

Beech Leaf Disease

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Beech Leaf Disease

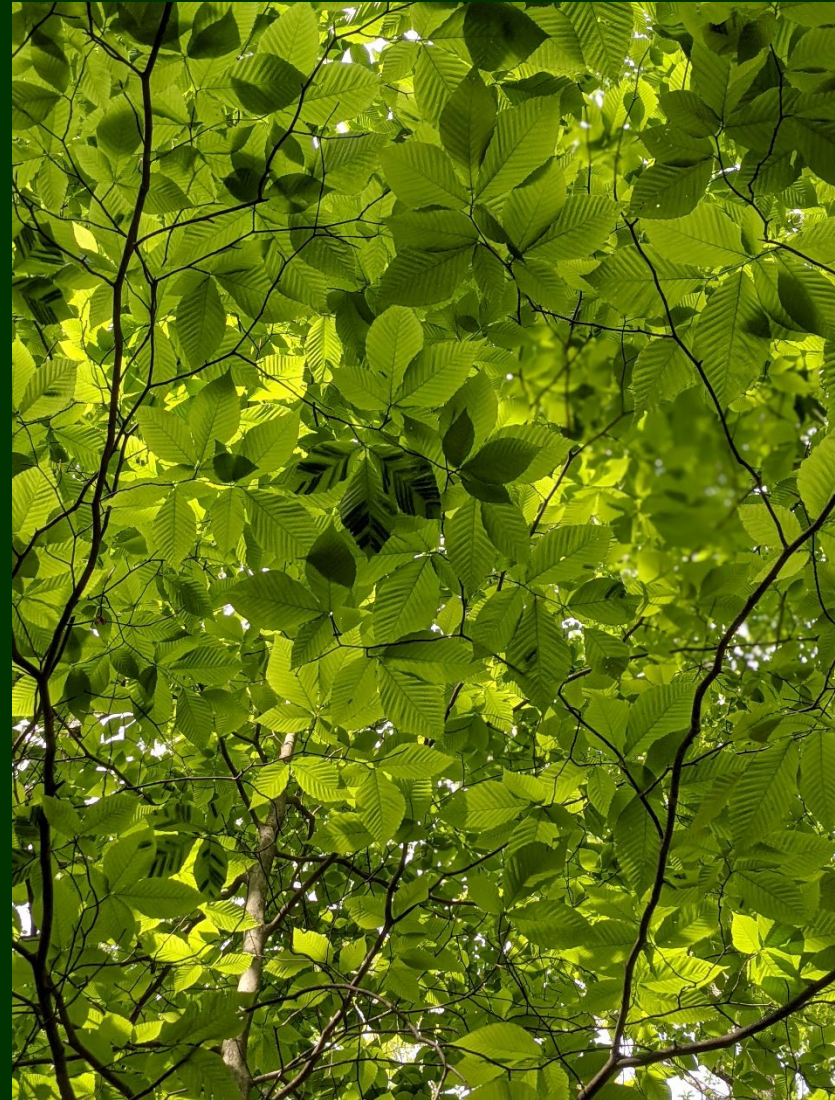
First identified in Ohio in
2012

Affects American,
European, Oriental
beeches:

