Fall Cankerworm in Virginia

Lori Chamberlin and Katlin DeWitt
Forest Health Program
Virginia Department of Forestry

VDOF Forest Health Program

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Fall Cankerworm

- *Alsophila pometaria,* Geometridae
- Native to North America
- Range from Canada to Florida, west to California, Colorado, Utah and Montana

Fall Cankerworm Life Cycle

Fall/Winter

Photo Credits:
Female FCW w/ eggs:USDA Forest Service - Region 8 - Southern , USDA Forest Service, Bugwood.org
male FCW: William M. Ciesla, Forest Health Management International, Bugwood.org

Fall Cankerworm Life Cycle

Fall/Winter

Early-Mid Spring

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Fall Cankerworm Life Cycle

Fall/Winter

Early-Mid Spring

Summer

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Female FCW w/ eggs:USDA Forest Service - Region 8 - Southern , USDA Forest Service, Bugwood.org
Pupae and male FCW: William M. Ciesla, Forest Health Management International, Bugwood.org

Fall Cankerworm Life Cycle

- One year life cycle
- Period of cold weather in fall triggers adult activity
- Reproduction can either be sexual, gynogenesis, or parthenogenetically
- Two color forms of larvae depending on population levels

Fall Cankerworm Hosts

- Not known to feed on evergreens
- Larvae feed on a variety of broadleaf tree and woody plant hosts
  - *Quercus**
  - *Carya*
  - *Prunus*
  - *Ulmus*
  - *Fagus*

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  - *Prunus*
  - *Ulmus*
  - *Fagus*

* Considered a favorite host and large outbreaks tend to occur in oak dominated forests

Fall Cankerworm Feeding Habits

- Begin feeding right at bud break
- Young larvae cause shotholes in foliage
- Older larvae consume all tissue down to midrib

Fall Cankerworm Feeding Damage

Fall Cankerworm Outbreaks

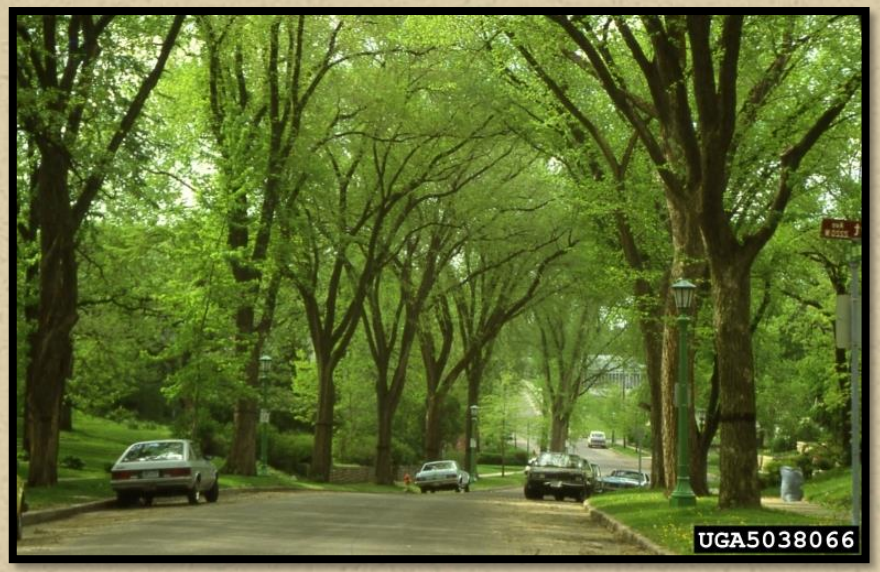
Video courtesy of Tom McAvoy

Fall Cankerworm Outbreaks

- Outbreaks can occur anywhere there are host species
- Most don't last long and are localized, though some can be quite extensive and last multiple years
- Consecutive years of defoliation can weaken trees
- Can also be a nuisance pest

Fall Cankerworm Outbreaks

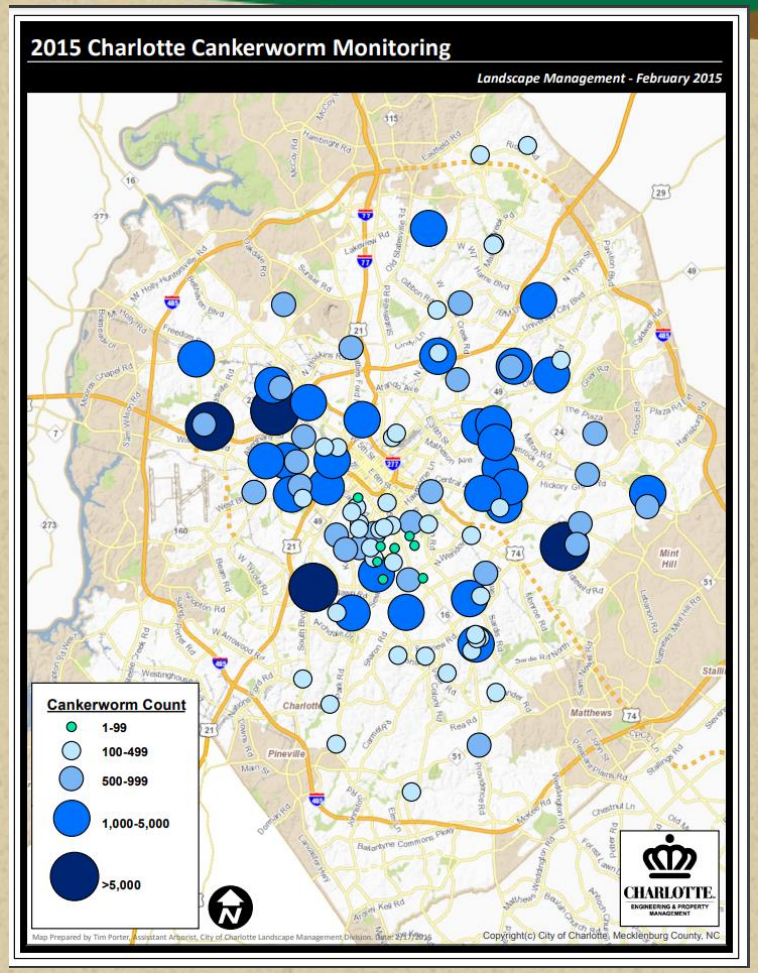
- Urban areas often host outbreaks
  - Lack species diversity
  - Subjected to other stressors
  - Mature trees



Joseph OBrien, USDA Forest Service, Bugwood.org

Fall Cankerworm Outbreaks

- Charlotte, NC
  - Has experienced FCW outbreaks almost every year for last 3 decades
  - Mature willow oaks
  - 2012 – 56% of the city had FCW damage



Control and Management

- Several natural enemies help to keep populations of FCW in check
  - *Telenomus alsophilae*
  - Genus *Calosoma*

Above: Telenomus alsophilae egg parasities emerging from elm spanworm, Arnold T. Drooz, USDA Forest Service, Bugwood.org
Left: Pennsylvania Department of Conservation and Natural Resources - Forestry , Bugwood.org

- Climatic conditions can help control populations

Control and Management

- In forested areas, outbreaks do not usually warrant treatment
- In urban and public use areas, direct control can be necessary if defoliation occurs for multiple consecutive years
- Reducing other stressors to urban trees can make them more resilient

Control and Management

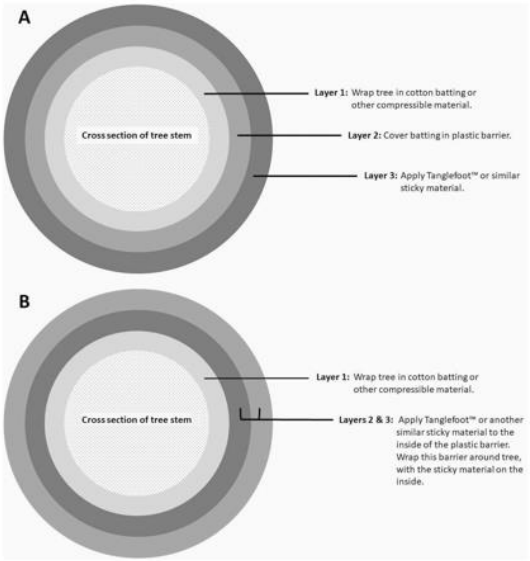
- *Bacillus thuringiensis* var. *kurstaki* (Btk)
  - Specific to Lepidopterans
  - Applied early when larvae are small
  - Can be sprayed aerially or on the ground

Gerald J. Lenhard, Louisiana State University, Bugwood.org

Control and Management

- Tree Banding
  - Should be placed mid-November through end of January
  - Helpful to aid in monitoring populations and determine when other controls are needed

Fig. 3. Two common types of sticky band traps are sticky traps (A) and barrier bands (B). On sticky traps, the sticky ...



J Integr Pest Manag, Volume 12, Issue 1, 2021, 23, https://doi.org/10.1093/jipm/pmab017

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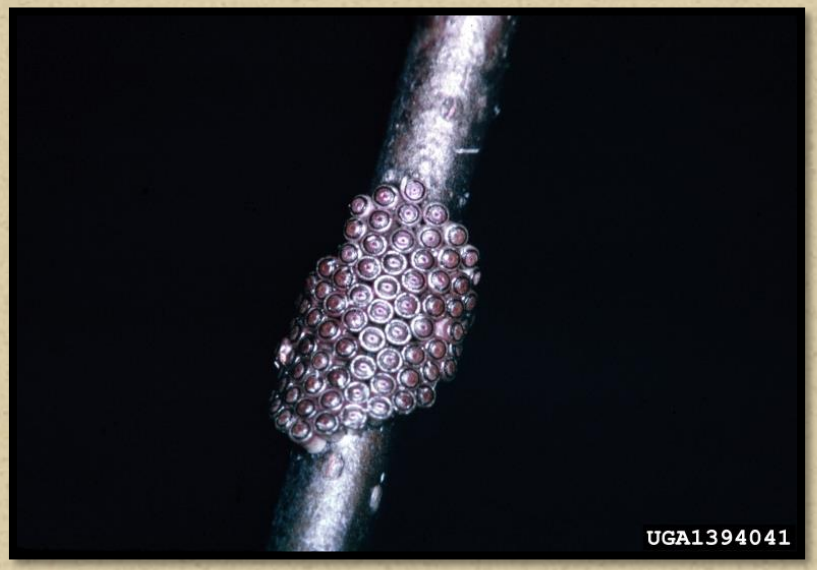
Banding Threshold

- Fairfax County began formal tree banding program in 2000
- Walter et al.* found moderate to heavy defoliation when >200 females were trapped per band
- Prince William County uses 100 females per band as threshold

*Walter, J.A., F. Finch, and D. Johnson. 2016. Re-evaluating fall cankerworm management thresholds for urban and suburban forests. Agric. For. Entomol. 18: 145-150.

