
- Beech leaf disease symptoms have been confirmed in Southern Region in locations across Aylmer and Guelph districts, and at one location in Aurora District.
- In 2021, beech leaf disease was confirmed in Peterborough District, expanding the known range in Ontario. New locations were detected in Guelph and Aylmer districts.

Regional summary

Southern

- In Aylmer District, beech leaf disease has now been identified in all counties, with new detections in some counties and municipalities. In Elgin County, moderate beech leaf disease symptoms were detected in several areas of West Elgin. Light symptoms were detected in understory and suppressed beech in a hardwood forest stand on Silver Clay Line near Rodney. Symptoms were also detected in a block of forest on Kerr Rd. west of West Lorne, but assessment of symptoms was challenging due to moderate to severe defoliation by LDD moth earlier in the season. In the Municipality of Chatham-Kent, moderate leaf symptoms were detected on understory beech at Walter Devereaux Conservation Area north of Ridgetown. In Oxford County, moderate to severe symptoms were detected on understory trees and on lower branches of overstory trees at Vansittart Woods, northeast of Woodstock.
- In Guelph District, symptoms of beech leaf disease were observed in Dundas Valley Conservation Area, north of Ancaster in the City of Hamilton. Several young, understory beech trees with severe symptoms were detected alongside a recreation trail. Light to moderate symptoms were also observed scattered in the forest understory. No symptoms were detected in overstory beech trees in the area. This represents the first detection of beech leaf disease in the City of Hamilton. In Haldimand County, severe beech leaf disease symptoms were detected in a forest near Varency. Symptoms were reported in beech trees in the overstory and understory. In Niagara Region, moderate beech leaf disease symptoms were detected near Ridgeway in Fort Erie. Symptoms were observed affecting understory, suppressed and overstory beech.
- In Peterborough District, symptoms of beech leaf disease were observed at Ferris Provincial Park in Campbellford, Northumberland County. The level of damage was light, with banding and crinkled leaves observed on four understory trees.

Trend analysis/outlook/issues

Work on beech leaf disease is ongoing and involves numerous partners. Now that a causal agent has been identified, the ministry plans to investigate how the nematode is being spread locally and regionally. In 2021, the ministry participated in the development of a highly sensitive DNA-based test to improve nematode detection. In 2019, a plot network was established to monitor effects of beech leaf disease on forests with and without beech bark disease. Mortality of understory beech trees is expected as well as changes in plant communities as more light reaches the forest floor. A research article about the 2019 survey is available in a 2021 issue of the journal Forest Ecology and Management.

Future monitoring in Ontario will be focused on determining if beech leaf disease will spread into the Great Lakes-St. Lawrence forest. The effect of beech leaf disease on beech bark disease affected forests in the Great Lakes-St. Lawrence remains unknown. Beech bark disease has severely affected this forest, resulting in the death of mature, overstory beech and increased numbers of immature beech that later become infected. This contrasts with beech in the Carolinian forest where much less damage is evident.

Two beech leaf disease monitoring studies were underway in 2021. One study was the continuation of the long-term beech health assessment plots in Aylmer and Guelph districts to determine the effects of beech leaf disease, beech scale, and beech bark disease on the health of beech trees and beech forests in Ontario. The second was a new pilot study to identify potential insect spreaders of the *Litylenchus crenatae mccannii* (LCM) nematode associated with beech leaf disease. This work involved establishing and monitoring Lindgren traps and collecting leaf/bud samples in Aylmer, Aurora, Peterborough, Kemptville, and Parry Sound districts as well as broad survey sampling of potential insect spreaders across all districts in southern Ontario and areas of Sudbury District.

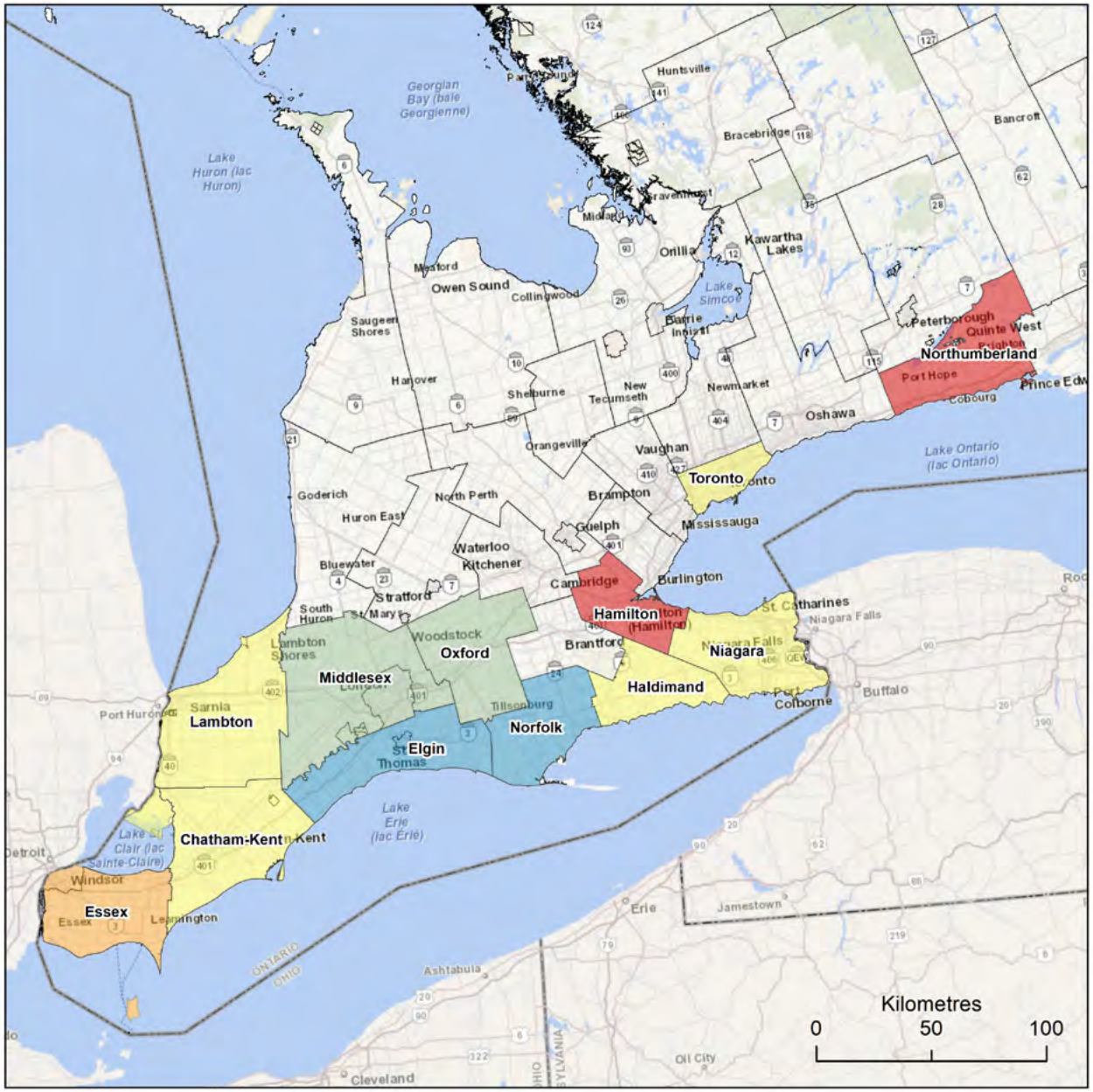
Future monitoring in Ontario will be focused on determining if beech leaf disease will spread into the Great Lakes-St. Lawrence forest. The effect of beech leaf disease on beech bark disease affected forests in the Great Lakes-St. Lawrence remains unknown. Beech bark disease has severely affected this forest, resulting in the death of mature, overstory beech and increased numbers of immature beech that later become infected. This contrasts with beech in the Carolinian forest where much less damage is evident.

Beech leaf disease in Ontario

Upper and single tier municipalities where beech leaf disease has been confirmed

Year of detection

- 2017
- 2018
- 2019
- 2020
- 2021



Blowdown

Pest information

Common name:	Blowdown
Scientific name:	NA
Pest origin:	NA
Pest type:	Abiotic
Host species:	Variable
Infestation area:	704 ha

Provincial key facts

- Blowdown, damage to trees caused by high winds or extreme weather events, is a natural disturbance process in forests. The extent and frequency of such damage is sporadic.
- Less area of blowdown was recorded in 2021 (704 ha) than in 2020 (1,466 ha). In 2021, localized areas of blowdown were found in all three regions, with the most area (604 ha) in the northeast. Note that due to COVID-19 restrictions, aerial mapping was focused on known areas of major forest disturbances so some blowdown in remote areas may not have been detected.

Regional summary

Northeast

- In Sault Ste. Marie District, 364 ha of blowdown were mapped. Most of this can be attributed to a storm on August 11. Heavy rain, strong winds, and hail occurred across the southern part of the district causing trees to be uprooted, snapped, and bent. The Northern Tornadoes Project (NTP) reported an EF-2 (Enhanced Fujita scale) in the Dunn's Valley area and an EF-1 north of Constance Lake. The severest damage was recorded north and south of Dunns Valley along the Dunns Valley, Shaw, and Franklin roads (Galbraith and Haughton townships), along Hwy 546 (Little White River Road) north of Constance Lake (Nouvel Twp), and on St. Joseph Island by Kentvale. Smaller and less severe damage was observed in the Sailors Encampment area in the northwest and along the south end of Baseline, in the southeast corner of theI island. A small area of

blowdown was also obseved near Basswood Lake at the junction of Melwel Road and Dunn Farm Trail. Trees were blown over in an easterly direction, with both hardwood and softwood trees affected. More damage from this storm may be recorded in 2022 as the damage from 2021 was mapped from the road. From a separate event, a small area of blowdown was mapped on the north end of a small lake between Garden River and Echo Lake on the southwest side of Kehoe Twp. Red maple, sugar maple, eastern white cedar, and eastern hemlock were blown down.

- In Sudbury District, small areas of blowdown totalling 188 ha were mapped in the northwest corner of the district. Most of the blowdown was south of Mozhabong Lake on the west side of Dusty Lake in Hotte Twp. Small areas of blowdown were also mapped east of Pogamasing Lake (Morse Twp) and on an island in Onaping Lake (Emo Twp).
- In North Bay District, 39 ha of blowdown were mapped north of Temagami between Net Lake and Red Squirrel Road.
- In Kirkland Lake District, 13 ha of blowdown were mapped southwest of Matachewan, on the east side of Mistinikon Lake (Yarrow Twp).

Southern

- In Parry Sound District, three small areas (63 ha) of blowdown were mapped on the southeast side of the district. The largest area was south of Huntsville, east of Mary Lake, near the junction of Muskoka Road 10 and Muskoka Road 2 (Brunel Road). The other two areas of blowdown were closer to Algonquin Provincial Park: one northwest of Oxtongue River Ragged Falls Provincial Park between Helve and Seventeen Mile lakes and the other, a little farther north between Rebecca and Bella lakes on the north side of Muskoka Road 8.

Northwest

- In Sioux Lookout District, a severe storm occurred on June 23 in Sioux Lookout. According to the weather station at Sioux Lookout Airport, wind gusts were up to 111 km per hour. Trees snapped and were uprooted and two areas of blowdown, totalling 30 ha, were mapped southeast of the town. South of the airport, blowdown was recorded between the Canadian National train track and Cornerstone Lane and on the south side of Abram Lake, east of David Lake along Shore Drive. Due to smoke from forest fires, the full extent of the blowdown was difficult to map and further damage could be recorded in 2022.
- In Dryden District, 7 ha of blowdown were mapped. The affected area was south of the community of Savant Lake between South and Sturgeon lakes near the junction of Geo and Vista roads.

Total area (in hectares) in which blowdown caused moderate to severe damage from 2017 to 2021, by NDMNRF district.

Region	Area of damage (ha)				
District	2017	2018	2019	2020	2021
Northeast					
Chapleau	697	653	1,238	-	-
Cochrane	84	-	-	38	-
Hearst	25	36	24	-	-
Kirkland Lake	140	123	-	-	13
North Bay	-	-	-	-	39
Sault Ste. Marie	10	-	25	-	364
Sudbury	326	11	-	-	188
Timmins	83	-	207	55	-
Wawa	-	133	254	-	-
Subtotal	1,365	956	1,748	93	604
Northwest					
Dryden	31	497	-	-	7
Fort Frances	319	113	-	1,169	-
Kenora	30	-	-	-	-
Nipigon	-	-	-	-	-
Red Lake	227	1,120	2,832	-	-
Sioux Lookout	468	1,032	3,188	204	30
Thunder Bay	-	9	-	-	-
Subtotal	1,075	2,771	6,020	1,373	37
Southern					
Algonquin Park	-	-	-	-	-
Aurora	-	-	-	-	-
Aylmer	-	-	-	-	-
Bancroft	-	-	-	-	-
Guelph	-	-	-	-	-
Kemptville	-	-	77	-	-

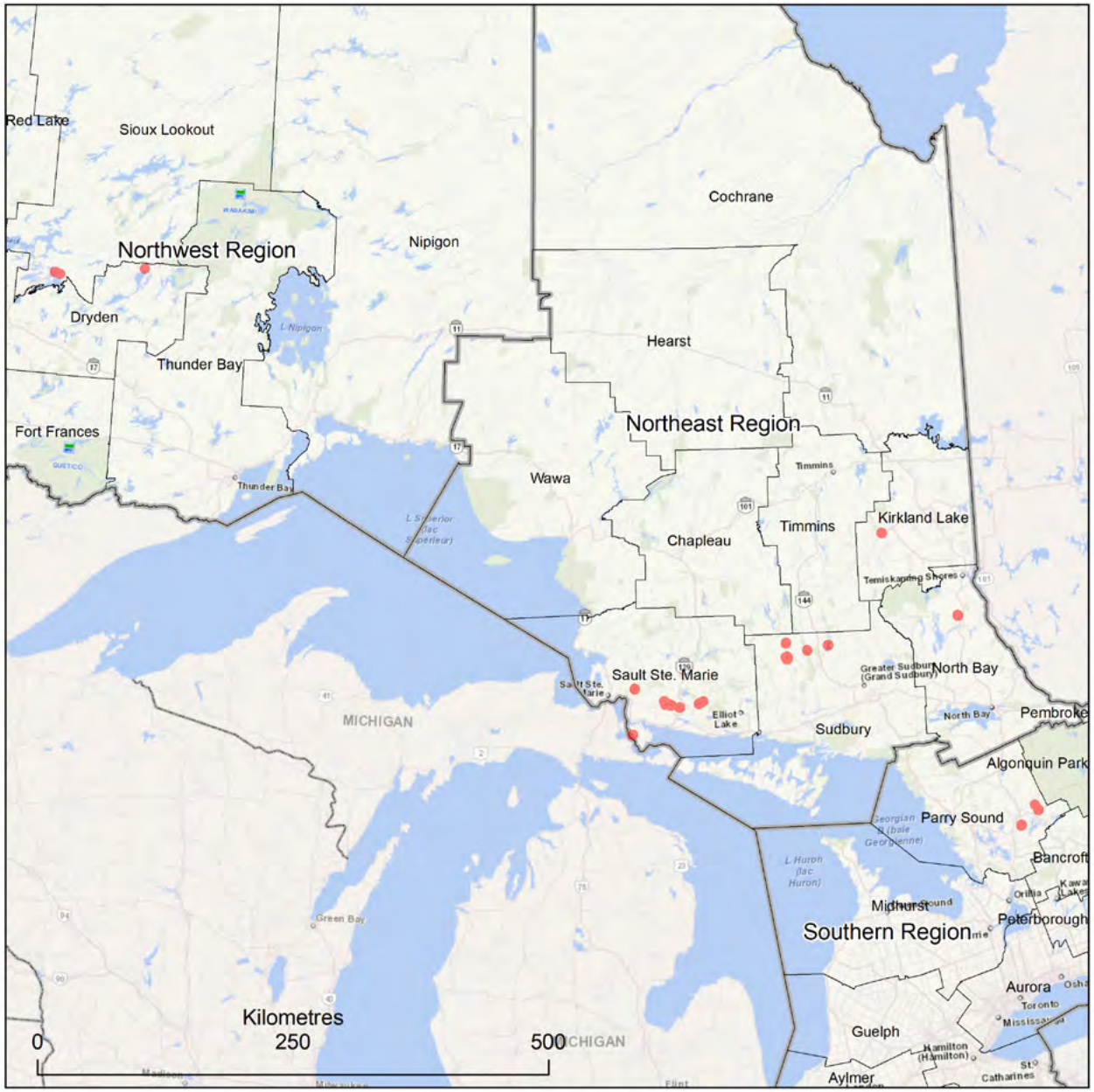
District	2017	2018	2019	2020	2021
Midhurst	-	-	-	-	-
Parry Sound	-	14	-	-	63
Pembroke	-	98	645	-	-
Peterborough	-	-	-	-	-
Subtotal	0	112	722	0	63
Provincial total	2,439	3,839	8,490	1,466	704

Blowdown 2021

Areas in Ontario where blowdown caused damage

Severe = 704 ha

Area of severe damage

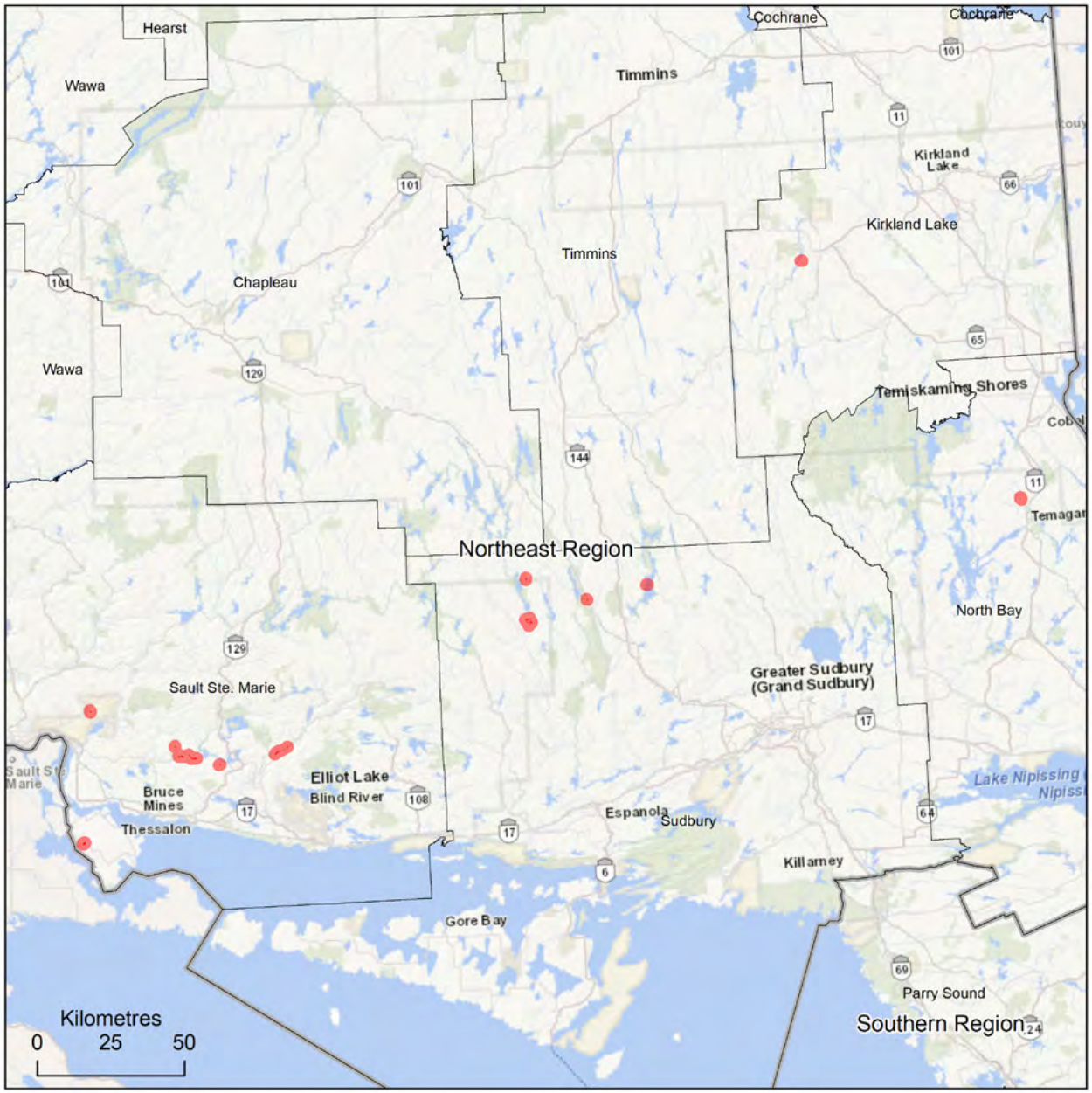


Blowdown 2021

Areas in Northeast Region where blowdown caused damage

Severe = 604 ha

Area of severe damage



Blowdown 2021

Areas in Southern Region where blowdown caused damage

Severe = 63 ha

Area of severe damage

Blowdown 2021

Areas in Northwest Region where blowdown caused damage

Severe = 37 ha

Area of severe damage

Brown spot needle blight

Pest information

Common name:	Brown spot needle blight
Scientific name:	*Lecanosticta acicola* (M.E. Barr)
Pest origin:	Native
Pest type:	Needle blight
Host species:	Scots pine, eastern white pine, red pine, Austrian pine
Infestation area:	327 ha

Provincial key facts

- This disease affects Scots and Austrian pine of all ages but is most damaging to seedlings and smaller trees.
- Several years of infection by brown spot needle blight reduces tree growth. Coupled with other factors, such as drought and secondary insect attack, this blight may result in branch and tree mortality.
- In some affected locations, previous years' needles turn brown and drop in June, leaving only current years' shoots on trees.
- In 2021 brown spot needle blight was recorded during aerial and ground surveys in Southern Region.

Regional summary

Southern

- In Parry Sound District, a total of 327 ha of moderate to severe brown spot needle blight damage were mapped southeast of Bracebridge near Hwy 118 and along Muskoka District Road 47, west of Bardsville. Damage included needle discolouration and thinning foliage.
- In Midhurst District, moderate damage from brown spot needle blight was detected in Scots pine plantations and on young fringe pines around Simcoe County Trail – Brentwood Tract, west of Borden in Adjala-Tosorontio Twp. Severe damage was also detected around Petrel Point Nature Reserve in South Bruce Peninsula. Several dead and dying fringe and open-grown Scots pine trees were affected. On some trees only current year needles remained.

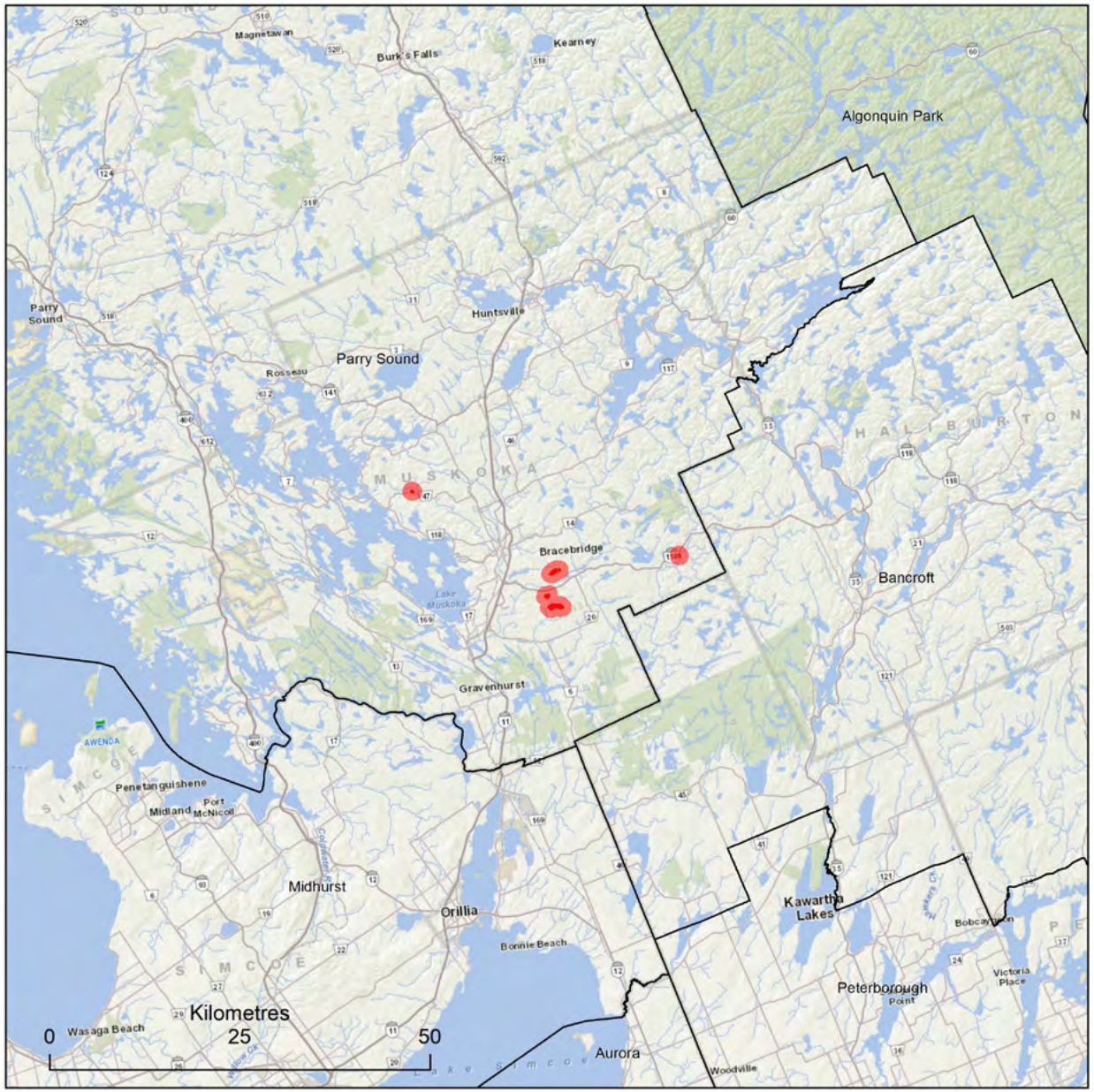
- In Bancroft District, brown spot needle blight caused moderate to severe damage to scattered Scots pine stands along Hwy 35 from Coboconk to Moore Falls. Brown spot needle blight also caused moderate to severe damage on open-grown mature Scots pine in the communities of Minden and Haliburton.

Brown spot needle blight 2021

Areas in Ontario where brown spot needle blight caused defoliation

Moderate to severe = 327 ha

Area of moderate to severe defoliation



Cedar leafminer complex

Pest information

Common name:	Cedar leafminer complex
Scientific name:	*Argyresthia aureoargentella* Brower, *Argyresthia canadensis* Freeman, *Argyresthia thuiella* (Peck), *Coletechnites thujaella* (kft.)
Pest origin:	Native to North America
Pest type:	Defoliator
Host species:	Eastern white cedar
Infestation area:	12,636 ha moderate to severe defoliation, 1,992 light defoliation

Provincial key facts

- Cedar leafminer complex is a group of similar insects that mine cedar foliage, including:
  - *Argyresthia aereoargentella* Brower
  - *Argyresthia canadensis* Freeman
  - *Argyresthia thuiella* (Pack)
  - *Coletechnites thujaella* (Kft.)
- The last large-scale cedar leafminer outbreak occurred in Southern Region from 2002 to 2007, resulting in high amounts of crown dieback and whole tree mortality.
- In 2021, small areas of moderate to severe and light cedar leafminer defoliation were mapped in Pembroke and Kemptville districts.

Regional summary

Northwest

- In Pembroke District, 9,294 ha of moderate to severe cedar leafminer defoliation were aerially mapped in three areas in the southern part of the district. On the southwest side of the district, two large areas of defoliation were recorded near the Bancroft District boundary along highways 515 and 514 from Combermere, Madawaska Valley Twp to Hardwood Lake, Brudenell-Lyndoch-Raglan Twp. In the southeast part of the district, smaller more scattered areas of moderate to severe defoliation were mapped between Renfrew and Calabogie

- in Admaston/Bromley and Madawaska townships. A little farther north, the third area of moderate to severe defoliation was made up of small and scattered areas of defoliation between Lake Dore and Constant Lake in North Algona Wilberforce and Bonnechere Valley townships. A total of 1,381 ha of light defoliation were mapped in two areas on the southeast side of Pembroke District. One large area was between Castelford and Braeside (Horton and McNabb/Braeside townships) along Lac des Chats near the Quebec border and the other was south of the City of Pembroke near Mud Lake, Laurentian Valley Twp.
- In Kemptville District, 3,342 ha of moderate to severe cedar leafminer defoliation were mapped. Most of the defoliation was mapped as small areas in the southwest corner of the City of Ottawa from Muns to Baxter's Corners and southward to Roger Stevens Drive. One small area of moderate to severe defoliation was also mapped south of the Village of Lanark along Highway 511, Lanark County. Light defoliation (611 ha) was recorded beside more severely defoliated areas near the junction of Dwyer Hill Road and Via Rail in the southwest parts of the City of Ottawa. During ground surveys, moderate to severe defoliation was observed from Actons Corners south to Hutchins Corners along County roads 25 and 18, North Grenville Twp. Light defoliation was observed in various locations throughout Augusta and Merrickville-Wolford townships.

Total area (in hectares) in which cedar leafminer caused moderate to severe defoliation from 2017 to 2021 by NDMNRF district.

Region	Area of damage (ha)				
District	2017	2018	2019	2020	2021
Northeast					
Dryden	-	-	-	-	-
Fort Frances	924	366	-	-	-
Kenora	-	-	-	-	-
Nipigon	-	-	-	-	-
Red Lake	-	-	-	-	-
Sioux Lookout	-	-	-	-	-
Thunder Bay	-	-	-	-	-
Subtotal	924	366	0	-	-
Southern					
Algonquin Park	-	-	-	-	-
Aurora	184	2,709	-	-	-
Aylmer	-	-	-	-	-

District	2017	2018	2019	2020	2021
Bancroft	130	98	-	-	-
Guelph	602	4,396	-	-	-
Kemptville	1,822	500	226	-	3,342
Midhurst	1,124	17,852	-	-	-
Parry Sound	44	-	-	-	-
Pembroke	-	-	-	-	9,294
Peterborough	1,073	527	118	-	-
Subtotal	4,979	26,082	344	-	12,636
Provincial total	5,903	26,448	344	-	12,636

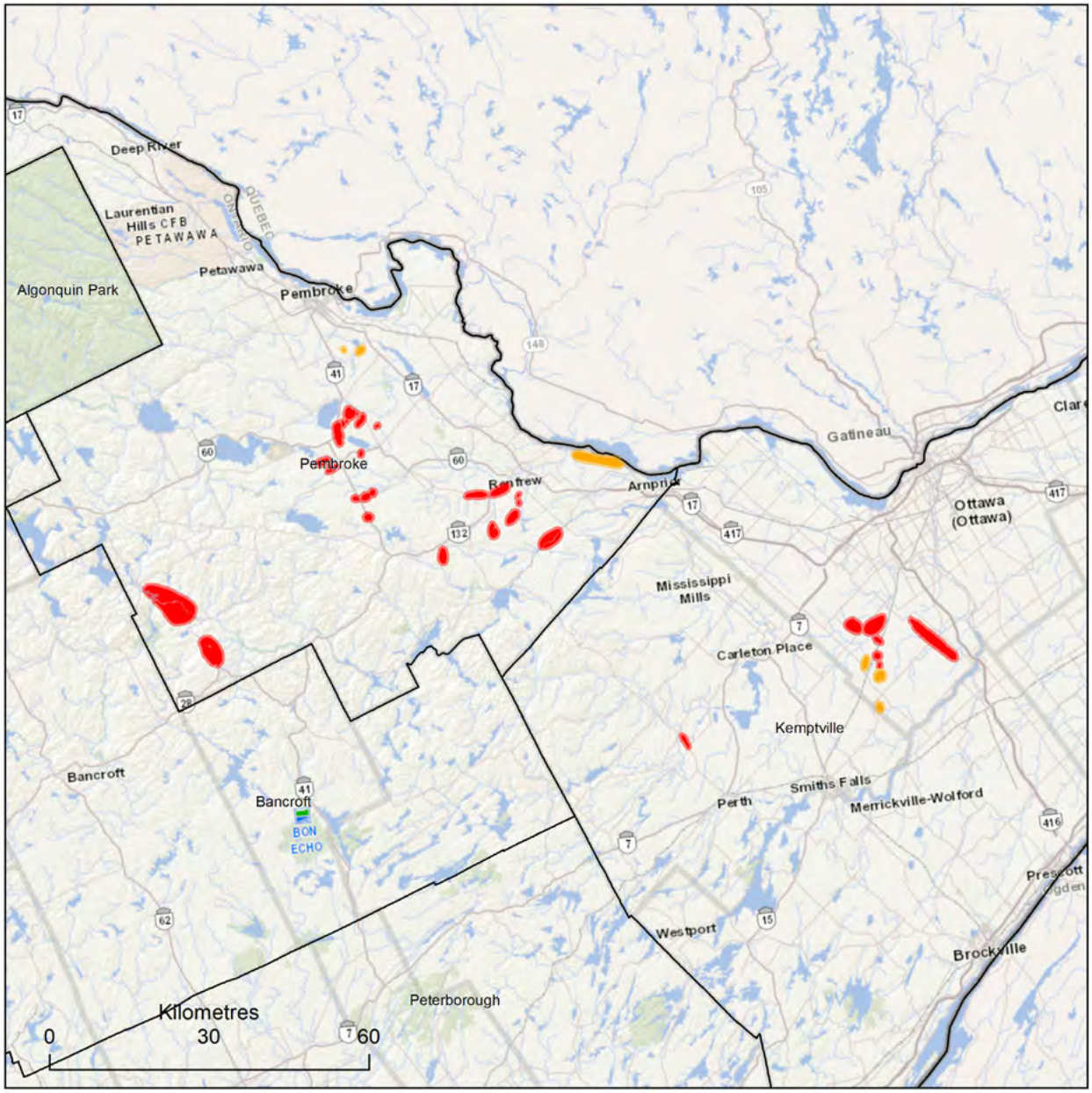
Cedar leafminer 2021

Areas in Ontario where cedar leafminer caused defoliation

Light = 1,992 ha
Moderate to severe = 12,636 ha

Area of light defoliation

Area of moderate to severe defoliation



Emerald ash borer

Pest information

Common name:	Emerald ash borer
Scientific name:	*Agrilus planipennis* (Fairmaire)
Pest origin:	Invasive - native to Asia
Pest type:	Wood borer
Host species:	Ash species
Infestation area:	610 ha

Provincial key facts

- Since it was detected in Windsor in 2002, emerald ash borer has been a major threat to ash in Ontario.
- Since 2002, emerald ash borer has spread east to Ottawa and north to Sault Ste. Marie and Thunder Bay.
- This beetle is expected to spread across the entire range of ash, causing widespread mortality in Ontario.
- In 2021, ash decline caused by emerald ash borer was aerially mapped in Northeast Region and collected and verified in the quarantine area in northeast and southern regions.

Regional summary

Northeast

- In Sault Ste. Marie District, increased ash decline caused by emerald ash borer was observed in the southern part the district. A total of 504 ha of ash mortality was mapped during aerial surveys, most of it on St. Joseph Island. Ash mortality was mapped in the northwest part of St. Joseph Twp, along the north shore of St. Joseph Island from east of Richards Landing, along McGregor Bay, to Green Point. Ash mortality was also mapped along the west shore of the island from Green Point southward to I-Line. A small area in the southern part of the island was mapped on Sterling Bay near the junction of 4th Concession and Weirzbicki Drive in Jocelyn Twp. Small areas of ash mortality were also mapped on the mainland. A long narrow strip was mapped on the shoreline where Shewfelt Creek flows into St. Mary's River in Tarbutt Twp. Other small areas of ash mortality

were observed near Stobie Creek northeast of Desbarats (Johnson Twp), near the junction of Hwy 17 and Hwy 638 east of Echo Bay, at the junction of Hillstrom and Pine Island roads in the southern part of Laird Twp, and along Garden River from St. Mary's River to Hwy 17. During ground surveys, further ash mortality was found on the west side of Bruce Mines and a new emerald ash borer collection was made in Blind River.

- In Sudbury District, 106 ha of mortality caused by emerald ash borer was mapped southwest of Meldrum Bay on Manitoulin Island. Emerald ash borer larvae and pupae were collected in the Municipality of Killarney and ash dieback was observed on the east side of Killarney.

Southern

- In Pembroke District, emerald ash borer continued to expand its range north- and westward from infestations previously recorded in the southeast corner of the district. Symptoms were observed during ground surveys in the Town of Calabogie, Greater Madawaska Twp, and south on Highway 511 to Dempsey's Lake. Larvae were collected from white ash on Highway 508 west of Calabogie. Ash decline was observed along Renfrew County Road 132, west of the City Renfrew to Dacre. Emerald ash borer was confirmed in black ash on Fergulsea Road in Admaston Twp, about 8 km west of the City of Renfrew. Emerald ash borer was confirmed in the City of Pembroke where severe symptoms including tree mortality were observed on River Road, and on Everett, Carmody, Elgin, Bennett, and Pembroke streets. Emerald ash borer was also confirmed on Cybulski Rd, northwest of Barry's Bay, moderate damage was observed on ash trees at the edge of a small wetland.

- In Kemptville District, emerald ash borer was confirmed during ground surveys on Highway 511 south of Tatlock Road in the Lanark Highlands, Lanark County. This collection represents a northwest expansion of emerald ash borer in Kemptville District. Symptoms, including ash mortality, were observed from Radley Lane to South Lavant Road.

- In Parry Sound District, emerald ash borer pupae and larvae were collected along Healy Lake Road, west of MacTier, and woodpecker damage and S-shaped galleries were observed at Massasauga Provincial Park. Emerald ash borer larvae were collected on Bon Echo Road, south of Hooton Lake, and Blind Bay Road, north of Killbear Provincial Park. Partially emerged adults were also observed on smaller diameter trees at Bon Echo Road.

Trend analysis/outlook/issues

Emerald ash borer parasitoid release

The ministry continues to collaborate with the Canadian Forest Service on the emerald ash borer biological control program in Ontario. Forest health technical staff support the operational component of the project, for example, by selecting release sites and releasing parasitoids.

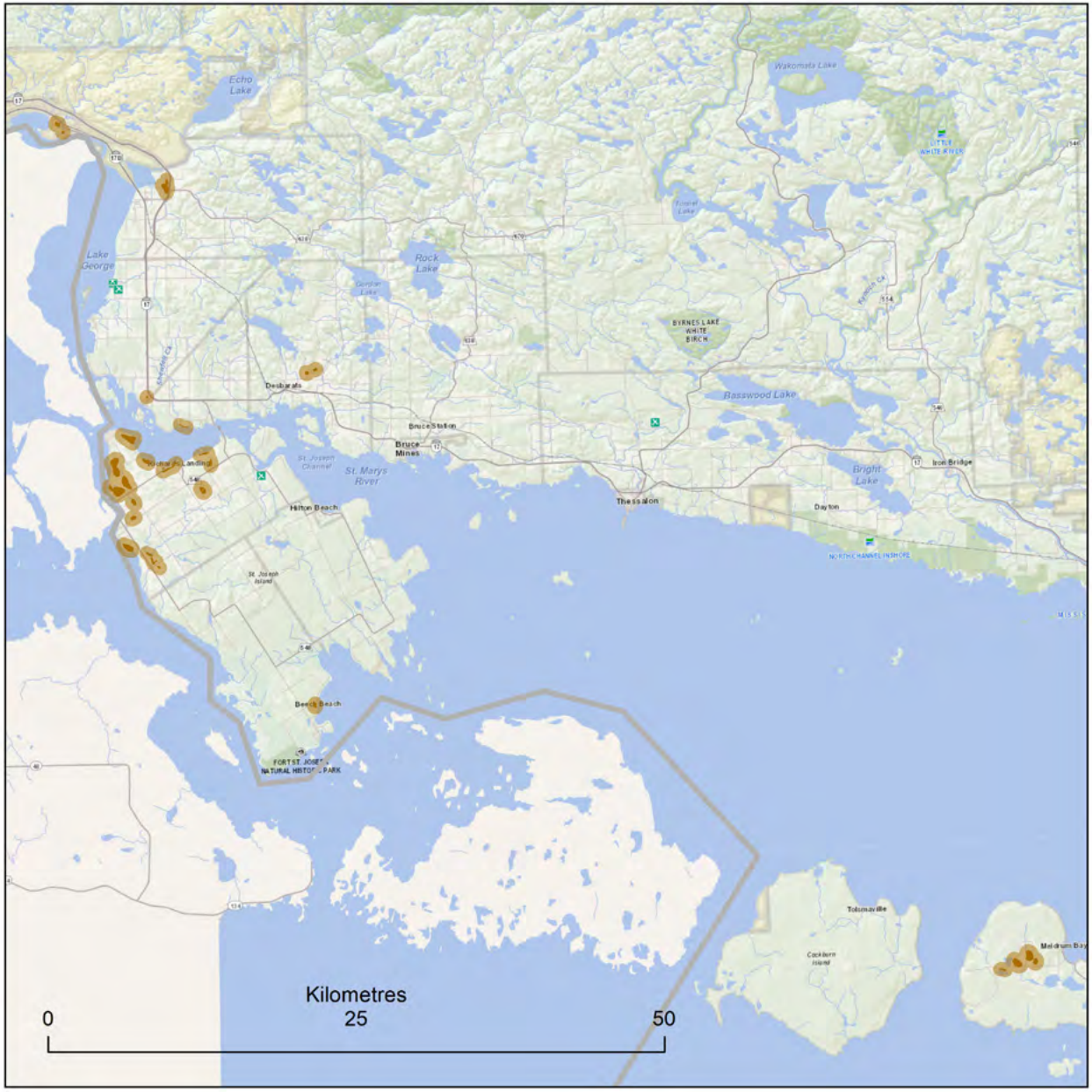
The biological control program involves the release of three species of parasitoid wasps that target various life stages of emerald ash borer, with the goals of reducing emerald ash borer populations and establishing parasitoid populations in infested areas. Originally from China and Russia, these wasps are highly host specific to emerald ash borer with high parasitism levels in their native range. Both *Tetrastichus planipennisi*, a larval parasitoid, and *Oobius agrili*, an egg parasitoid with two generations per year, originate from China. The third species, *Spathius galinae*, is a larval parasitoid from Russia that is effective on the borer in green ash. Canadian Forest Service researchers provide regular updates on the status of this biological control program. For more information, visit https://inspection.canada.ca/plant-health/invasive-species/insects/emerald-ash-borer/wasps/eng/1371137262586/1371137530758.

Emerald ash borer 2021

Areas in Ontario where emerald ash borer caused mortality

Mortality = 610 ha

Area of mortality



Forest tent caterpillar

Pest information

Common name:	Forest tent caterpillar
Scientific name:	*Malacosma disstria* Hbn.
Pest origin:	Native to North America
Pest type:	Defoliator
Host species:	Various deciduous species
Infestation area:	36,926 ha

Provincial key facts

- On average in Ontario, forest tent caterpillar outbreaks have occurred every ten to twelve years, with each outbreak continuing for three to five years.
- In the south, forest tent caterpillar feed primarily on sugar maple and oak, and in the north this pest is found mostly on trembling aspen but also feeds on several other deciduous species.
- In 2021, 36,926 ha of defoliation were aerially mapped, an increase from 2020 when populations of forest tent caterpillar were too small to be mapped. The 2021 infestation was only mapped in Northeast Region.

Regional summary

Northeast

- In In Hearst District, after a six year infestation no defoliation was recorded in 2020. However, in 2021, 26,041 ha of moderate to severe defoliation were mapped during aerial surveys. In the remotest parts of the district, small areas of forest tent caterpillar were observed near Ballantyne Lake Drumlins that border the Mattagami River. Additional defoliation was observed southwest towards Opasatika Lake, crossing Hwy 11 between the Town of Kapuskasing and Opasatika. The heaviest defoliation was observed about 30 km southwest of Opasatika and eastward from Opasatika Lake towards Saganash Lake.

- In Cochrane District, 3,027 ha of moderate to severe defoliation were aerially mapped in 2021. The bulk of this defoliation was mapped in the eastern corner of the district, north of Lake Abitibi, with the highest concentration close to the Ontario-Quebec border in the townships of Abbotsford and Adair. Smaller areas of

defoliation were recorded north of the Town of Cochrane beside Lillabelle Lake in Glackmeyer Twp, and east of Fraserdale Wetland Complex in Tolmie Twp.

- In Timmins District, 1,606 ha of moderate to severe defoliation were aerially mapped in 2021. Larger areas of moderate to severe defoliation were recorded south of Hwy 101 between the community of South Porcupine and Night Hawk Lake, with most of the defoliation in Shaw Twp. Small to medium sized areas of defoliation were found along Pine Street South from the City of Timmins to Loonwing Lake, between La Motte Lake Provincial Park east towards Ketchiwaboose Lake, north of the City of Timmins largely in the townships of Jessop and Murphy, and three areas on the west side of the district in Penhorwood, Reeves, and Hilary Townships.

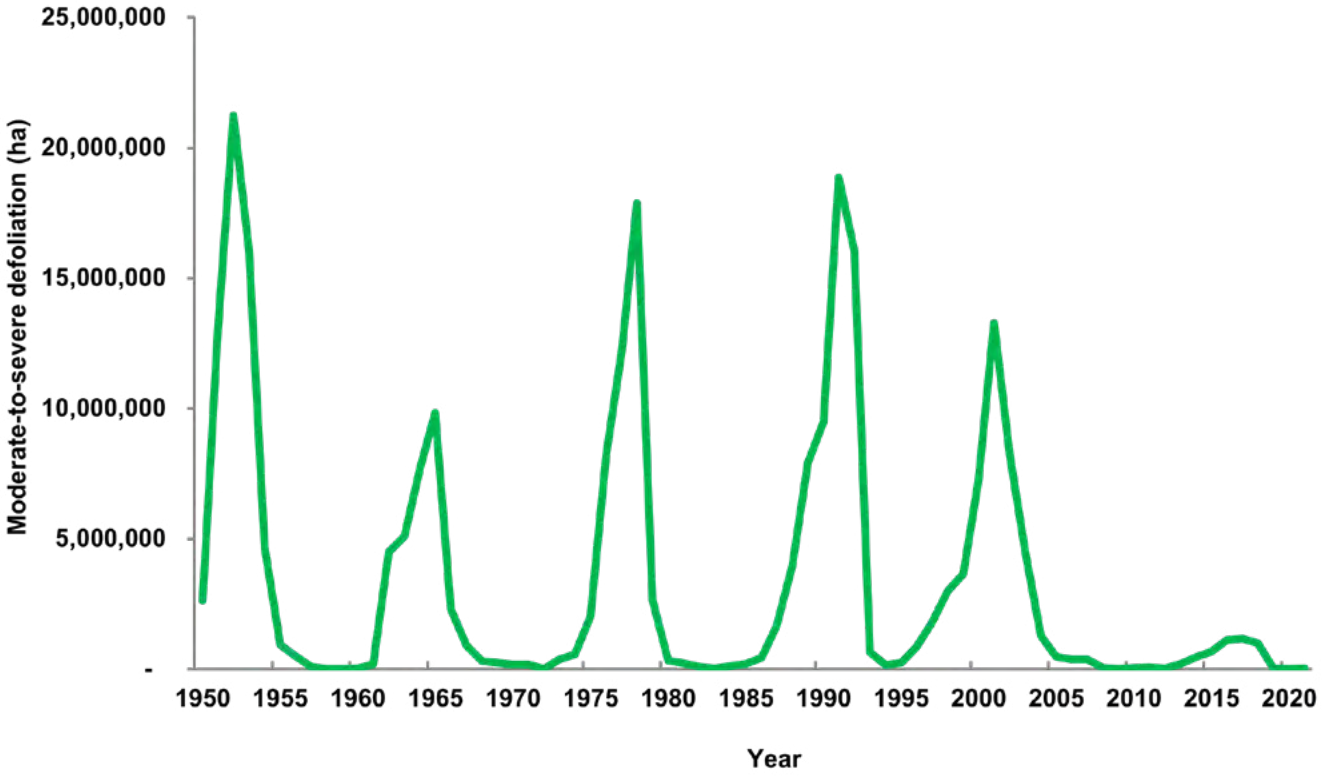
- In Chapleau District, moderate to severe forest tent caterpillar defoliation was aerially mapped in two small areas in the northern part of the district. One area was between the community of Foleyet and Ivanhoe Provincial Park along Hwy 101 in the southeast corner of Foleyet Twp; the other area was recorded farther north in the southwest corner of Steffanson Twp north of the Canadian National Railroad tracks and Dunrankin River.

- In Sudbury District, moderate to severe defoliation from forest tent caterpillar was mapped in Greater Sudbury, Val Caron, Val Therese, and Hanmer, with near complete defoliation in the affected areas. Forest tent caterpillar was also observed causing moderate to severe defoliation alongside LDD caterpillars along Regional Road 85 north of Bailey Corners, west of Greater Sudbury airport, and along Bethel Lake Trail, on the south side of Ramsey Lake, in the City of Sudbury. These areas of defoliation were included in the LDD affected hectare tally.

Total area (in hectares) in which forest tent caterpillar caused moderate to severe defoliation in 2017 to 2021, by NDMNRF district.

Region	Area of damage (ha)				
District	2017	2018	2019	2020	2021
Northeast					
Chapleau	-	-	-	-	359
Cochrane	26,385	33,428	7,732	-	3,027
Hearst	590,451	237,395	22,470	-	26,041
Kirkland Lake	600	521	-	-	-
North Bay	33,907	25,724	69	-	-
Sault Ste. Marie	95,087	148,442	50	-	-

District	2017	2018	2019	2020	2021
Sudbury	52,063	72,435	3,073	-	5,893
Timmins	10,966	888	-	-	1,606
Wawa	-	-	-	-	-
Subtotal	809,459	518,833	33,393	0	36,926
Northwest					
Dryden	9,803	-	-	-	-
Fort Frances	11,465	-	-	-	-
Kenora	67,620	9	-	-	-
Nipigon	814	-	-	-	-
Red Lake	1,003	-	-	-	-
Sioux Lookout	513	-	-	-	-
Thunder Bay	-	29	-	-	-
Subtotal	91,218	38	0	0	0
Southern					
Algonquin Park	369	-	-	-	-
Aurora	-	-	-	-	-
Aylmer	-	-	-	-	-
Bancroft	138,664	235,831	-	-	-
Guelph	-	-	-	-	-
Kemptville	58,782	126,179	-	-	-
Midhurst	-	434	-	-	-
Parry Sound	14,472	11,618	95	-	-
Pembroke	25,276	27,731	-	-	-
Peterborough	35,330	71,543	-	-	-
Subtotal	272,893	473,337	95	-	-
Provincial total	1,173,570	992,207	33,488	0	36,926



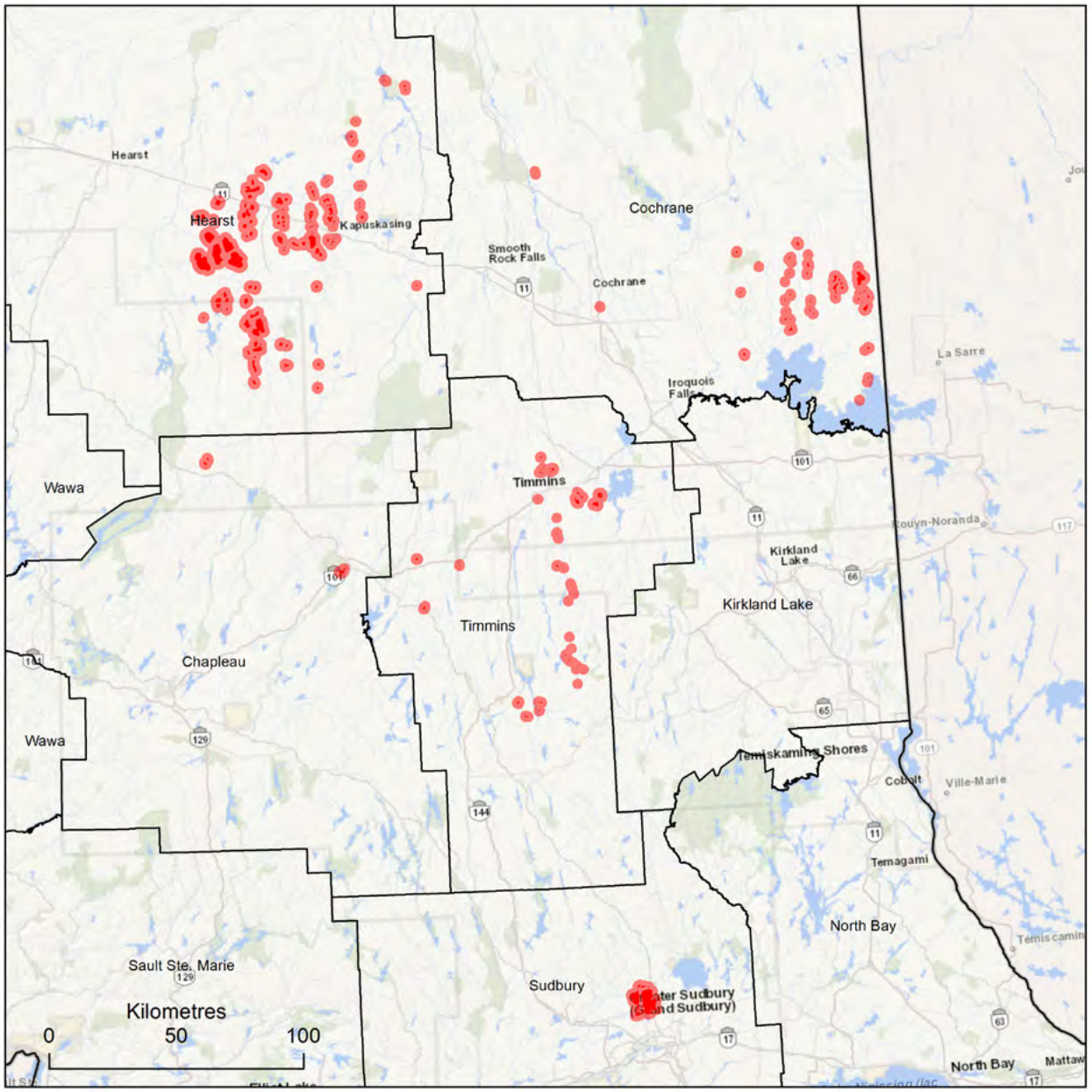
Total area (in hectares) in which forest tent caterpillar caused moderate to severe defoliation in Ontario from 1950 to 2021.

Forest tent caterpillar 2021

Areas in Ontario where forest tent caterpillar caused defoliation

Moderate to severe = 36,926 ha

Area of moderate to severe defoliation



Imported willow leaf beetle

Pest information

Common name:	Imported willow leaf beetle
Scientific name:	*Plagiodera versicolora (Laich.)*
Pest origin:	Invasive — native to Europe
Pest type:	Defoliator
Host species:	Willow spp.
Infestation area:	14 ha

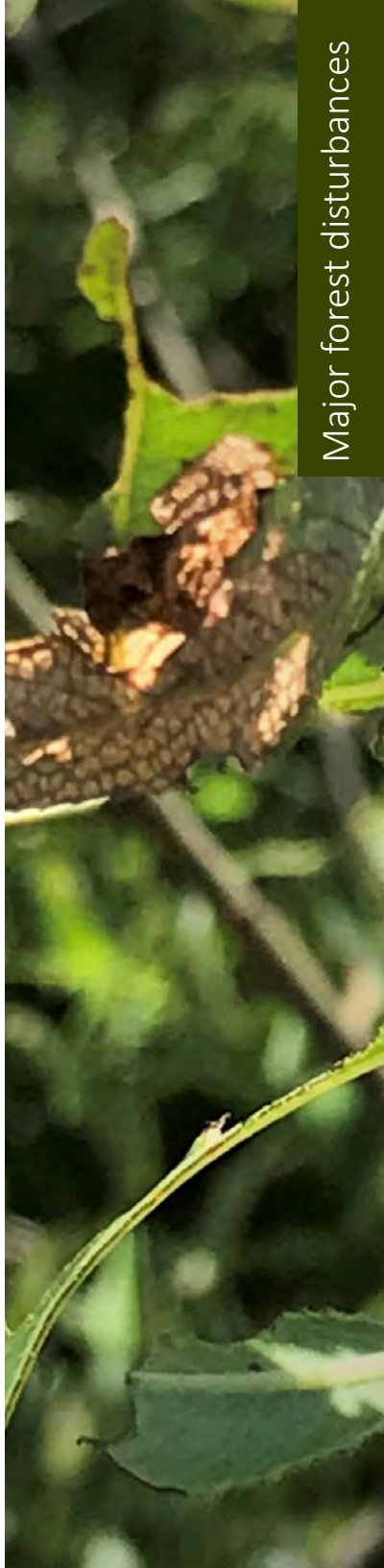
Provincial key facts

- Imported willow leaf beetle was introduced to North America in 1915 and is now widely distributed across the range of willow in Ontario.
- Up to three generations of this insect can occur in a year.
- This pest has the potential to cause severe defoliation; however, damage to trees is not serious unless defoliation occurs in several consecutive years.
- In 2021, imported willow leaf beetle defoliation was reported in a few localized areas in Southern Region.

Regional summary

Southern

- In 2021, 14 ha of moderate to severe imported willow leaf beetle defoliation were recorded across the south end of Muskrat Lake near Cobden, Whitewater Region Twp, Pembroke District. During ground surveys, moderate to severe defoliation was also observed along several creeks east of Muskrat Lake.
- In the southern part of Kemptville District, light imported willow leaf beetle defoliation was detected during ground surveys. It occurred on various species and age classes of willow in a riparian hedgerow bordering Lyn Creek in the Village of Lyn, Elizabethtown-Kitley Twp, Leeds-Grenville County.



Imported willow leaf beetle 2021

Areas in Ontario where imported willow leaf beetle caused defoliation

Moderate to severe = 14 ha

Area of moderate to severe defoliation

Jack pine budworm

Pest information

Common name:	Jack pine budworm
Scientific name:	*Choristoneura pinus pinus* Freeman
Pest origin:	Native to North America
Pest type:	Defoliator
Host species:	Jack pine
Infestation area:	346,266 ha (moderate to severe); 1,172 ha (mortality)

Provincial key facts

- Jack pine budworm outbreaks occur in Ontario about every eight to 10 years.
- In the past, large-scale control programs have been undertaken to protect high value jack pine stands during an outbreak, with the most recent carried out in 2021 in Northwest Region.
- In 2021, 346,266 ha of moderate to severe jack pine budworm defoliation were aerially mapped, primarily in Northwest Region with a small area in Northeast Region. This area is a substantial decrease in defoliation relative to the last three years. Due to safety concerns associated with fires and smoke advisories in Northwest Region, aerial mapping was difficult and somewhat limited.

Regional summary

Northwest

- In Thunder Bay District, the total area of moderate to severe jack pine budworm defoliation increased from 3,761 ha in 2020 to 107,439 ha in 2021. Most of the defoliation was mapped in the northern part of the district, stretching from Dawn Lake in Wabakimi Provincial Park in the north to Kopka Lake on the west side of Lake Nipigon in the south and from the western district boundary by Foam Lake to Falcon Lake by the eastern district boundary. The remainder of the moderate to severe jack pine budworm defoliation was mapped on the west central side of the district, west of Upsala. It was concentrated on the north side of Hwy 17 from the turn off to Graham Road near Hay Lake, north to Goshen Lake near the district boundary. South of Hwy 17, in this same general area, moderate to severe defoliation was also recorded along the Firesteel River. Farther west along Hwy 17, a large area of defoliation was mapped along the Thunder Bay/Dryden district boundary near English

River between Hawk and Savoy lakes.

- In Dryden District, 82,098 ha of moderate to severe jack pine budworm defoliation were mapped, down from 321,062 ha in 2020. Most of the defoliation was on the eastern side of the district, concentrated in the Ignace area on both sides of Hwy 17 from Oval Lake to Encamp Lake and stretching up to Mameigwess Lake and Shikag Lake. Farther north, scattered areas of moderate to severe defoliation were mapped near Sturgeon Lake to Uneven Lake on the northeast side of the district. Close to the northeast district boundary, small areas of jack pine budworm defoliation were observed from Caribou Lake to Baldhead Lake. Small areas of defoliation were mapped on the west side of the district on both sides of Hwy 17. On the south side of Hwy 17, small areas of defoliation were documented between Upper Stewart Lake by Vermillion Bay to Wabigoon Lake, south of Dryden. On the north side of Hwy 17, scattered areas of defoliation were mapped near Daniels, Cobble, Amesdale, Sunstrum, and Whitefish lakes, with a larger area of defoliation south of Thaddeus Lake. Northeast of Dryden, small areas of defoliation were recorded from Beaver Lake to Basket and Suzanne lakes. Jack pine mortality (828 ha) was also mapped, most likely the result of consecutive years of jack pine budworm defoliation. Small areas of mortality were mapped southeast of Vermillion Bay, north of Dryden near Beaver Lake and Lola Lake Provincial Nature Reserve, on the east side of Hwy 622 between Smirch and Osprey lakes and an area split by the Dryden/Sioux Lookout district boundary between Wyatt and Watcomb lakes.

- In Sioux Lookout District 55,644 ha of moderate to severe jack pine budworm defoliation were mapped, a substantial decrease from 377, 043 ha mapped in 2020. Most of the defoliation was in the southern part of the district, north and northeast of Sioux Lookout. Large areas of defoliation were observed on the east side of Lac Seul in the Expanse and Archer lakes area, between Rapid Lake and Armit Lake, from Horse Lake to Arc Lake and from Marchington Lake to the eastern district boundary near Valley Lake. Some areas of defoliation were recorded south of Sioux Lookout but were smaller and scattered. Southeast of Sioux Lookout, defoliation was mapped in the Forty Mile, Jorick, and Pepperbell lakes area. Southwest of Sioux Lookout, only a few small areas of defoliation were observed between Kathly and Muskie lakes and on the south side of Minnitaki Lake. In all, 212 ha of jack pine mortality were mapped in one area along the Sioux Lookout/Dryden district boundary northwest of Silver Dollar between Wyatt and Watcomb lakes.

- In Kenora District, 52,726 ha of moderate to severe jack pine budworm defoliation were mapped, a decline from 112,902 ha recorded in 2020. Most of the defoliation was recorded in the northcentral part of the district. Large areas of moderate to severe defoliation were mapped north of Hwy 17, close to the Manitoba border from Umfreville Lake to Pickerel Lake northwest of Kenora. Another large area of defoliation was recorded farther east from Minaki to Redditt and south to Silver Lake. Other areas of defoliation were close to these two larger areas but smaller and scattered. Other small areas of defoliation were observed northwest of Grassy Narrows near Scenic Lake and towards Separation Lake, north and south of Hwy 17 by Willard Lake, and on the far east side of the district between Perrault and Ladysmith lakes.

- In Nipigon District, 36,380 ha of moderate to severe jack pine budworm defoliation were mapped between Lake Nipigon and the Albany River, southwest of Fort Hope. Large areas of defoliation in this area were recorded in the Kagianagami and Allard lakes area while smaller areas of defoliation were recorded north of these two lakes towards the Albany River. Another small area of moderate to severe defoliation south of the larger areas was mapped close to the western district boundary between Ara Lake and Ogoki Reservoir in the area of Sedgman Lake Provincial Park Nature Reserve. Jack pine mortality (131 ha) was also mapped in this area in the park and south of Ottertail River.

- In Fort Frances District, 11,843 ha of moderate to severe jack pine budworm defoliation were mapped, an increase from 139 ha in 2019 and 2,442 ha in 2020. The area of defoliation continued along the northwest side of the district but expanded southward in 2021. All the defoliation was mapped between Hwy 11 and the Fort Frances/Dryden district boundary, but mainly on the west and east sides of Turtle River-White Otter Lake Provincial Park, between Eltrut and Entwine lakes and north of Jones Lake to the Fort Frances/Dryden district boundary. Smaller areas of defoliation were also recorded north of Kaminni Lake to Wawapus Lake near the northern district boundary and on the south side of Hwy 622 between Dovetail and Nevison lakes.

Northeast

- In Sudbury District, a total of 137 ha of moderate to severe defoliation were mapped in Espanola near Apsey Lake Road and Duplessis Road (Merritt Twp) as well as a small area on the northeast side of Elizabeth Lake (Foster Twp). During ground surveys, moderate to severe defoliation was evident farther south on Apsey Lake Road and, after two consecutive years of severe defoliation, jack pine mortality was recorded in the stand east of the Espanola Regional Hospital. Light defoliation was also observed along Jacklin Road, north of Espanola.

Jack pine forest health plots

- In the mid-1990s, plots were established in jack pine stands in the northeast and northwest regions to monitor the effects of jack pine budworm and the overall health of jack pine forests across northern Ontario.

- In 2021, 96 plots (45 in Northeast Region, 51 in Northwest Region) comprising 4,800 jack pine trees, were assessed. Trees were rated for the presence of any pest, disease, or abiotic factors that affect health/condition as well as the abundance of male flowers.

Regional plot summary

- In Northeast Region, 73% of the live jack pine trees were less than 25% defoliated and in the Northwest Region, 70% were less than 25% defoliated and 22% of the live trees were between 25% and 50% defoliated. The numbers in Northwest Region reflect a trend that the jack pine trees in those plots are recovering from the current jack pine budworm outbreak. In Northeast Region, 98% of live jack pine trees had live tops and in

Northwest Region 93% had live tops, while 5% had bare tops and 2% had dead tops.

- In 2021, 46 trees in jack pine plots in Northeast Region died. This mortality was caused by armillaria root rot (70%), abiotic factors such as blowdown (11%), wood borers and ants (8%), and unknown causes (11%).
- In Northwest Region, 53 trees in jack pine plots died. Most (70%) of the mortality was due to unknown causes. Known causes identified were abiotic factors such as blowdown and ice damage (19%) and armillaria root rot (11%).
- Surveys revealed plentiful male flowers in Northeast Region, with 56% of the live jack pine trees having moderate to high numbers. In contrast, in Northwest Region 87% of the live trees assessed had nil to light numbers of male flowers, possibly the influence of the jack pine budworm outbreak.
- In Northwest Region, all plots had some jack pine budworm defoliation. The average defoliation of all trees assessed was 11%. Most of the plots had an average defoliation of <25%, but a few plots had an average of up to 32% defoliation. In Northeast Region, jack pine budworm defoliation was not found in the jack pine plots.
- In Northeast Region, 64% of the live trees in the forest health plots had no noteworthy pests affecting them. Western gall rust was observed on 33% of the live trees. In Northwest Region, 78% of the live trees were affected by jack pine budworm, 10% of the jack pine trees with varying levels of whitespotted sawyer beetle, and the remainder of the live trees had no pests.

Trend analysis/outlook/issues

Jack pine budworm spray program

In 2021, MNDMNRF undertook an insect pest management program for jack pine budworm affected stands in Kenora, Sioux Lookout, and Dryden districts. The bacterial insecticide Btk (Foray 76B) was applied at 1.5 L/ha to 70,080 ha of jack pine stands. An efficacy assessment confirmed that the foliage protection program was successful in meeting its objective of keeping defoliation below 40% in 40+ year old jack pine stands.

Four project areas were treated with Btk in 2021. Project area 1 (21,697 ha) was mostly in the Kenora District west of Vermillion Bay, Project area 2 (21,739 ha) was near Dryden (Dryden District), Project area 3 (184 ha) was near Ear Falls and had many contingency blocks, and Project area 4 (26,457 ha) was between Ignace and Sioux Lookout and northwest of Sioux Lookout. To assess spray efficacy, 29 plots were established in sprayed areas and 17 plots were established in untreated areas. Due to COVID-19 restrictions, spray assessment was limited to defoliation surveys

with population comparisons not done in 2021. In Project area 1, the average defoliation in sprayed jack pine stands was 13.2% and in unsprayed stands was 26.7%. In Project area 2, the average defoliation in sprayed stands was 11.6% and in unsprayed stands was 28.1%. In Project areas 3 and 4 (3 had very few sprayed stands), the average defoliation in sprayed stands was 7.4% and in unsprayed stands was 20.2%. Unsprayed jack pine stands had relatively low defoliation, indicating that jack pine budworm population levels were decreasing, but spraying did reduce overall defoliation.

Jack pine budworm pheromone trapping

Jack pine budworm pheromone trapping was completed across the province in 2021. Traps were deployed at 72 locations: 33 in Northwest Region, 30 in Northeast Region, and nine in Southern Region. Northwest Region had the highest average number of moths per trap at 80 male moths. The highest average number of moths per trap was at a trap location in Dryden District, with 159 male moths per trap, and nine other locations in Northwest Region had average moth counts >100. These traps were in Thunder Bay, Kenora, and Red Lake districts.

In Northeast Region, the average number of male moths per trap was much lower than in the Northwest Region at 19 male moths per trap. The locations with the highest average number of catches were two trap sites in Sudbury District, with an average of 59 male moths per trap. Three other locations in Sudbury District averaged 31 to 56 moths per trap and one location in Sault Ste. Marie District had an average moth count of 30.5 moths per trap.

In Southern Region, the average number of moths were relatively high at 57 moths per trap. The four trap locations with the highest number of moths were all in Pembroke District near Petawawa and Bonnechere Provincial Park, with counts ranging from 75 to 108 moths per trap. The highest count was in Fraser Twp, south of Petawawa.

Jack pine budworm defoliation forecast survey

In Ontario, jack pine budworm defoliation forecasting is based on surveys of the number of overwintering larvae on jack pine branches. Jack pine budworm overwinter as a second instar larvae (L2) by encapsulating themselves in silken shelters (hibernacula) under branch scales and bark cracks. Larvae are typically in these shelters from late August until the following spring. This overwintering stage of the lifecycle provides an opportunity to collect branches to extract and count larvae to forecast the potential severity of defoliation for the following year. Defoliation forecasts are used to determine which stands should be considered for protection.

Locations for L2 surveys are selected based on defoliation mapped during the current infestation and are generally in or near the current defoliation. For our annual surveys, areas historically prone to jack pine budworm defoliation were also selected, as were high value jack pine stands near infestations. From each location, 10 jack pine trees were selected, and a 1 m branch was sampled from the mid- to upper crown of each tree. Branches were sent to a laboratory to be processed in a sodium hydroxide washing procedure that is used to extract the second instar larvae from their hibernacula. These larvae were then separated from other fine debris using hexane and a separatory

funnel and put onto filter papers for microscopic examination. Larvae were counted under a microscope to determine the average number of larvae per branch for each sample location. This average was used to forecast expected jack pine budworm defoliation in 2022. An average of more than 54 larvae per branch indicates potential for severe defoliation. Moderate defoliation is forecast when 16 to 54 larvae are found per branch. Light defoliation can be expected when 15 or fewer larvae are found on each branch.

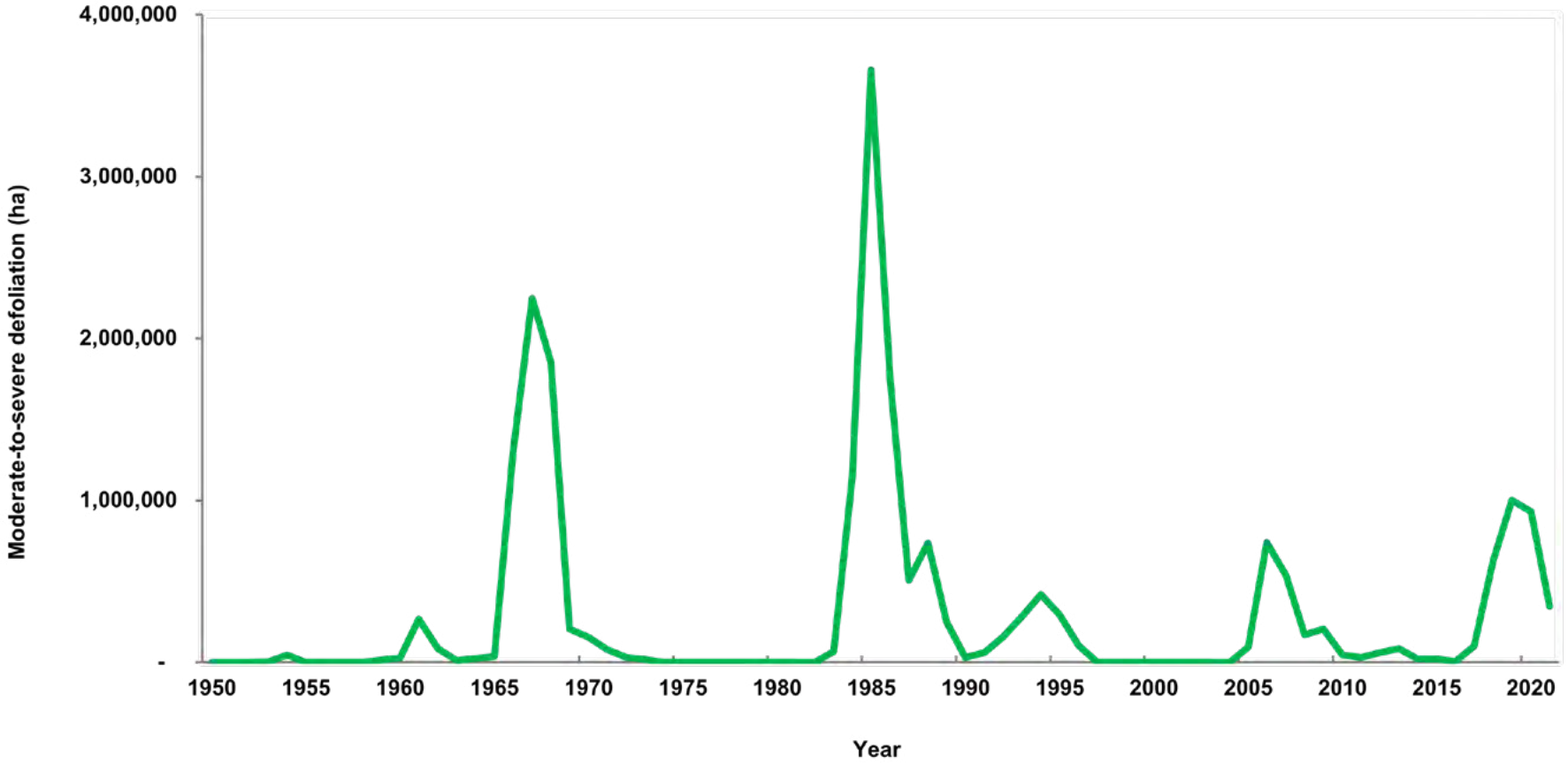
In Northwest Region, 17 locations (170 trees) were sampled for overwintering larvae in 2021. Most (14) of the locations were in Dryden District, with the remainder (3) in Thunder Bay District. For Dryden District, moderate defoliation was forecast for eight locations and light defoliation was forecast for six locations. For Thunder Bay District, moderate defoliation was forecast for two locations and light defoliation was forecast for one location.

In Northeast Region, five locations (50 trees) were sampled for overwintering larvae in 2021. All locations were in Sudbury District in jack pine stands historically defoliated by jack pine budworm and close to the area of defoliation mapped in 2021. Light defoliation was forecast for all areas sampled.Total area (in hectares) in which jack pine budworm caused moderate to severe defoliation from 2017 to 2021, by NDMNRF district.

Total area (in hectares) in which jack pine budworm caused moderate to severe defoliation from 2017 to 2021, by NDMNRF district.

Region	Area of damage (ha)				
District	2017	2018	2019	2020	2021
Northeast					
Chapleau	-	-	-	-	-
Cochrane	-	-	-	-	-
Hearst	-	-	-	-	-
Kirkland Lake	-	-	-	-	-
North Bay	-	-	-	-	-
Sault Ste. Marie	-	-	-	-	-
Sudbury	-	-	-	128	137
Timmins	-	-	-	-	-
Wawa	-	-	-	-	-
Subtotal	0	0	0	128	137
Northwest					
Dryden	-	3,603	105,209	321,062	82,098

District	2017	2018	2019	2020	2021
Fort Frances	-	-	139	2,442	11,843
Kenora	-	10,278	51,126	112,902	52,726
Nipigon	-	-	-	-	36,380
Red Lake	100,187	613,574	771,404	112,425	-
Sioux Lookout	-	-	73,381	377,043	55,644
Thunder Bay	-	-	10	3,761	107,439
Sub total	100,187	627,455	1,001,269	929,635	346,129
Provincial total	100,187	627,455	1,001,269	929,763	346,266



Area (in hectares) of moderate to severe defoliation caused by jack pine budworm in Ontario, 1950–2021.

Jack pine budworm 2021

Areas in Ontario where jack pine budworm caused defoliation

Moderate to severe = 346,266 ha
Mortality = 1,172 ha

Area of moderate to severe defoliation

Area of mortality

Jack pine budworm 2021

Areas in Northwest Region where jack pine budworm caused defoliation

Moderate to severe = 346,129 ha
Mortality = 1,172 ha

Area of moderate to severe defoliation

Area of mortality

Jack pine budworm 2021

Areas in Northeast Region where jack pine budworm caused defoliation

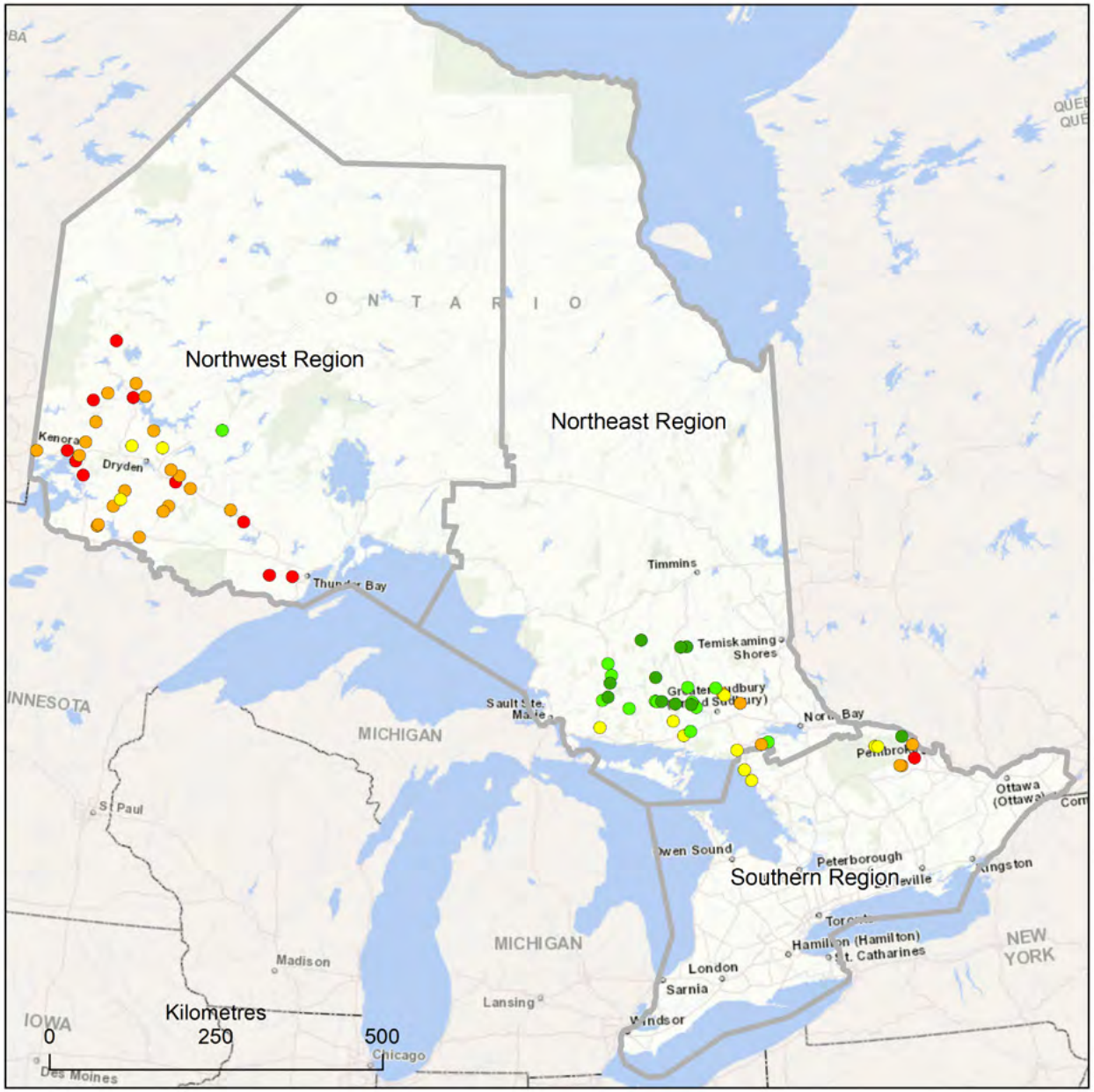
Moderate to severe = 137 ha

Area of moderate to severe defoliation

Jack pine budworm pheromone trapping results 2021

Average number of moths per trap

- < 10
- 10 - 25
- 25 - 50
- 50 - 100
- > 100



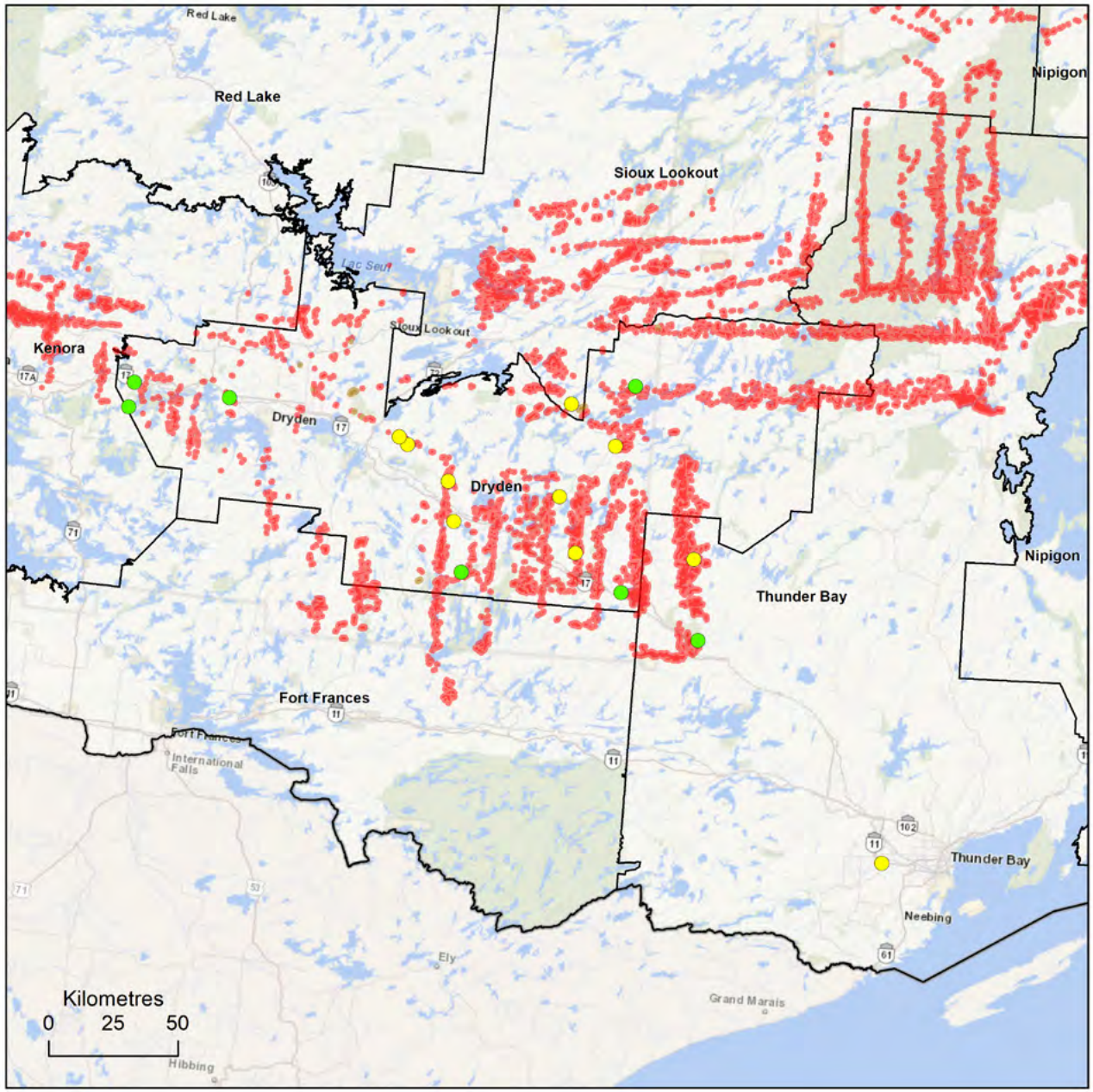
Jack pine budworm second instar larvae survey results Northwest Region

Defoliation forecast 2022

- Moderate
- Light

Jack pine budworm defoliation 2021

- Area of moderate to severe defoliation
- Area of mortality



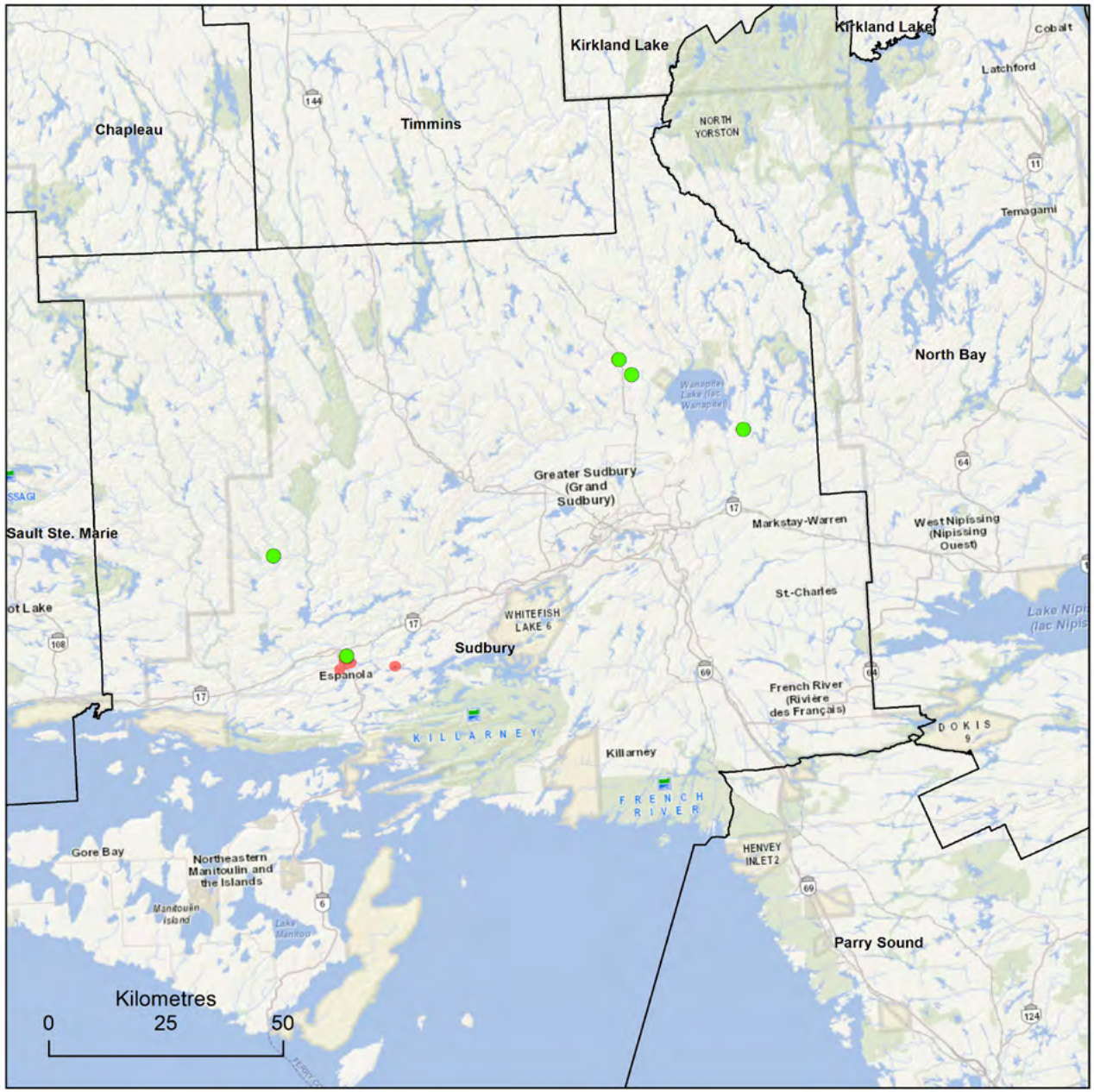
Jack pine budworm second instar larvae survey results Northeast Region

Defoliation forecast 2022

- Moderate
- Light

Jack pine budworm defoliation 2021

- Area of moderate to severe defoliation
- Area of mortality



Large aspen tortrix

Pest information

Common name:	Large aspen tortrix
Scientific name:	*Choristoneura conflictana* (Wlk.)
Pest origin:	Native to North America
Pest type:	Defoliator
Host species:	Trembling aspen
Infestation area:	5,486 ha

Provincial key facts

- Large aspen tortrix is second only to forest tent caterpillar as an aspen defoliator.
- It is an early season defoliator that prefers trembling aspen, but if aspen are completely defoliated before larvae finish feeding, it will feed on other trees and shrubs (e.g., birches, alder, and choke cherry).
- This pest has periodic outbreaks, with sharp increases and quick decreases after two to three years of moderate to severe defoliation.
- In 2021, large aspen tortrix defoliation was mapped in the Northeast Region.

Regional summary

Northeast

- In Kirkland Lake District, 5,354 ha of moderate to severe large aspen tortrix defoliation were scattered throughout the district. Most of the defoliation was mapped in the centre of the district from just north of Hwy 101 to Hwy 65 near the southern district border. Areas were also mapped north of Hwy 560 and in the northeast corner of the district, just south of Lake Abitibi.
- In the north part of North Bay District, small areas of moderate to severe large aspen tortrix defoliation were mapped in Vogt Twp on the south edge of Lake Temagami, Dane Twp at the east end of Lady Evelyn Lake, Barr Twp along the Montreal River, and Kittson Twp between McLennon and Larabie lakes. These areas of moderate to severe defoliation totalled 132 ha.

Total area (hectares) iin which large aspen tortrix caused moderate to severe defoliation from 2017 to 2021 by NDMNRF district.

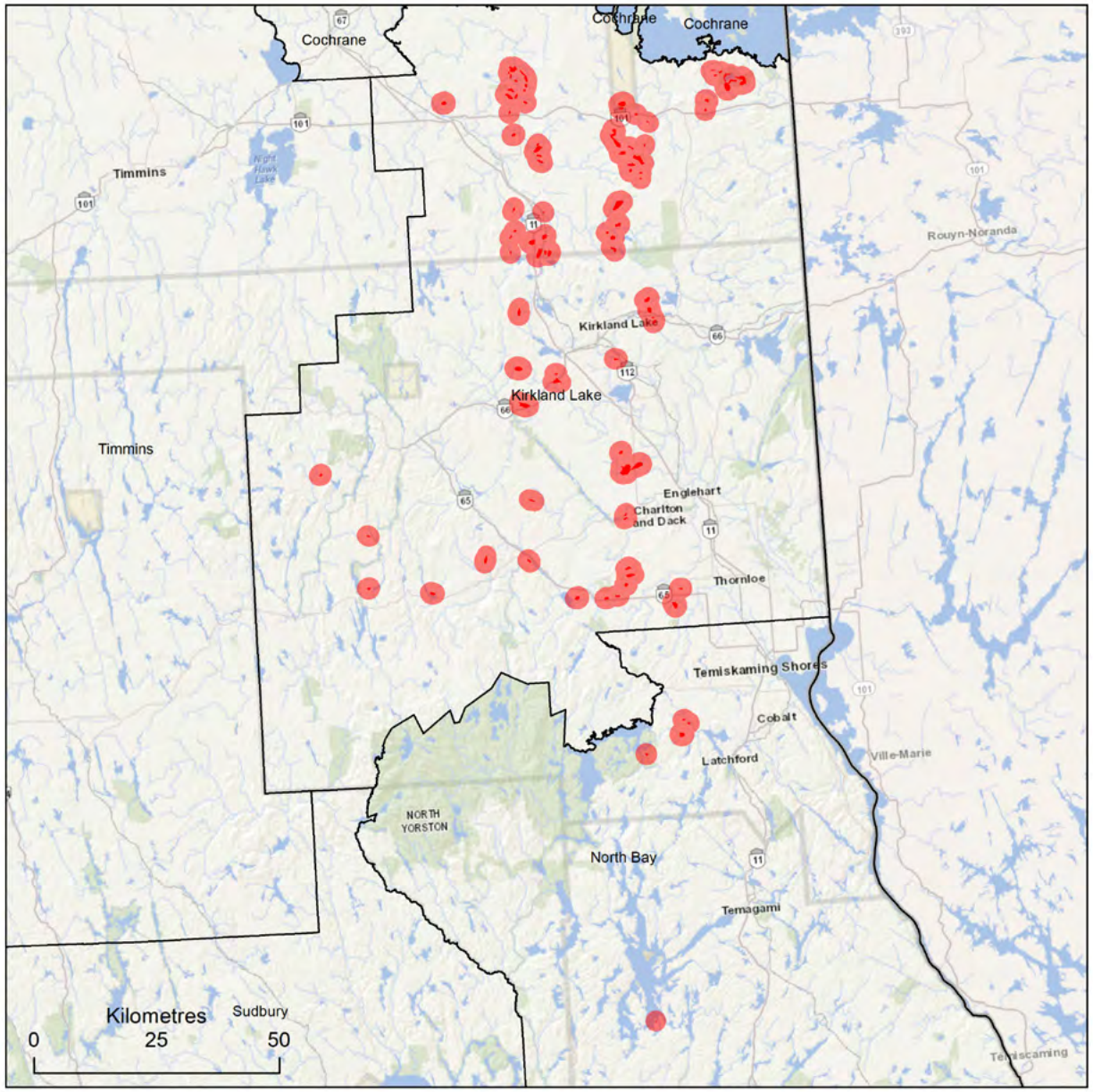
Region	Area of damage (ha)				
District	2017	2018	2019	2020	2021
Northeast					
Chapleau	34,084	27,701	357	-	-
Cochrane	-	-	6,171	13,651	-
Hearst	-	36	-	-	-
Kirkland Lake	-	-	379	4,143	5,354
North Bay	-	-	-	124	132
Sault Ste. Marie	-	1,375	-	266	-
Sudbury	-	-	-	1,524	-
Timmins	12,355	9,716	9,641	2,737	-
Wawa	1,858	379	-	313	-
Subtotal	48,297	39,206	16,548	22,759	5,486
Provincial total	48,297	39,206	16,548	22,759	5,486

Large aspen tortrix 2021

Areas in Ontario where large aspen tortrix caused defoliation

Moderate to severe = 5,486 ha

Area of moderate to severe defoliation



LDD moth

Pest information

Common name:	LDD moth
Scientific name:	*Lymantria dispar dispar* (L.)
Pest origin:	Invasive — native to Europe
Pest type:	Defoliator
Host species:	Most hardwood species
Infestation area:	1,779,744 ha moderate to severe; 9,101 ha light

Provincial key facts

- LDD moth (formerly known as gypsy moth) was discovered in Ontario in 1969, with the first incidence of severe defoliation recorded in Kemptville District in 1981.
- LDD moth outbreaks are cyclical, typically occurring every seven to 10 years. In Ontario, major outbreaks have peaked in 1985, 1991, and 2002. The most recent outbreak, which peaked in 2008, was much less severe than previous ones.
- LDD moth prefers a range of hosts from oak, birch, and aspen in the north to hardwoods, such as oak, sugar maple, and American beech, and occasionally softwoods, such as eastern white pine and Colorado blue spruce, in the south. In 2021, defoliation was recorded on preferred host trees and, in some areas, was severe on secondary hosts such as eastern white pine and white spruce.
- Moderate to severe LDD moth defoliation more than tripled from 586,385 ha in 2020 to 1,779,744 ha in 2021. This outbreak is the largest recorded in Ontario.
- In 2021, defoliation was aerially mapped in all districts in Southern Region, while in Northeast Region four districts had mappable LDD moth defoliation. No defoliation was observed in Northwest Region.

Regional summary

Southern

- In 2021, the largest contiguous area of moderate to severe LDD moth defoliation was recorded in Peterborough District (374,313 ha). Large areas of moderate to severe defoliation were mapped southeast of Rice Lake, Northumberland County, extending north and east to the border of Kemptville District. Defoliation was

concentrated in the northern parts of Hastings, Lennox and Addington, and Frontenac counties along the Bancroft District border. Defoliation decreased south of Tweed and Tamworth, Hasting, and Lennox and Addington counties. At the east end of the district, in South Frontenac Twp, defoliation stopped near Loughborough, Sydenham, and Dog lakes, with small areas of damage scattered north of the City of Kingston. Defoliation was more extensive and severe in Quinte West and Belleville in 2021 than in 2020. At the west boundary of Peterborough District, moderate to severe defoliation was mapped around Pontypool, in the southern part of the City of Kawartha Lakes. Smaller areas of defoliation extended into the south end of Peterborough County. The most severe areas of defoliation in Peterborough County were concentrated at the north end of Selwyn and Douro-Dummer townships along the Bancroft District border. New isolated areas of moderate to severe defoliation were mapped in Balsam Lake and Indian Point provincial parks, at the north end of the City of Kawartha Lakes. Areas of light defoliation, totalling 2,290 ha, were also mapped at the edges of more severely affected areas throughout the district. The largest area of light defoliation was recorded between Buckhorn and Upper Chemong lakes and east of Warsaw Caves Conservation Area in Duouro-Dummer Twp.

- In Bancroft District, 371,806 ha of moderate to severe LDD moth defoliation and 944 ha of light defoliation were mapped in 2021, an increase from 2020. Most of the defoliation occurred in a continuous swath across the south end of Bancroft District, near the defoliation in Peterborough District. Defoliation extended from Peterborough District into Trent Lakes and North Kawartha townships to include most of Kawartha Highlands Provincial Park, except the north end which only had small, scattered areas of defoliation. From the park, defoliation extended northward into Cardiff, Highlands East Twp, at the south end of Haliburton County. It continued east through Hastings County, ending with small areas around Bancroft, and continued into Lennox and Addington County, to Upper Mazinaw Lake and along Hwy 41 into Pembroke District. An area of defoliation was also mapped around Weslemkoon Lake and, farther north, smaller areas of defoliation were recorded along the Opeongo River near Bark Lake (Pembroke District boundary) and between Galeairy and Rapid lakes near the Algonquin Provincial Park boundary, both in Southern Algonquin Twp. In the east end of the district, defoliation was mapped throughout Frontenac County joining with defoliation in Lanark County, Kemptville District. A few new areas of moderate to severe defoliation were mapped in the west end of Bancroft District. Defoliation was mapped in Uphill and extended into Queen Elizabeth II Wildlands Provincial Park at the north end of the City of Kawartha Lakes, near the south end of Parry Sound District. Light defoliation totalling 944 ha was also mapped in a few areas in the southeastern part of Bancroft District. Most of it was on the west side of Catchacoma Lake, west of Kawartha Highlands Provincial Park and south of Faraday Lake northeast of the community of Cardiff in Faraday Twp.

- In Kemptville District, 226,362 ha of moderate to severe LDD moth defoliation and 261 ha of light defoliation were aerially mapped. Most of the defoliation was in the western half of the district (Lanark and Leeds-Grenville counties), with smaller areas scattered in the central part and east of Ottawa. The most concentrated areas of moderate to severe defoliation on the west side of the district extended from the northwest corner (west of Clyde Forks) eastward to Almonte and Carleton Place. The defoliation stretched south to the St.

Lawrence River to Rockport, Mallorytown, and east of Brockville. The defoliation became more fragmented east of Pakenham from Fitzroy Harbour to Ashton Station and smaller scattered areas of defoliation continued east to Stanley Corners and Kanata, all in the City of Ottawa. Small areas of defoliation were recorded around Rockcliffe Park (close to the Quebec border), between Carleton University and Mooney's Bay and farther southeast between Hunt Club and Leitrim roads near the junction of Davidson and Hawthorne roads. Two small areas of moderate to severe defoliation were also observed farther east near the border of the City of Ottawa and the City of Clarence Rockland, south of County Road 17. Small areas of light defoliation (261 ha) were mapped on the southwest side of the district at Landon Bay in the Thousand Islands National Park and north of Phillipsville, Rideau Lakes Twp, both in Leeds-Grenville County.

- In Midhurst District, 176,264 ha of moderate to severe LDD moth defoliation were mapped. Most of the defoliation was on the east side of the district in Simcoe and Dufferin counties, with smaller, scattered areas observed on the west side of the district in Bruce County and to a lesser extent in the south central part of the district in Grey County. In Simcoe County, most hardwood forests were defoliated by LDD moth. Larger, more contiguous areas of forest were defoliated in the northern part of the county, with smaller, more fragmented areas evident in the south. In Dufferin County, most of the moderate to severe LDD moth defoliation was mapped on the east side of the county from Honeywood in the north to Salem in the southeast. Smaller, more scattered areas of defoliation were observed southwest of this larger area, from Mono Cliffs Provincial Park to southern boundary of the county/district near the community of Craigsholme (County Road 3). On the west side of the district, small areas of LDD moth defoliation were mapped in the southern part of Bruce County from Mount Hope in the north to Whitechurch in the south. In this area, defoliation was mapped in and around Greenrock Swamp Wetland Complex between Glammis (County Road 15) and Kinloss (County Road 9). In Grey County, only small areas of LDD moth defoliation were mapped, both extensions of larger areas of defoliation in Simcoe and Bruce counties. On the east side of Grey County, defoliation was recorded from Collingwood to Pretty River Valley Provincial Park and continued south to Noisy River Provincial Park on both sides of County Road 124. On the west side of Grey County, small areas of defoliation were mapped from Hanover to Mount Forest, as well as a little farther north near Chesley from Scone to Habermehl Lake.

- In Pembroke District, 146,848 ha of moderate to severe defoliation and 5,605 ha of light LDD defoliation were mapped in 2021. Defoliation was concentrated in the southern part of the district in two larger areas and in small areas scattered in between. The largest area was along the southern district boundary, from Arnprior and Renfrew to the Centennial Lake area near the Bancroft District boundary south of Griffith (Greater Madawaska Twp). The other large area was north of Barry's Bay and Golden Lake to the Algonquin Provincial Park boundary. More scattered areas of defoliation were recorded south of Petawawa, in the Cobden area, and north and south of Eganville. A moderate sized area of defoliation was also mapped in the Opeongo Mountains area around Lake Clear and Constant Lake mostly in Bonnechere Valley Twp. Other small areas of moderate to severe defoliation were mapped south of Barry's Bay around Muskrat, Halfway, Canoe, Negeek, and Diamond lakes, all in Madawaska Valley Twp. West of Barry's Bay, moderate to severe defoliation was also mapped on

the west side of Trout Lake and at the north end of Bark Lake to the Bancroft District boundary. During ground surveys, small pockets of moderate to severe defoliation were detected north of the City of Pembroke, in the Town of Petawawa, from Deep River to Meilleurs Bay, from Mackey Creek to Driftwood Provincial Park, and in Stonecliffe and Yates. A total of 5,605 ha of light LDD moth defoliation were mapped in the southern part of Pembroke District. This total consisted of five areas, three large and two small, of defoliation. The larger areas were concentrated around the Opeongo Mountains area and east of Combermere between Halfway Lake and Madawaska River (Madawaska Valley Twp). The two smaller areas were south of Cobden on the east side of Hwy 17 between Kohlsmith and Magnesium roads.

- In Aylmer District, 120,487 ha of moderate to severe LDD moth defoliation were aerially mapped in 2021, the fifth consecutive year of defoliation in the district. Moderate to severe defoliation caused by LDD moth was aerially mapped across the fragmented hardwood forests of Aylmer District, except in the southwest part where only small areas of defoliation were mapped during ground surveys. The latter included areas west of Chatham, in the southern part of the City of Windsor, and between Cedar Creek Basin (Essex County) and Wheatley Provincial Park (municipality of Chatham-Kent).

- In Guelph District, moderate to severe LDD moth defoliation was mapped for the fifth consecutive year. The total area of defoliation more than doubled from 52,168 ha in 2020 to 112,978 ha in 2021. Defoliation was widespread across the district, with a few exceptions where no defoliation was detected during aerial and ground surveys. These exceptions included the northern part of Wellington County between Mount Forest and Luther Lake in Wellington North Twp and a small area between Seaforth (Huron County) and Millbank (Perth County). Other smaller areas without LDD moth defoliation occurred sporadically throughout the district and in some cases was due to lack of forest cover or preferred host trees.

- In Aurora District, the area of moderate to severe LDD moth defoliation increased from 15,613 ha in 2020 to 97,164 ha in 2021. Defoliation was extensive in the Regional Municipality of Halton with most of the defoliation on the north and west sides of the municipality. Defoliation became more scattered and smaller areas were mapped in the central part of the municipality, with very little defoliation on the south side of Hwy 403 in the Oakville and Burlington areas mostly due to the lack of forest cover. In the Regional Municipality of Peel, larger areas of LDD moth defoliation were recorded in the northern area of the municipality from Mono Mills to Terra Cotta. Defoliation became more scattered and smaller areas were recorded south of Snell Grove to Eldorado Park. This pattern continued in the Regional Municipality of York where larger areas of defoliation were mapped in the northern part of the municipality particularly from Royal Beach to Lincolnville, in the Willow Beach Conservation Area, and from East Gwillimbury to King City. Areas of defoliation became smaller ad more scattered in the southern part of the municipality in the Woodbridge, Kleinburg, Richmond Hill, and Markham areas all north of Hwy 401. In the Regional Municipality of Durham, larger areas of LDD moth defoliation were mapped on the west side of the municipality from Zephyr to Mount Zion on the west side of Hwy 12. Large areas of defoliation were also mapped on the east side of Hwy 12 from Myrtle Station to Kenda at the eastern district boundary. Smaller,

more scattered areas of defoliation were north and southwest of these larger areas.

- In Parry Sound District, LDD moth caused 75,350 ha of moderate to severe defoliation in 2021, an increase from 2,046 ha mapped in 2020. Most of the moderate to severe defoliation occurred in the southwest section of the district. Defoliation was concentrated along Hwy 400 and Georgian Bay from Parry Sound to Port Severn, around Lake Muskoka, Lake Rosseau, and Lake Joseph. Scattered areas of defoliation were also mapped east of Gravenhurst and along Hwy 400 north of Parry Sound to French River. In addition, where defoliation was severe, conifers, including white spruce and eastern white pine, were affected, for example, south along Hwy 400 and around Torrance Barrens. Small areas of light to moderate defoliation were observed during ground surveys along Muskoka Rd 3 and off Hwy 520 near Ardbeg. Some areas, like Torrance Barrens Dark Sky Reserve northwest of Gravenhurst, were completely defoliated and LDD moth had begun to defoliate understory grasses and shrubs.

- In 2021, a new area of moderate to severe LDD moth defoliation was recorded in Algonquin Provincial Park (2,255 ha). Defoliation was mapped in the southeast corner of the park from Beechnut Lake to Whitebark Lake. Defoliation was observed on both sides of Beechnut Lake Road.

Northeast

- In Sudbury District, 68,875 ha of moderate to severe defoliation were recorded in 2021, an increase from 24,262 ha mapped in 2020. Larger areas of defoliation were mapped in the City of Greater Sudbury, Municipality of Killarney, Killarney Provincial Park, and across Manitoulin Island. Scattered areas were also mapped near St. Charles, along Hwy 69 south of Sudbury to French River, east of Sudbury along Hwy 17 near Whitefish Lake, south and southwest of Espanola, and north of Webbwood. Forest tent caterpillar larvae were found feeding alongside LDD moth larvae north of Sudbury along Regional Rd 85 north of Bailey's Corners.

- In Sault Ste. Marie District, 3,641 ha of moderate to severe defoliation was recorded in the southern part of the district. Most of the defoliation was between Thessalon and Algoma Mills with smaller scattered areas west towards Sault Ste. Marie. Northeast of Thessalon, larger areas of moderate to severe LDD moth defoliation were observed around Basswood and Little Basswood lakes. Farther east, moderate size areas of defoliation were mapped near Clear Lake, south of Bright Lake, southwest of Deans Lake and north of Mississagi River along Pahpashoah Creek on the east side of Thompson Twp. Most of the larger areas northeast of Blind River were in the Lauzon Lake area in Striker Twp and the southwest side of adjacent Long Twp. The easternmost areas of moderate to severe defoliation were smaller and north of the municipality of Serpent River straddling Spragge and Lewis townships, as well south of the Serpent River close to the mouth of the Serpent River where it drains into Lake Huron in Serpent River First Nation Reserve 7. Smaller, more scattered areas of LDD moth defoliation were mapped between Garden River and Thessalon. Most of this defoliation was south of Echo Lake to Port Findlay along St. Mary's River in Macdonald, Laird, and Tarbutt and Tarbutt Additional townships. Farther east,

small areas of defoliation were observed north of Desbarats (Johnson Twp), between Bruce Mines and Ottertail Lake in Plummer and Plummer Additional townships and northwest of Thessalon on the southeast side of Lefroy Twp north and west of the community of Nestorville. One small area of moderate to severe LLD moth defoliation was recorded in Prince Twp northwest of the City of Sault Ste. Marie at the junction of Second Line West and Walls Side Road, east of Gros Cap.

- In North Bay District, 3,349 ha of moderate to severe defoliation were mapped in 2021. The defoliation was mapped just east of Corbeil, along Trout Lake, Northshore Road, and along Hwy 11 near Nipissing Junction and Jennings Lake. Other areas of moderate to severe LDD moth defoliation were recorded in the Verner, Lavigne, and Notre Dame du Lac areas mostly south of Hwy 17. Smaller, more scattered areas of LDD moth defoliation were mapped east of Powassan near Genesee Creek and on the south shore of Lake Nipissing near Meadow Bay and Shoal Creek. In the northern part of the North Bay District, small areas of defoliation were observed in North Cobalt, into New Liskeard, and along Hwy 65 near Sutton Bay.

- In Kirkland Lake District, for the first time, moderate to severe LDD moth defoliation was aerially mapped totalling 52 ha. Three small areas of moderate to severe defoliation were mapped in the southeastern part of the district. Two of the areas were between Hanbury and Judge, one along Hwy 65 in Casey Twp near Casey Mountain and the other farther west near the junction of Hanbury and Salebarn roads. The third area was southwest of Earlton along St. Jean Baptiste Creek.

Trend analysis/outlook/issues

Cool, wet conditions provide an ideal environment for the proliferation of *Entomophaga maimaiga* (*E. maimaiga*), a fungus known to cause LDD moth populations to collapse. In 2021, spring was hot and dry, and it wasn't until June that much rain fell in Southern Region. *E. maimaiga* was found across most districts in Southern Region, but at varying levels. The dry hot weather may have contributed to these varying levels of larval infection.

Nuclear polyhedrosis virus (NPV) is a viral infection that is known to kill LDD moth larvae. More NPV was evident in Southern Region in 2021 than 2020. Infection rates were more prevalent in areas with several years of LDD moth defoliation.

In Northeast Region, low levels of both *E. maimaiga* and NPV were observed during ground checks of LDD moth defoliation. Egg masses were also small in most areas, suggesting a less healthy egg population.

LDD moth defoliation forecast survey

In Ontario, LDD moth defoliation forecasting is based on surveys of the number of overwintering egg masses on tree trunks, branches, woody debris, leaf litter, and other surfaces. Female adult LDD moths lay eggs in August in brownish tan coloured masses, in which the number of eggs varies from 100 to 1,000. In the egg, the embryo

develops into a small larva, the stage in which it spends the rest of the winter. This overwintering stage of the lifecycle provides an opportunity to count egg masses to forecast the potential severity of defoliation the following spring and summer. Several methods are used to estimate the number of egg masses, including timed walks and fixed-area plots. In Ontario, the modified Kaladar plot (MKP), which is a fixed area plot (10 m X 10 m = 0.1 ha), is used to forecast defoliation. In this method, all egg masses above the ground are counted in the fixed area plot and egg masses on the ground are counted in 10 mini-plots (1 m X 1 m) in the fixed plot. Locations for MKPs are selected using current areas of defoliation and host availability.

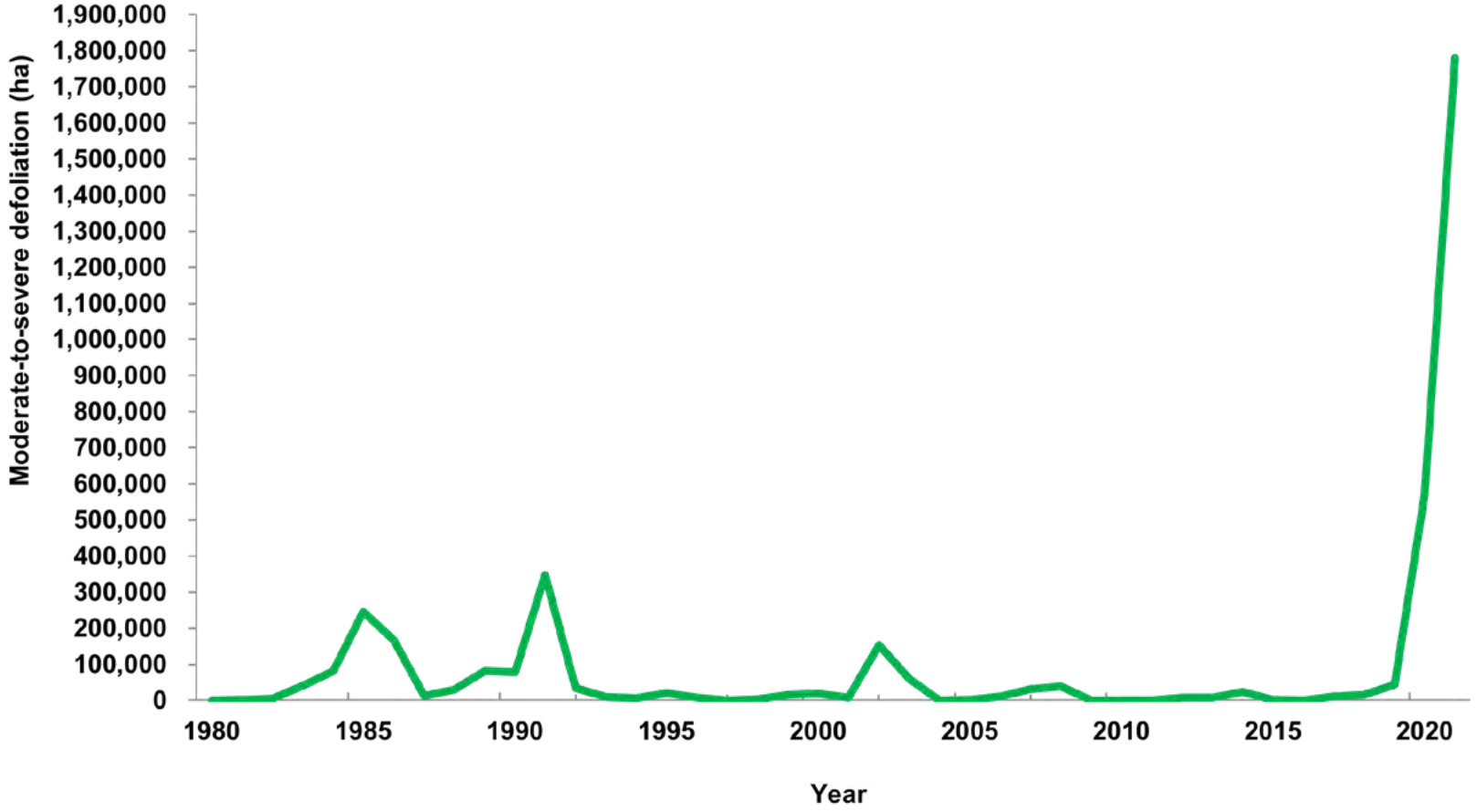
Formulas from the MKP protocol, which factor in egg mass location and the proportion of new versus old egg masses, are used to calculate the number of egg masses per hectare to forecast LDD moth defoliation. More than 6,175 egg masses per hectare indicates potential for severe (>75%) defoliation. Estimates of 1,236 to 6,175 egg masses per hectare indicate potential for moderate (40–75%) defoliation and 1 to 1,235 egg masses per hectare indicate potential light defoliation (1–40%).

During leaf off in November 2021, 16 locations in six Southern Region districts were surveyed for LDD moth egg masses: Aylmer (2), Bancroft (4), Guelph (1), Midhurst (1), Parry Sound (4), and Pembroke (4). The defoliation forecast for 2022 was severe for 11 locations, moderate for four, and light for one.

During the survey, investigation of egg masses revealed predation by birds and small mammals was relatively low in most districts surveyed, except for Aylmer District where predation was high. Small pinholes in egg masses indicated the presence of the tiny parasitic wasp, Ooencyrtus kuvanae, which varied in abundance but was highest in Aylmer, Guelph, and Midhurst districts, low to moderate in Parry Sound and Bancroft districts, and low in Pembroke District.

Total area (in hectares) in which LDD moth caused moderate to severe defoliation from 2017 to 2021 by NDMNRF district.

Region	Area of damage (ha)				
District	2017	2018	2019	2020	2021
Northeast					
Chapleau	-	-	-	-	-
Cochrane	-	-	-	-	-
Hearst	-	-	-	-	-
Kirkland Lake	-	-	-	-	52
North Bay	-	-	-	407	3,349
Sault Ste. Marie	-	-	-	246	3,641
Sudbury	-	-	93	24,262	68,875
Timmins	-	-	-	-	-
Wawa	-	-	-	-	-
Subtotal	0	0	93	24,916	75,916
Southern					
Algonquin Park	-	-	-	-	2,255
Aurora	-	2,764	1,949	15,613	97,164
Aylmer	627	983	19,994	47,219	120,487
Bancroft	-	-	-	127,992	371,806
Guelph	8,768	11,154	17,557	52,168	112,978
Kemptville	-	-	-	84,563	226,362
Midhurst	-	36	2,978	41,743	176,264
Parry Sound	-	-	177	2,046	75,350
Pembroke	-	-	-	13,547	146,848
Peterborough	1,461	-	409	159,578	374,313
Subtotal	10,856	14,937	43,065	544,468	1,703,827
Provincial total	10,856	14,937	43,158	569,384	1,779,744



Total area (in hectares) in which LDD moth caused moderate to severe defoliation in Ontario from 1980 to 2021.

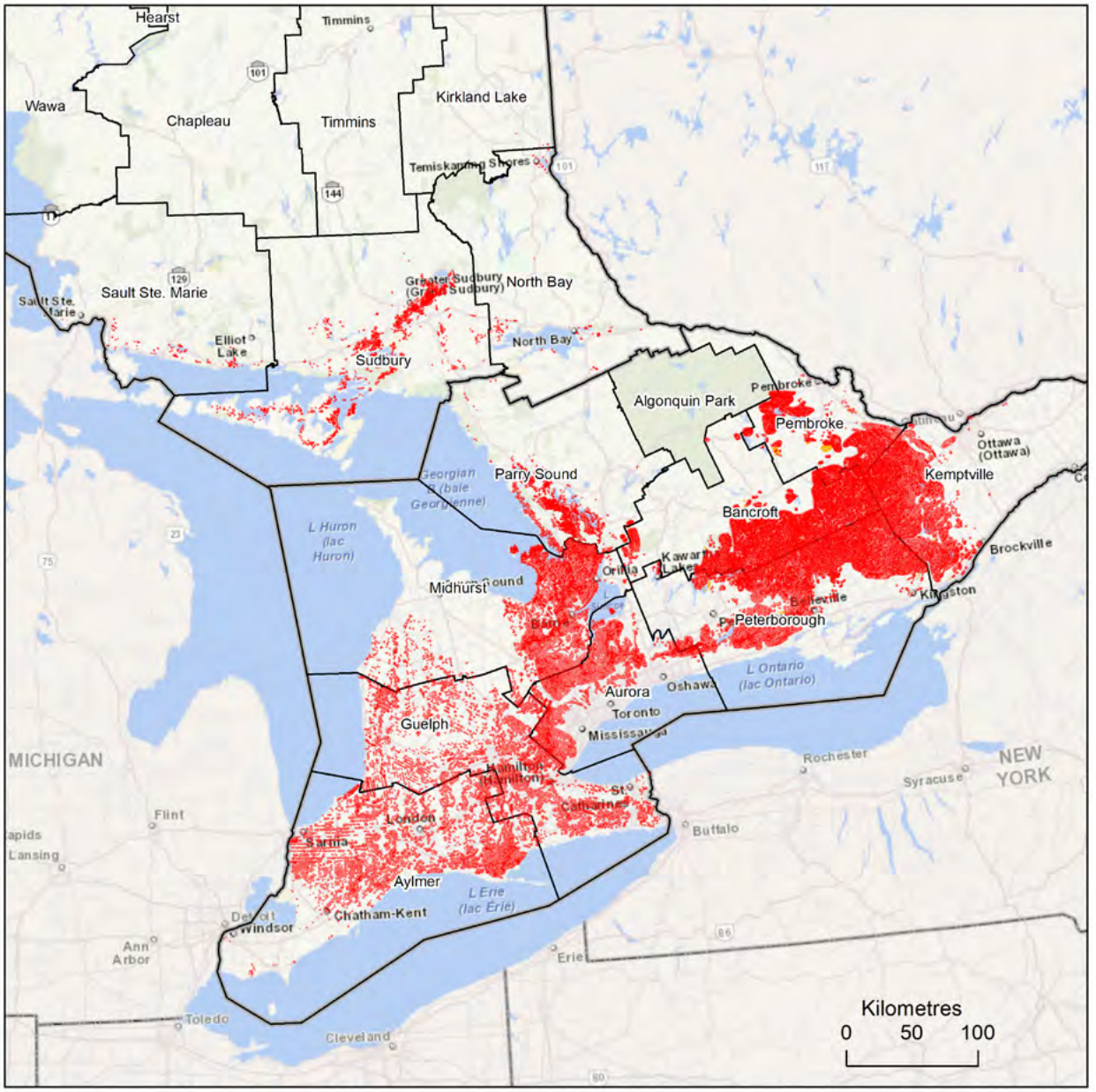
Lymantria dispar dispar 2021

Areas in Ontario where Lymantria dispar dispar caused defoliation

Light = 9,101 ha
Moderate to severe = 1,779,744 ha

Area of light defoliation

Area of moderate to severe defoliation



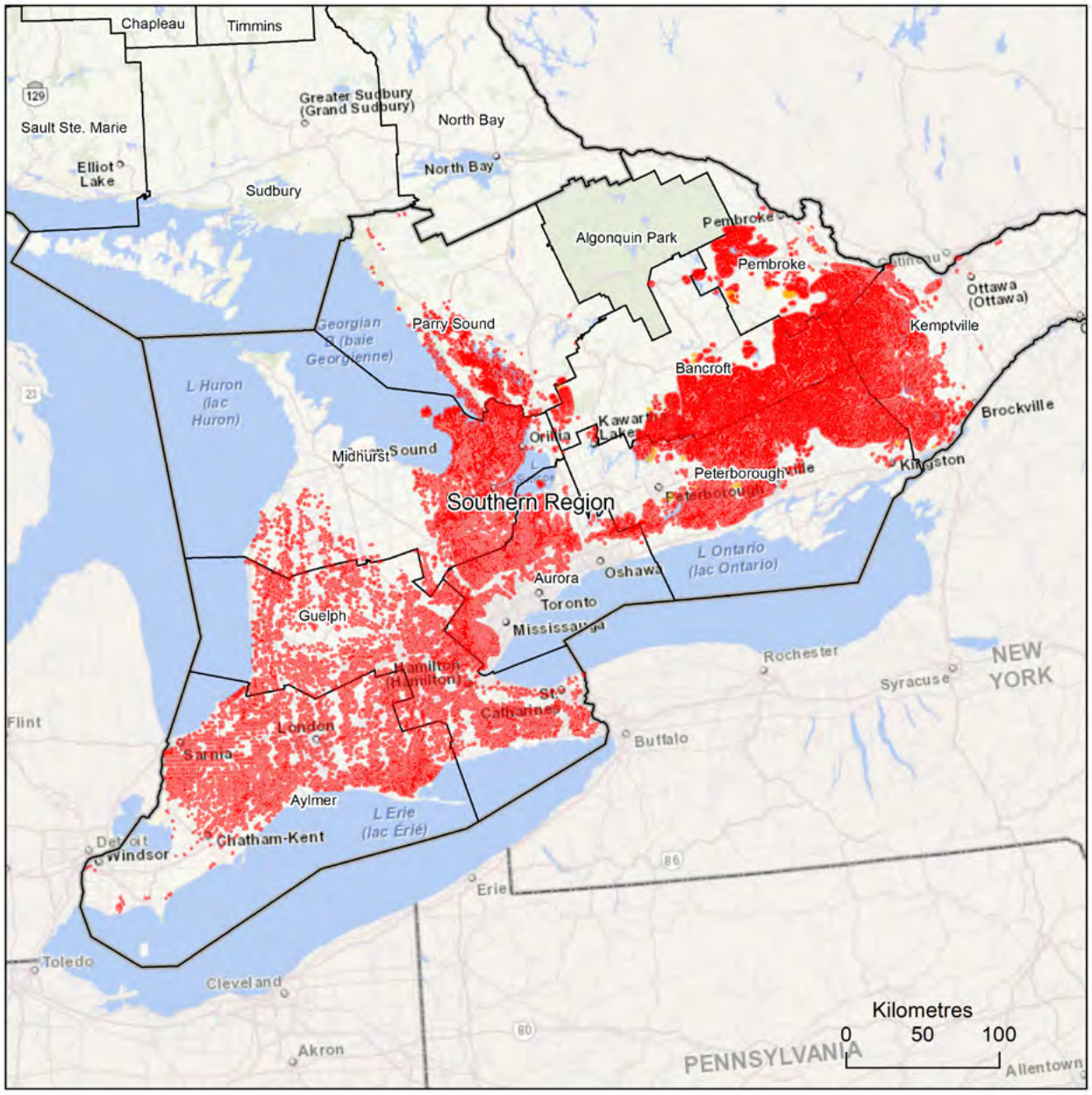
Lymantria dispar dispar 2021

Areas in Southern Region where Lymantria dispar dispar caused defoliation

Light = 9,101 ha
Moderate to severe = 1,703,828 ha

Area of light defoliation

Area of moderate to severe defoliation

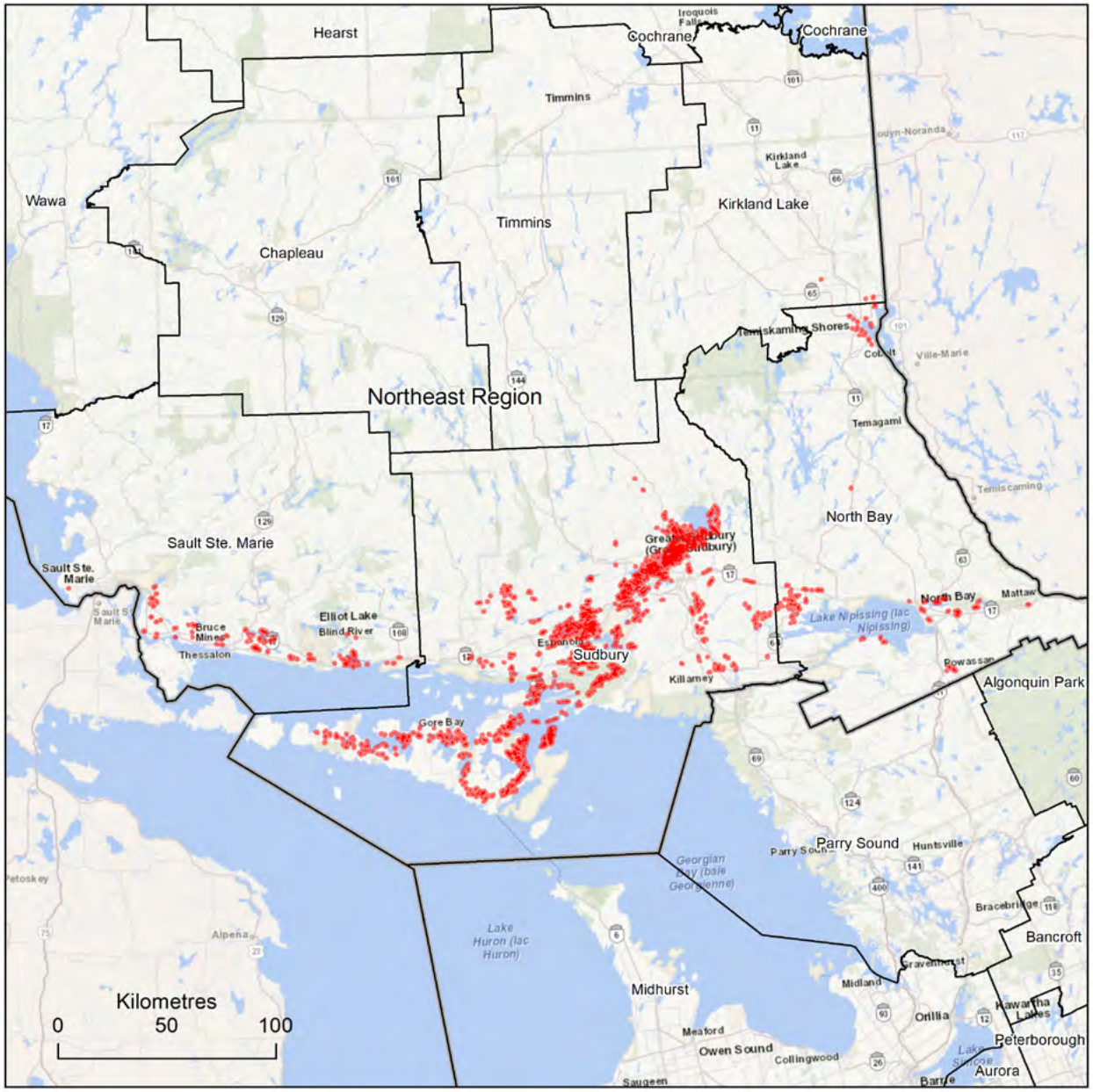


Lymantria dispar dispar 2021

Areas in Northeast Region where Lymantria dispar dispar caused defoliation

Moderate to severe = 75,916 ha

Area of moderate to severe defoliation



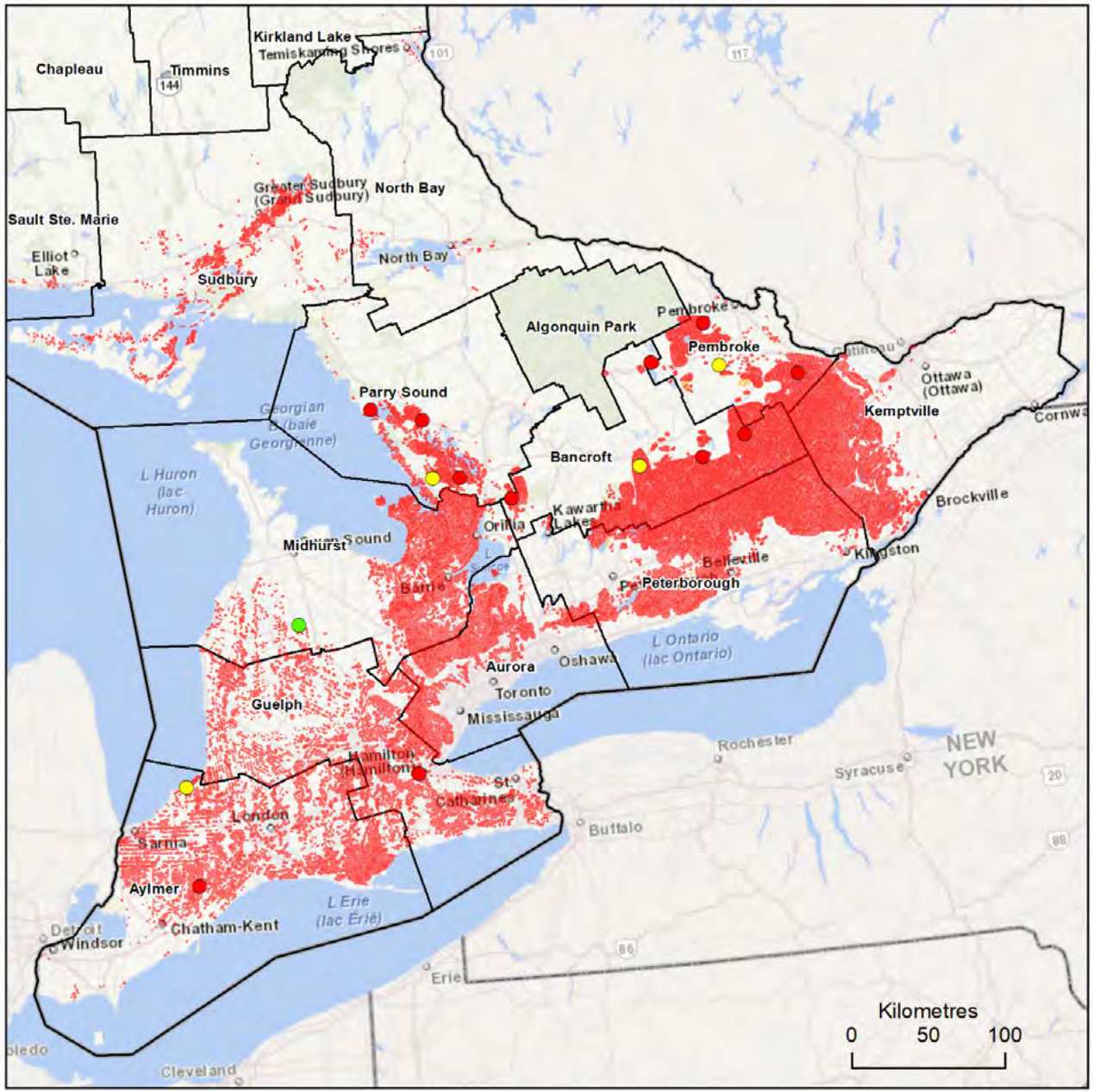
Lymantria dispar dispar egg mass survey results

Defoliation Forecast 2022

- Severe
- Moderate
- Light

Lymantria dispar dispar defoliation 2021

- Area of moderate to severe defoliation
- Area of light defoliation



Oak decline and mortality

Pest information

Common name:	Oak decline and mortality
Scientific name:	NA
Pest origin:	NA
Pest type:	Complex
Host species:	Red oak
Infestation area:	300 ha

Provincial key facts

- The red oak mortality and decline in northeast and southern regions of Ontario is attributable to a combination of several events over the past six years.
- In 2017 and 2018, severe forest tent caterpillar defoliation was recorded in both regions.
- Drought-like conditions preceded and coincided with this defoliation.
- In May 2015, a frost event occurred across the southern part of Northeast Region. Four consecutive days of below freezing temperatures caused red oak to flush with stunted or damaged leaves.
- Red oaks are commonly found on rocky sites with shallow soil, making them susceptible to drought stress.
- The combination of these stressors has predisposed the red oak to secondary factors including armillaria root rot, two-lined chestnut borer, and other wood borers.
- In 2021, red oak decline and mortality was mapped and reported in northeast and southern regions.

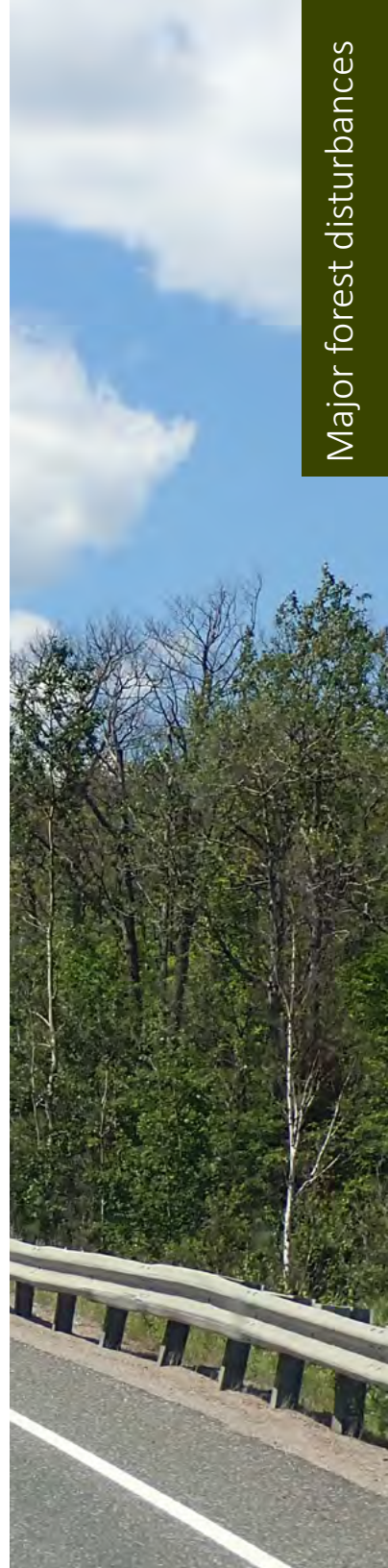
Regional summary

Northeast

- In Sudbury District, 42 ha of oak decline were mapped south of Espanola, north of Walford, and northeast of Spanish. These locations are near areas of oak decline recorded in 2020.

Southern

- In Parry Sound District, 258 ha of oak decline were mapped southeast of the junction of Hwy 124 and Hwy 400 near Mill Lake (Municipality of McDougall). Forest tent caterpillar and LDD defoliation were mapped in this oak stand for several consecutive years.

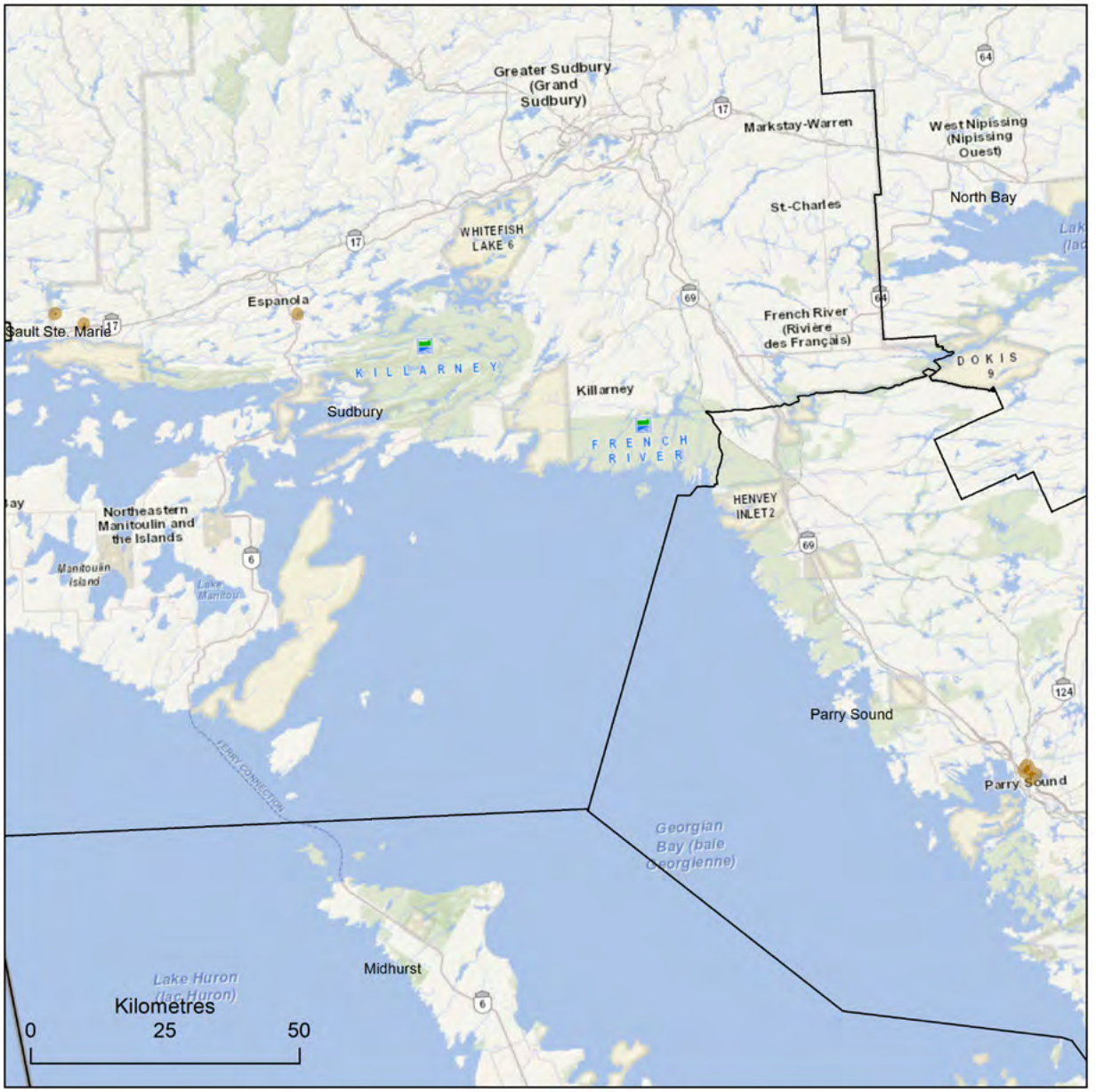


Oak decline 2021

Areas in Ontario where oak decline was observed

Mortality = 300 ha

Area of mortality

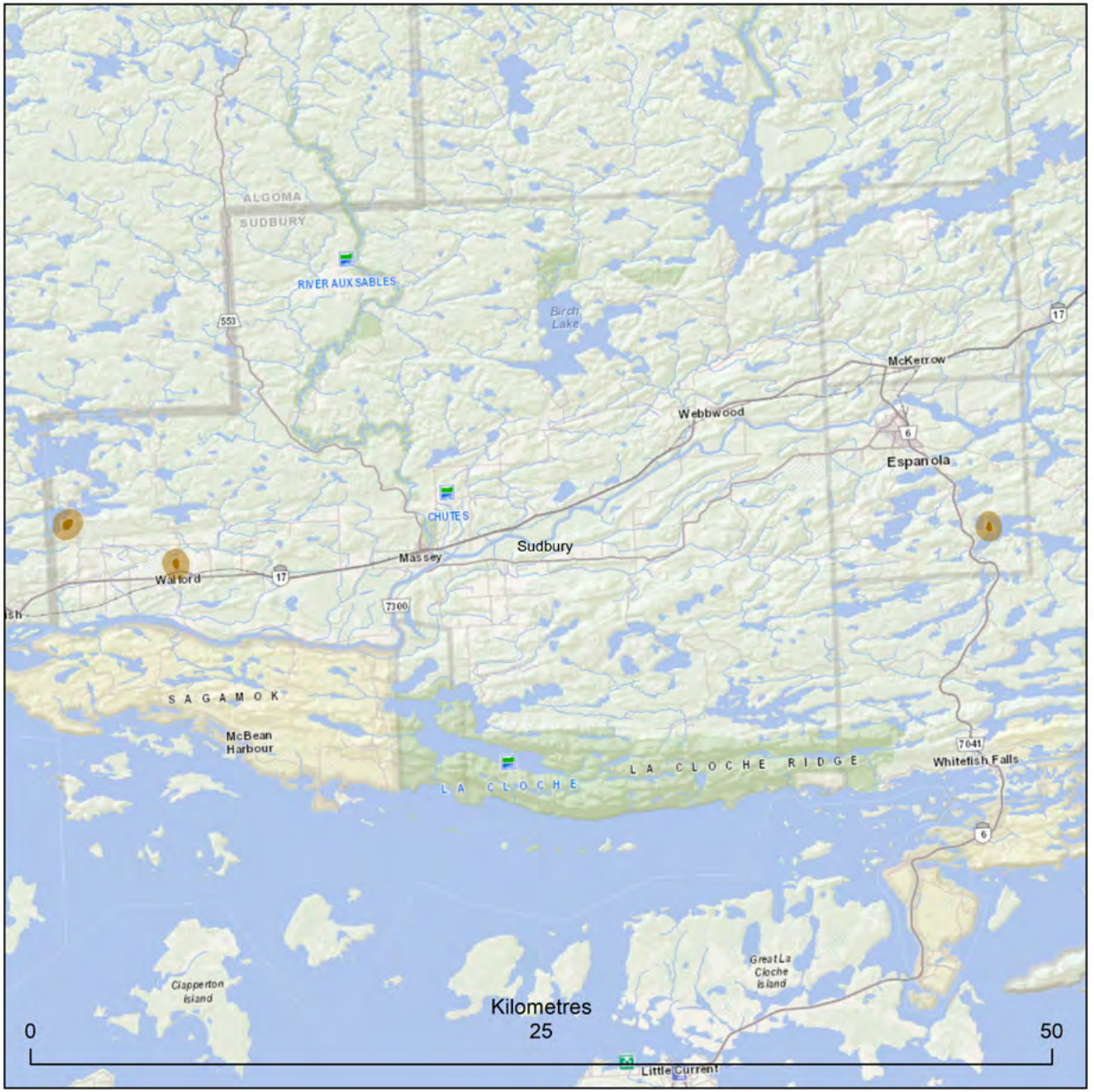


Oak decline 2021

Areas in the Northeast Region where oak decline was observed

Mortality = 42 ha

Area of mortality



Oak decline 2021

Areas in the Southern Region where oak decline was observed

Mortality = 258 ha

Area of mortality

Oak wilt

Pest information

Common name:	Oak wilt
Scientific name:	*Bretziella fagacearum* (Bretz)
Pest origin:	Unknown
Pest type:	Vascular disease
Host species:	All oak species
Infestation area:	None

Provincial key facts

- Oak wilt is a disease caused by an invasive forest pathogen, newly named *Bretziella fagacearum*. The disease is present in the northern United States, near the Ontario/Canadian border, posing a high risk of introduction. Locally, the disease is spread by insect vectors such as sap beetles (Coleoptera: Nitidulidae) and root grafting. Long distance movement is often the result of people moving oak wilt infected wood.
- Oak wilt poses a risk to all oak species in eastern Canada, especially the red oaks (*Quercus* section Lobatae). Oak wilt has not been detected in Canada but was detected and treated on Belle Island, Michigan, between Detroit and Windsor.
- Sweet smelling, fungal pressure pads develop on stems and large branches of newly killed trees and cause the bark to crack. Nitidulid beetles, attracted to the fungus, crawl through the cracks to feed on the fungus. New infections of oak wilt occur when nitidulid beetles transfer fungal spores on their bodies from the pressure pads on infected trees to fresh wounds on uninfected oak trees. Oak wilt pockets develop when the fungus spreads through root grafts from infected to nearby uninfected trees.
- Of the hundreds of species of sap beetles, only a subset has behaviours (flight timing, host preference) that result in oak wilt transmission. Current species of interest are *Carpophilus sayi* and *Colopterus truncatus*, since they are known vectors for oak wilt in the United States.
- Current efforts are focused on early detecting and preventing oak wilt establishment by developing best management practices and pruning guidelines.

Regional summary

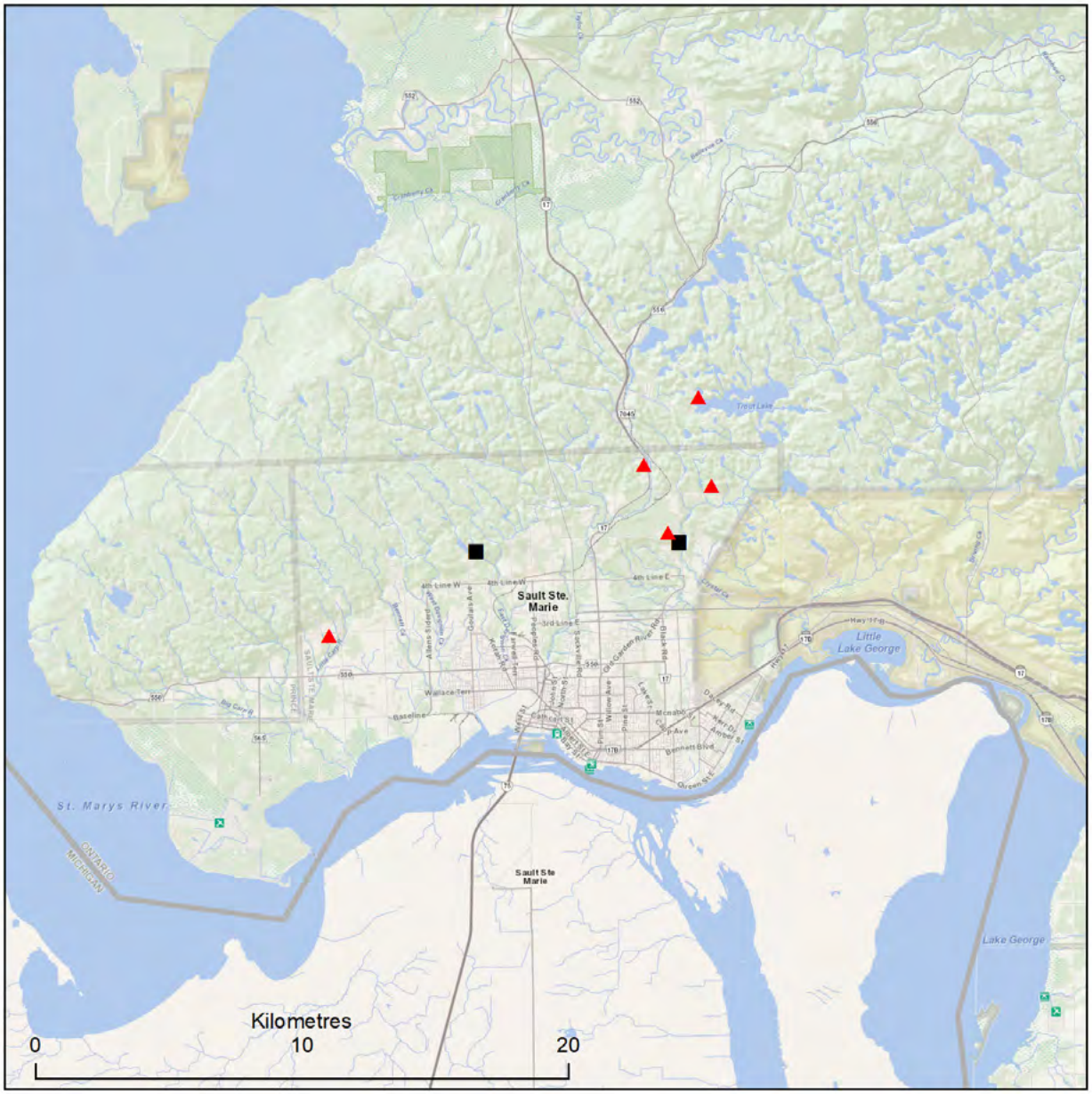
- In 2021, NDMNRF continued to investigate flight behaviour and degree day models and identify potential nitidulid beetle species that could be vectors of oak wilt in Ontario, where oak is at its northern range in Canada. Forest health program staff worked alongside local conservation authorities and partners to maintain beetle traps and collect specimens.
- Flight traps to capture beetles and equipment to monitor temperature were established at four locations in Ontario and maintained from April to October.
- At two locations, four different styles of flight traps were compared to determine which worked best for monitoring for nitidulid beetles. This study was repeated in New Brunswick by federal collaborators.
- At seven locations (two in southern and 5 in Northern Ontario), red oak trees were wounded weekly or bi-weekly between April and August to determine when oak wounds are attractive to beetles.
- From collections made during 2021, 23 nitidulid species from more than 14,000 specimens have been sorted and identified, including Carpophilus sayi and Colopterus truncatus. Degree day models are being built to identify when nitidulid beetles are flying and therefore most likely to transmit disease.

Nitidulid beetle flight trap and wounding locations 2021

Nitidulid beetle monitoring locations in the Sault Ste. Marie area

■ Flight trap location

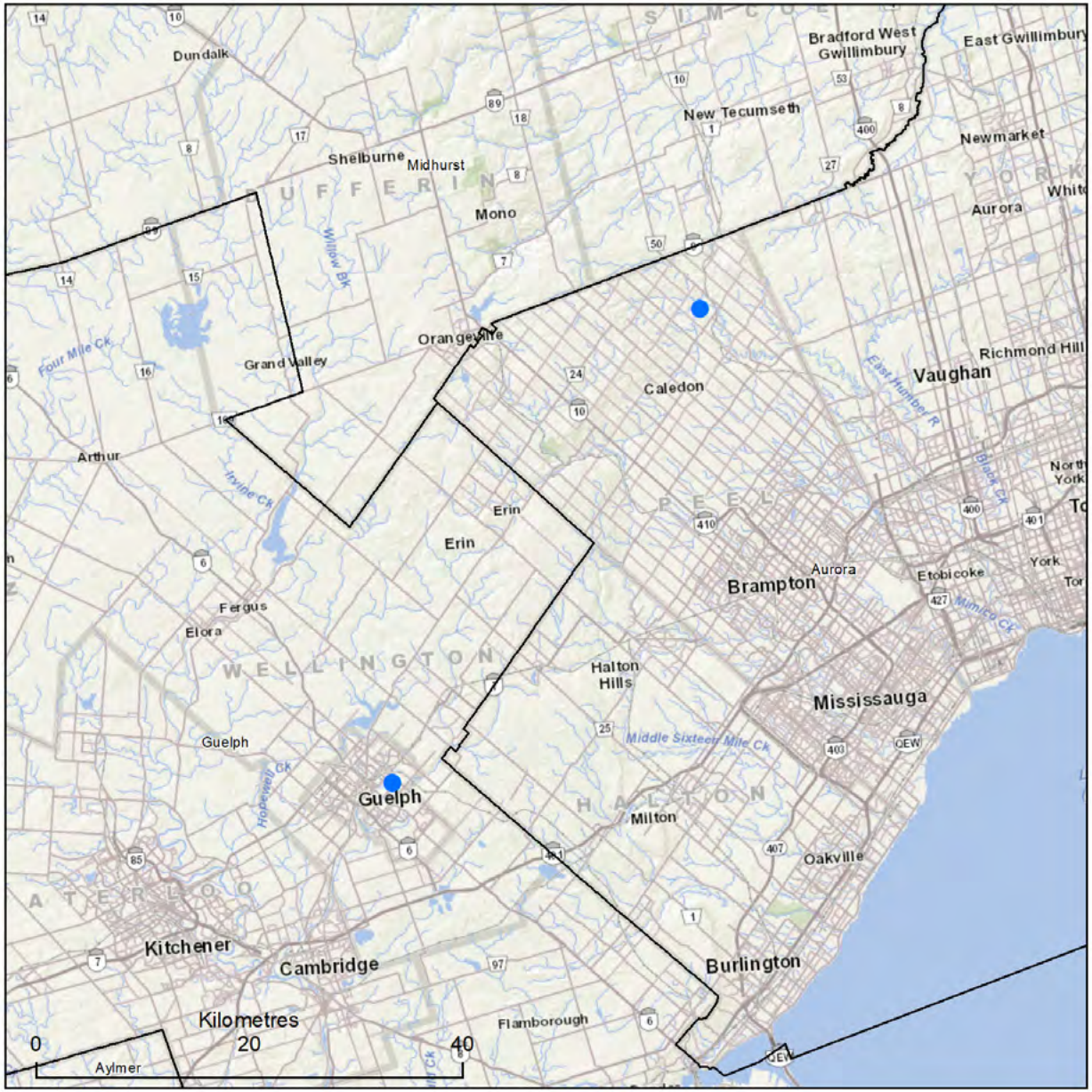
▲ Tree wounding location



Nitidulid beetle flight trap and wounding locations 2021

Nitidulid beetle monitoring locations in Southern Region

Flight trap and tree wounding location



Spruce budworm

Pest information

Common name:	Spruce budworm
Scientific name:	*Choristoneura fumiferana* (Clem.)
Pest origin:	Native to North America
Pest type:	Defoliator
Host species:	Balsam fir, white spruce, black spruce, tamarack, eastern white pine
Infestation area:	1,302,537 ha moderate to severe defoliation; 31,673 ha mortality

Provincial key facts

- Spruce budworm is one of the most damaging native insects affecting fir and spruce in Ontario.
- Spruce budworm outbreaks occur periodically when the primary host, balsam fir, reaches 40 years of age.
- Outbreaks can last several decades and can result in extensive mortality to balsam fir and spruce.
- In 2021, moderate to severe spruce budworm defoliation in the province increased to 1,302,537 ha from 442,426 ha in 2020, with most of the defoliation mapped in Northeast Region and a small amount in Southern Region.
- A total of 31,673 ha of spruce budworm mortality were mapped in 2021 compared with 9,358 ha in 2020. All aerially mapped mortality was in Northeast Region.

Regional summary

Northeast

- In Cochrane District, 370,496 ha of moderate to severe defoliation were mapped, a substantial increase from 139,451 ha in 2020. While the defoliation in the southwest corner of the district continues to coalesce into larger visible areas of defoliation, it has also spread into the southeast corner of the district northeast of Iroquois Falls towards the Quebec border. On the southwest side of the district, one of the largest areas of defoliation was recorded from Greenwater Provincial Park northwest to the Fraserdale Wetland Complex in the townships of Colquhoun, Leitch, and Marven. In the southcentral part of the district, large areas of defoliation were mapped east of Hwy 652, mostly in the townships of Tweed, Bragg, and Raven. In the southeast part of the district, larger areas of moderate to severe defoliation were mapped between Lake Abitibi and Little

Abitibi Provincial Park. In 2021, a total of 157 ha of spruce budworm mortality were mapped in the southwest part of the district west of the Mattagami River in the townships of Mabee and Bradburn, north and south of Carmichael Lake in Carmichael Twp, and southwest of Moonbeam Lake in Machin Twp.

- In Timmins District, 316,739 ha of moderate to severe defoliation were mapped, a notable increase from 97,342 ha in 2020. Moderate to severe defoliation was detected throughout the entire district in 2021. North of Gogama to the northern district boundary moderate to severe defoliation was more contiguous and had expanded in areas mapped in 2020. South of Gogama to the southern district boundary new areas of moderate to severe defoliation were mapped. A large area of defoliation was recorded south of Hwy 560, between the Canadian National Railway line and Hwy 144 from Westree to the Timmins/Sudbury district border. Larger areas of defoliation were also recorded on the west side of Hwy 144 from Duke Lake to Expanse Lake near the Sudbury District boundary and another area close to the Kirkland Lake District boundary east of Shining Tree from Big Four Lake to East Shining Tree Lake. Smaller more scattered areas of defoliation were observed west of Shining tree between Groves Lake and Lower Opikinimika Lake as well as on the southeast side of the district between Burwash and Karchuk lakes. In all, 1,002 ha of spruce budworm-caused tree mortality were mapped in Timmins District. In the northwest corner of the district, mortality was mapped at Flying Post 73 First Nations Reserve, west of Fortune Lake in Fortune Twp, and around Geary Township Shoreline Bluff in Geary Twp. In the northeast corner of the district, mortality was mapped south of Night Hawk Lake and north of Frederick House Lake.

- In Chapleau District, 160,903 ha of moderate to severe defoliation were mapped, an increase from 52,654 ha in 2020. All the defoliation was on the east side of the district, with continued to expansion in the northeast and new areas of defoliation mapped below Hwy 101 in the southeast part of the district. Most of this new defoliation was south of Ivanhoe Lake to Sultan Industrial Road. South of Sultan Industrial Road, a heavier concentration of spruce budworm defoliation was evident between Biscotasing Lake and Wakami Lake extending as far south as the Chapleau/Sudbury district border. Smaller isolated areas of defoliation were found in the southern part of the district southeast of Wenebegon Lake in Bounsall Twp and farther north on the west side of Tony Lake in De Gaulle Twp. In the northeast part of the district, moderate to severe defoliation expanded south and east of Kapuskasing Lake to the Timmins District boundary. West of Kapuskasing Lake, one small isolated area of defoliation was mapped on the west side of Makonie Lake in Lloyd Twp. In 2021, 7,563 ha of spruce budworm mortality of balsam fir and white spruce were mapped in the northeast part of Chapleau District. Most of this mortality occurred east of Kapuskasing Lake in the townships of Lougheed, Davin, Ossin, Wadsworth, Shenango, and Nova. Two smaller areas of mortality were mapped in the north and south respectively: one area in the northeast corner of the district in Montcalm Twp northeast of Elk Lake and the other northeast of Helen Lake in Ceylon Twp below the Canadian Pacific Railroad tracks.

- In Sudbury district, 157,832 ha of moderate to severe defoliation from spruce budworm were mapped across the district, a substantial increase from 23,421 ha in 2020. Most of the increase in defoliation was mapped in the northern part of the district. A sizable area of spruce budworm defoliation was mapped north of Greater

Sudbury between Hwy 144 and Lake Wanapitei that extended as far north as the Sudbury/Timmins district border. Smaller more scattered areas of defoliation were mapped west of Hwy 144 and reached the three neighbouring districts of Timmins, Chapleau, and Sault Ste. Marie in the northwest corner of the district. New areas of spruce budworm defoliation were also recorded in Killarney Provincial Park and on the west side of Manitoulin Island. Defoliation continued to expand on the east side of Manitoulin Island. Defoliation from spruce budworm remained in the central part of the district southwest of Sudbury along Hwy 17 to the community of Spanish. A total of 2,714 ha of white spruce and balsam fir mortality were mapped in the central part of the district, east of Lake Wanapitei, west of Markstay, west of Chelmsford, north of Onaping Falls, north of Nairn Centre, and south of Whitefish. One small isolated area of mortality was mapped on Manitoulin Island north of South Baymouth.

- In Hearst District, 128,557 ha of moderate to severe spruce budworm defoliation were mapped on the east side of the district. Defoliation in the southeast corner continued to expand and new areas of defoliation were recorded west and north of the originally infested area. Defoliation continued from the north end of Remi Lake to the Northern Claybelt Forest Complex in the southeast corner of the district. In the west, large areas of defoliation were mapped southwest of Opasatika, mostly in the townships of Shearer, Parnell, and Barker, and one isolated area was mapped east of Rufus Lake in Opasatika Twp. Ground surveys from Opasatika to Rufus Lake along Fergus Road revealed large areas of light defoliation not detectable by aerial surveys. North of the larger area of moderate to severe defoliation, new areas of spruce budworm defoliation were aerially mapped near Little Long Rapids on the Mattagami River, in the townships of Harmon and Mowbray about 113 km north of Moonbeam to the Remi River north of Gurney Lake. Smaller areas of new defoliation were also found southwest of Little Long Rapids along the Mattagami River, from the Bennet Lake Esker Kame Complex south to Guilfoyle Lake in the townships of Boyle and Guilfoyle. Isolated areas of light defoliation were also detected during ground surveys in the townships of Boyle and Guilfoyle. A total of 473 ha of spruce budworm mortality were mapped in the southeast part of the district. Small areas of mortality were found north of Moonbeam towards Rene Brunelle Park, north of Fauquier in Machin Twp, south of Fauquier in the townships of Macvicar and Carmichael, and along the Hearst/Chapleau district border in the townships of Watson and Poulett.
- In Kirkland Lake District, 126,772 ha of moderate to severe defoliation were mapped in 2021 — a substantial increase from 3,614 ha in 2020. In 2021, new areas of defoliation were recorded across the district. Large areas of defoliation were mapped south of Lake Abitibi in the northern part of the district as well as south of Ramore along Hwy 11 to Englehart in the central part of the district. The infestation in the Elk Lake area expanded north over to Matachewan and along the Matachewan River. The infestation in West Montreal River Provincial Park expanded north to Robertson Lake (Robertson Twp) and south to the north end of Lady Evelyn Smoothwater Provincial Park along the North Bay District boundary. In 2021, a small area of mortality (16 ha) was mapped south of Larder River Provincial Park southeast of Englehart in Ingram Twp.

- In North Bay District, 30,601 ha of moderate to severe spruce budworm defoliation were mapped in 2021, slightly more than what was recorded in 2020. In the northern part of the district, new large areas of defoliation were recorded west of Latchford to Sugar Lake in Lady Evelyn-Smoothwater Provincial Park, extending as far north as Hwy 558 at Mowat Landing in Barr and Klock townships. In the eastern part of the district, modest areas of defoliation were observed from Lake Nipissing eastward towards the Quebec and Ontario provincial border, with the largest areas of defoliation south of Mattawa. In the southwestern part of the district, moderate to severe defoliation was mapped near Field and north to the Temagami River. Smaller areas of defoliation in the southern part of the district were recorded on the eastern side of Restoule Bay, Keso Bay Road, and south of Lake Nipissing southeast of the French River Main Channel. A total of 19,748 ha of spruce budworm mortality were mapped in the district, an increase from 5,318 ha in 2020. Most of the mortality was mapped northeast of Lake Nipissing to the Quebec border and north of Temagami to New Liskeard. Small areas of spruce budworm mortality were also mapped south of Temagami to the junction of Hwy 11 and Hwy 64 near Martin River.
- In Sault Ste. Marie District, 6,435 ha of moderate to severe spruce budworm defoliation were aerially mapped in the southern part of the district. Most of the defoliation was north and west of the City of Sault Ste. Marie, in the southcentral part of the district from Desbarats to Iron Bridge, including St. Joseph Island, and a new area of defoliation was recorded south of Elliot Lake to Serpent River. In the Sault Ste. Marie area, spruce budworm defoliation was mapped in the northeast corner of Korah Twp and stretched north into Pennefeather and Aweres townships where defoliation was moderate to severe along Hwy 17 in the community of Heyden to the northwest corner of Aweres Twp near Cranberry Creek. On the west side of the City of Sault Ste. Marie, spruce budworm defoliation was mapped in Awenge and Parke townships near Carpin Beach. The defoliation spread into Prince Twp along Airport Road and a little farther north onto the hillsides east of Gros Cap. In the southcentral part of the district, defoliation was recorded east of Echo Bay over to Gordon Lake, Poplar Dale, and Dunns Valley, as well as south of Bar River in Laird and Tarbutt townships. More areas of moderate to severe spruce budworm defoliation were recorded between Hwy 638 and Hwy 129, primarily along the Thessalon River system (Lefroy Twp) and on the east side of Rose Twp between McKinnon Creek and Emerson Lake. Other areas of defoliation were aerially mapped northeast of Thessalon between Livingston Creek and Cranberry Lake (Thessalon Twp) and northeast of Basswood Lake in Day, Wells, and Parkinson townships. Small, scattered areas of defoliation were also observed on the north end of St. Joseph Island east of Richards landing and south of Sailors Encampment as well as south to southeast of Iron Bridge in Gladstone, Bright, and Thompson townships. In 2021 a new area of spruce budworm defoliation was recorded south of Elliot Lake between Depot Lake and Serpent River along Hwy 17. Most of this defoliation was at the junction of Esten, Proctor, Spragge, and Lewis townships, and in Serpent River First Nations Reserve 7. During ground surveys, moderate to severe defoliation was observed along the Hwy 17 corridor between Iron Bridge and Blind River.
- For the second consecutive year, moderate to severe spruce budworm defoliation was mapped in the southern part of Wawa District in Lake Superior Provincial Park totalling 3,855 ha. Defoliation was recorded along Hwy 17 from Gargantua Road in the north to the southern district boundary south of Agawa Bay. Light defoliation was

observed during ground surveys in Rabbit Blanket Lake camping area and Old Woman's Bay, both in the park. Trace populations of spruce budworm were also detected in the communities of Manitouwadge and Wawa.

Southern

- In Parry Sound district, 348 ha of moderate to severe defoliation were mapped in 2021, a decrease from 6,869 ha in 2020. Small areas of defoliation were detected near Key River, north of Dollars Lake, in Ahmic Harbour, and east of Lake of Many Islands.
- In Peterborough District, decline and mortality of mature white spruce stands were observed during ground surveys in Balsam Lake Provincial Park. No defoliation in this area was observed in 2020 or 2021, but four years of consecutive moderate to severe spruce budworm defoliation between 2016 and 2019 may have contributed to this white spruce mortality.

Trend analysis/outlook/issues

Spruce budworm spray program

In 2021, the ministry undertook an insect pest management program for spruce budworm affected stands in Hearst, Cochrane, Chapleau, and Timmins districts. The bacterial insecticide Btk (Foray 76B) was applied at 1.5 L/ha to 53,914 ha of spruce/fir stands. An efficacy assessment confirmed that the foliage protection program was successful in reducing the defoliation in affected stands but did not meet its objective of keeping defoliation below 40% in all affected stands.

Four project areas were treated with Btk in 2021: the Abitibi River Forest project area (31,937 ha), mainly in Cochrane District; Gorden Cosens Forest project area (10,966 ha), mostly in Hearst District; Pineland Forest project area (10,176 ha), largely in Chapleau District; and Romeo Malette Forest project area (835 ha), in Timmins District. To assess spray efficacy, 27 plots were established in areas that had been sprayed and 19 plots were established in untreated areas. Due to COVID-19 restrictions, spray assessment was limited to defoliation surveys; population comparisons were not done in 2021. In Abitibi River Forest, average defoliation in sprayed spruce/fir stands was 66.9% compared to 69.8% in unsprayed stands. In Gordon Cosens Forest, average defoliation in sprayed stands was 56.9% vs. 67.6% in unsprayed stands. In Pineland Forest, average defoliation in sprayed stands was 26.9% compared with 61.6% in unsprayed stands. In the Romeo Malette Forest, average defoliation in sprayed stands was 52.1% relative to 71.9% in unsprayed stands. Only the Pineland Forest project met the foliage protection objective of <40% defoliation. This outcome may be attributed to abnormally high populations of spruce budworm, but unfortunately populations were not assessed in 2021 due to COVID-19 restrictions.

Spruce budworm pheromone trapping

Spruce budworm pheromone trapping was carried out across the province in 2021. Traps were deployed at 60 locations: 15 in Northwest Region, 27 in Northeast Region, and 18 in Southern Region. The highest average number

of moths recorded per trap was 1,259 in Sault Ste. Marie District. Two other locations had an average of more than 1,000 male moths/trap, one in Chapleau District (1,100) and the other in Pembroke District (1,007). In Northeast Region, the average number of male moths per trap was 458. In Southern Region, the average number of male moths per trap was 347, with the highest counts in Pembroke and Kemptville districts. In Northwest Region, the average number of moths continued to be relatively low, averaging 88, but increased from 27 moths per trap recorded in 2019 (traps were not deployed in 2020 due to COVID-19 restrictions). The highest counts in Northwest Region were in Grain Twp in Nipigon District with an average of 479 male moths/trap.

Spruce budworm defoliation forecast survey

In Ontario, spruce budworm defoliation forecasting is based on surveys of the number of overwintering larvae on tree branches. Spruce budworm overwinter as second instar larvae (L2) by encapsulating themselves in silken shelters (hibernacula) under branch scales and bark cracks. These larvae typically shelter from late August until the following spring. This overwintering stage of the lifecycle provides an opportunity for monitoring crews to collect branches and extract and count larvae to forecast the potential severity of defoliation the following spring and summer. Defoliation forecasts are used to determine which stands should be considered for protection. Locations for L2 surveys are selected based on defoliation mapped during the current infestation and are generally in or near areas of current defoliation. From each location, 10 trees were selected, and a 1 m branch was sampled from the mid- to upper crown of each tree. Branches were sent to a laboratory to be processed in a sodium hydroxide washing procedure to extract the second instar larvae from their hibernacula. Extracted larvae were collected and counted under a microscope to determine the average number of larvae per branch for each sample location. This average was used to forecast spruce budworm defoliation for 2022. An average of more than 65 larvae per branch indicates potential for severe defoliation, 26 to 65 larvae per branch indicates potential for moderate defoliation, and less than 25 larvae per branch indicates potential for light defoliation.

In Northeast Region, 36 locations (360 trees) were sampled for larvae in 2021. These locations were divided among districts: Cochrane (12), Chapleau (8), Hearst (5), Kirkland Lake (4), Timmins (3), Sudbury (2), and North Bay (2). In Cochrane District, the defoliation forecast for 2022 is severe for 10 locations, moderate for one, and light for one. In Chapleau District, the defoliation forecast is severe for five locations, moderate for two, and light for one. In Hearst District, the defoliation forecast is severe for one and moderate for four locations. In Kirkland Lake District, the forecast is severe for two locations, moderate for one, and light for one. In Timmins District, the forecast is severe for two locations and moderate for one location. In Sudbury District, the defoliation forecast is severe for one location and moderate for one location. In North Bay District, the defoliation forecast is severe for one location and moderate for one location.

Six of the 36 locations averaged more than 100 second instar larvae per branch, two each in Cochrane and Chapleau districts and one each in Hearst and Timmins districts. The location in Timmins District (Wilhelmina Twp) had the most second instar larvae per branch, with an average of 166.5.

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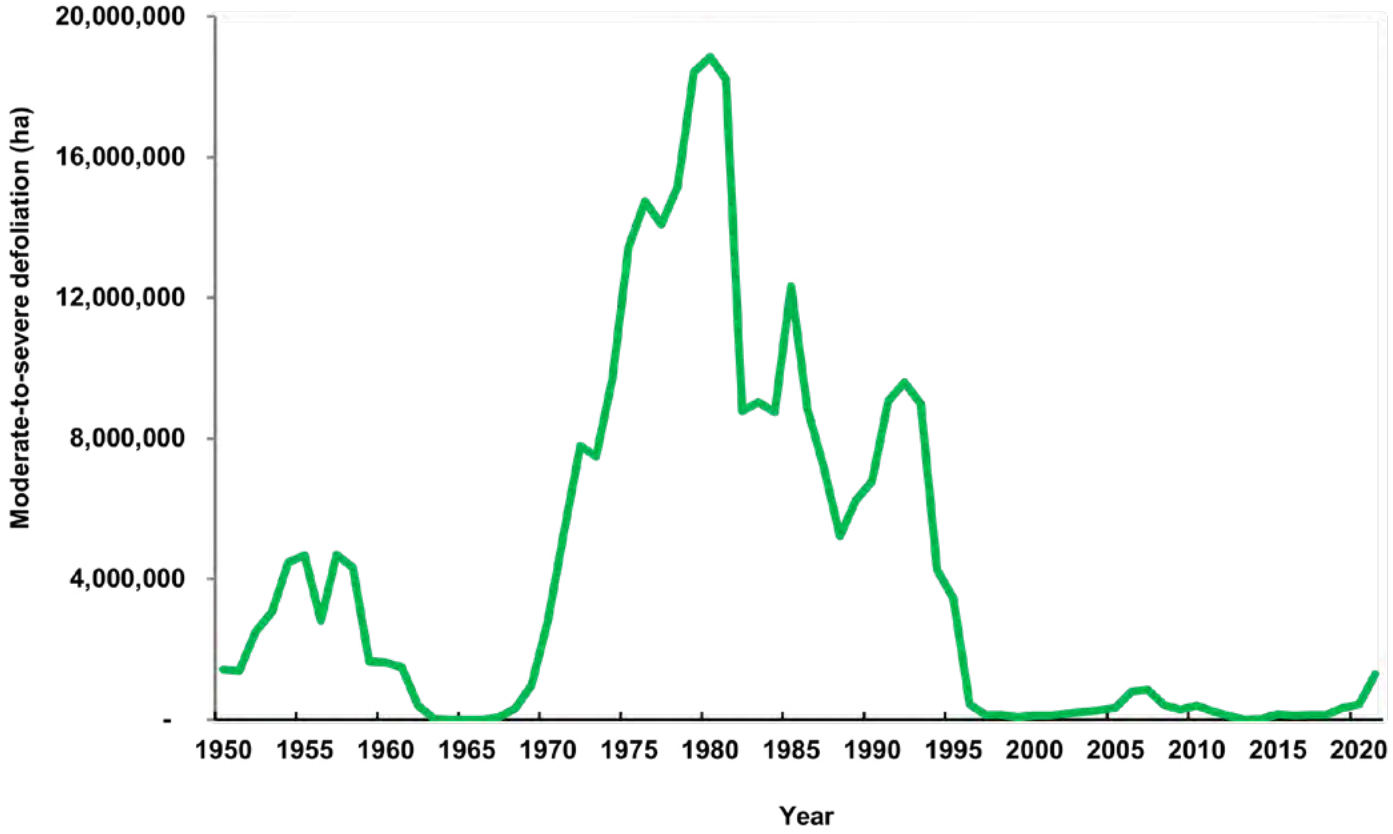
Total area (hectares) in which spruce budworm caused moderate to severe defoliation from 2017–2021 by NDMNRF district.

Region / District	Area of damage (ha) 2017	2018	2019	2020	2021
Northeast					
Chapleau	22,429	30,680	67,918	52,654	160,903
Cochrane	53,967	31,841	109,026	139,451	370,496
Hearst	22,168	16,522	72,338	77,840	128,557
Kirkland Lake	132	-	972	3,614	126,772
North Bay	4,058	33,933	15,154	29,431	30,601
Sault Ste. Marie	-	-	4,363	10,826	6,435
Sudbury	-	803	9,635	23,421	157,832
Timmins	43,772	23,230	60,175	97,342	316,739
Wawa	-	-	-	977	3,855
Subtotal	146,525	137,008	339,580	435,557	1,302,190
Southern					
Algonquin Park	-	-	-	-	-
Aurora	-	-	-	-	-
Aylmer	-	-	-	-	-
Bancroft	55	-	-	-	-
Guelph	-	-	-	-	-
Kemptville	-	-	-	-	-
Midhurst	-	-	-	-	-
Parry Sound	-	-	2,753	6,869	348
Pembroke	-	-	-	-	-
Peterborough	492	74	-	-	-
Subtotal	547	74	2,753	6,869	348
Provincial total	147,072	137,082	342,333	442,426	1,302,537



Total area (in hectares) iin which spruce budworm caused moderate to severe defoliation in Ontario from 1950 to 2021.

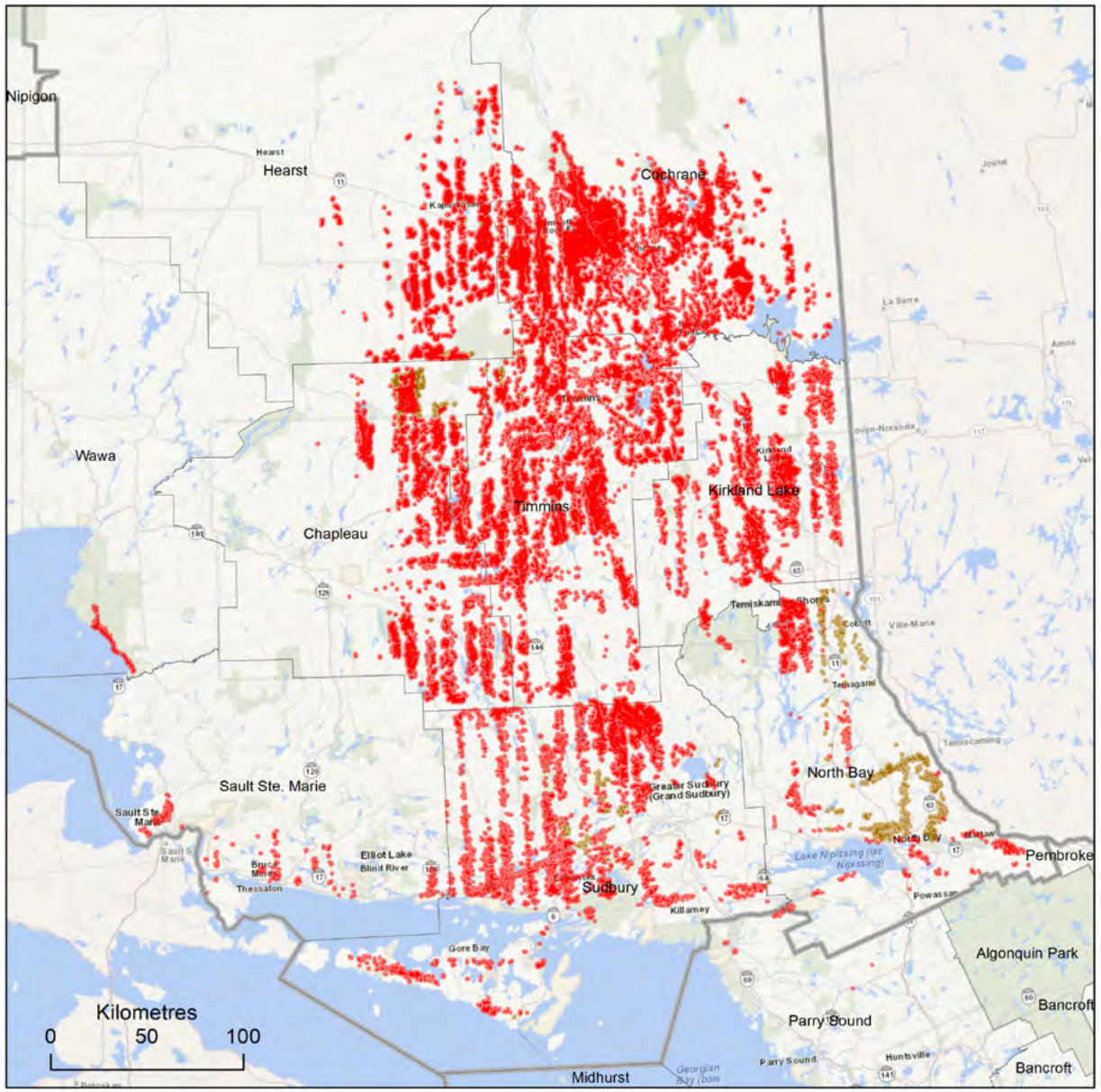
Spruce budworm 2021

Areas in Ontario where spruce budworm caused defoliation

Moderate to severe = 1,302,537 ha
Mortality = 31,673 ha

Area of moderate to severe defoliation

Area of mortality



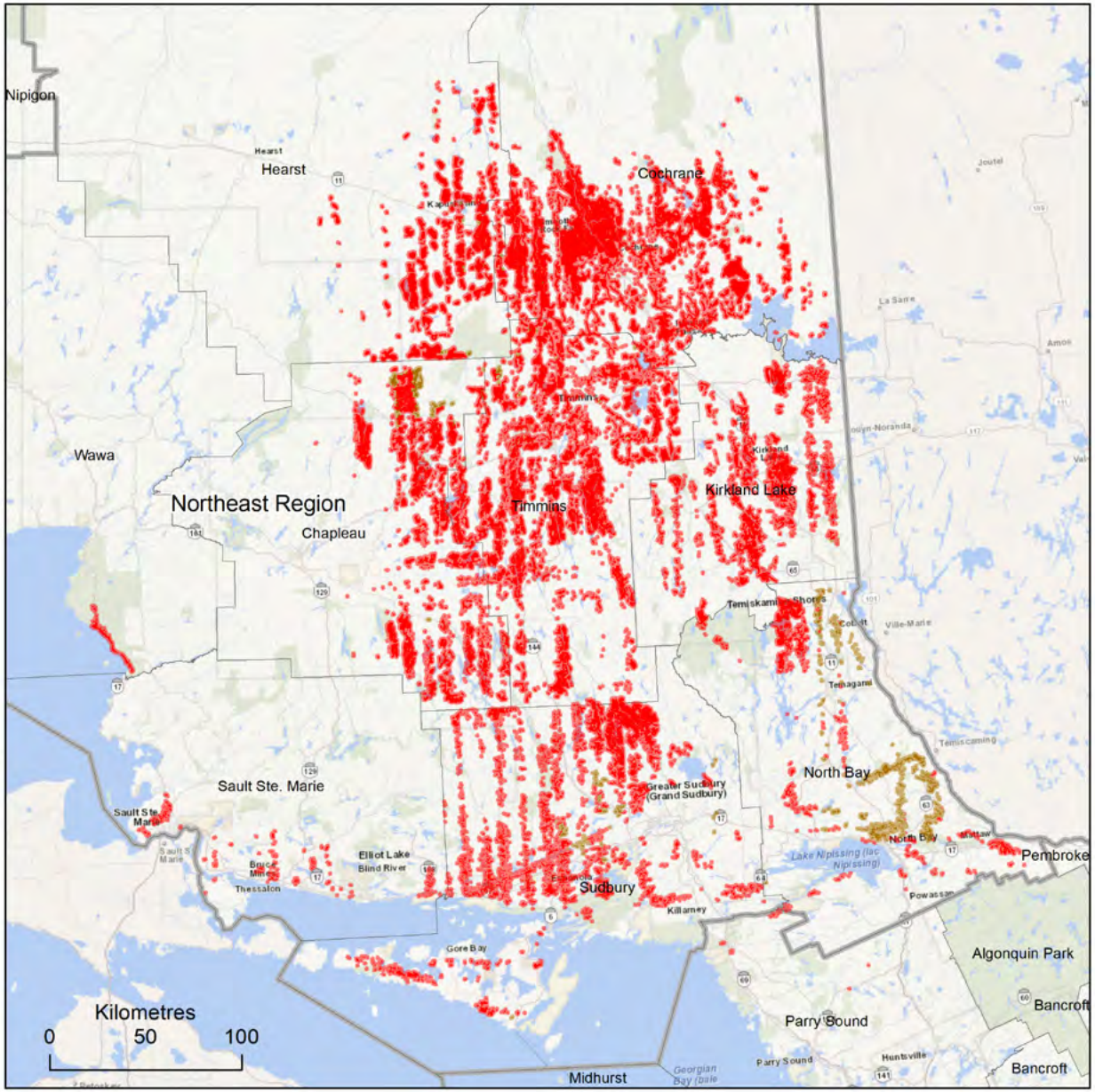
Spruce budworm 2021

Areas in Northeast Region where spruce budworm caused defoliation

Moderate to severe = 1,302,190 ha
Mortality = 31,673 ha

Area of moderate to severe defoliation

Area of mortality

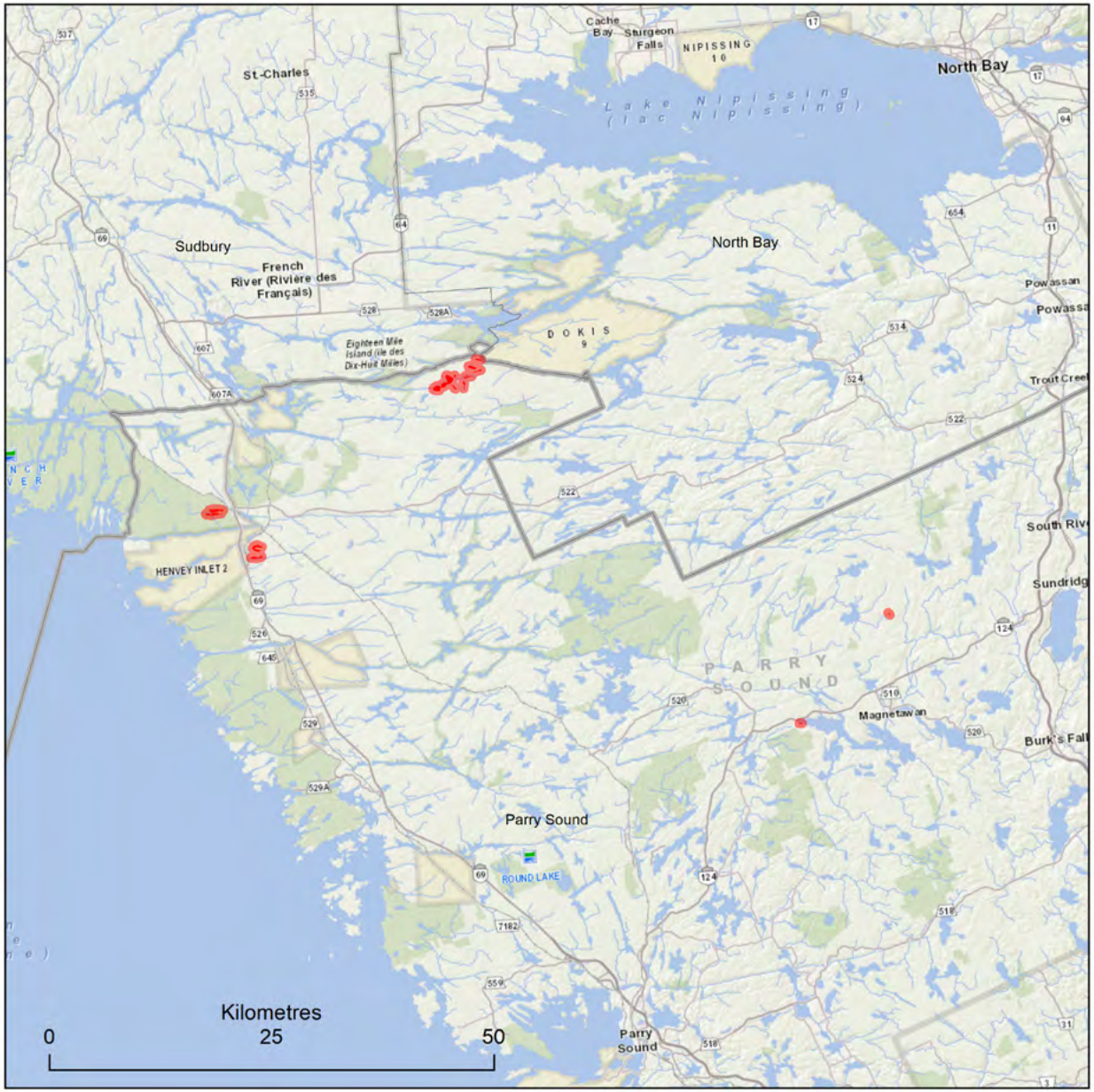


Spruce budworm 2021

Areas in Southern Region where spruce budworm caused defoliation

Moderate to severe = 348 ha

Area of moderate to severe defoliation



Spruce budworm pheromone trapping results 2021

Average number of moths per trap

- < 10
- 10 - 25
- 25 - 50
- 50 - 100
- > 100

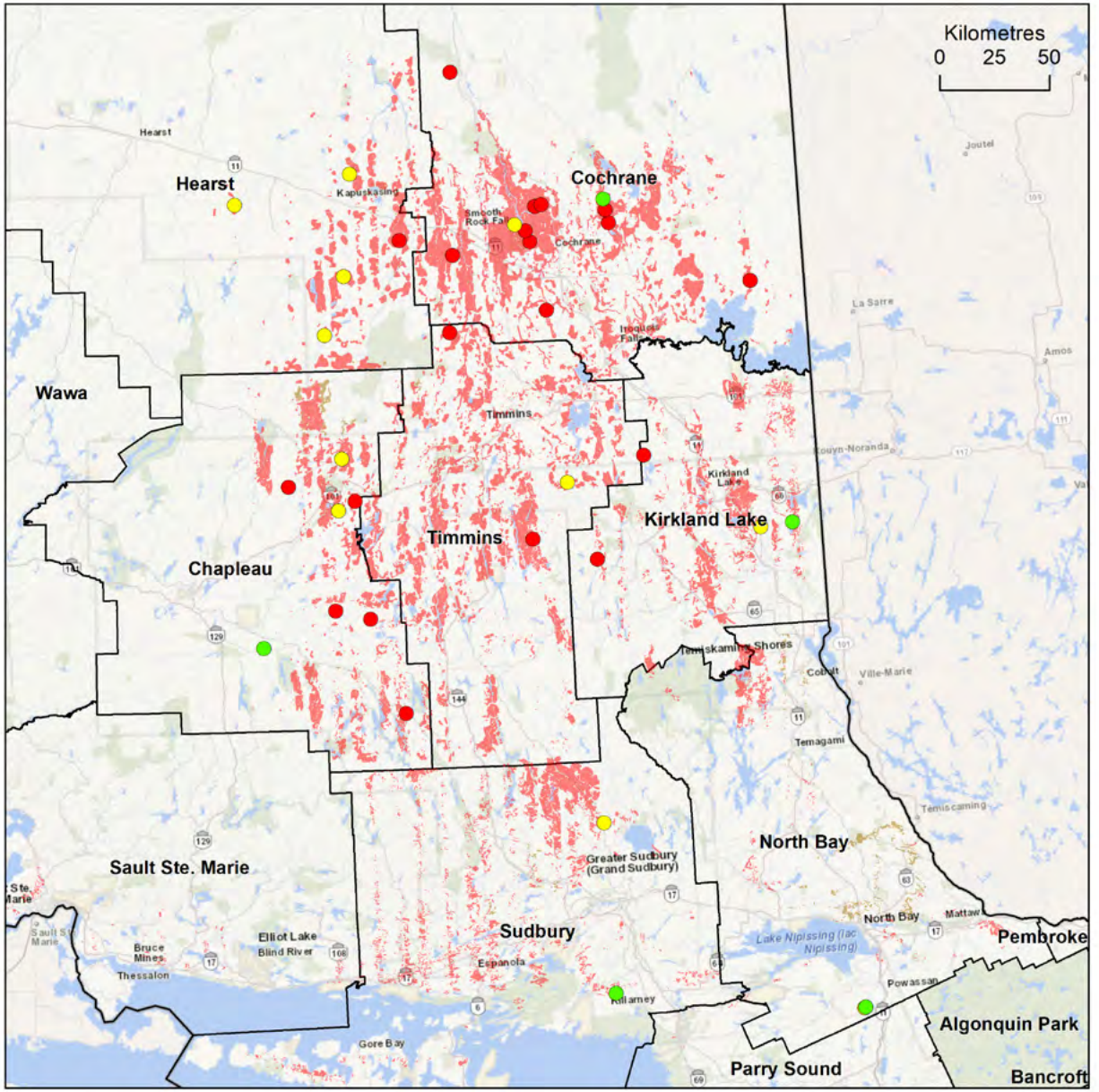
Spruce budworm second instar larvae survey results

Defoliation forecast 2022

- Severe
- Moderate
- Light

Spruce budworm defoliation 2021

- Area of moderate to severe defoliation
- Area of mortality



Whitespotted sawyer beetle

Pest information

Common name:	Whitespotted sawyer beetle
Scientific name:	*Monochamus s. scutellatus* (Say)
Pest origin:	Native to North America
Pest type:	Wood borer
Host species:	Eastern white pine, balsam fir, red pine, white spruce, jack pine
Infestation area:	300 ha (mortality)

Provincial key facts

- Whitespotted sawyer beetle is one of the most widely distributed and common wood borers in North America.
- This pest is mainly found on recently dead or dying trees.
- Larva tunnelling damage severely downgrades lumber value.
- Larger populations often occur near other forest disturbances, such as blowdown, drought, multiple years of defoliation, fire, and harvests.
- This beetle is often confused with the invasive Asian long-horned beetle.
- In 2021, 300 ha of whitespotted sawyer beetle mortality and damage were mapped in the Northeast Region.

Regional summary

Northeast

- In Kirkland Lake District, 300 ha of mortality were aerially mapped on the north and south sides of Hwy 560 in Mickle and Roadhouse townships, just west of Elk Lake. Whitespotted sawyer beetle damage was also observed during ground surveys along Beauty Lake Road on the edge of jack pine stands near slash piles and recently cut areas.
- In Wawa District, red foliage was observed during ground surveys on Caramat Industrial Road, south of the Town of Caramat. Damage was on jack pine trees across the road from slash piles left from forest harvesting. Whitespotted sawyer beetle maturation feeding was recorded on the branches in the form of chew marks left by the adult beetles. The same type of damage was noted on jack pine and black spruce near a deforested area east of the community of Manitouwadge, in Foote Twp.

Whitespotted sawyer beetle 2021

Areas in Ontario where whitespotted sawyer beetle caused mortality

Mortality = 300 ha

Area of mortality

Minor forest disturbances

Ash leaf spot

Pest information

Common name:	Ash leaf spot
Scientific name:	*Mycosphaerella effigurata* (Schwein.) House
Pest origin:	Native to North America
Pest type:	Leaf disease
Host species:	Ash spp.
Infestation area:	Localized

Provincial key facts

- Mycosphaerella leaf spot is a common fungal disease that can affect all ash species.
- Leaf diseases are normally more prevalent in wet and humid weather. Fallen leaves re-infect new leaves the following year.
- The fungus typically causes small yellow foliar spots or irregular green blotches on leaves. When infections are severe, it can cause large areas of leaf necrosis giving leaves a scorched appearance and may result in premature leaf drop.
- After repeated severe infections, trees may lose vigour and become more susceptible to other pests and pathogens.
- In 2021, ash leaf spot was reported in one district in Southern Region.

Regional summary

Southern

- In Guelph District, high incidence of ash leaf spot were detected during ground surveys at two locations in Fort Erie, Niagara Region. At Stevensville Conservation Area, all young ash trees surveyed had moderate to severe damage. At Shagbark Nature Park, ash leaf spot affected all young, open-grown white ash surveyed. Although leaf spot presence was high at both locations, premature leaf drop was not observed at the time of survey (late August).

Balsam fir sawfly

Pest information

Common name:	Balsam fir sawfly
Scientific name:	*Neodiprion abietis* (Harr.)
Pest origin:	Native to North America
Pest type:	Defoliator
Host species:	Balsam fir
Infestation area:	Localized

Provincial key facts

- Infestations of balsam fir sawfly are common in eastern Canada (Newfoundland and Labrador) and less frequent in Ontario.
- Outbreaks occurred in southeastern Ontario in the Ottawa Valley in the early 1940s and 50s and again in the late 1960s and early 70s.
- More than five or six consecutive years of defoliation can cause some mortality, but since spruce budworm often occurs simultaneously, it is difficult to distinguish which insect is causing the most damage.
- Balsam fir sawfly defoliation was not reported in Ontario in 2020 but was mapped annually in Southern Region from 2016 to 2019. It was last mapped in Northeast Region in 2016. In 2021, balsam fir sawfly was reported in Southern Region.

Regional summary

Southern

- In Kemptville District, balsam fir sawfly caused light defoliation in a mature stand of balsam fir on South Lavant Road, Lanark Highlands Twp, Lanark County. Symptoms included discoloration of old needles, especially in the top third of trees at the forest edge. LDD moth was also present and caused light defoliation in early June.

Basswood leafminer

Pest information

Common name:	Basswood leafminer
Scientific name:	*Baliosus nervosus* (Panz.)
Pest origin:	Native to North America
Pest type:	Defoliator
Host species:	Basswood
Infestation area:	Localized

Provincial key facts

- Basswood leafminer is distributed throughout the range of basswood in Ontario.
- Adults skeletonize the upper layer of the leaf and the larvae mine the leaves.
- Basswood leafminer are often found in southern Ontario, with minor feeding damage on edge and understory trees. During periodic outbreaks, mature trees can be defoliated to the upper crown.
- In 2021, basswood leafminer was recorded in two districts in Southern Region.

Regional summary

Southern

- In Aylmer District, moderate to severe defoliation was observed during ground surveys in areas of Elgin, Middlesex, and Lambton counties and the municipality of Chatham-Kent. Many of these areas have had basswood leafminer defoliation for several consecutive years. In Elgin County, moderate to severe defoliation of basswood of all age and canopy classes was detected in woodlots along the Hwy 401 corridor between Dutton and Rodney in the western part of the county. Moderate to severe defoliation of understory basswood was also detected in woodlots near the intersection of Centennial Road and Fruitridge Line in Central Elgin. Since basswood forms a large component of the forest in these areas, defoliation was highly visible by mid-August. In the municipality of Chatham-Kent, moderate to severe defoliation of all age and canopy classes of basswood was detected along Littlejohn Road (County Road 12) from the eastern edge of Delaware Nation at Moraviantown territory, and along County Road 20 to Highgate. Moderate to severe defoliation was also detected north of

Ridgetown around Botany. In Middlesex County, moderate to severe defoliation was detected on conservation lands along the Sydenham River south of Alvinston in Southwest Middlesex and in woodlots west of Mt. Brydges near the intersection of Christina Road (County Road 14) and Glendon Drive in Strathroy-Caradoc.

- In Midhurst District, scattered moderate to severe defoliation was detected during ground surveys in Grey, Dufferin, and Simcoe counties. In Grey County, moderate to severe defoliation of basswood of all age and canopy classes was detected in Allan Park Conservation Area near Hanover. In Dufferin County, light to moderate defoliation of understory basswood trees was detected in Dufferin County Forest – Main Tract. In Simcoe County, light to moderate defoliation of understory basswood trees was detected in Eldred King Woodlands east of Newmarket along Hwy 48.

Beech blight aphid

Pest information

Common name:	Beech blight aphid
Scientific name:	*Grylloprociphilus imbricator* (Fitch)
Pest origin:	Native to North America
Pest type:	Sucking insect
Host species:	American beech
Infestation area:	Localized

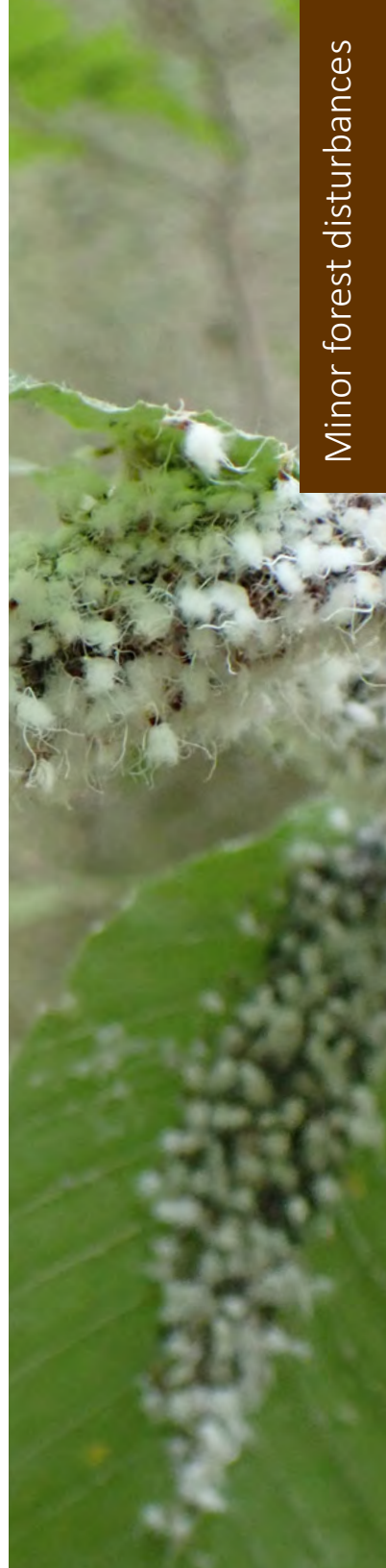
Provincial key facts

- The beech blight aphid is also known as the boogie woogie aphid, named after the movement of their woolly posterior when the colony is disturbed.
- Beech blight aphids are not a serious detriment to tree health but may cause dieback on heavily infested branches.
- The *Scolias spongiosa* species of sooty mould is exclusively associated with the beech blight aphid and feeds exclusively on the honeydew it produces.
- In 2021, beech blight aphids were observed in Parry Sound District in Southern Region.

Regional summary

Southern

- In Parry Sound District, moderate to severe damage was caused by beech blight aphid on South Crane Lake Road. About 40% of the understory beech trees in the stand had at least two branches covered with aphids. In addition, sooty mold from the honeydew they excrete was found underneath the aphids on lower branches or the forest floor.



Beech scale

Pest information

Common name:	Beech scale
Scientific name:	*Cryptococcus fagisuga* (Linding.)
Pest origin:	Invasive — native to Europe
Pest type:	Sucking insect
Host species:	American beech
Infestation area:	Localized

Provincial key facts

- Beech scale was first found in Canada in the 1890s in Halifax, Nova Scotia.
- In Ontario, it was first found in 1966 in Elgin County along the north shore of Lake Erie.
- This insect is now found across the range of beech in Ontario.
- Infestation with scale predisposes beech trees to beech bark disease, which reduces vigour and eventually kills the tree.
- In 2021, beech scale was observed in northeast and southern regions.

Regional summary

Northeast

- In North Bay District, trace to moderate amounts of beech scale were reported alongside Legrou Lake Rd (East Mills Twp), South River Rd (Nipissing Twp), Rye Rd (Nipissing Twp), and MacBrian's Rd (Calvin Twp). Trace to light scale was observed only on larger diameter beech at South River Rd and MacBrian's Rd. At Rye Rd and Legrou Lake Rd, moderate scale was observed on large diameter trees with trace scale on a few smaller diameter trees.

Southern

- In Parry Sound District, high levels of beech scale were evident near Healy Lake Road (Conger Twp), South Crane Lake Road (Conger Twp), Bear Lake Road (Livingston Twp), Tribble Road (Cardwell Twp), and Bon Echo Road

(Foley Twp). Moderate scale was observed at North Sandy Plains Road (Humphrey Twp). Scale was only evident on larger diameter overstory trees at Healy Lake Road, South Crane Lake Road, and North Sandy Plains Road but was found on all sizes of trees at Bear Lake Road, Tribble Road, and Bon Echo Road.

- In Midhurst District, high levels of beech scale were detected on Sideroad 20, west of Holland Centre (Chatsworth Twp) and at Stoney Island Conservation in Tiverton on two large diameter trees, with trace to light levels of scale on understory trees. Moderate levels of beech scale were detected in West Rocks Management Area in Owen Sound, Simcoe County Forest — Webb Tract in Innisfil and on Concession Road 5, west of Ballcroy (Adjala-Tosorontio Twp). Light levels of beech scale were detected at Saugeen Bluffs Conservation Area, north of Paisley, and Allan Park Conservation Area on Normanby Bentick Townline in Owen Sound. Trace to light levels of beech scale were detected at Lion's Head Provincial Park and Hope Bay Forest Provincial Park, both in Lion's Bay.
- In Guelph District, light to moderate levels of beech scale were observed on American beech trees of all ages and canopy classes by Glanbrook Landfill in the City of Hamilton. Beech bark disease cankers and beech leaf disease symptoms were also observed at this site.
- In Aylmer District, trace to light levels of beech scale were observed on larger diameter trees along the Ausable River, west of Parkhill (Middlesex County). Varying levels of beech scale continue to persist across most of eastern and central Aylmer District, but have yet to be detected west of Blenheim in the district.
- In Aurora District, light to moderate levels of beech scale were detected in eastern Aurora District including Happy Valley Tract (King Twp), Thorton Bales Conservation Area (King Twp), and Eldred King Woodlands (Whitchurch Twp). Trace levels were observed at Mountsberg Conservation Area, west of Campbellville in Halton Region.

Birch casebearer

Pest information

Common name:	Birch casebearer
Scientific name:	*Cleophora serratella* (L.)
Pest origin:	Invasive — native to Europe
Pest type:	Defoliator
Host species:	White birch
Infestation area:	Localized

Provincial key facts

- Birch casebearer was first reported in North America in 1927.
- Consecutive years of severe defoliation by this insect can cause branch and twig mortality and when outbreaks are severe may kill the tree.
- This casebearer produces one generation per year.
- It prefers white birch but can be found on other species of birch and alder.
- Localized defoliation by birch casebearer was found in northeast and southern regions in 2021.

Regional summary

Northeast

- At the end of June, severe defoliation by birch casebearer was recorded in Sault Ste. Marie District at the north end of Ranger Lake Road/Hwy 556 and along Hwy 129 south of the Ranger Lake Road junction. On Ranger Lake Road, several birch trees along the edge of the Mississagi River were severely defoliated in the northwest corner of Villeneuve Twp. The defoliation occurred in small areas of birch for about 1 km south of the bridge over the Mississagi River. On Hwy 129, severe birch casebearer defoliation was observed in the southern part of Sturgeon Twp in two small areas of white birch on the east side of the Mississagi River, about 20 km south of Hwy 556.

Southern

- In Kemptville District, birch casebearer caused light white birch defoliation on the fringe of a mixed forest on Algonquin Road, near Glenmore, Augusta Twp, Leeds and Grenville County. Birch formed a minor component of the stand, but all white birch trees were affected, averaging 10% defoliation.

Birch leafminer

Pest information

Common name:	Ambermarked birch leafminer and birch leafminer
Scientific name:	*Profenusa thomsoni* (Konow) *and Fenusa pusilla* (Lepeletier)
Pest origin:	Invasive — native to Europe
Pest type:	Defoliator
Host species:	White birch
Infestation area:	Localized

Provincial key facts

- Ambermarked birch leafminer was introduced from Europe.
- Birch leafminer was first found in Quebec in 1929, with the first outbreak recorded in Ontario in 1939.
- Birch leafminer damage is more severe on open-grown white birch.
- Birch leafminer produces two to four generations per year but ambermarked birch leafminer produces only one generation.
- Birchleafminer is found from Newfoundland to Alberta in Canada.
- Localized defoliation was recorded in two districts in Southern Region in 2021.

Regional summary

Southern

- In Pembroke District, light to moderate birch leafminer defoliation was observed between the Village of Combermere (Madawaska Twp) close to the Bancroft District boundary and along Wilno South Road in Kilaloe-Haggarty-Richards Twp. In Laurentian Valley Twp, ambermarked birch leaf miner larvae were collected on Round Lake Road, northeast of the community of Round Lake. Average birch defoliation was 10%.
- Light defoliation was observed across the central and eastern parts of Kemptville District, particularly in Clarence-Rockland Twp, Glengarry-Prescott-Russel County, and Merrickville-Wolford and Augusta townships, Leeds-Grenville County. Light birch leafminer defoliation (average 10%) was observed on fringe white birch in a mixed forest on Algonquin Road, near Glenmore in Augusta Twp.

Birch skeletonizer

Pest information

Common name:	Birch skeletonizer
Scientific name:	*Bucculartrix canadensisella* (Chambers)
Pest origin:	Native to North America
Pest type:	Defoliator
Host species:	White birch
Infestation area:	Localized

Provincial key facts

- Birch skeletonizer has minimal effects on host trees as it is a late season defoliator.
- Outbreaks of this pest are cyclical and relatively short-lived (2–3 years).
- Defoliation by this pest has not been reported in Ontario since 2014.
- In 2021, moderate birch skeletonizer defoliation was reported in one district in Southern Region.

Regional summary

Southern

- In Algonquin Park, birch skeletonizer caused moderate defoliation on white birch in mature mixed forests on Barron Canyon Road between Lake Traverse and Sand Lake Gate. Here, white birch was also infected by septoria leaf spot in late summer, contributing to the overall defoliation levels.

Dothistroma needle blight

Pest information

Common name:	Dothistroma or red band needle blight
Scientific name:	*Dothistroma septosporum* (Dorogin) M. Morelet
Pest origin:	Native to North America
Pest type:	Needle blight
Host species:	Austrian pine
Infestation area:	Localized

Provincial key facts

- This disease affects Austrian and Scots pine of all ages but is most damaging to seedlings and smaller trees.
- Several years of infection reduces tree growth. Coupled with other factors, such as drought and secondary insect attack, it may result in branch or tree mortality.
- In some areas, previous years' needles were brown and dropping in June, leaving only current year's shoots on trees.
- Dothistroma was last collected in Southern Region in 2018 to support research work at Laval University in Quebec.

Regional summary

Southern

- In Bancroft District, Dothistroma needle blight caused moderate to severe damage of roadside Austrian pines along Hwy 118 in Haliburton. This pest was detected during ground surveys and collected alongside brown spot needle blight.

Drought

Pest information

Common name:	Drought
Scientific name:	NA
Pest origin:	NA
Pest type:	Abiotic
Host species:	Various coniferous and deciduous species
Infestation area:	Localized

Provincial key facts

- Drought is a prolonged period of dryness that can affect forest growth and survival.
- Symptoms can include wilted foliage; sparse canopy; and leaf scorch, yellowing, drop, and premature fall colouration.
- Trees weakened by drought have reduced ability to survive insect and disease infestations.
- Drought was not aerially mapped in 2021, but below average precipitation and high temperatures caused drought symptoms in parts of Southern Region.

Regional summary

Southern

- Precipitation was lower than average in the early parts of the summer in 2021 resulting in drought stress in parts of Kemptville District. Symptoms of drought stress including browning of branch tips, top down decline, and whole tree mortality were observed in eastern white cedar forests over 9 km on Dwyer Hill Road from Burritts Rapids to Roger Stevens Drive, City of Ottawa. Moderate scorch affected sugar maples from Silver Lake to Fallbrook and on Wolfgrove Road, Lanark County. Symptoms included chlorosis, curled leaves with red margins, leaf spots, branch dieback, and early leaf drop. Sugar maple anthracnose was also present. Moderate drought stress also affected urban, open-grown, mature sugar maple trees in the Village of Merrickville, Leeds-Grenville County. Light leaf scorch damage was observed on sugar maples on Burchill and McConnell roads in Montague Township, Lanark County.

European fruit lecanium

Pest information

Common name:	European fruit lecanium
Scientific name:	*Parthenolecanium corni* (Bouché)
Pest origin:	Invasive — native to Europe
Pest type:	Sucking insect
Host species:	White ash, black locust
Infestation area:	Localized

Provincial key facts

- Adult females are stationary and conspicuous with a brown, round protective scale, and nymphs and adult males are mobile.
- Scales feed on the sap on tree branches, twigs, and leaves, which can cause stress and decline.
- Honeydew excreted from adult scales can also encourage the growth of sooty mould.
- In 2021, European fruit lecanium was reported on urban trees in northeast and southern regions.

Regional summary

Northeast

- In Sudbury District, moderate damage was caused by European fruit lecanium in Hanmer, Greater Sudbury. Scale was found covering the branches of several urban ash trees causing crown dieback. On one tree, every branch was coated in scale.

Southern

- In Kemptville District, a large population of European fruit lecanium were observed on twigs and branches of black locusts along Main Street in the Village of Merrickville, Leeds-Grenville County. Tree canopies appeared thin, however leaf-out was incomplete making the level of damage difficult to assess.

Fall cankerworm

Pest information

Common name:	Fall cankerworm
Scientific name:	*Alsophila pometaria* (Harris)
Pest origin:	Native to North America
Pest type:	Defoliator
Host species:	Basswood, Manitoba maple
Infestation area:	Localized

Provincial key facts

- Fall cankerworm is an early season defoliator of hardwood trees that can reach epidemic levels throughout its range in North America.
- The distribution of this native pest is believed to coincide with the range of basswood in Ontario.
- It has one generation per year.
- In North America, fall cankerworm has an outbreak cycle with large populations present for two to three years followed by sharp population declines for five to eight years.
- Fall cankerworm was aerially mapped in Southern Region in rural woodlots as well as urban settings in 2016, 2017, and 2018. It was last reported in smaller areas in 2019 but not aerially mapped, indicating a population collapse in Southern Region.
- Fall cankerworm is often found feeding alongside LDD moth.
- In 2021, localized populations were reported in southern and northwest regions.

Regional summary

Northwest

- In the Town of Sioux Lookout, Sioux Lookout District, fall cankerworm caused moderate to severe defoliation of semi-mature Manitoba maple along the waterfront of Pelican Lake. Defoliated Manitoba maple were also observed in homeowner's yards as well as business parking lots. Fall cankerworm defoliation was last recorded in the Town of Sioux Lookout in 2009.

Southern

- In Peterborough District, fall cankerworm larvae were collected alongside LDD larvae on basswood on Hwy 7 west of Kaladar, Lennox and Addington County. In this area, severe LDD defoliation of various hardwood trees was observed and fall cankerworm was an incidental observation.

Fall webworm

Pest information

Common name:	Fall webworm
Scientific name:	*Hyphantria cunea* (Drury)
Pest origin:	Native to North America
Pest type:	Defoliator
Host species:	American elm, ash spp., alder spp., cherry spp., poplar spp., black walnut, hickory spp. and white birch
Infestation area:	Localized

Provincial key facts

- Fall webworm is one of the few native North American insects accidently introduced into Europe and Asia.
- Its effect on tree health is usually limited because defoliation occurs late in the growing season, but persistent infestation can cause branch and crown dieback.
- In Canada, only one generation of fall webworm occurs per year, whereas two will occur in warmer climates.
- High populations of this pest often last only two to three years, making associated tree mortality unlikely.
- In 2021, fall webworm was reported in northeast and southern regions.

Regional summary

Northeast

- In Sault Ste. Marie District, fall webworm incidence was relatively low, but higher than was observed in 2020. Higher incidence of fall webworm was recorded along the southern part of Hwy 556 (Ranger Lake Road), along Hwy 556 near Little Garden River, and along Hwy 129 north of Hwy 556 in Villeneuve and Rollins townships. Nests were evident on young white birch, alder spp., and pin cherry.
- In North Bay District, fall webworm was observed causing moderate to severe defoliation along Hwy 17 from the City of North Bay, east to Corbeil and west to just past Nova Beaucage Road. Fall webworm was also detected southeast of the City of North Bay along Hwy 11, from Jennings Lake to the exit for Lakeshore Drive.

Southern

- In Parry Sound District, moderate to severe defoliation from fall webworm was observed in the Muskoka region, around the towns of Gravenhurst and Bracebridge. Areas of defoliation were clustered, rather than continuous, with a few trees of moderate to severe defoliation together, with several kilometres before the next cluster. In 2021, more defoliation was evident on black ash than in previous years.
- In Midhurst District, defoliation was detected across the district. Light to moderate defoliation was reported in Oro-Medonte Twp, Copeland Forest in Hillsdale, and along Maple Valley Road in Severn Twp. Light defoliation was reported on Durham Road, near Durham Conservation Area, and Concession 2 in Grey County, east of Durham, Southgate Twp.
- In Peterborough District, fall webworm was observed intermittently during ground surveys in late August. Moderate to severe defoliation of regenerating white ash were reported along 5th Line and Hwy 28, Douro-Dummer Twp, Peterborough County.
- In Guelph District, low to moderate defoliation was detected along County Road 151 between Whalen Line and County Road 8 in Perth County, around Brant Conservation Area and Grand River, both west of the City of Brantford, and Dundas Valley in the City of Hamilton. Nests were found mainly on black walnut, black cherry, and hickory spp., especially on open-grown and woodlot fringe trees. Although many large webs were evident, defoliation was low to moderate.
- In Aylmer District, light to moderate defoliation was reported on open-grown and woodlot fringe black walnut, black cherry, and hickory spp. throughout Norfolk County. Light defoliation was detected in Elgin Country on black walnut and black cherry trees, particularly in the west part of the county along Hwy 3 between the community of Blenheim (Chatham-Kent) and the City of St. Thomas.

Flatheaded poplar borer

Pest information

Common name:	Flatheaded poplar borer
Scientific name:	*Dicerca tenebrica* (Kby.)
Pest origin:	Native to North America
Pest type:	Wood borer
Host species:	Trembling aspen
Infestation area:	Localized

Provincial key facts

- Widely distributed throughout much of Canada.
- Adults are present from March to November
- Adult females generally lay their eggs during July and August on rough bark around branches or branch stubs. Larvae bore into the sapwood and remain in the tree for two to five years before emerging as adults.
- Dying or recently dead trees are more likely to be attacked than healthy trees.
- In 2021, this wood borer was encountered more frequently in Northeast Region.

Regional summary

Northeast

- In Timmins District, an unusually high population of flatheaded poplar borer larvae and adults were found on trembling aspen in the southern part of the district. Semi-mature to mature aspen had larvae ejecting frass from oval shaped galleries. Between May and July, adults were observed.
- In Hearst District, flatheaded poplar borer adults were often seen during May and June in the southeast corner of the district near the Chapleau District boundary. Although larval galleries were not often located, the number of adults flying indicated a larger than average population in the district.

Hemlock woolly adelgid

Pest information

Common name:	Hemlock woolly adelgid
Scientific name:	*Adelges tsugae* Annand
Pest origin:	Invasive — native to Asia
Pest type:	Defoliator
Host species:	Eastern hemlock
Infestation area:	Localized

Provincial key facts

- In Canada, populations of hemlock woolly adelgid are established in British Columbia and Nova Scotia.
- In Ontario, hemlock woolly adelgid was first found in Etobicoke, near Toronto, in 2012 on five ornamental trees. In 2013, the Canadian Food Inspection Agency (CFIA) detected an infestation during pest-specific surveys in the Niagara Gorge near Niagara Falls. Then, in 2019, the pest was again detected by CFIA during surveys in the Niagara Gorge and in a forested area near Wainfleet, Niagara Region.
- The insect has two generations per year in Canada, and is dispersed naturally by wind, birds, and mammals. It can also be spread by human movement of nursery stock and other wood products such as firewood.
- Feeding damage causes branch, twig, bud, and shoot dieback, and leads to premature needle loss and eventual tree mortality.
- In 2021, this pest was detected in one area of Southern Region.

Regional summary

Southern

- In 2021, the Canadian Food Inspection Agency confirmed the presence of hemlock woolly adelgid in a forested area in Fort Erie, Niagara Region in Guelph District. This detection occurred outside the current regulated areas for the invasive pest in Ontario, which includes the city of Niagara Falls and township of Wainfleet.

Trend analysis/outlook/issues

NDMNRF forest health field staff have been trained in survey protocols and procedures for detection of hemlock woolly adelgid. The ministry will continue to collaborate with federal counterparts in both the CFIA and Natural Resources Canada-Canadian Forest Service to support related survey and scientific initiatives.

Jack pine sawfly

Pest information

Common name:	Jack pine sawfly
Scientific name:	*Neodiprion pratti banksianae* (Roh.)
Pest origin:	Native to North America
Pest type:	Defoliator
Host species:	Jack pine
Infestation area:	Localized

Provincial key facts

- Jack pine sawfly is considered a serious defoliator of jack pine in southern Canada from Manitoba to New Brunswick.
- Infestations periodically occur in natural stands and plantations.
- The larvae only feed on the needles of the previous year's growth and leave current year needles intact. Larvae also consume small amounts of bark later in the season, producing notches in older branches.
- After two or more years, heavily infested trees often have the unusual appearance of bare branches with tufts of new growth at the tips.
- In 2021, a small population of jack pine sawfly was detected in a mature jack pine plantation in Southern Region.

Regional summary

Southern

- In Pembroke District, near the village of Round Lake, jack pine sawfly caused defoliation in a mature jack pine plantation on Round Lake Road. Defoliation and needle discolouration were limited to the top of the crowns and average overall defoliation was 20%.

Japanese beetle

Pest information

Common name:	Japanese beetle
Scientific name:	*Popillia japonica* (Newm.)
Pest origin:	Invasive — native to Japan
Pest type:	Defoliator
Host species:	American basswood, Linden, wild grape
Infestation area:	Localized

Provincial key facts

- Populations of this invasive insect have existed in Ontario since its discovery in the Niagara Peninsula, Southern Region, in 1939.
- Commonly encountered as an exotic horticultural pest, the Japanese beetle will also feed on many native tree species. Adults are heavy feeders, known to attack both foliage and fruit of more than 250 host plants. Preferred woody hosts in Ontario include basswood, oak, and white birch.
- Japanese beetle was last reported in Southern Region in 2018.
- In 2021, Japanese beetle was reported during ground surveys in Aylmer and Peterborough districts, Southern Region.

Regional summary

Southern

- In Aylmer District, populations of Japanese beetles were abundant and were observed feeding on foliage of a variety of woody and herbaceous hosts, particularly wild grape, maple leaf viburnum and Virginia creeper. In Middlesex County, severe defoliation of a row of open-grown linden trees was detected in mid-August along Hwy 402 at Longwoods Road (Hwy 2) in Delaware West (Middlesex Centre). Moderate to severe defoliation of woodlot fringe basswood was observed near the corner of Olde Drive and Dundonald Road, north of Glencoe (Southwest Middlesex).
- In the south end of Peterborough District, a small number of Japanese beetles were observed causing light defoliation on overgrown wild grapevine at Potter's Creek (Quinte Conservation Area) in Belleville.

Larch casebearer

Pest information

Common name:	Larch casebearer
Scientific name:	*Coleophora laricella* (Hübner)
Pest origin:	Invasive — native to Europe
Pest type:	Defoliator
Host species:	Tamarack
Infestation area:	Localized

Provincial key facts

- Larch casebearer was introduced to North America in Massachusetts in 1886 and was detected in Ontario in 1905. This pest is now found across the range of tamarack and throughout European larch plantations in Ontario.
- Larch casebearer is a serious defoliator of tamarack. In Southern Region, defoliation was most recently aerially mapped in 2018.
- Larch casebearer defoliation was not detected during aerial surveys in 2021. Observations of small populations and resulting defoliation were detected during ground surveys in Southern Region.

Regional summary

Southern

- In Bancroft District, larch casebearer caused light to moderate defoliation on scattered semi- mature larch trees along Hwy 503 from Gooderham to Kinmount, along the south edge of Haliburton County. Detections were made during ground surveys.
- In Kemptville District, trace defoliation was reported on the fringes of a semi-mature eastern white cedar/white spruce stand on Montague Boundary Road in Montague Twp, Lanark County.
- In Pembroke District, trace defoliation was observed on the fringes of a semi-mature eastern white pine/ trembling aspen mixed forest on Pucker Street southwest of the City of Renfrew in Admaston Twp. Symptoms included short, discoloured, and shrivelled needles in the lower half of the tree.
- In Algonquin Provincial Park, larch casebearer larvae were collected from tamarack in a mature tamarack/ eastern white pine mixed forest on Barron Canyon Road. No defoliation was reported, and larvae were only detected on one tree.

Northern tent caterpillar

Pest information

Common name:	Northern tent caterpillar
Scientific name:	*Malacosoma californicum pluviale* (Dyar)
Pest origin:	Native to North America
Pest type:	Defoliator
Host species:	Pin cherry, willow
Infestation area:	Localized

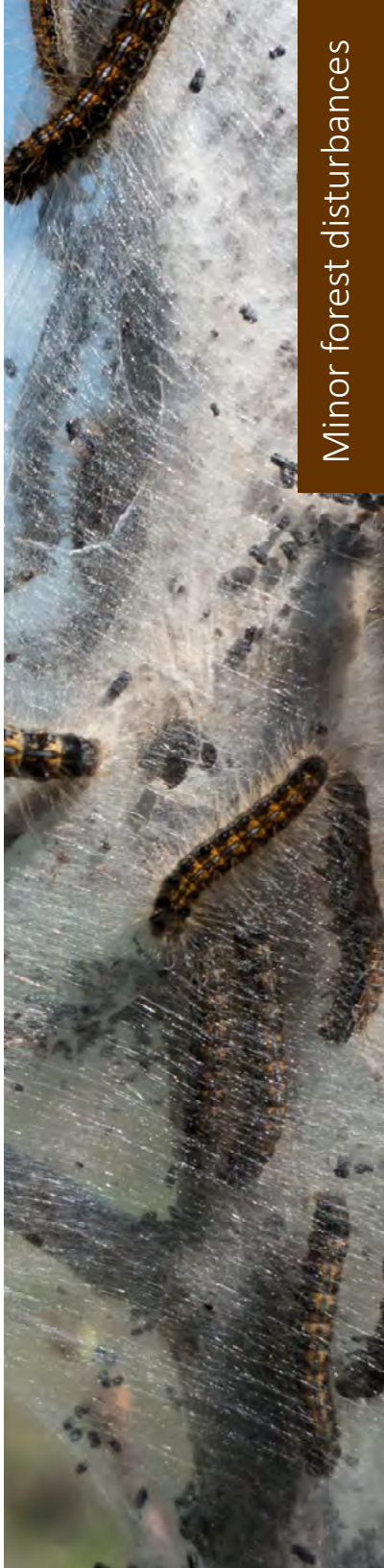
Provincial key facts

- Emergence of northern tent caterpillar larvae coincides with budbreak on host trees.
- Larvae feed mainly on pin cherry and willow but can be found on a wide range of trees and shrubs in Ontario.
- Young larvae protect themselves in silken nests in the crotches of branches. Nests enlarge as the larvae grow.
- Even when infestations are severe or persist in an area for a few years, damage is limited to growth loss and branch dieback.
- In 2021, this insect was detected in Northeast Region after limited presence between 2018 and 2020.

Regional summary

Northeast

- In Timmins District, during the first two weeks in June, northern tent caterpillar was regularly found on young pin cherry in the southern part of the district. Several areas with larger populations were found along Gibson Lake Road, Pine Street South, Price Road, and Hwy 560. Small populations were observed between 2018 and 2020 but in 2021 they were above average overall and observed farther north than normal in this district.



Rhizosphaera needle blight

Pest information

Common name:	Rhizosphaera needle blight
Scientific name:	*Rhizosphaera pini* (Corda)
Pest origin:	Native to North America
Pest type:	Foliar disease
Host species:	Balsam fir
Infestation area:	Localized

Provincial key facts

- Damage to forest stands by rhizosphaera needle blight is minimal but it can be a serious problem in Christmas tree plantations.
- Needle drop causes tree to look thin and discoloured infected needles are unaesthetic.
- This disease infects trees from the bottom up.
- Spores are spread primarily by rain splash.
- In 2021, severe rhizosphaera needle blight damage was recorded in one district in Southern Region.

Regional summary

Southern

- In Pembroke District, severe rhizosphaera needle blight damage was observed on balsam fir in a semi-mature mixed woodlot on Meitz Road, Laurentian Valley Twp. Damage included red discoloration of needles on branch tips, and in some cases all the needles on some trees. It appeared that repeated infections caused some trees to have a lack of needles and the trees looked sparse. Whole tree mortality was observed but was less than 5% of the balsam fir in the area. High levels of the needle blight were found on the needles in the sample. On average, half the balsam fir trees were affected with varying degrees of damage.

Septoria leaf spot

Pest information

Common name:	Septoria leaf spot
Scientific name:	*Sphaerulina betulae* (Pass.) Quaedvl., Verkley & Crous,
	Sphaerulina populicola (Peck) Quaedvlieg, Verkley & Crous
	Sphaerulina musiva (Peck) Quaedvl., Verkley & Crous
Pest origins:	Native to North America
Pest type:	Foliar disease
Host species:	White birch, balsam poplar, and trembling aspen
Infestation area:	Localized

Provincial key facts

- Septoria leaf spot is a common fungal disease of poplar and birch.
- This disease commonly infects leaves but can also cause branch and main stem cankers, particularly on hybrid poplar.
- Leaf diseases are normally more prevalent in wet and humid weather. Fallen leaves re-infect new leaves the following year.
- After repeated severe infections, trees may lose vigour and become more susceptible to other pests and pathogens.
- In 2021, species of septoria leaf spot were reported in northeast and southern regions.

Regional summary

Northeast

- Septoria leaf spot (Sphaerulina betulae) caused severe damage on white birch in Wawa District, northwest of the community of Wawa. About 90% of white birch in this area had yellow to brown discoloration. Moderate damage on white birch was also reported along Hwy 17 between the community of Wawa and the junction of Hwy 614.
- In Chapleau District, septoria leaf spot (S. betulae) caused moderate to severe damage on white birch along Sultan Industrial Road, north along the Foleyet Timber Road and along Hwy 101, between the communities of

Chapleau and Wawa. A small area of balsam poplar, roughly 20 m x 20 m, was severely infected by septoria leaf spot (S. populicola) along Sultan Industrial Road, east of the turn for Ramsey Lake/Westbranch Road. Septoria leaf spot (S. musiva) caused light damage on trembling aspen along Sultan Industrial Road.

- In Timmins District, moderate to severe septoria leaf spot (S. betulae) damage was observed on white birch in late August. This fungal disease was observed throughout the district, with severe damage found south of Hwy 101.
- Septoria leaf spot of white birch (S. betulae) was severe in the southcentral part of the Sault Ste. Marie District. High levels of infection were observed in late August along Hwy 546 (Little White River Road) and north of the community of Elliot Lake along Hwy 639/Hwy 108, particularly around Ompah Lake. A small area of severe damage was also observed along Chevis Road between Dean Lake and Mississaugi River, west of the community of Blind River.
- In North Bay District, severe septoria leaf spot (S. populicola) damage was observed on balsam poplar, east of the community of Cobalt on Hwy 118 and 567.

Southern

- In Pembroke District, septoria leaf spot (S. betulae) damage, ranging from 10 to 50% of the leaves was observed from the Village of Combermere to the community of Bonnechere along Hopefield Road, Old Barry's Bay Road, Wilno South Road, and Round Lake Road in late August. Damage was also observed from the City of Pembroke to the Town of Deep River and along Wylie Road, Laurentian Hills Twp. Symptoms ranged from brown leaf spots to large necrotic leaf blotches.
- In Bancroft District, septoria leaf spot (S. betulae) caused moderate to severe damage to understory white birch trees along the north side of Pine Lake in the community of West Guilford, Haliburton County. Light damage was also observed on roadside white birch along Glamour Lake Road during ground surveys.
- Septoria leaf spot of birch (S. betulae) caused moderate to severe damage in late summer on Barron Canyon Road in Algonquin Provincial Park.

Spruce gall adelgid

Pest information

Common name:	Spruce gall adelgid
Scientific name:	*Adelges sp*
Pest origin:	Native to North America
Pest type:	Gall making insect
Host species:	White spruce, Norway spruce
Infestation area:	Localized

Provincial key facts

- Not a serious pest of forest trees. In heavy infestations, the tips of the infested branches may die from the green to brown pineapple-shaped galls.
- Can be a problem on ornamental spruce or Christmas tree plantations.
- Easily remedied by pruning affected shoots in spring or early summer.

Regional summary

Southern

- In Aylmer District, old and current shoot damage caused by spruce gall adelgids were highly prevalent in white spruce and Norway spruce plantations in a nature reserve east of Parkhill, Middlesex County.
- In Midhurst District, moderate spruce gall adelgid damage was found on fringe white spruce trees at Epping – John Muir Lookout Conservation Area in Grey County. Moderate shoot damage was also identified on white spruce in Allan Park Conservation Area, Grey County.

Tar spot on maple

Pest information

Common name:	Tar spot on maple
Scientific name:	*Rhytisma americanum* Hudler & Banik, *Rhytisma acerinum* (Pers.)
Pest origin:	Native to North America
Pest type:	Fungal foliar disease
Host species:	Maples
Infestation area:	Localized

Provincial key facts

- Tar spot on maple is exacerbated by wet weather in spring.
- Damage from tar spot is predominantly aesthetic but, during severe infections, black spots coalesce to infect entire leaves, reducing the tree's photosynthetic ability.
- Heavy infection of tar spot can lead to early leaf drop.
- Fallen infected leaves should be raked up and disposed of to lessen infection rates the following year.
- In 2021, tar spot on maple was only recorded in Southern Region.

Regional summary

Southern

- In Guelph District, high levels of leaf spots were observed on all open-grown silver and red maples surveyed at Stevensville Conservation Area in Fort Erie, Niagara Region. Through the residential area of Stevensville, open-grown Norway maple were affected by tar spot, and about half the trees were dropping leaves prematurely (by the end of August) due to severe infection by the foliar fungus.

White pine blister rust

Pest information

Common name:	White pine blister rust
Scientific name:	*Cronartium ribicola* J. C. Fisch.
Pest origin:	Invasive — native to Asia and Europe
Pest type:	Rust disease
Host species:	White pine
Infestation area:	Localized

Provincial key facts

- This disease is relatively common throughout Ontario where Ribes spp. (the alternate host) occur near five needle pine trees.
- It causes branch dieback, reduces growth, and, if infection reaches the stem, eventually kills the tree.
- Porcupine damage can be present on trees with white pine blister rust since they are attracted to the sweet sap at the canker.
- In 2021, white pine blister rust was monitored in several eastern white pine plantations in Northeast Region.

Regional summary

Northeast

- In Kirkland Lake District, eastern white pine plantations were surveyed for blister rust in Evanturel, Eby, and Ingram townships. Evanturel had the highest occurrence of white pine blister rust (39% of trees) compared to Eby (0%) and Ingram (19%), with 79% severe and 21% non-severe blister rust damage. Evanturel also had the most porcupine damage (29%) compared to Ingram (10%), with none recorded at Eby.
- In North Bay District, eastern white pine plantations were surveyed for blister rust in Gurd Twp, with 15% of trees affected by blister rust and 7% by porcupine damage.

Trend analysis/outlook/issues

Per cent of trees damaged by various agents and average tree and height and diameter in eastern white pine plantations surveyed in Northeast Region.

	Kirkland Lake District			North Bay District
Damaging agent	Evanturel	Eby	Ingram	Gurd
White pine blister rust	39	0	19	15
Severe	79	0	45	32
Non-severe	21	0	55	68
Mortality	0	0	0	0
Average tree height (m)	10.1	3.7	5.5	7.7
Average tree diameter (cm)	17.3	5.3	11.8	15.8
Porcupine	29	0	10	7
Dead top	0	11	0	0
Bear damage	0	1	0	0
White pine weevil	0	0	6	0
Sapsucker	0	0	1	0

Yellowheaded spruce sawfly

Pest information

Common name:	Yellowheaded spruce sawfly
Scientific name:	*Pikonema alaskensis* (Rohwer)
Pest origin:	Native to North America
Pest type:	Defoliator
Host species:	White spruce
Infestation area:	Localized

Provincial key facts

- Yellowheaded spruce sawfly is a common pest in Ontario.
- It's a serious pest of Christmas tree plantations, open-grown trees, and plantations.
- This sawfly generally feeds on younger open-grown or roadside trees.
- Severe defoliation by this sawfly can kill branches or the entire tree; less severe defoliation can impede growth.
- In 2021, yellowheaded spruce sawfly was reported in northeast and southern regions.

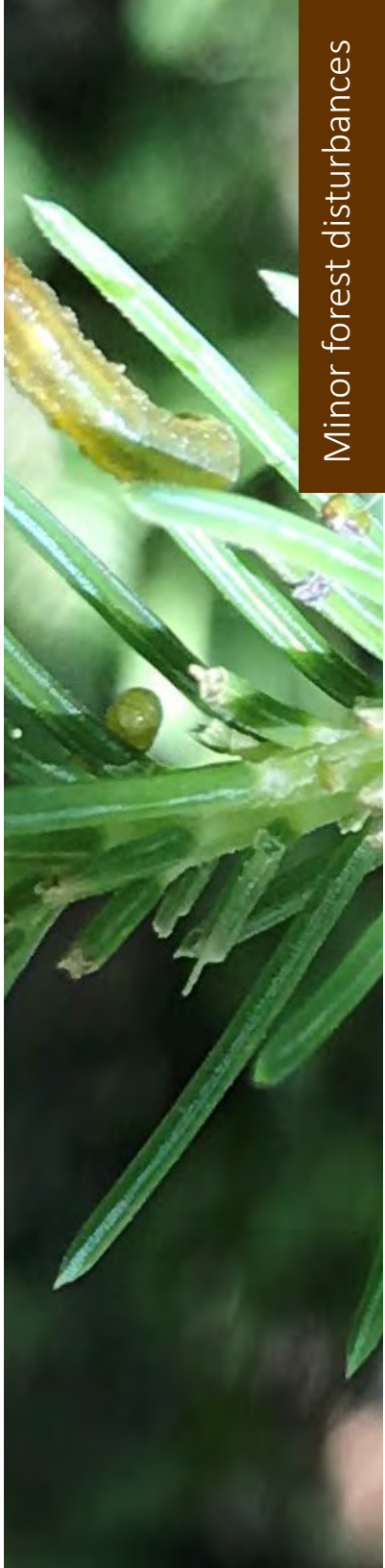
Regional summary

Northeast

- In Chapleau District, yellow headed spruce sawfly caused light defoliation on white spruce along the Sultan Industrial Road, east of the community of Sultan. Only the lower portion of a few spruce were affected.
- In Wawa District, severe yellowheaded spruce sawfly defoliation was observed on young spruce along the Hwy 17 corridor, just south of the community of Wawa. Yellowheaded spruce sawfly defoliation was also observed on six mature white spruce in this area, with 20 to 40% of new shoots on the lower part of the trees affected.

Southern

- In Bancroft District, yellowheaded spruce sawfly caused light defoliation of young open-grown spruce trees along Hwy 127, north of the community of Maynooth, Hastings County.



Zimmerman pine moth

Pest information

Common name:	Zimmerman pine moth
Scientific name:	*Dioryctria zimmermani* (Grt.)
Pest origin:	Native to North America
Pest type:	Wood borer
Host species:	White pine
Infestation area:	Localized

Provincial key facts

- The Zimmerman pine moth is known to attack all species of pines in Ontario and occasionally spruce and fir.
- Larval feeding under the bark weakens branches or the main stem making the tree and branches susceptible to breakage.
- Infestations of Zimmerman pine moth can cause substantial losses in Christmas tree plantations.
- Feeding damage caused by this insect was observed in one district in Southern Region in 2021.

Regional summary

Southern

- In Aylmer District, old pitch masses and damage caused by Zimmerman pine moth larvae were detected during spring ground surveys in a young eastern white pine plantation at St. Williams Conservation Reserve's nursery tract in Norfolk County. A follow-up site visit in early June revealed new masses of pitch streaming down the main stems of infested trees. Feeding damage by this wood borer was causing decline and mortality in about 60% of eastern white pine trees in the plantation.

Printed in Ontario, Canada

ISBN 978-1-4868-5876-7 (pdf)
ISSN 1913-617X (online)