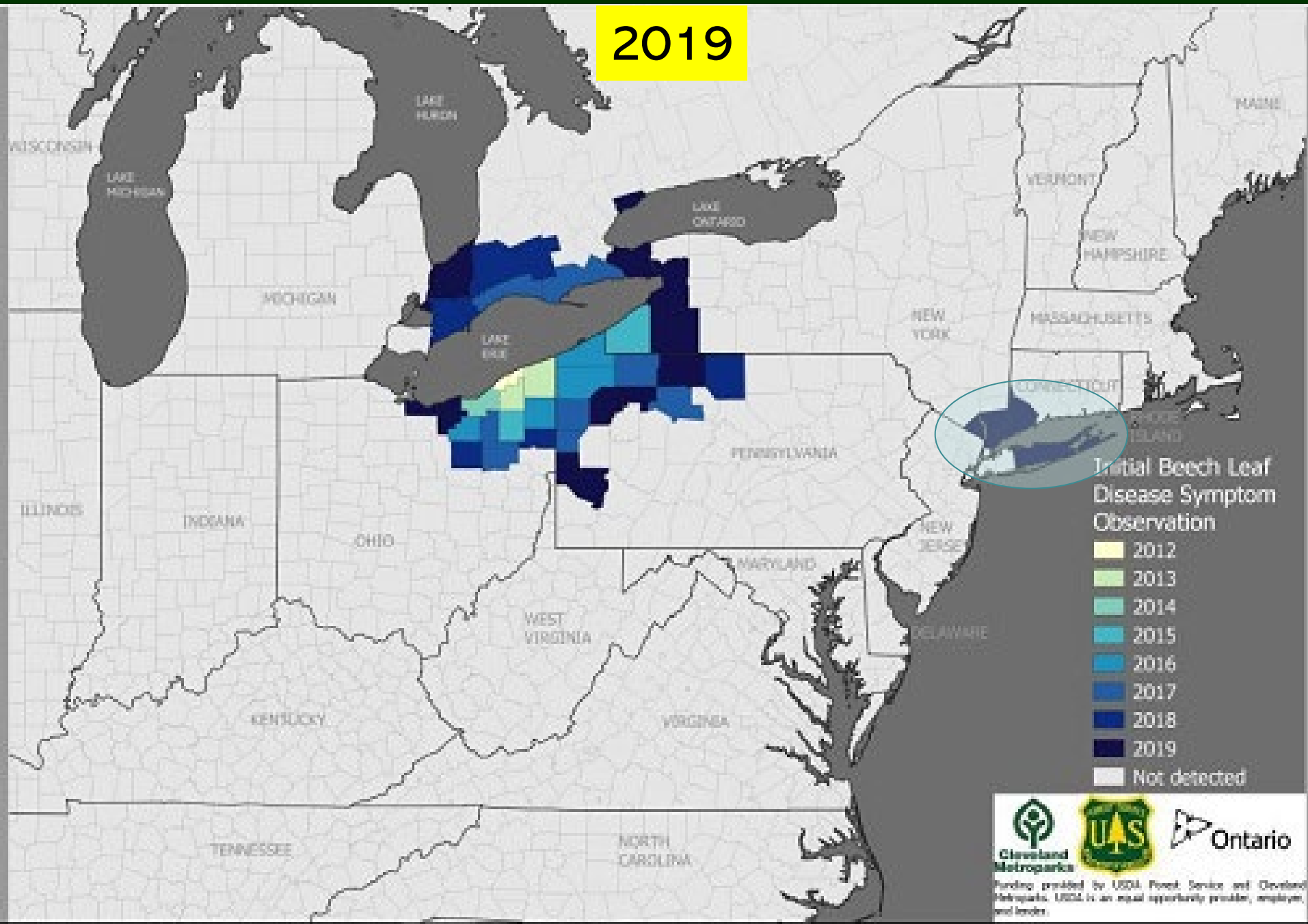
Fagus grandifolia

F. sylvatica

F. orientalis



2019



Beech Leaf Disease

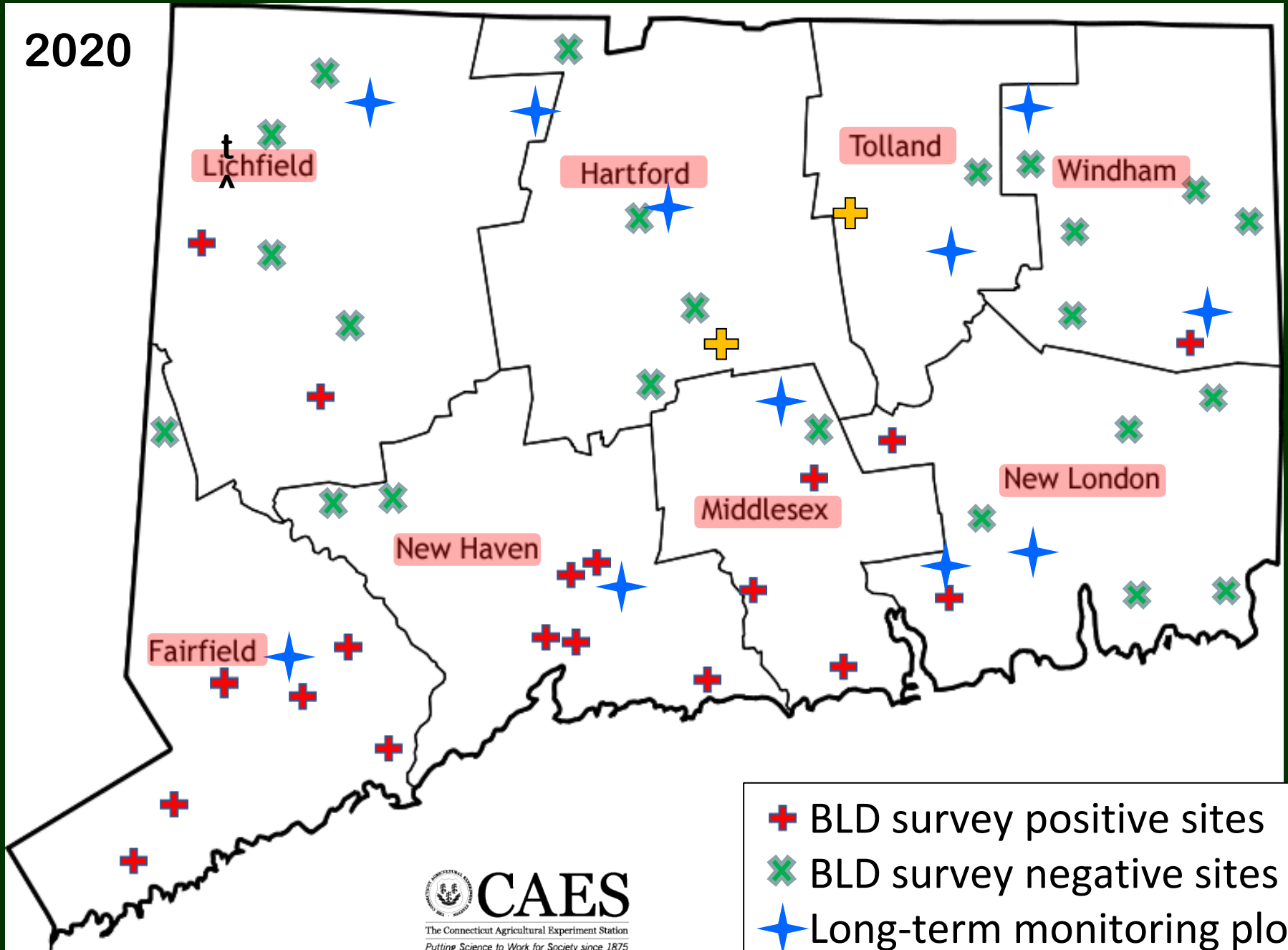
2020 Fieldwork

USFS Region 9 Emerging Pest Funding:

- Distribution surveys;
- 11 long-term monitoring plots in CT.

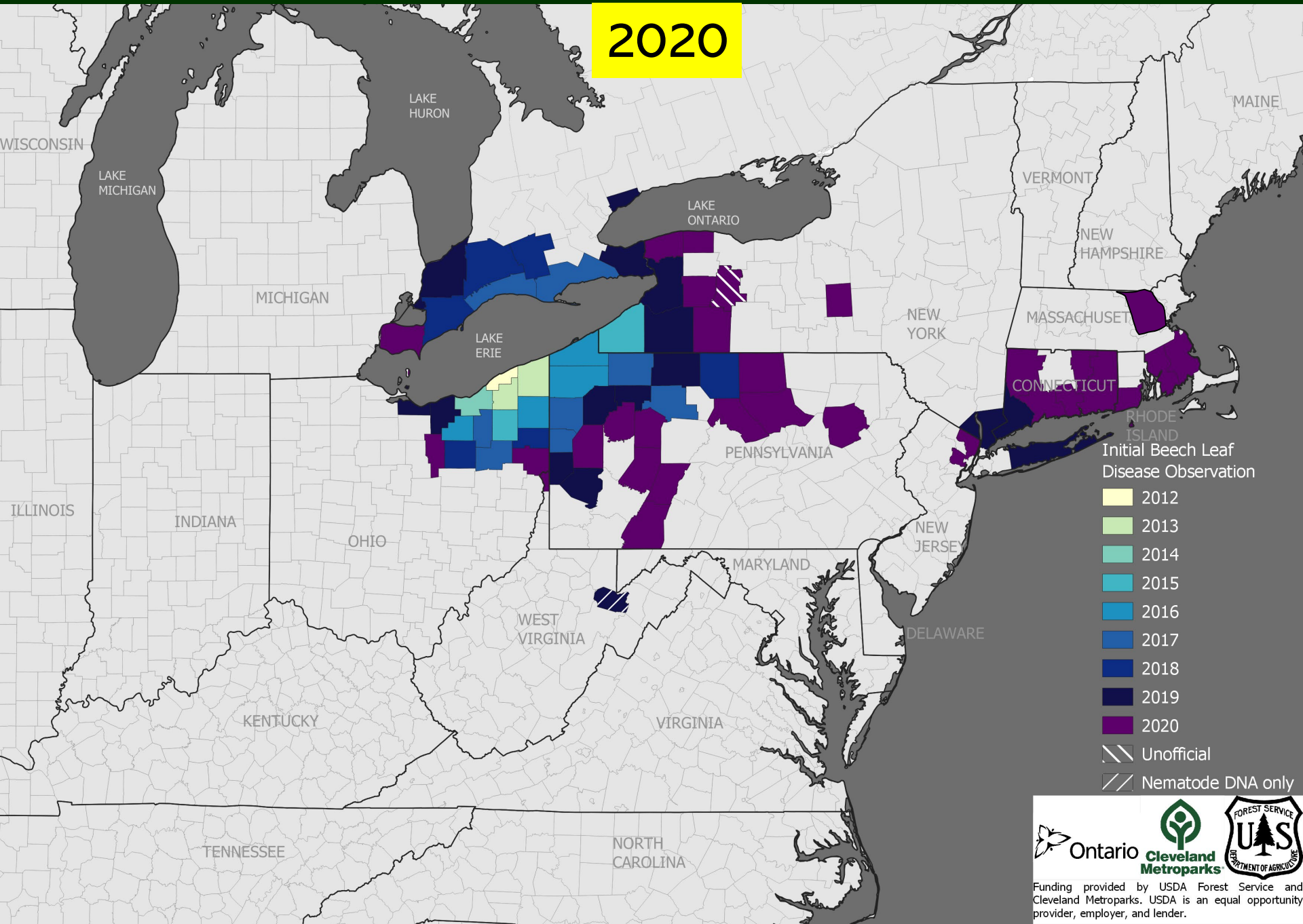


2020



- + BLD survey positive sites
- × BLD survey negative sites
- ★ Long-term monitoring plots

2020



Initial Beech Leaf Disease Observation

- 2012
- 2013
- 2014
- 2015
- 2016
- 2017
- 2018
- 2019
- 2020

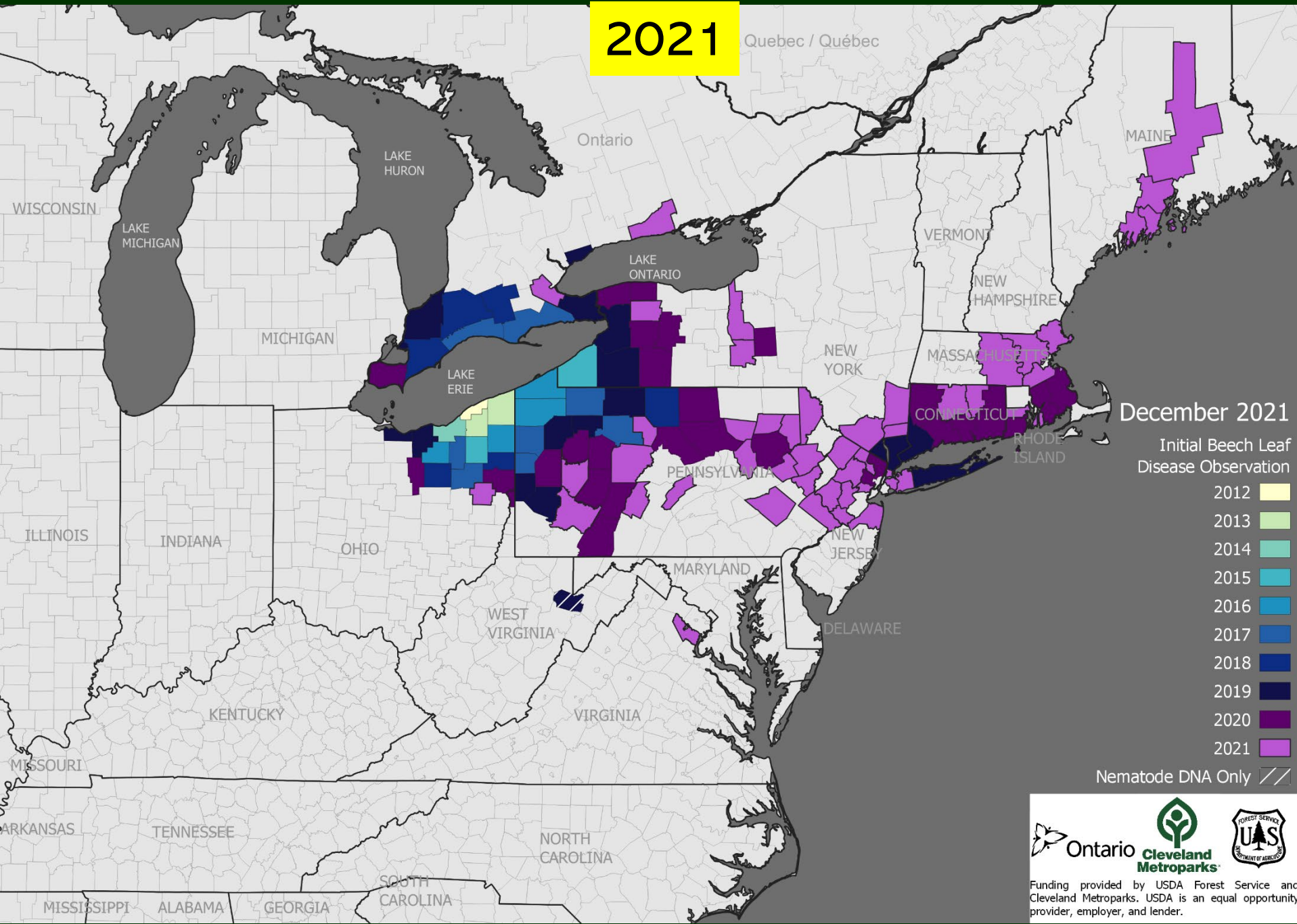
- Unofficial
- Nematode DNA only



Funding provided by USDA Forest Service and Cleveland Metroparks. USDA is an equal opportunity provider, employer, and lender.

2021

Quebec / Québec



December 2021

Initial Beech Leaf Disease Observation

- 2012
- 2013
- 2014
- 2015
- 2016
- 2017
- 2018
- 2019
- 2020
- 2021

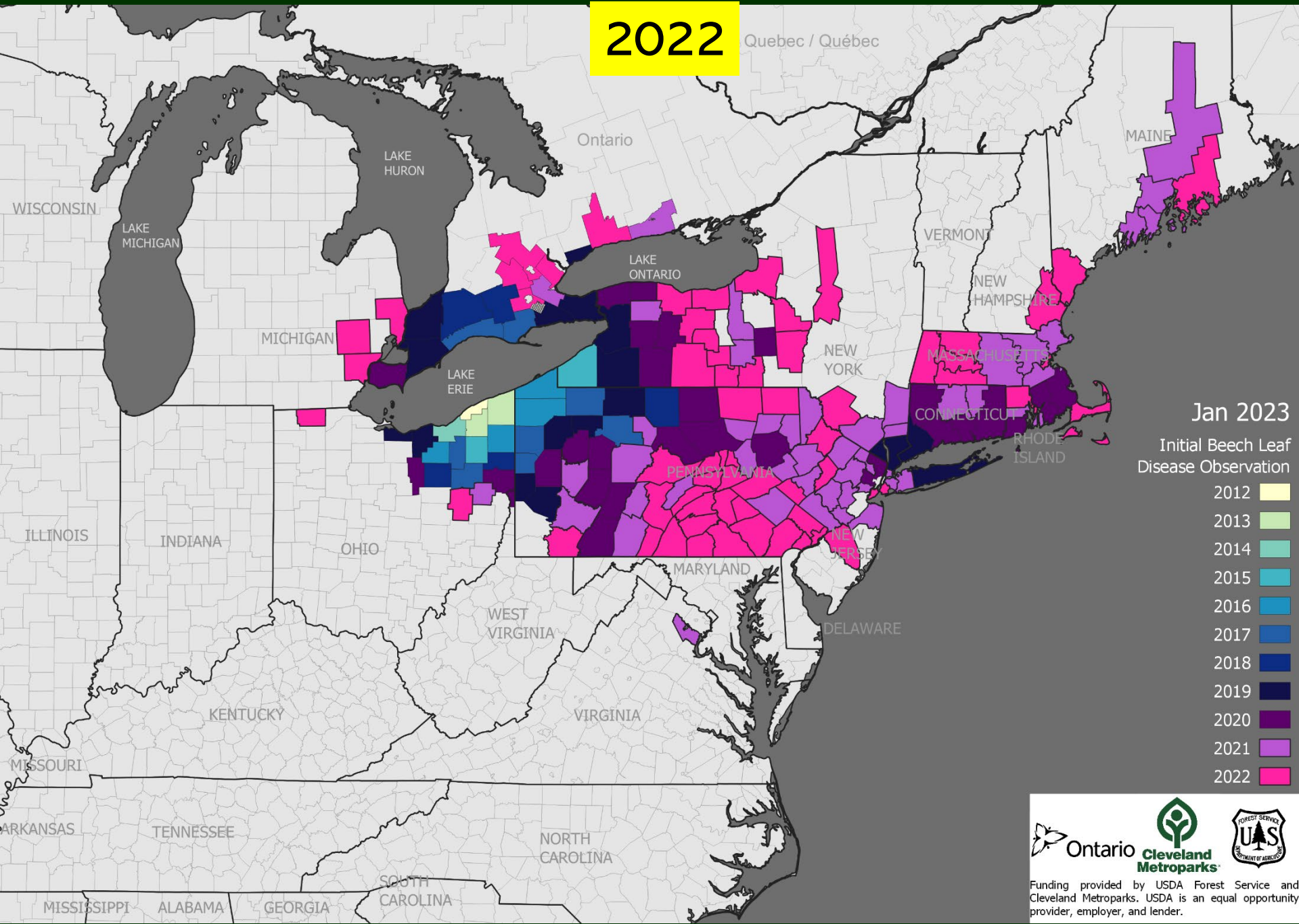
Nematode DNA Only



Funding provided by USDA Forest Service and Cleveland Metroparks. USDA is an equal opportunity provider, employer, and lender.

2022

Quebec / Québec



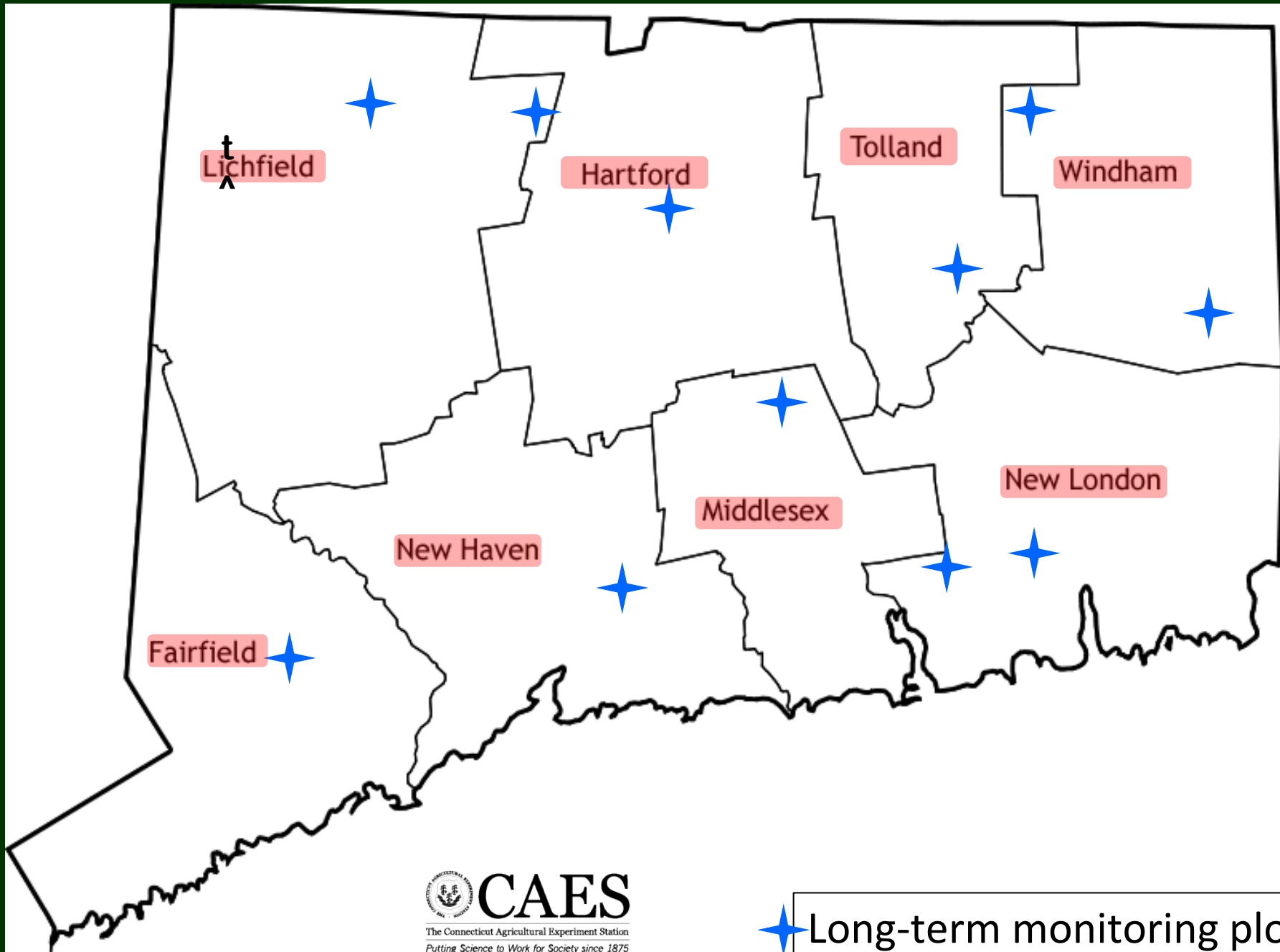
Jan 2023

Initial Beech Leaf Disease Observation

- 2012
- 2013
- 2014
- 2015
- 2016
- 2017
- 2018
- 2019
- 2020
- 2021
- 2022



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BLD Long-Term Monitoring Plots - CT

County	Site	2020	2021	2022
Fairfield	Centennial Watershed	BLD absent	BLD present	BLD present
New Haven	Naugatuck State Forest	BLD absent	BLD absent	BLD present
Middlesex	Meshomasic State Forest	BLD absent	BLD present *	BLD present
New London	Nehantic State Forest	BLD present	BLD present	BLD present
	Oswegatchie Hills	BLD absent	BLD absent	BLD present
Litchfield	Tunxis State Forest	BLD absent	BLD absent	BLD present
	Great Mountain Forest	BLD absent	BLD absent	BLD absent
Hartford	MDC Reservoir #6	BLD absent	BLD absent	BLD present
Tolland	Nathan Hale State Forest	BLD absent	BLD absent	BLD present
Windham	Pachaug State Forest	BLD present	BLD present	BLD present
	Yale Myers Forest	BLD absent	BLD absent	BLD absent

	BLD present
	BLD absent

*1 sapling of 8

Beech Leaf Disease

Disease Progression

Early season:

- Leaves emerge fully symptomatic
- Darkened bands, hypertrophy
- No new symptoms appear during growing season







Beech Leaf Disease

Disease Progression

Late season:

- Banding darkens, thickens, hardens



Beech Leaf Disease

Disease Progression

Subsequent seasons:

- Aborted bud development
- Thinning of canopy
- Mortality in 2-5 yrs in *some* diseased saplings



Beech Leaf Disease

Disease Progression:
2022

West Rock Ridge State Park
New Haven/Hamden

















Beech Leaf Disease

Disease Progression:
2022

The 2022 BLD

Hell-scape

West Rock Ridge State Park
New Haven/Hamden



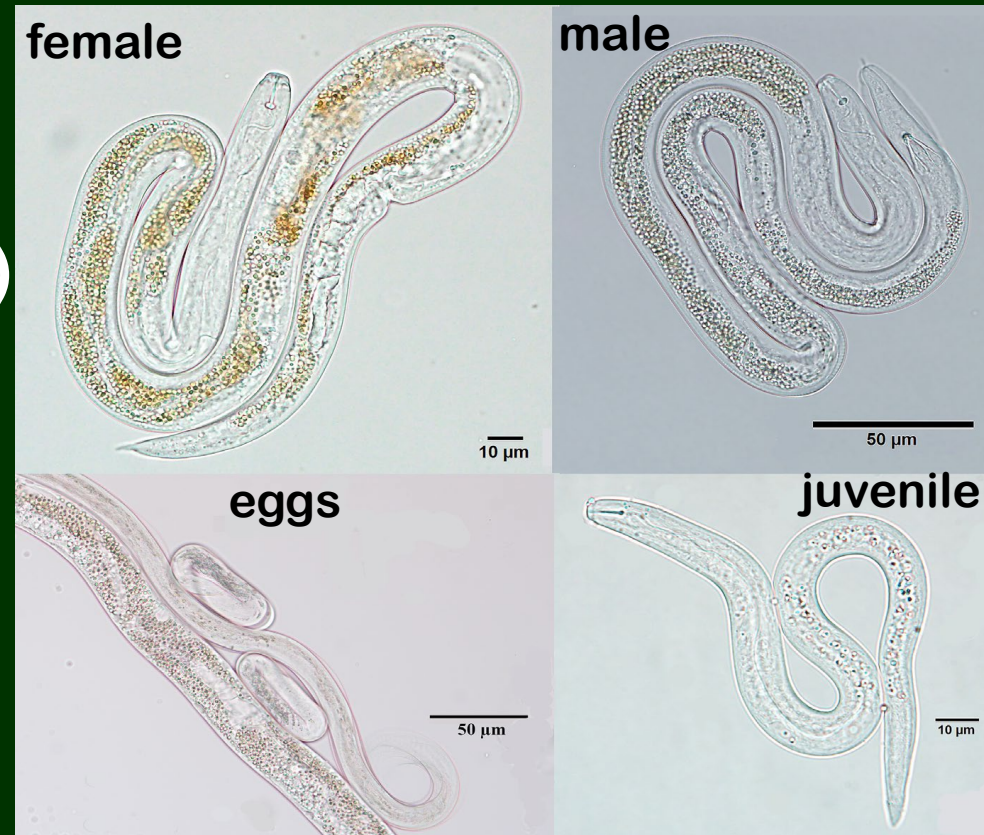
Secondary
leaf flush,
spring,
fall



Beech Leaf Disease

Nematode:

- *Litylenchus crenatae*, subspecies *mccannii* (*Lcm*)
 - Confirmed and **proven** as causal in 2019
- *Litylenchus crenatae*, subspecies *crenatae* (*Lcc*)
 - Known only in Japan, on Japanese beech (*F. crenata*)
 - “blister galls” on foliage
 - No documented mortality



Carta et al. 2020
Forest Pathology 50(2)

Foliar nematodes

- Require water films to move outside of leaf;
- In presence of water, juveniles and adults will exit/enter through leaf stomata;
- Any “wet event” will trigger egress of nematodes from leaves.

Beech Leaf Disease

Transmission (vectors) of
BLD nematode:

Little is known

Local movement via rain
splash?



Beech Leaf Disease

Intermediate- and long-distance transmission:

- Vectors: insects, mites, birds, mammals?
 - passage through bird gut?
 - Overwintering birds – e.g., finches – regularly feed on beech buds
- Nurseries (European beech)

Beech Leaf Disease

Life cycle of BLD nematode

Spring, bud-break through early summer:

- None (or few) nematodes directly observed in symptomatic leaves;
- DNA signal confirms presence of the nematode:
 - eggs?
 - recalcitrant juveniles/adults?

Non-uniform
distribution of BLD
nematode in early-
season
symptomatic tissue

➤ eggs?

CO-1 PCR

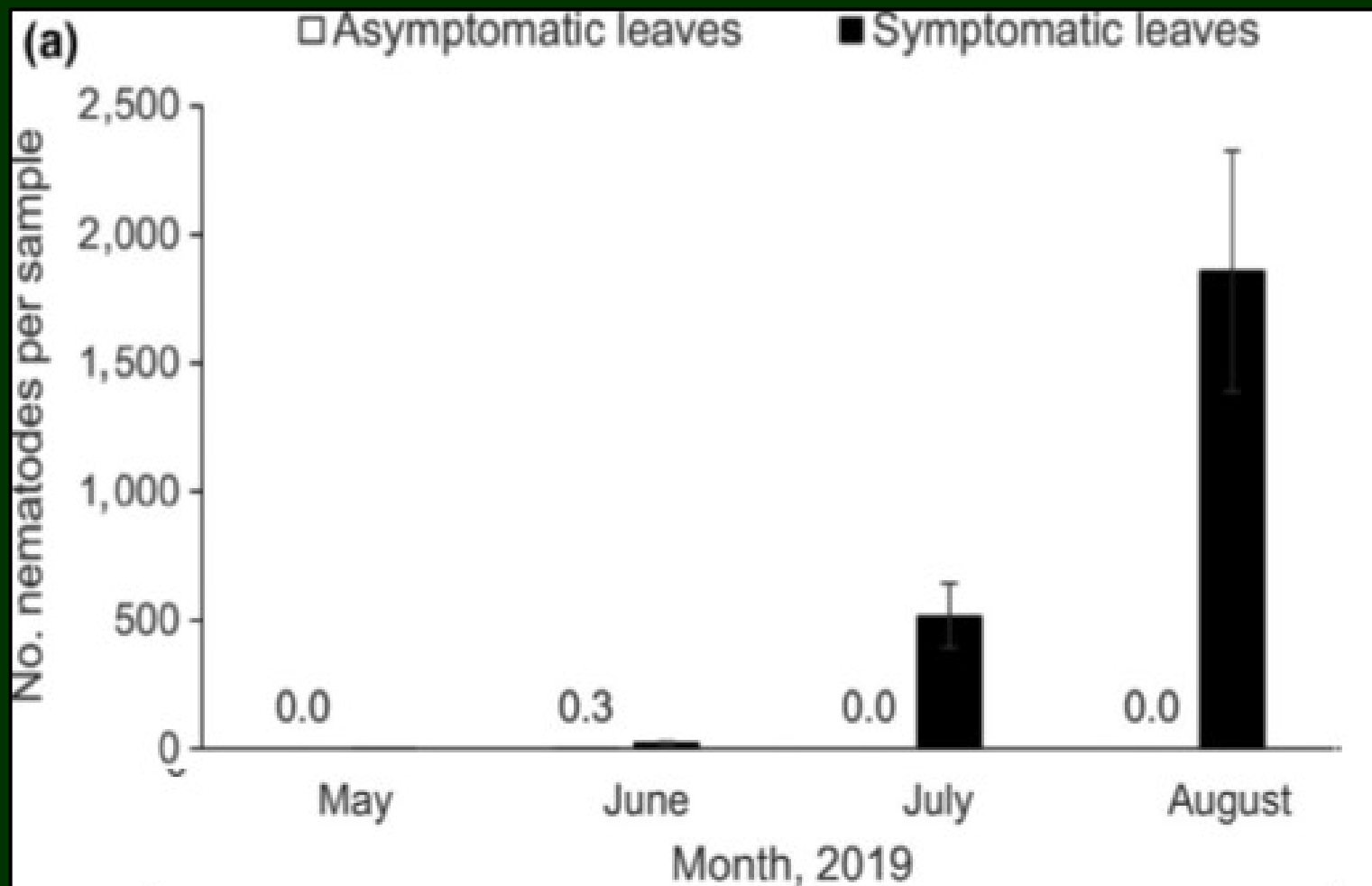


Beech Leaf Disease

Life cycle of BLD nematode

Late summer to fall:

- Population densities of juveniles and adults increase dramatically through autumn
- Nematodes migrate from leaves to buds



Reed et al. Forest Pathology 50(3): e12599

Beech Leaf Disease

Life cycle of BLD nematode

Winter:

- Juveniles, adults, eggs overwinter in buds
- Damage leaf primordia
 - Dr. Paulo Vieira, USDA-ARS.

Bud infestation by Lcm in autumn is variable

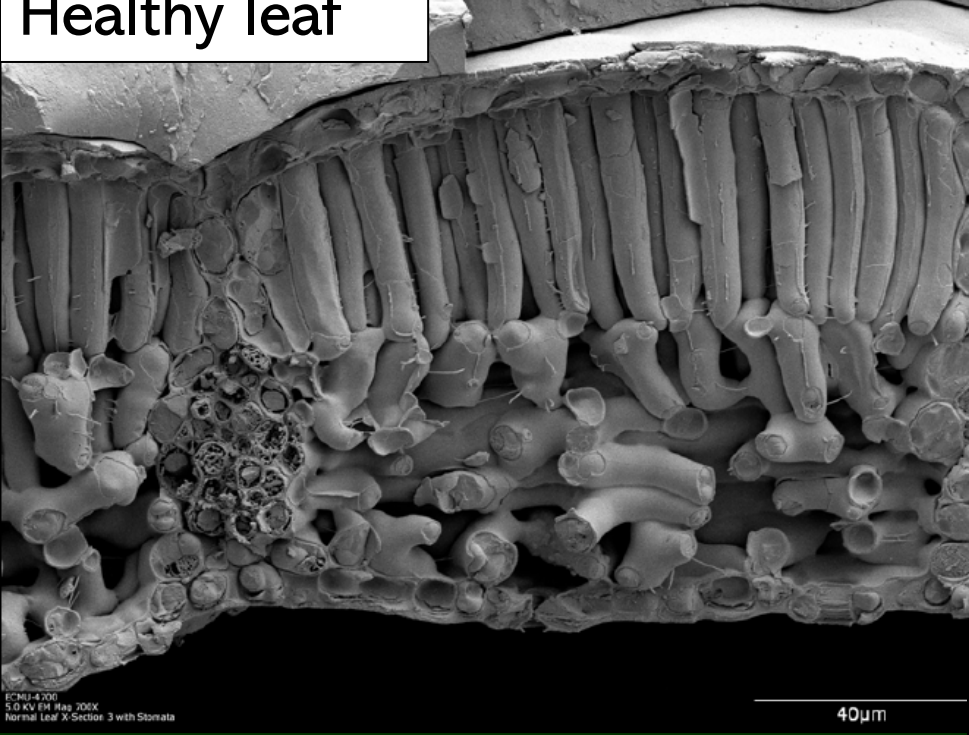


Bud infestation by Lcm in autumn is variable

Symptoms correlate among bud leaf cohorts

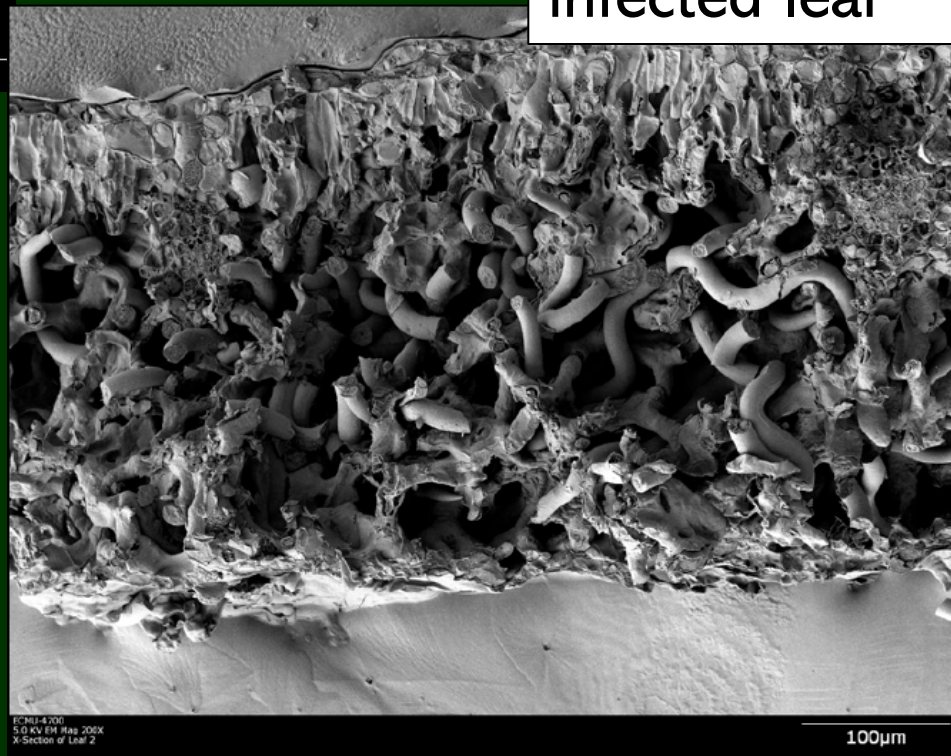


Healthy leaf



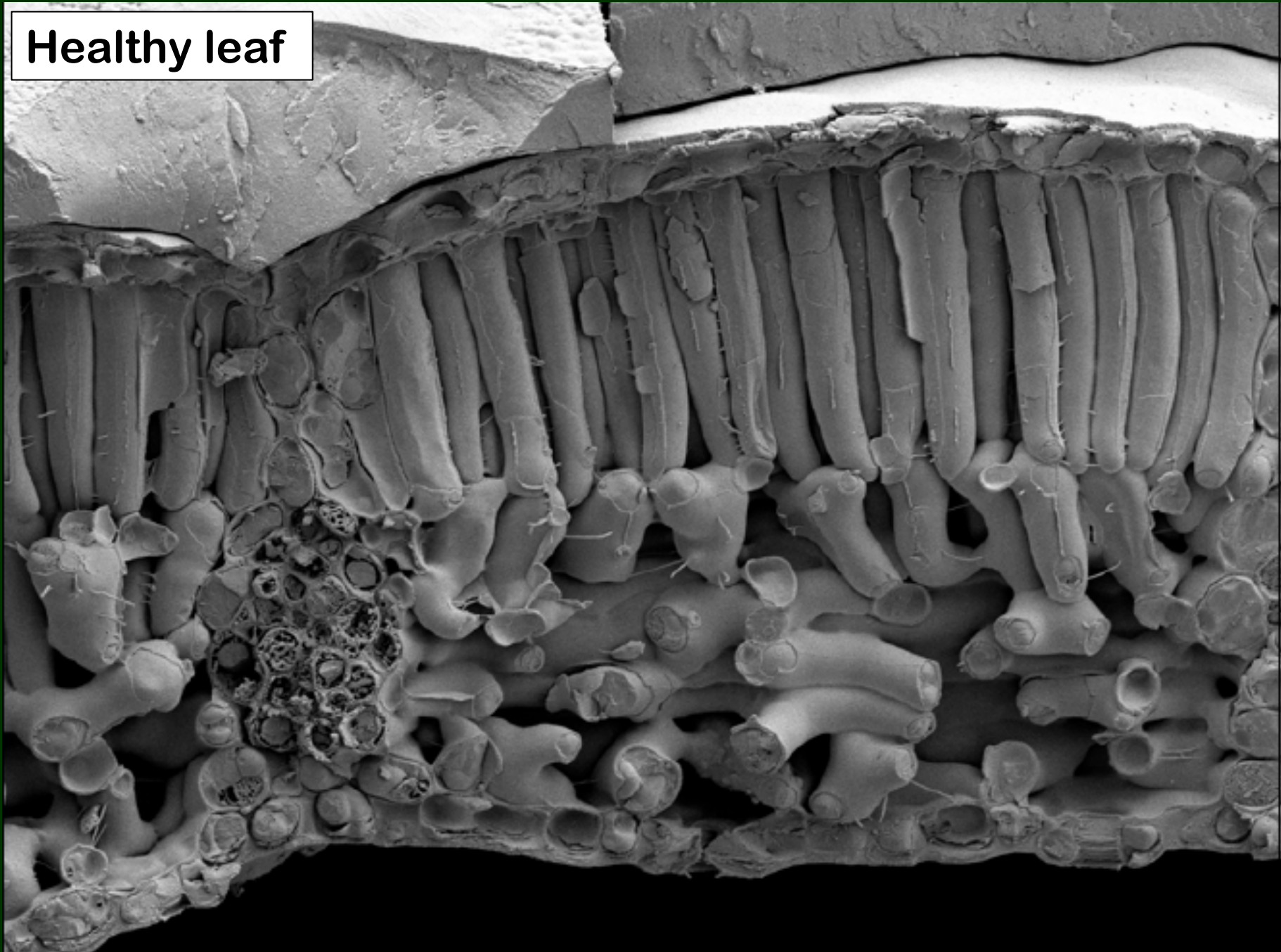
Beech leaves, in cross-section, late season

infected leaf



Electron micrograph images:
Gary Bauchan, Lynn Carta
USDA-ARS

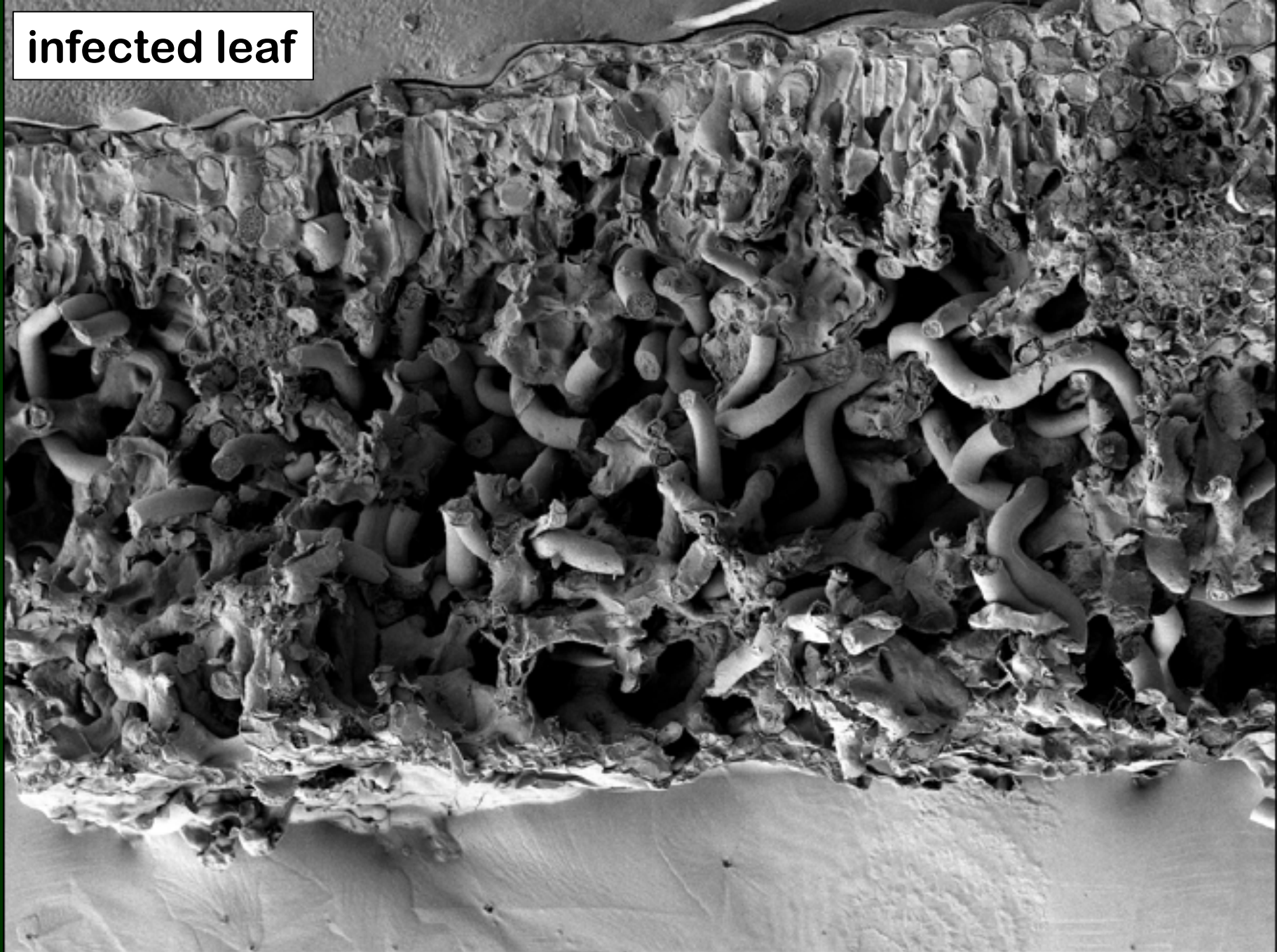
Healthy leaf



ECMU-4700
5.0 KV EM Mag 700X
Normal Leaf X-Section 3 with Stomata

40µm

infected leaf



ECMU-4700
5.0 KV EM Mag 205X
X-Section of Leaf 2

100µm

Lcm nematodes in leaf tissue, late autumn

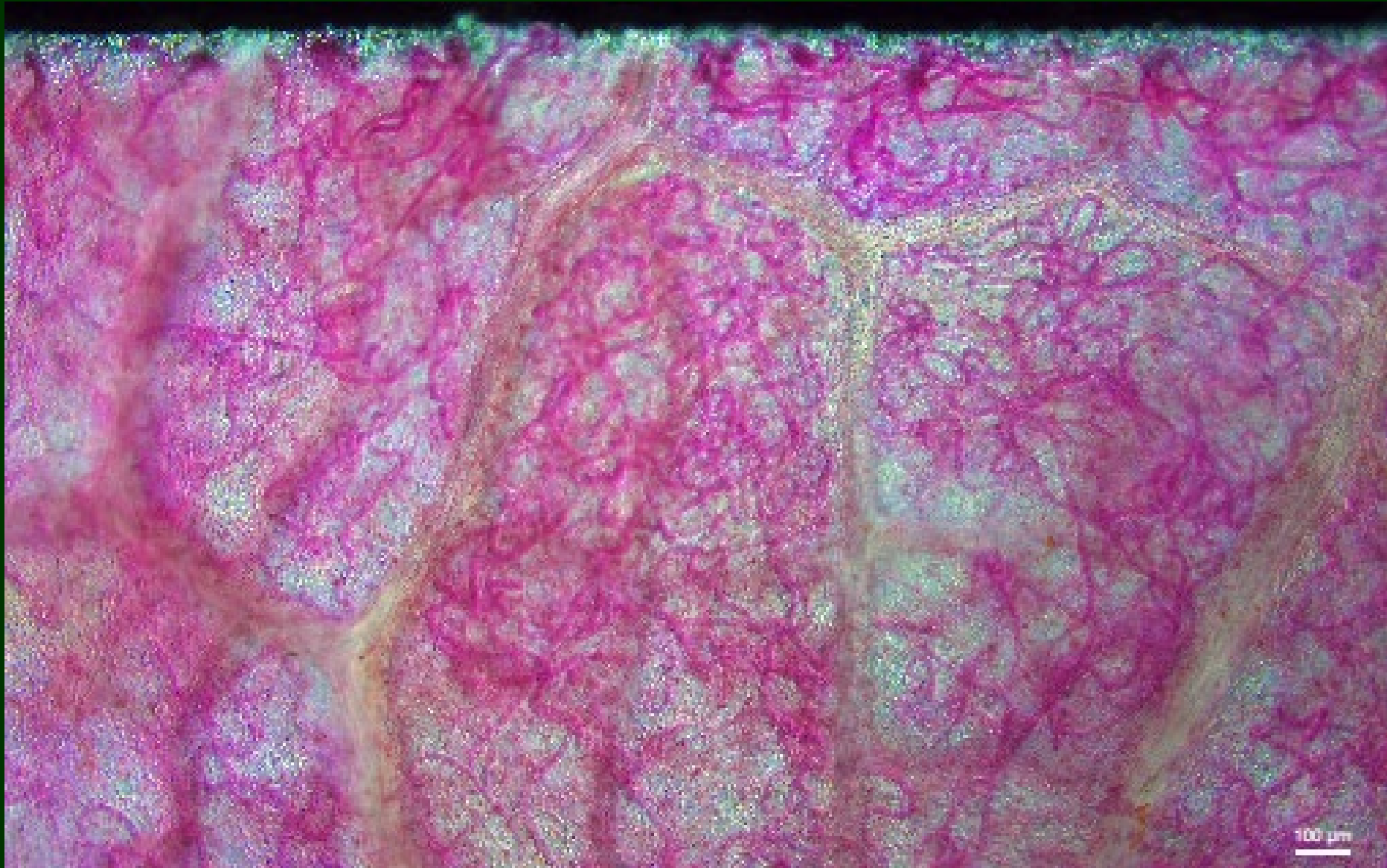


Image: Paulo Vieira, USDA-ARS

Lcm eggs in bud scale, late autumn

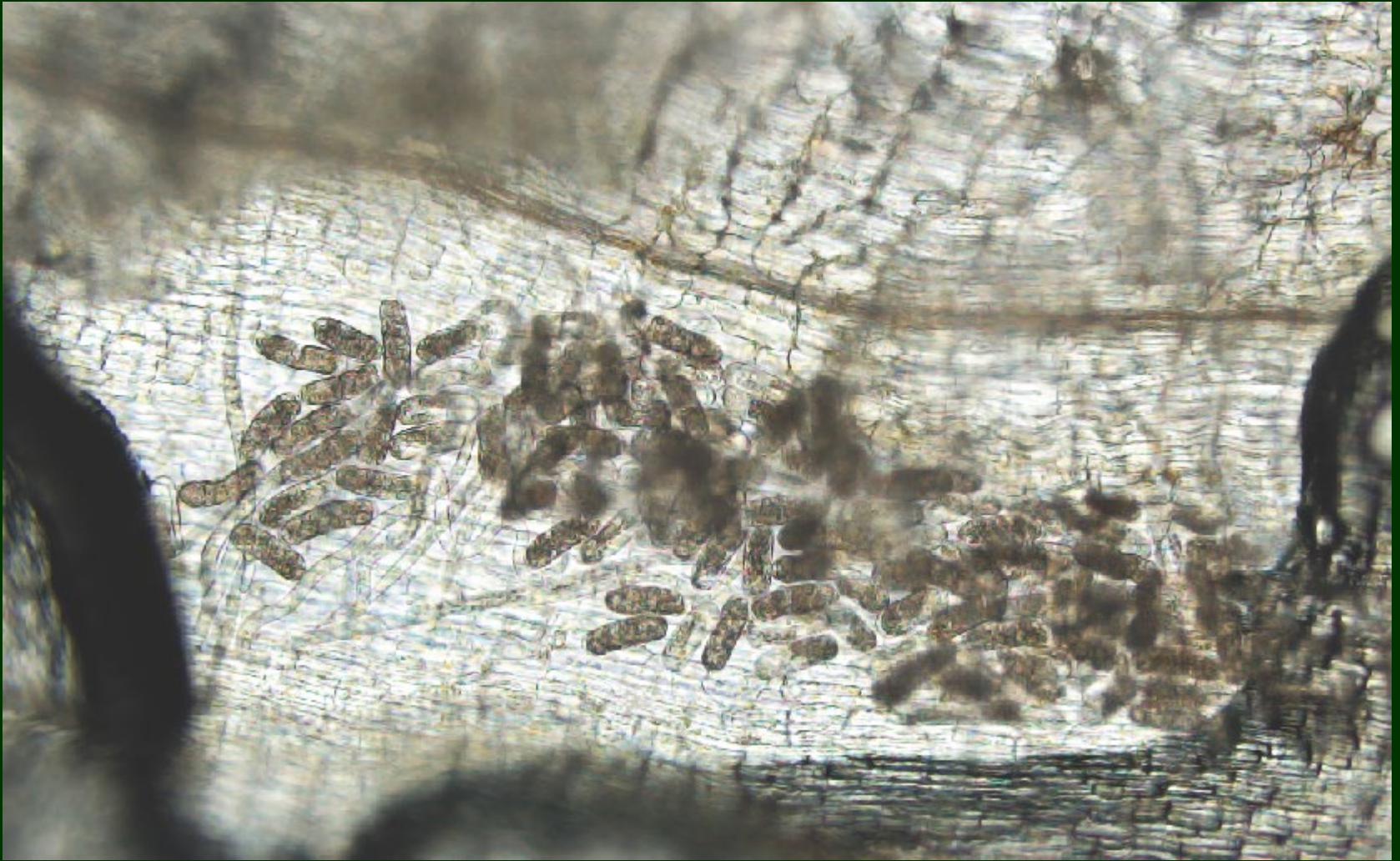


Image: Paulo Vieira, USDA-ARS

Beech Leaf Disease Research

➤ Molecular diagnostics

- Early detection of *Lcm* in *symptomatic and asymptomatic foliage*
- Discriminate between *Lcm* and Japanese subspecies, *L. crenatae* subsp. *crenatae* (Lcc)

➤ Population genetics

- DNA “Fingerprinting” markers
- Number of introductions into North America
- Pathways of spread

Beech Leaf Disease Research

➤ Origin of Lcm

- USFS International Programs
- Funding for expedition to Japan (2024)
- Lcm's native host

- Collaborators:
 - Dr. Paulo Vieira, USDA-ARS, Beltsville
 - USFS State & Private Forestry
 - Dr. Cameron McIntire, Durham, NH
 - Dr. Danielle Martin, Morgantown, WV
 - Japanese researchers

QUESTIONS?



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