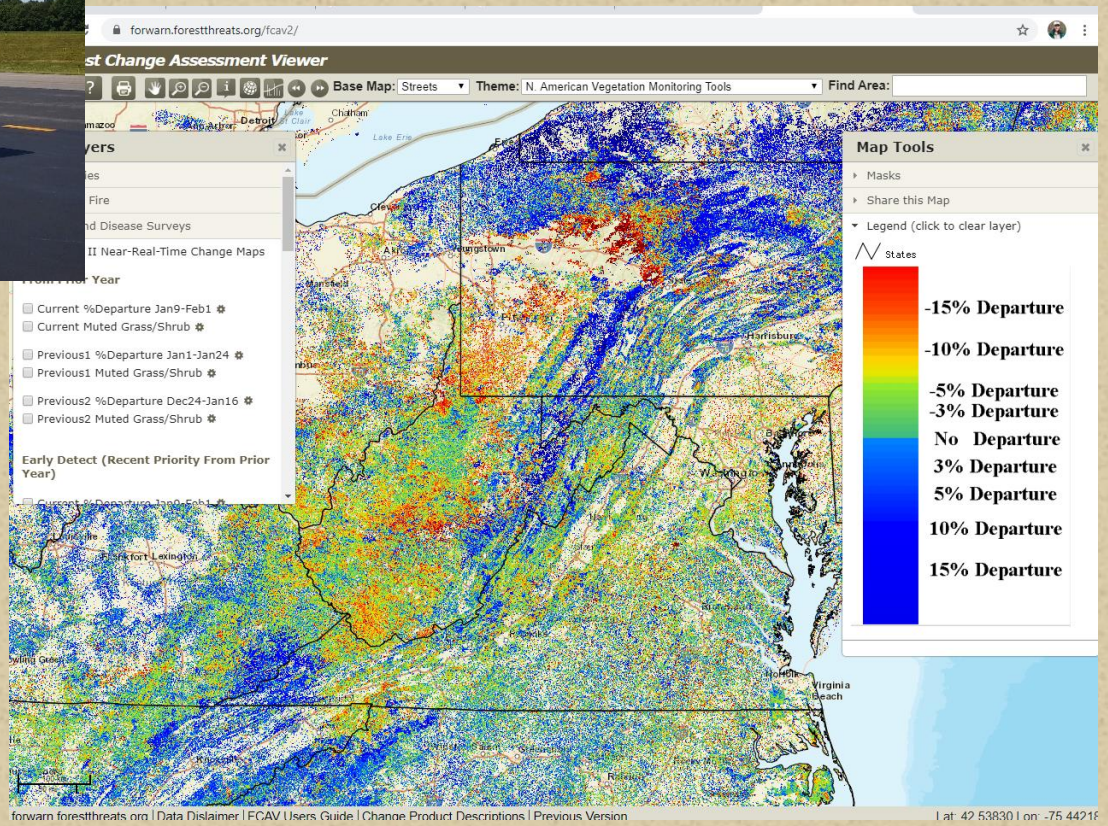
Egg Mass Surveys

- Can be helpful for looking at population densities and for planning a spray program
- Can also help determine rate of parasitism



James B. Hanson, USDA Forest Service, Bugwood.org

History of Fall Cankerworm



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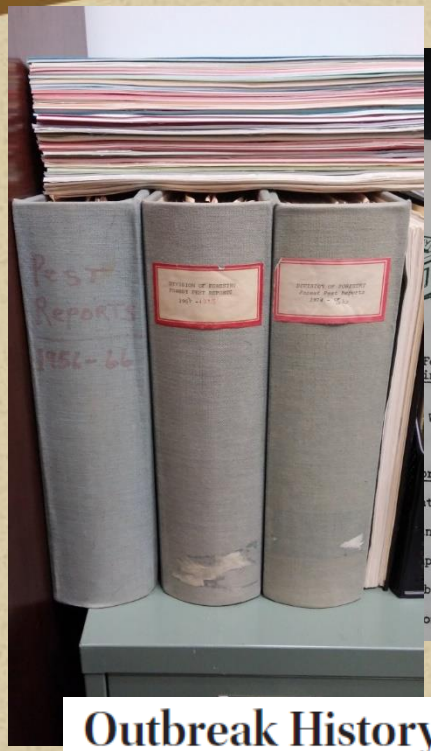
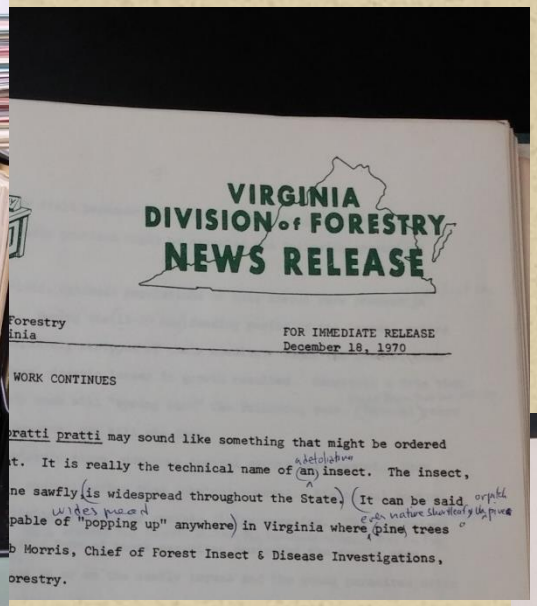




VIRGINIA
DIVISION of FORESTRY
NEWS RELEASE

Forestry
inia

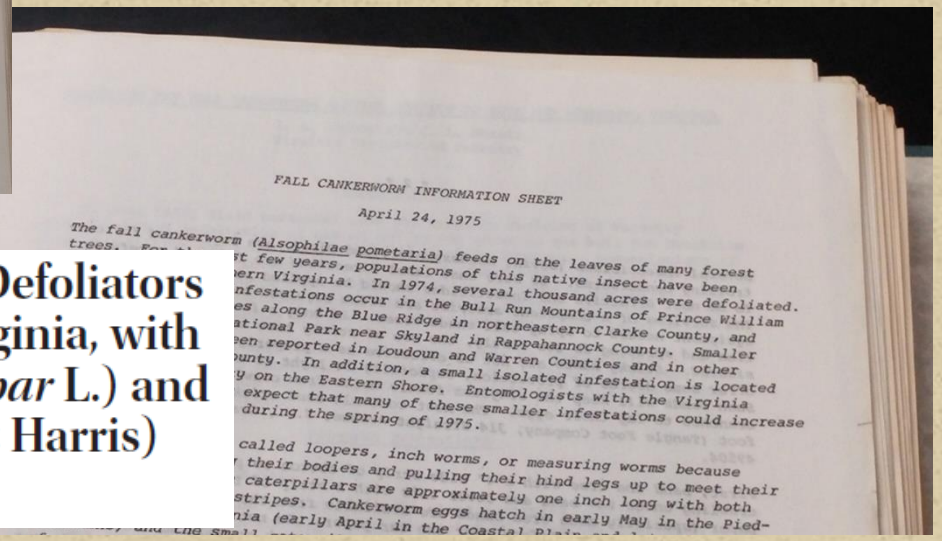
FOR IMMEDIATE RELEASE
December 18, 1970

WORK CONTINUES

ratti pratti may sound like something that might be ordered
t. It is really the technical name of (an) insect. The insect,
defoliator
ne sawfly (is widespread throughout the State.) (It can be said
pable of "popping up" anywhere) in Virginia where (pine) trees
widespread
b Morris, Chief of Forest Insect & Disease Investigations,
orestry.

Reviewed archived reports since 1955 for "major" pest incidences

- At least 500 acres
- Moderate to severe defoliation (> 30% canopy loss)



FALL CANKERWORM INFORMATION SHEET

April 24, 1975

The fall cankerworm (Alsophilae pometaria) feeds on the leaves of many forest
t few years, populations of this native insect have been
ern Virginia. In 1974, several thousand acres were defoliated.
nfestations occur in the Bull Run Mountains of Prince William
es along the Blue Ridge in northeastern Clarke County, and
ational Park near Skyland in Rappahannock County. Smaller
een reported in Loudoun and Warren Counties and in other
unty. In addition, a small isolated infestation is located
y on the Eastern Shore. Entomologists with the Virginia
expect that many of these smaller infestations could increase
during the spring of 1975.

called loopers, inch worms, or measuring worms because
their bodies and pulling their hind legs up to meet their
caterpillars are approximately one inch long with both
stripes. Cankerworm eggs hatch in early May in the Pied-
nia (early April in the Coastal Plain and

Outbreak History (1953-2014) of Spring Defoliators Impacting Oak-Dominated Forests in Virginia, with Emphasis on Gypsy Moth (*Lymantria dispar* L.) and Fall Cankerworm (*Alsophila pometaria* Harris)

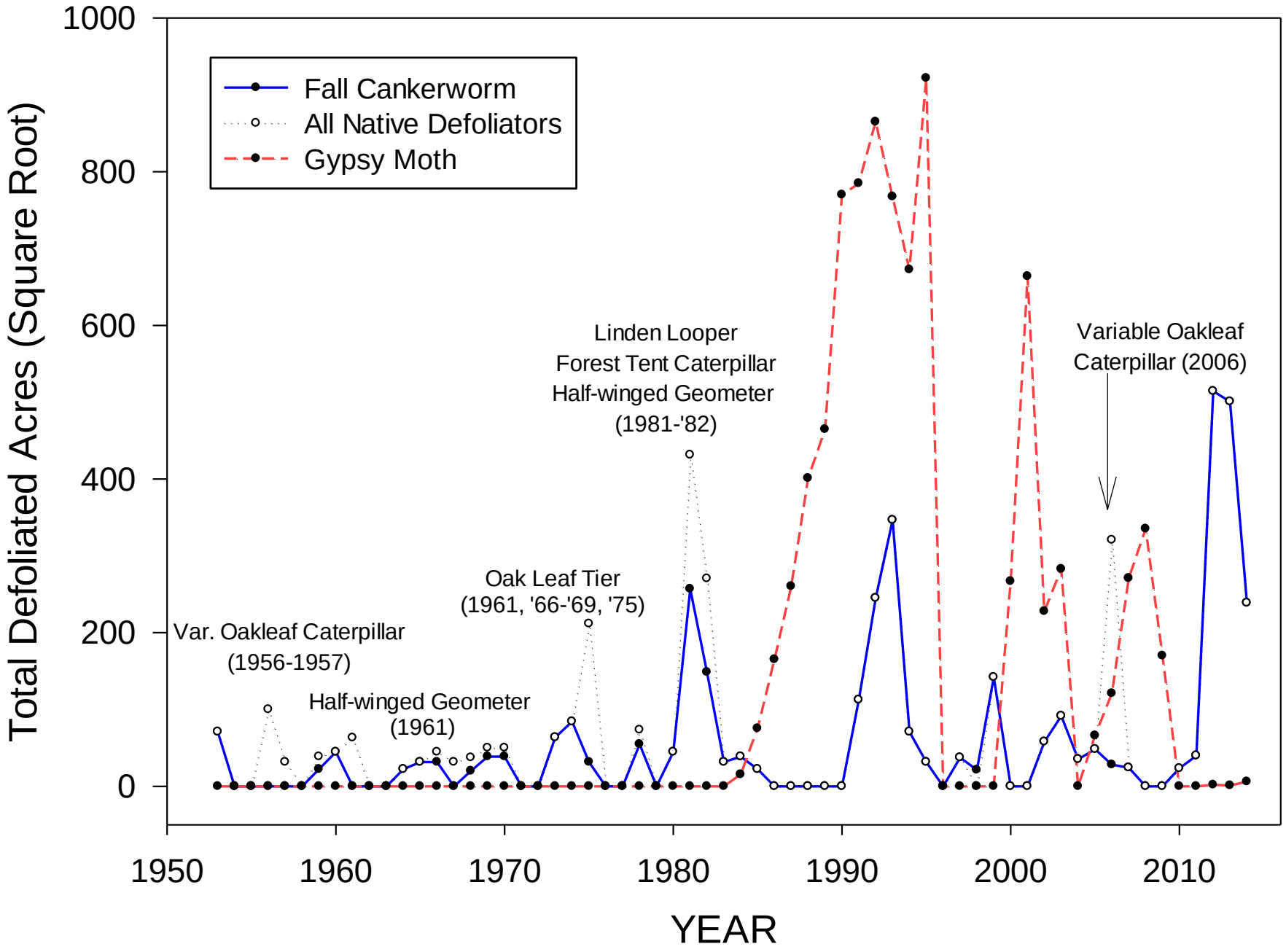
CHRISTOPHER ASARO AND LORI A. CHAMBERLIN

Lymantria dispar

Photo credit: Mike Skinner

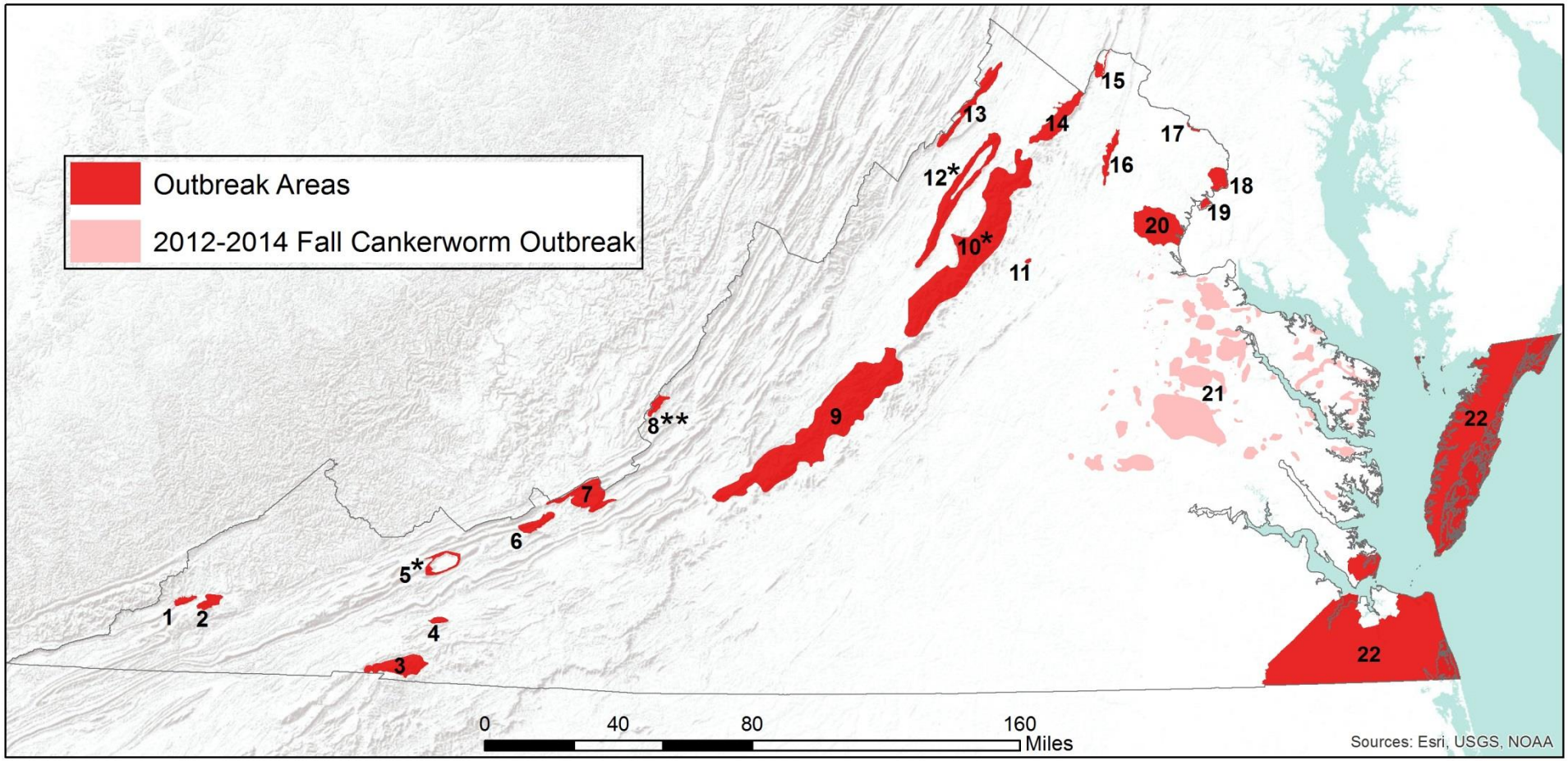
- Native to Europe
- Introduced to Massachusetts in 1869
- Feeds on hundreds of tree species
- Formerly known as the gypsy moth

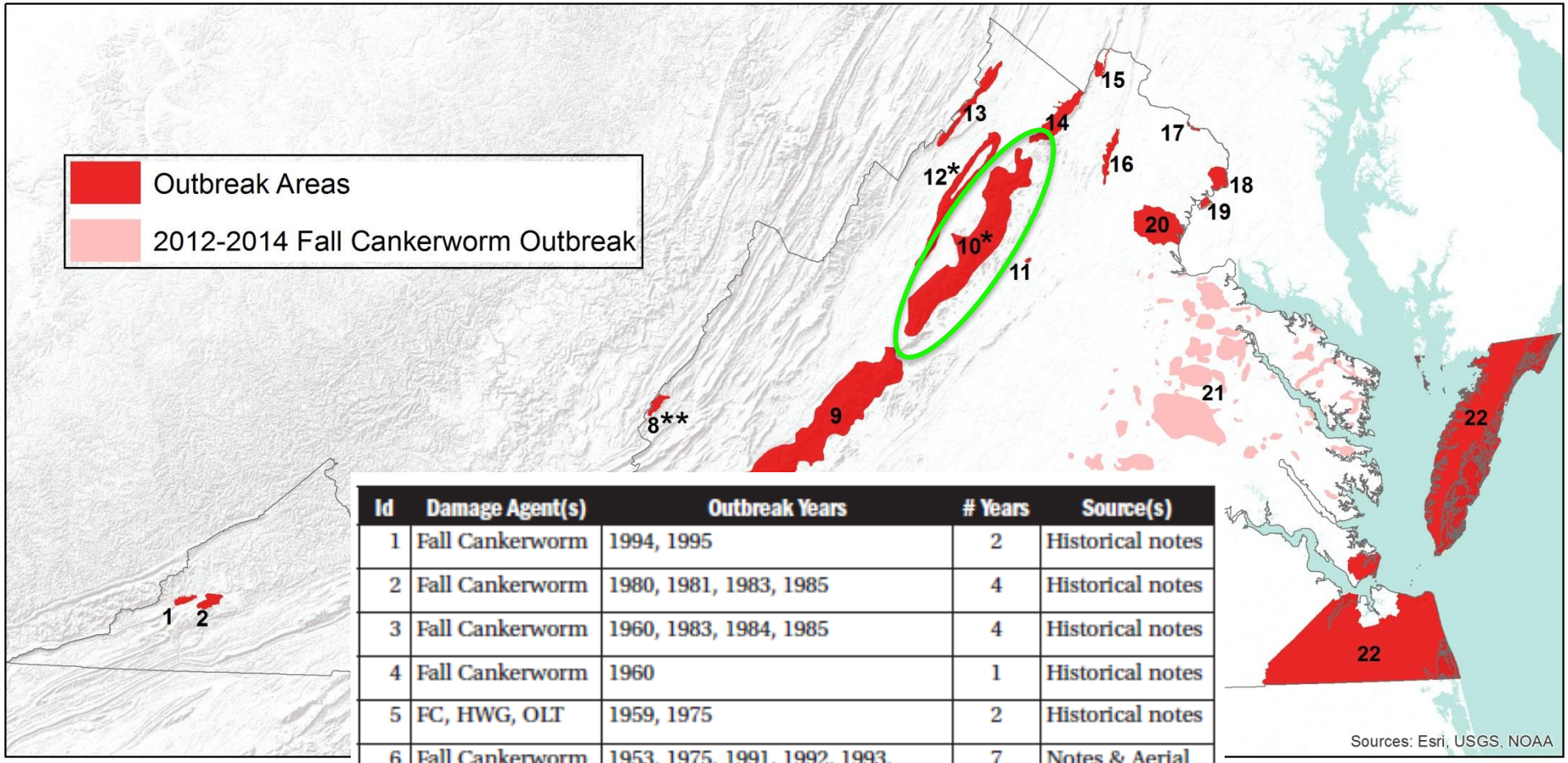
GW National Forest, Augusta Co. 2008


Fall Cankerworm
All Native Defoliators
Gypsy Moth
Total Defoliated Acres (Square Root)
1000
800
600
400
200
0
1950
1960
1970
1980
1990
2000
2010
YEAR
Var. Oakleaf Caterpillar
(1956-1957)
Half-winged Geometer
(1961)
Oak Leaf Tier
(1961, '66-'69, '75)
Linden Looper
Forest Tent Caterpillar
Half-winged Geometer
(1981-'82)
Variable Oakleaf
Caterpillar (2006)

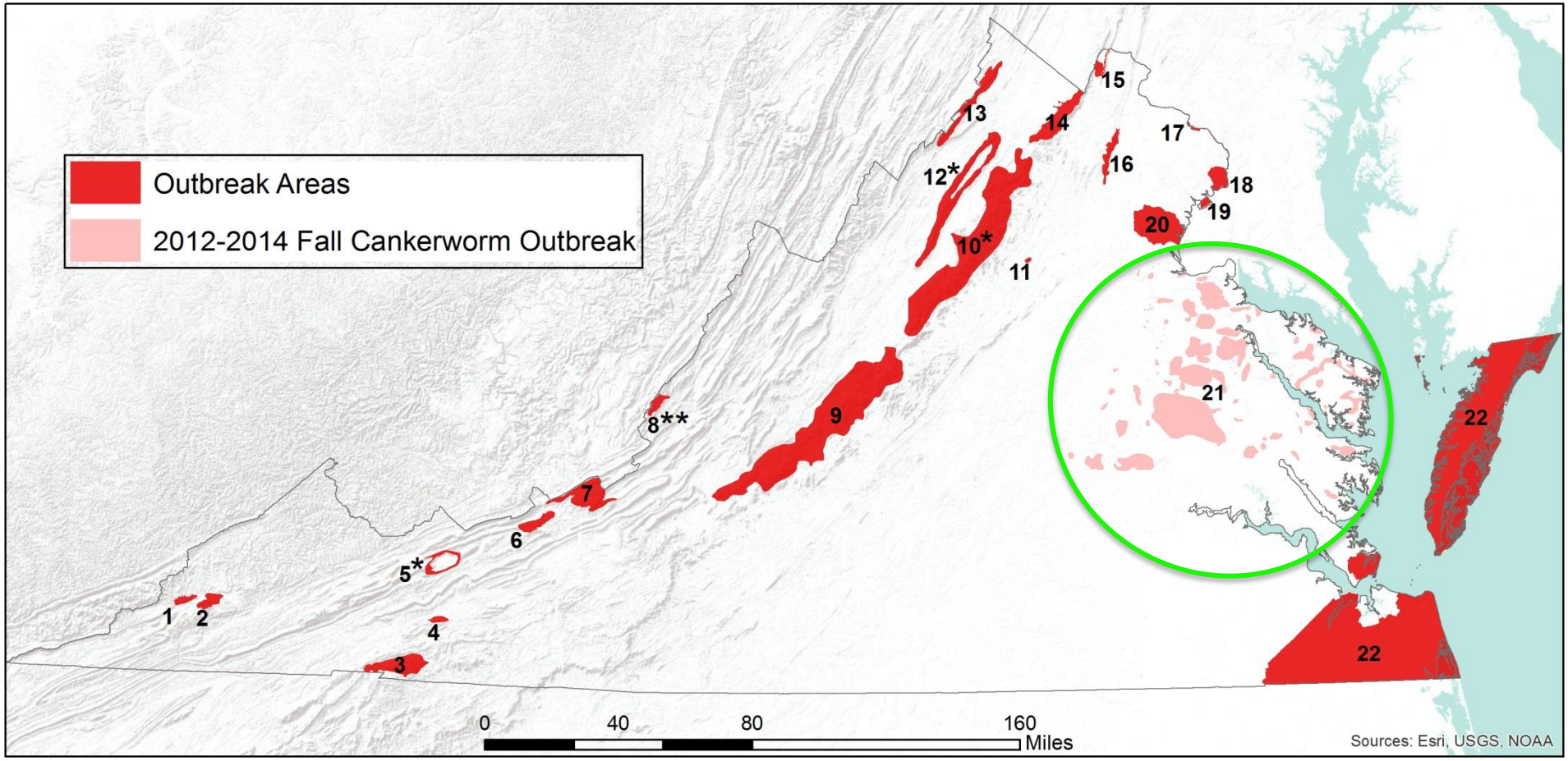
Outbreak History Map

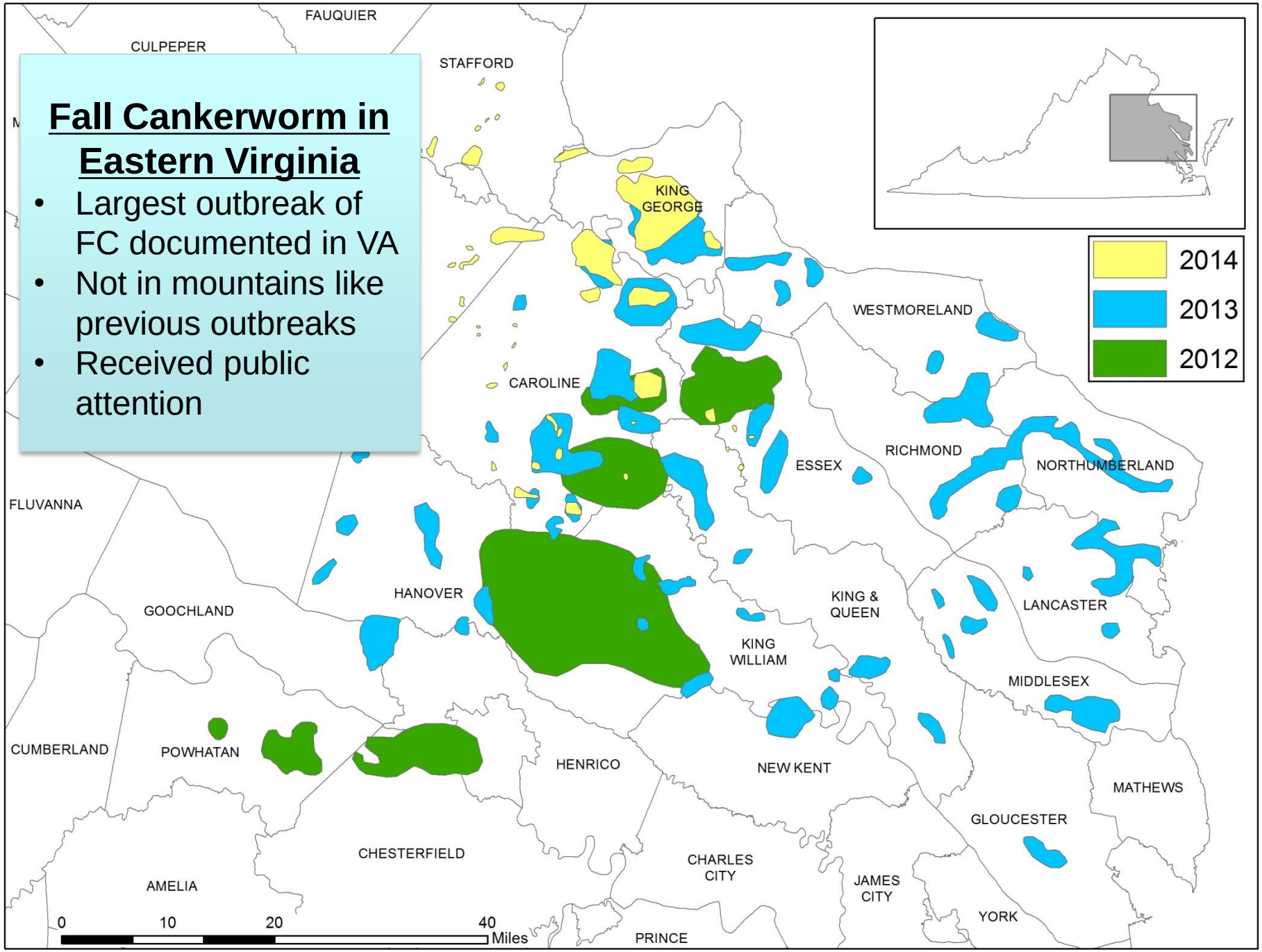
fall cankerworm and other defoliator outbreaks (1953-2014)

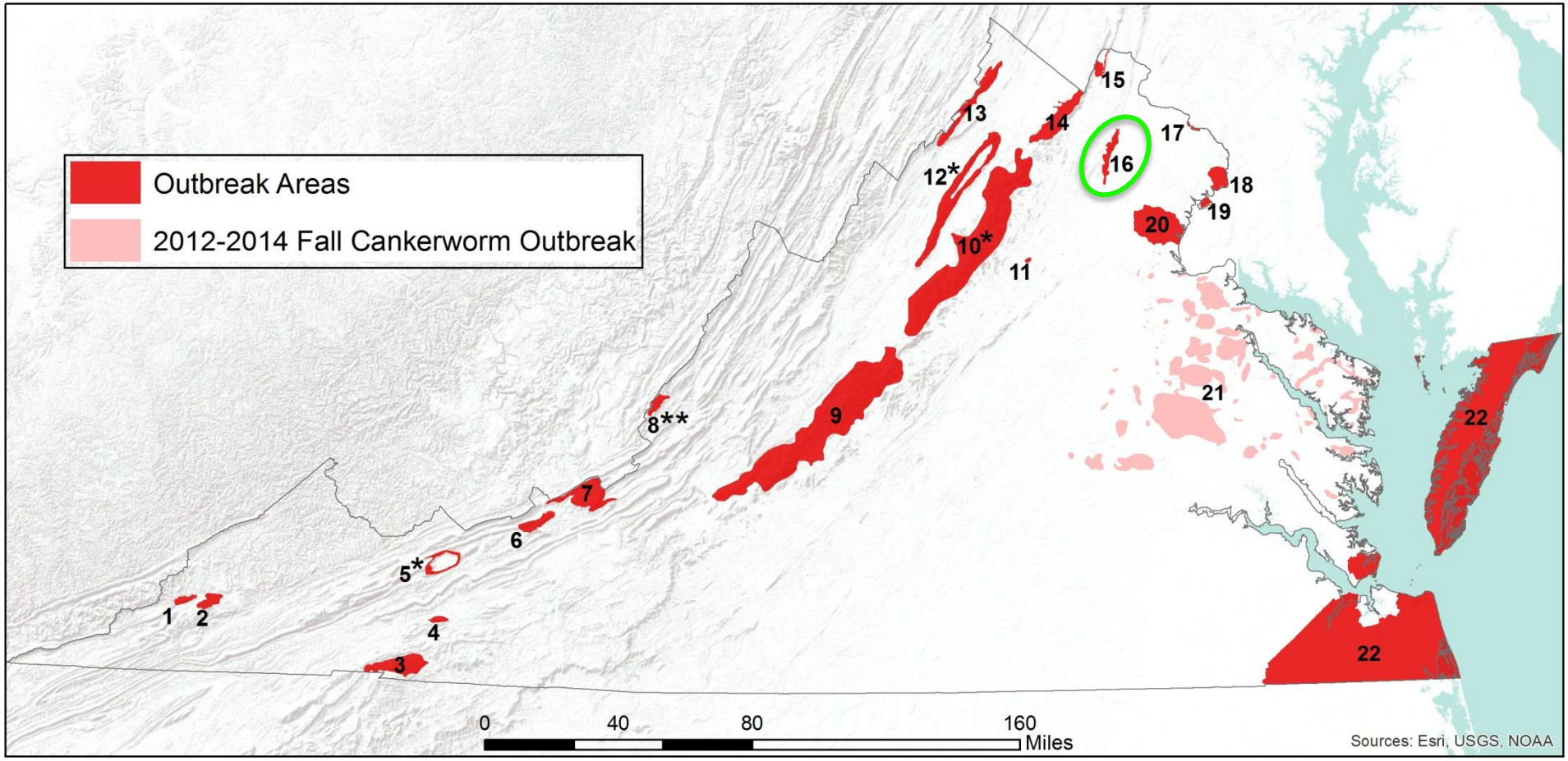


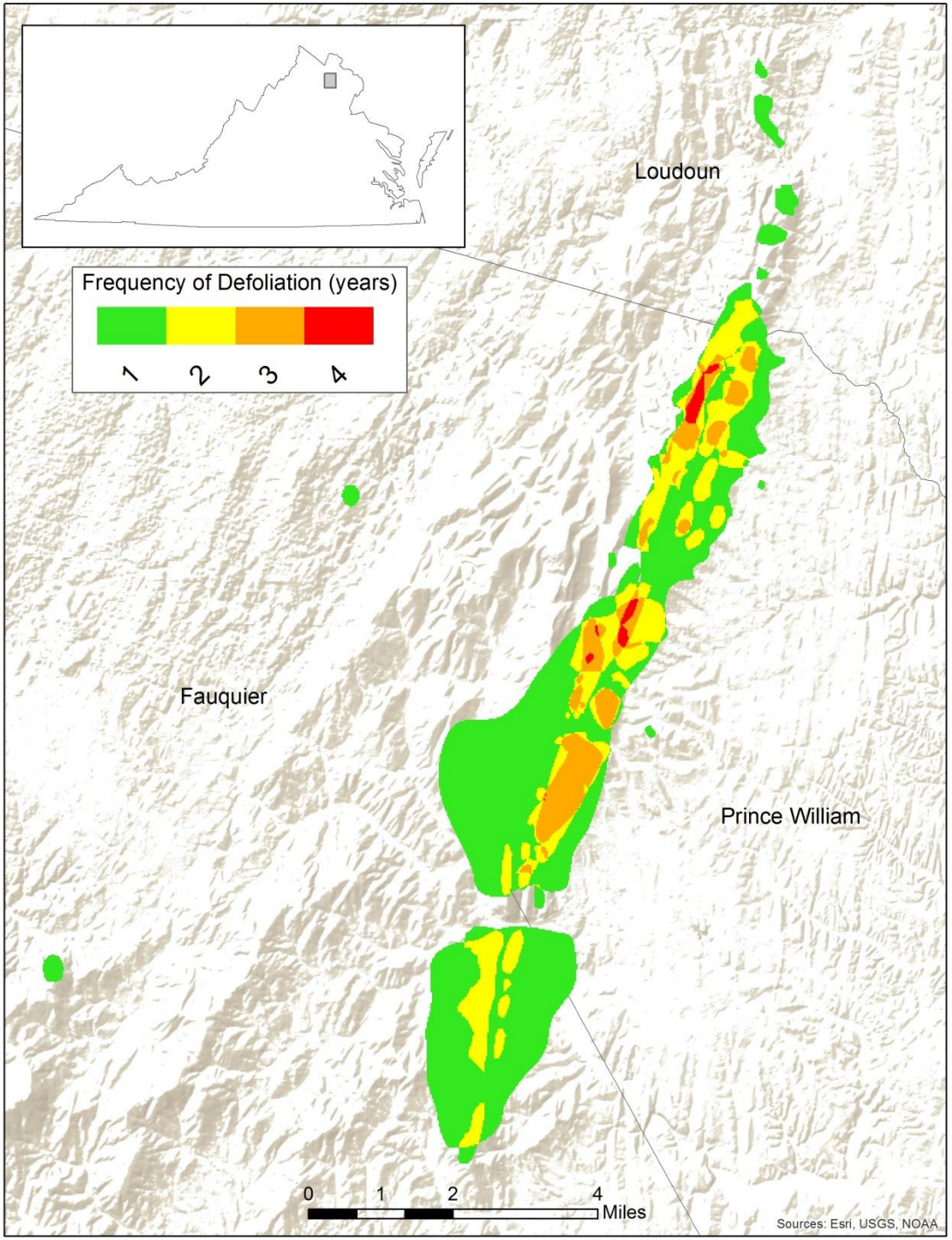


Id	Damage Agent(s)	Outbreak Years	# Years	Source(s)
1	Fall Cankerworm	1994, 1995	2	Historical notes
2	Fall Cankerworm	1980, 1981, 1983, 1985	4	Historical notes
3	Fall Cankerworm	1960, 1983, 1984, 1985	4	Historical notes
4	Fall Cankerworm	1960	1	Historical notes
5	FC, HWG, OLT	1959, 1975	2	Historical notes
6	Fall Cankerworm	1953, 1975, 1991, 1992, 1993, 1995, 2003	7	Notes & Aerial
7	Fall Cankerworm	1953, 1975, 1991, 1992, 1993, 1995, 2003	7	Historical notes
8	Oak Leaf Tier	1966, 1967, 1968, 1969, 1970, 1975	6	Historical notes
9	Fall Cankerworm	1964, 1965, 1966, 1975, 1981, 1997	6	Notes and aerial
10	FC, LL, HWG, FTC	1974, 1975, 1978, 1980, 1981, 1982, 1983, 1994, 2005, 2010	10	Historical notes
11	Fall Cankerworm	1994, 1995	2	Historical notes
12	Fall Cankerworm	1981, 2005, 2006	3	Notes & Aerial
12	Oak Leaf Tier	1961	1	Historical notes


Outbreak Areas
2012-2014 Fall Cankerworm Outbreak
1
2
3
4
5*
6
7
8**
9
10*
11
12*
13
14
15
16
17
18
19
20
21
22
22
0
40
80
160
Miles
Sources: Esri, USGS, NOAA


Fall Cankerworm in Eastern Virginia
• Largest outbreak of FC documented in VA
• Not in mountains like previous outbreaks
• Received public attention
FAUQUIER
CULPEPER
STAFFORD
KING GEORGE
WESTMORELAND
CAROLINE
ESSEX
RICHMOND
NORTHUMBERLAND
FLUVANNA
HANOVER
GOOCHLAND
KING & QUEEN
LANCASTER
KING WILLIAM
MIDDLESEX
CUMBERLAND
POWHATAN
HENRICO
NEW KENT
MATHEWS
GLOUCESTER
CHESTERFIELD
CHARLES CITY
JAMES CITY
AMELIA
YORK
PRINCE
0 10 20 40 Miles
2014
2013
2012


Outbreak Areas
2012-2014 Fall Cankerworm Outbreak
1
2
3
4
5*
6
7
8**
9
10*
11
12*
13
14
15
16
17
18
19
20
21
22
22
0
40
80
160
Miles
Sources: Esri, USGS, NOAA



Fall Cankerworm on Bull Run Mountains

- Small mountain chain
- More documented outbreaks of FCW than any other area in VA
- Forest dominated by chestnut, scarlet, white oak, hickory and maple
- Unclear why this site has had so much defoliation

Estimated Total Defoliated Acres in Virginia

YEAR	EST. TOTAL DEFOLIATED ACRES Fall Cankerworm	EST. TOTAL DEFOLIATED ACRES Gypsy Moth	YEAR	EST. TOTAL DEFOLIATED ACRES Fall Cankerworm	EST. TOTAL DEFOLIATED ACRES Gypsy Moth
1953	5,000	0	1984	1,500	235
1954	0	0	1985	500	5,650
1955	0	0	1986	0	27,259
1956	0	0	1987	0	67,695
1957	0	0	1988	0	160,815
1958	0	0	1989	0	215,988
1959	500	0	1990	0	593,000
1960	2,000	0	1991	12,645	616,200
1961	0	0	1992	60,000	748,100
1962	0	0	1993	120,000	589,100
1963	0	0	1994	5,000	452,475
1964	500	0	1995	1,000	849,584
1965	1,000	0	1996	0	0
1966	1,000	0	1997	1,400	0
1967	0	0	1998	450	0
1968	400	0	1999	20,170	0
1969	1,500	0	2000	0	71,171
1970	1,500	0	2001	0	440,682
1971	0	0	2002	3,364	51,845
1972	0	0	2003	8,397	79,927
1973	4,050	0	2004	1,251	0
1974	7,100	0	2005	2,332	4,362
1975	1,000	0	2006	790	14,623
1976	0	0	2007	592	73,408
1977	0	0	2008	0	112,343
1978	3,000	0	2009	0	28,835
1979	0	0	2010	550	0
1980	2,000	0	2011	1,600	0
1981	65,967	0	2012	264,569	4
1982	22,085	0	2013	250,836	1
1983	1,000	0	2014	57,031	36

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- Fall Cankerworm has been the most common recurring defoliator in VA for the last 65 years
-

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- 2010 – 2014:
  - Largest documented outbreak of FCW
  - >500,000 acres

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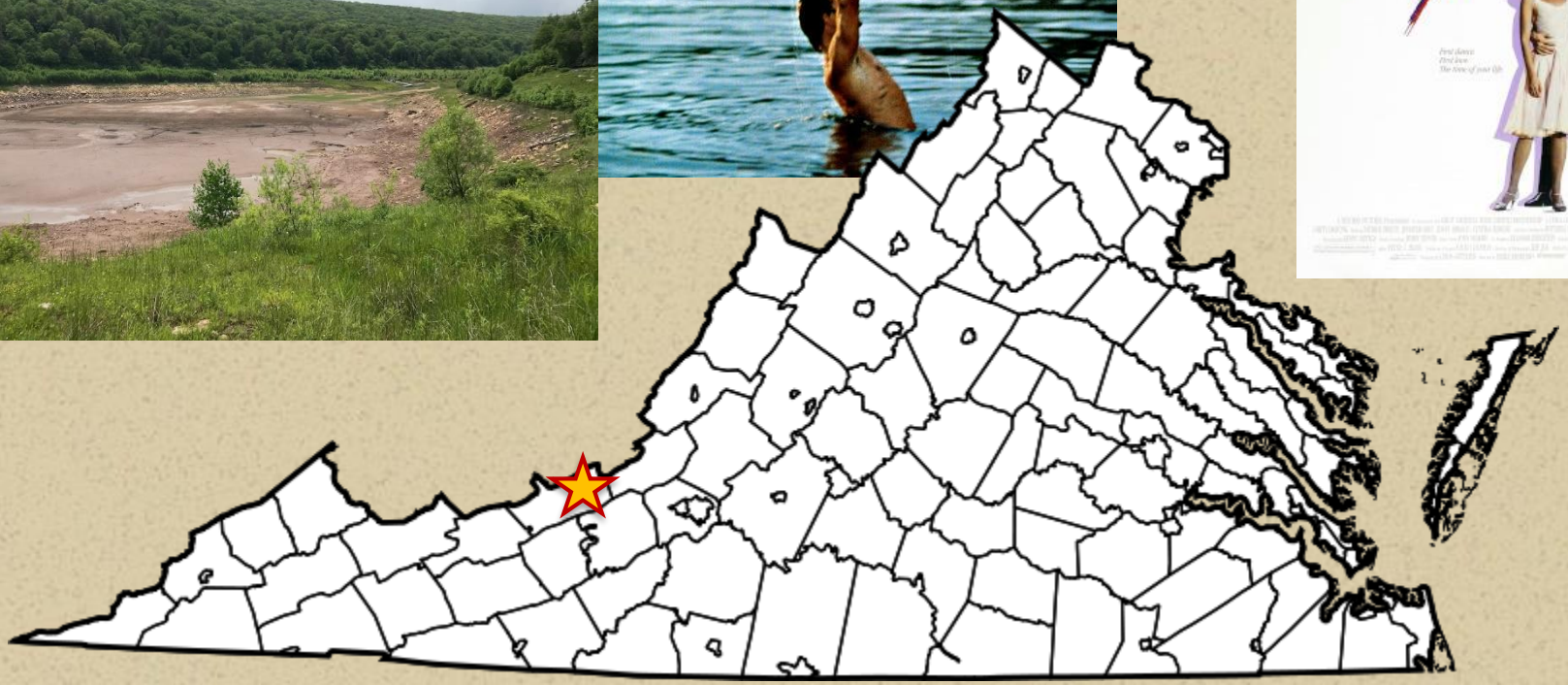
Year	Fall Cankerworm	L. dispar
2015	0	8,506
2016	0	54,139
2017	0	33,978
2018	?	23,613
2019	?	8,924
2020	?	0
2021	0	18,538

Case Study: Mountain Lake

- Small fall cankerworm outbreak 2018-2020
- VDOF didn’t receive reports until 2020
- Used different techniques to retroactively gather data
- Oak mortality observed in 2021 following crash of fall cankerworm outbreak

Case Study: Mountain Lake

Photo: Artisan Entertainment/Everett Collection

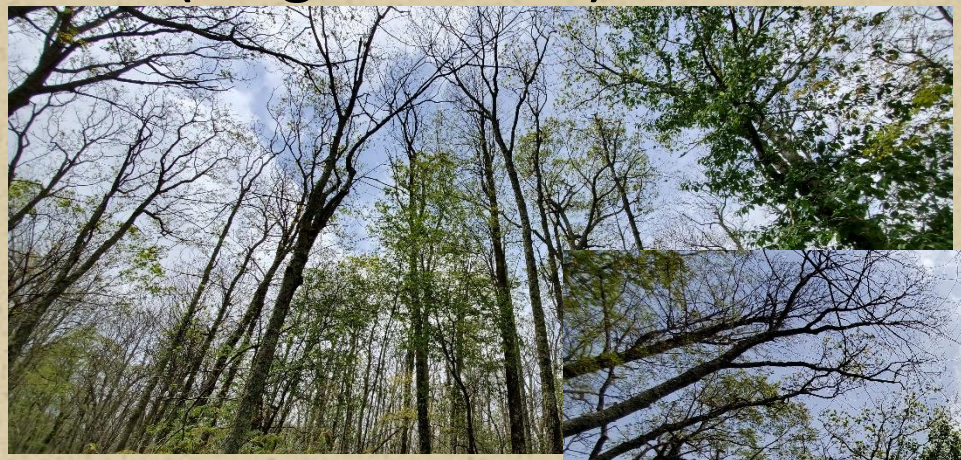


Case Study: Mountain Lake

- 2018: Photo documentation from Aaron Kamoske, USFS employee that worked at Mountain Lake in 2018

Case Study: Mountain Lake

- 2019: Aerial survey (USFS) mapped defoliation as *L.dispar*, but photo documentation by Tom McAvoy (Virginia Tech) confirms cankerworm



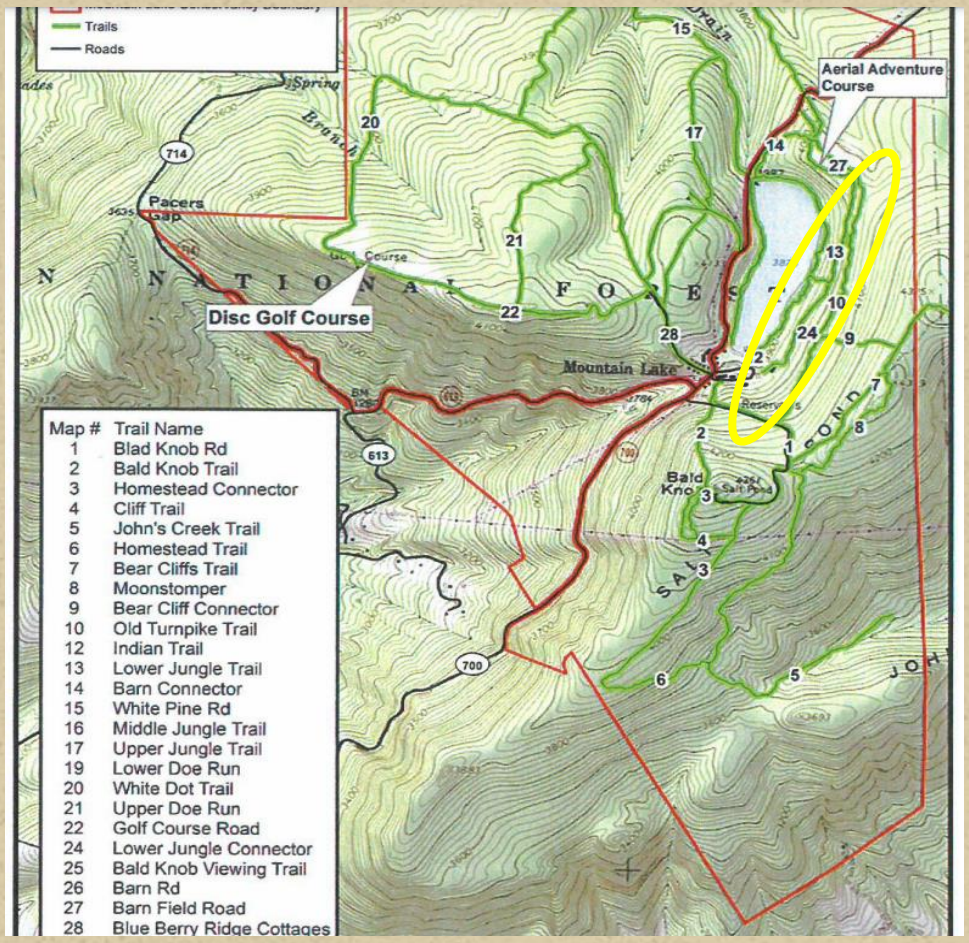
Case Study: Mountain Lake

- 2020: Ground surveys by VDOF confirm fall cankerworm (no aerial survey due to COVID-19)

Case Study: Mountain Lake

- 2021: Dead oaks documented with aerial and ground surveys

Case Study: Mountain Lake



- Walk along the Old Turnpike Trail
- Stop every 75 meters (~246 feet) and walk into woods towards the lake
- Find location approx equidistant from Old Turnpike and Lower Jungle trails
- Measure 10th acre plot (radius = 37.2 ft)
- Within each plot take gps point, measure basal area, and collect the following data for all trees greater than 4 inches:
  - Species
  - DBH
  - Status: Healthy/Declining/Mortality
  - Note any evidence of defoliation, cankers/conks, hypoxylon or armilllaria

Case Study: Mountain Lake

Species	# Trees	Avg DBH	% Healthy	% Declining	% Dead	% Dead/Declining
ROPS	1	7.1	0.0%	0.0%	100.0%	100.0%
QURU	63	15.0	14.3%	22.2%	63.5%	85.7%
QUAL	5	15.5	20.0%	60.0%	20.0%	80.0%
TSCA	102	7.7	20.6%	78.4%	1.0%	79.4%
ACPE	3	4.7	66.7%	33.3%	0.0%	33.3%
BELE	15	11.5	80.0%	6.7%	13.3%	20.0%
ACRU	34	10.5	82.4%	17.6%	0.0%	17.6%
ACSA	2	7.2	100.0%	0.0%	0.0%	0.0%
AMAR	1	4.2	100.0%	0.0%	0.0%	0.0%
BENI	3	7.0	100.0%	0.0%	0.0%	0.0%
HAVI	1	5.3	100.0%	0.0%	0.0%	0.0%
MAAC	2	11.8	100.0%	0.0%	0.0%	0.0%
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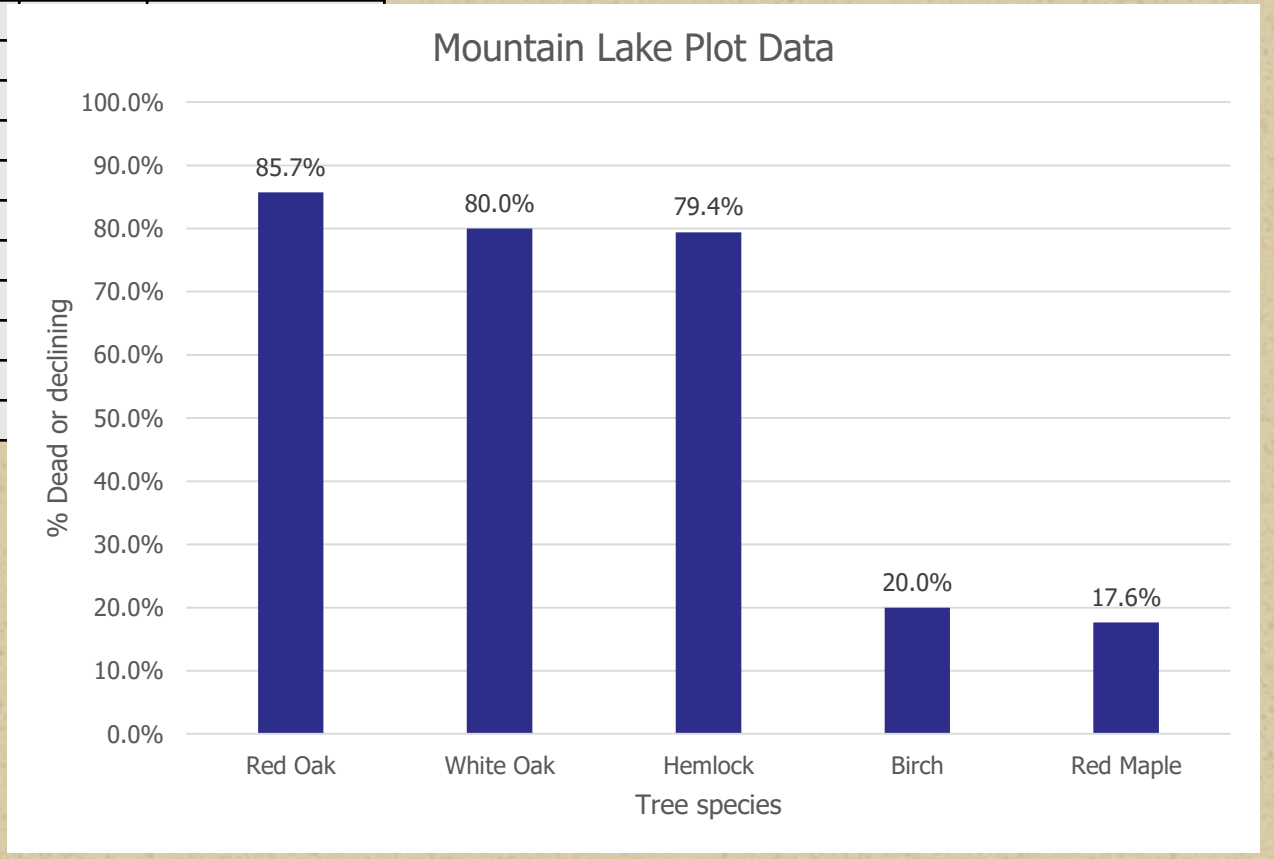

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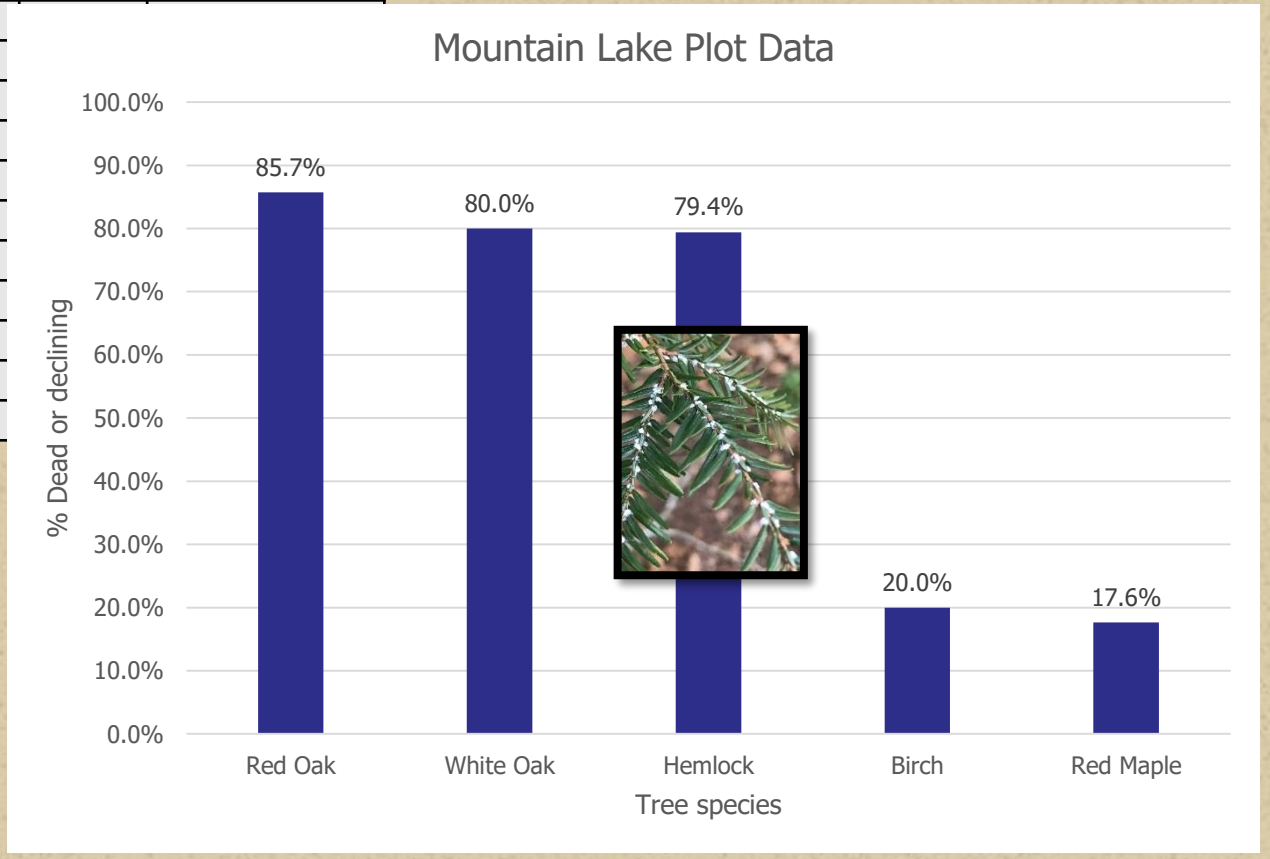

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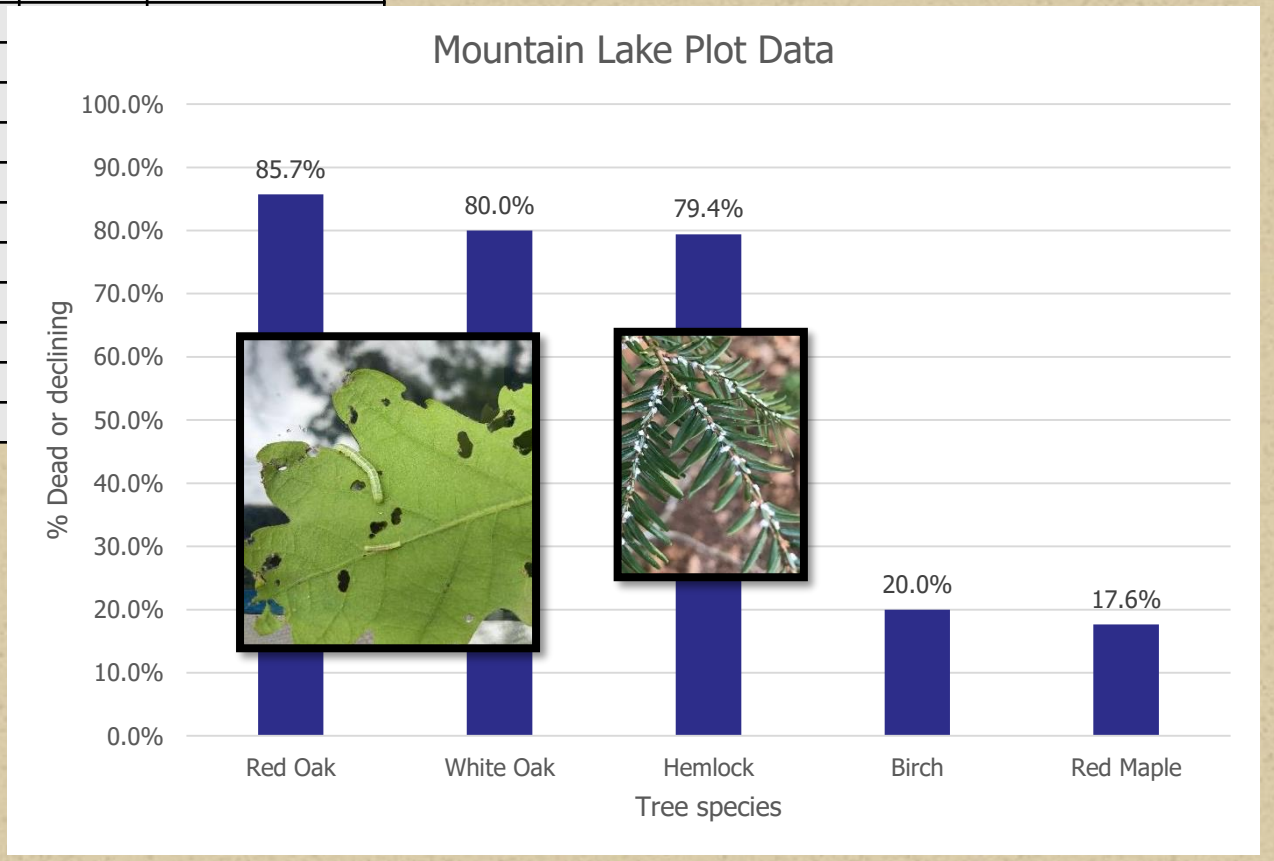
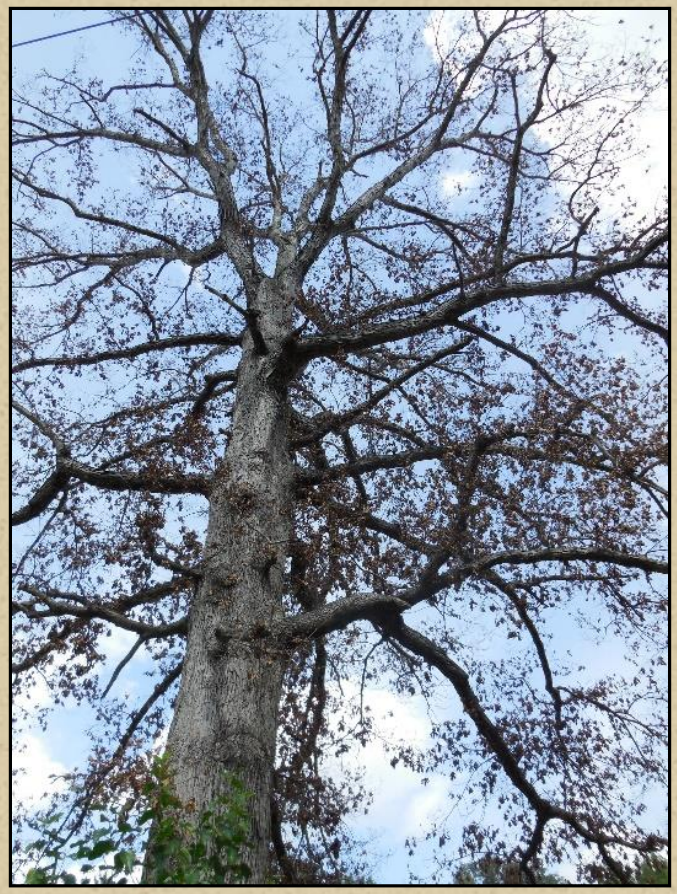


Oak Decline

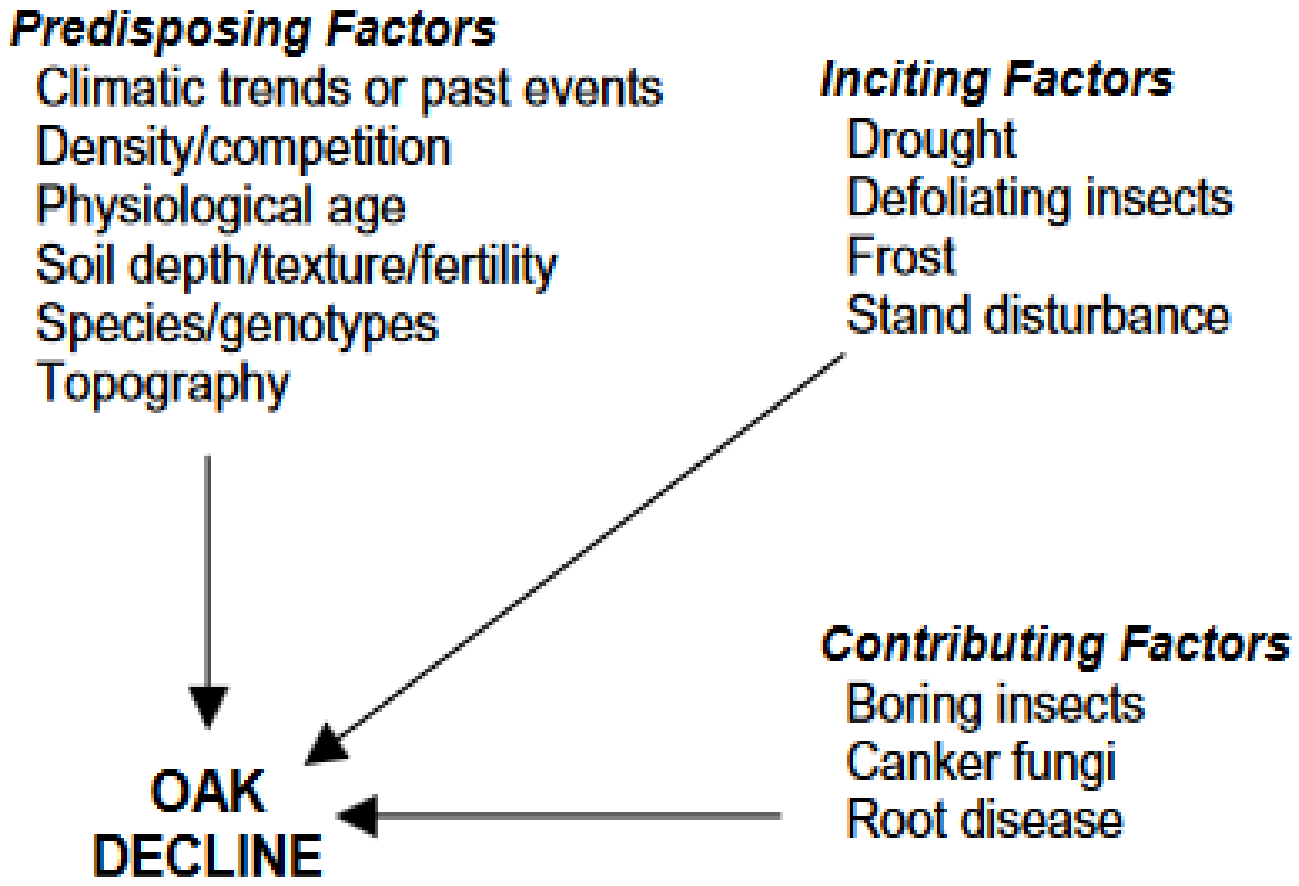
Oak Decline

- Symptoms
  - Crown dieback progressing from top down and outside inward
  - Premature autumn leaf color
  - Foliage browning but remaining on tree
  - Tree mortality after a few years or decades



Oak Decline

- The **gradual** failure in the health of a tree that results from the **interaction** between three groups of stress factors: predisposing, inciting, and contributing



Causal factors of oak decline organized by their function in the decline syndrome.

From: Starkey et al. 2004.

Oak Decline

- **Predisposing Factors**: weaken tree over time
  - Poor soil
  - Topography
  - Competition
  - Advanced age
  - Urban environment

Photo credit: Eric Wiseman, Virginia Tech

Oak Decline

- **Inciting Factors**: rarely kill the tree outright but initiate decline
  - Defoliating insects
  - Drought events
  - Frost

Oak Decline

- **Contributing Factors**: secondary pests that ultimately lead to tree death
  - Boring insects
  - Root diseases

Decline Disease Spiral

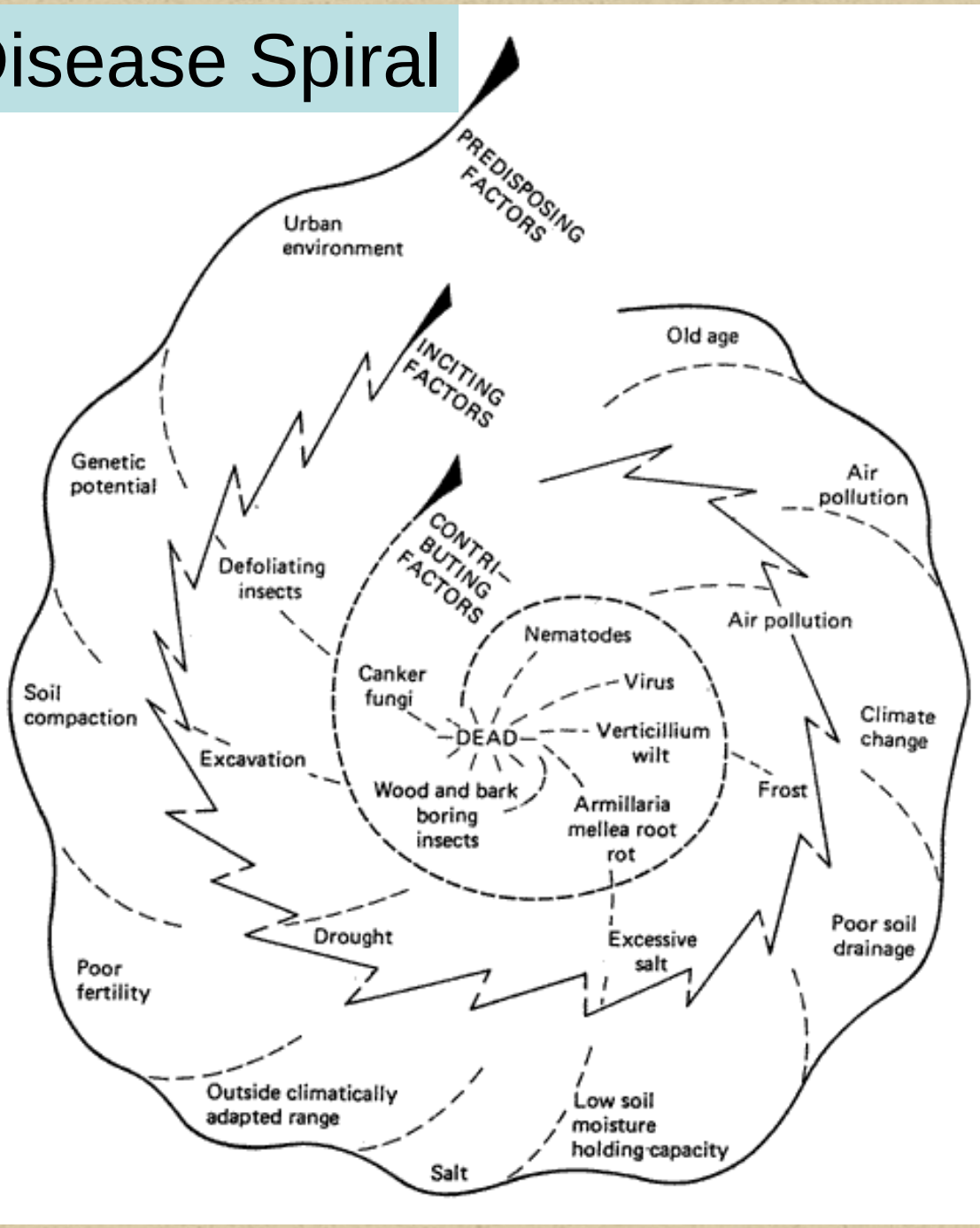
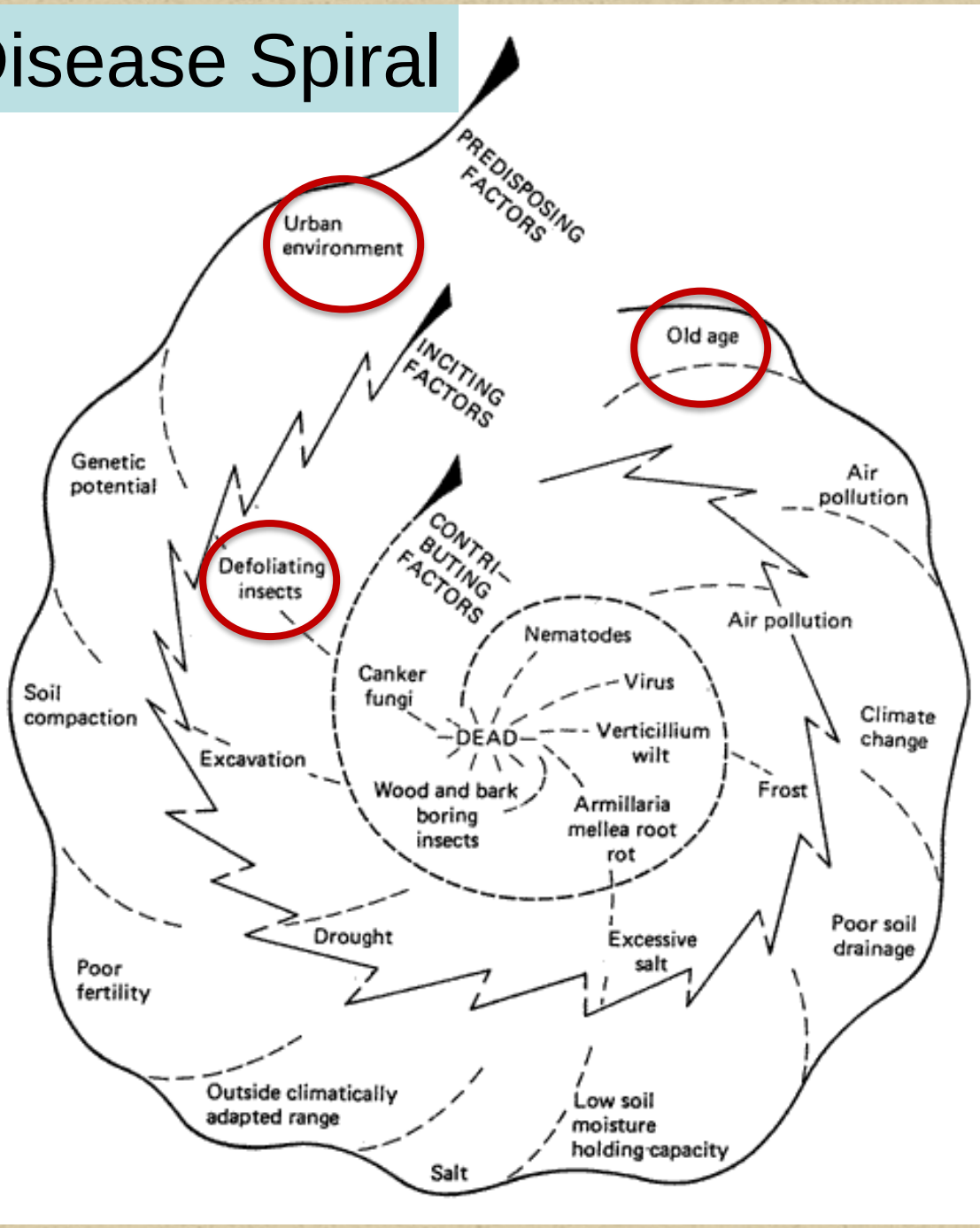


Fig. 1. Decline disease spiral (Reprinted with permission from Tree Disease Concepts by Paul D. