# SCBI Tree Disease Guide

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## Introduction

The aim of this guide is to identify tree species of concern within the SCBI ForestGEO plot, and the diseases that are most likely to affect them, so that we can properly identify the causes of decline.

This is designed as a field resource for our **Annual Tree Health & Mortality Census**, with the material likely to be most heavily referenced up front. Methods are explained at the end.

## Using this guide

1. Prior to beginning the census, technicians should familiarize themselves with the overall concern levels of the tree species in the plot (Table 1) and, ideally, familiarize themselves with the most common forest insects and diseases affecting species of moderate or high concern. We hope to add images to this guide, but in the meantime, please refer to the *Tree and Forest Health Guide* of the Virginia Department of Forestry. Memorizing the concern level of for common species will make the census process faster, as will knowing common signs of insects/ disease on high or moderate concern level species.
2. In the field, check the concern level of each species you census (Table 1). If the species is of high or moderate concern and is AU or dead, refer to Table 2 to identify insects and diseases affecting the species. Then refer to the *Tree and Forest Health Guide* of the Virginia Department of Forestry for symptoms of these causes.

# Tree Species of Concern

**Table 1. Summary of the health/ mortality status of all tree species in the SCBI ForestGEO plot.** Included is IUCN status, n of living individuals ≥ 10 cm DBH in the SCBI ForestGEO plot, numbers of known species of forest insects or pathogens (FIP) and exotic FIP (EFIP) affecting the species, levels of concern based on mortality rates and "alive-unhealthy" (AU) status, and overall level of concern based on these metrics. Codes: H = high, M = moderate; L = low. Tree species codes are defined in the document SCBI_ForestGEO_sp_ecology.csv.

| | | | | | current concern level | | |
|---|---|---|---|---|---|---|---|
| Tree species code | IUCN status | n living | n FIP | n EFIP | mortality status | AU status | overall |
| acne | Least concern | 11 | 10 | 1 | L | M | L |
| acpl | Least concern | 7 | 9 | 1 | L | L | L |
| **acru** | **Least concern** | **170** | **11** | **1** | **L** | **M** | **M** |
| **aial** | | **3** | **1** | **1** | **M** | **H** | **M** |
| caco | Least concern | 213 | 5 | 0 | M | L | L |
| cagl | Least concern | 710 | 4 | 0 | L | L | L |
| caovl | | 292 | 4 | 0 | L | L | L |
| cato | Least concern | 604 | 4 | 0 | L | L | L |
| **cade** | **Critically Endangered** | **1** | **1** | **1** | **L** | **L** | **H** |
| **ceoc** | **Least concern** | **35** | **0** | **0** | **H** | **M** | **M** |
| divi | Least concern | 1 | 0 | 0 | L | L | L |
| fagr | Least concern | 343 | 7 | 2 | L | L | L |
| **fram** | **Critically Endangered** | **125** | **10** | **1** | **H** | **H** | **H** |
| **frni** | **Critically Endangered** | **2** | **10** | **1** | **H** | **H** | **H** |
| **frpe** | **Critically Endangered** | **10** | **9** | **1** | **H** | **H** | **H** |
| **juci** | **Endangered** | **1** | **4** | **1** | **M** | **H** | **H** |
| **juni** | **Least concern** | **107** | **4** | **0** | **L** | **M** | **M** |
| litu | Least concern | 2097 | 4 | 0 | L | L | L |
| nysy | Least concern | 484 | 0 | 0 | L | L | L |
| pato | | 2 | 0 | 0 | M | L | L |
| pipu | Least concern | 1 | 12 | 0 | L | L | L |
| **pist** | **Least concern** | **76** | **14** | **0** | **L** | **M** | **M** |
| pivi | Least concern | 2 | 12 | 0 | M | L | L |
| ploc | Least concern | 27 | 1 | 0 | L | M | L |
| **prav** | **Least concern** | **39** | **2** | **0** | **H** | **M** | **M** |
| prse | Least concern | 10 | 2 | 0 | M | L | L |
| **qual** | **Least concern** | **353** | **13** | **2** | **L** | **H** | **H** |
| **quco** | **Least concern** | **1** | **13** | **2** | **L** | **H** | **M** |
| **qufa** | **Least concern** | **1** | **13** | **2** | **L** | **H** | **M** |
| **qumi** | **Least concern** | **2** | **13** | **2** | **H** | **H** | **M** |

*(continued)*

| Tree species code | IUCN status | n living | n FIP | n EFIP | mortality status | AU status | overall |
|---|---|---|---|---|---|---|---|
| **qupr** | **Least concern** | **177** | **13** | **2** | **H** | **M** | **H** |
| **quru** | **Least concern** | **311** | **14** | **2** | **L** | **M** | **M** |
| **quve** | **Least concern** | **222** | **13** | **2** | **H** | **H** | **H** |
| **rops** | **Least concern** | **2** | **3** | **0** | **H** | **H** | **M** |
| **saal** | **Least concern** | **41** | **3** | **0** | **H** | **H** | **M** |
| tiam | Least concern | 120 | 4 | 2 | L | L | L |
| **ulam** | **Endangered** | **7** | **12** | **4** | **H** | **L** | **H** |
| **ulru** | **Least concern** | **72** | **12** | **4** | **H** | **H** | **H** |

# Tree- Disease Matrix

**Table 2. Matrix of forest insects and pathogens likely to occur at the SCBI ForestGEO plot, and the tree taxa they affect.** Tree species codes are defined in the document SCBI_ForestGEO_sp_ecology.csv.

Part 1/2: Tree species codes ACNE-JUNI

| | acne | acpl | acru | aial | caco | cagl | caovl | cato | cade | ceoc | divi | fagr | fram | frni | frpe | juci | juni |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Xylella fastidiosa (Bacterial Leach Scorch) | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Anoplophora glabripennis (Asian Longhorn Beetle)** | **1** | **1** | **1** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| Nakacisina disstria (Forest Tent Caterpillar) | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Glycobius speciosus (Maple Borer) | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Heterocampa guttivitta (Saddled Prominent) | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ennomos subsignaria (Elm Spanworm) | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 |
| Phellinus igniarus / Phellinus laevigatus / Phellinus tremulae (White Trunk Rot) | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| Climacodon septentrionale (Northern Tooth Bracket Fungus) | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 |
| Cicadellidae (leafhoppers) | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 |
| Boisea trivittata (Boxelder Bug) | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Paracelemensia acerofoliella (Maple Leafcutter) | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Aphis gossypii (Aphid) | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Lycorma delicatula (Spotted Lanternfly)** | **0** | **0** | **0** | **1** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| Scolytus quadrispinosus (Hickory Bark Beetle) | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Hyphantria cunea (Fall Webworm) | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 |
| Heterocampa manteo (Variable Oakleaf Caterpillar) | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 |
| Nectria cinnabarina (Coral Spot Canker) | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 |
| Ophignomonia leptostyla (Walnut Anthracnose) | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| **Cryphonectria parasitica (Chesnut Blight)** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| Neofusicoccum spp. (Stem Canker) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| **Agrilus planipennis (Emerald Ash Borer)** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **1** | **1** | **0** | **0** |

Part 1/2: Tree species codes ACNE-JUNI *(continued)*

| | acne | acpl | acru | aial | caco | cagl | caovl | cato | cade | ceoc | divi | fagr | fram | frmi | frpe | juci | juni |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Cryptococcus fagisuga Lindinger (Woolly Beech Scale)** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **0** | **0** | **0** | **0** | **0** |
| **Neconectria spp. , Nectria coccinea (Beech Bark Disease)** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **0** | **0** | **0** | **0** | **0** |
| Litylenchus crenatae n. sp (Beech Leaf Disease) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| Alsophila pometaria (Fall Cankerworm) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 |
| Candidatus Phytoplasma (Ash Yellows) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 |
| Podosesia syringae (Lilac Ash Borer) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 |
| **Ophiognomonia clavigignenti-juglandacearum (Butternut Canker)** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **0** |
| Geosmithia morbida (Thousands Cankers Disease) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| Neonectria galligena (Nectrua Canker) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |

Part 2/2: Tree species codes LITU-ULRU

| | litu | nysy | pato | pipu | pist | pivi | ploc | prav | prse | qual | quco | qufa | qumi | qupr | quru | quve | rops | saal | tiam | ulam | ulru |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Xylella fastidiosa (Bacterial Leach Scorch) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 |
| **Anoplophora glabripennis (Asian Longhorn Beetle)** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **1** |
| Nakacisina disstria (Forest Tent Caterpillar) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| Ennomos subsignaria (Elm Spanworm) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 |
| Cicadellidae (leafhoppers) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 |
| Aphis gossypii (Aphid) | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Hyphantria cunea (Fall Webworm) | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 |
| Heterocampa manteo (Variable Oakleaf Caterpillar) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 |
| Nectria cinnabarina (Coral Spot Canker) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| Alsophila pometaria (Fall Cankerworm) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| Euzophera ostricolorella (Root Collar Borer) | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Odontopus calcaetus (Yellow Poplar Weevil) | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| Ceratocystis spp. (Bluestain Fungus) | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ophiostoma spp. (Bluestain Fungus) | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sirex noctilio (Sirex Woodwasp) | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Scleroderris lagerbergii (Sclerroderis Canker) | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ips pini (Pine Engraver Beetle) | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ips grandicollis (Southern Pine Engraver) | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ips calligraphus (Six-spined Ips) | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ips avulsus (Small Southern Pine Engraver) | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Choristoneura pinus (Jack Pine Budworm) | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cronartium quercuum (Fusiform Rust) | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| Phellinus pini (Red trunk Rot) | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Dendroctonus frontalis Zimmermann (Southern Pine Beetle) | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cronartium ribicola (White Pine Blister Rust) | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| pineus strobi (Pine Bark Adelgid) | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Part 2/2: Tree species codes LITU-ULRU *(continued)*

| | litu | nysy | pato | pipu | pist | pivi | ploc | prav | prse | qual | quco | qufa | qumi | qupr | quru | quve | rops | saal | tiam | ulam | ulru |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Euzophera semifuneralis (American Plum Borer) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Apiosporina morbosa (Black Knot Disease) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Lymantria dispar (Gypsy Moth)** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **1** | **1** | **1** | **1** | **1** | **1** | **0** | **0** | **0** | **0** | **0** |
| **Phytophthora ramorum (Sudden Oak death)** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **1** | **1** | **1** | **1** | **1** | **1** | **0** | **0** | **0** | **0** | **0** |
| Agrilus bilineatus (Two Lined Chestnut Borer) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| Armillaria spp. (Honey Fungus) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| Ceratocystis fagacearum (Oak Wilt) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| Anisota senatoria (Orangestriped Oakworm) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| Enaphalodes rufulus (Red Oak Borer) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Phellinus robiniae / Phellinus rimosus / Polyporus (Heart Rot Fungus) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| Odontota dorsalis (Black Locust Leaf Miner) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| Megacyllene robiniae (Locust Borer) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| Raffaelea lauricola (Laurel Wilt) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| Xyleborus glabratus (Redbay Ambrosia Beetle) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| **Popillia japonica (Japanese Beetle)** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **0** | **0** |
| **Thrips calcaratus (Basswood Thrips)** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **0** | **0** |
| **Scolytus multistriatus (Smaller European Elm Bark Beetle)** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **1** |
| **Scolytus schevyrewi (Banded Elm Bark Beetle)** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **1** |
| **Ophiostoma ulmi/Ophiostoma nova-ulmi/Ophiostoma himal-ulmi (Dutch Elm Disease)** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **1** |
| Scaphoideus luteolus Van Duzee (Whitebanded Leafhopper) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| Hylurgopinus rufipes (Native Elm Bark Beetle) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |

# Pictoral guide to most important pests & diseases

This is in progress. A complete guide is the *Tree and Forest Health Guide* of the Virginia Department of Forestry.

## Insect pests

### Phloem feeders (Sapsuckers)

Phloem feeders pierce plant tissues to access nutrient-rich phloem sap. They are often quite small (e.g., adelgids, aphids, scale insects) but can be larger (e.g., cicadas, spotted lanternfly, brown marmorated stink bug). They are mostly in the insect order Hemiptera, including aphids, planthoppers, leafhoppers, treehoppers, whiteflies, cicadas, spittlebugs, scale insects, and shield bugs [@jiang_challenging_2019]. Damage can range from negligible to mortality. They can transmit / enable bacterial or fungal infections.

#### *Spotted Lanternfly*

### Defoliators

### Root/Shoot/Twig Insects

### Bark Beetles/ Wood Borers

## Diseases

### Rusts

### Root

### Cankers

### Foliage

### Vascular

# Methods & Definitions

## Tree species concern levels

We assigned concern levels – high (H), moderate (M), or low (L) – to each tree species based on results of the SCBI ForestGEO mortality census, IUCN status, and the presence and lethally of pest and pathogen species.

### Concern level based on observed tree mortality rates

*High concern:*

- mortality rate $\geq$ 5 % $yr^{-1}$ in more than one year, OR...
- dominant species ($\geq$ 100 individuals of DBH $\geq$ 10 cm) with an overall increasing trend and $\geq$ 5 % $yr^{-1}$ in the most recent year (2021)

*Moderate concern:*

- mortality rate $\geq$ 5 % $yr^{-1}$ in only one year (but does not meet high concern criteria of dominant species with increasing trend)

*Low concern:*

- mortality rate $<$ 5 % $yr^{-1}$ in all census years

### Concern level based on the fraction of alive but unhealthy ("AU" status) trees observed in the latest census

*High concern:*

- $\geq$ 20% of living trees were unhealthy in the latest census.

*Moderate concern:*

- $\geq$ 10% (but <20%) of living trees were unhealthy in the latest census.

*Low concern:*

- <10% of living trees were unhealthy in the latest census.

### Overall concern level

- If IUCN Red List status was anything other than "Least Concern", the species was flagged as high concern
- If an exotic pest or disease with high / moderate lethality was known to be present in region, any species affected by that pest/ disease was flagged as H/M concern. *(Note: we have not yet set up the data/ code infrastructure for this, but rather adjusted individual species as appropriate.)*
- If either mortality rate or AU concern level was M or H, overall concern was assigned to match the highest concern level, but lowered one level in the case of species with <50 individuals in the plot and only one M or H ranking.
- If IUCN Red List status was anything other than "Least Concern", there were no known highly lethal exotic pests or diseases present, and both mortality and AU concern levels were low, the species was flagged as low concern.

## Identifying tree species - disease pairs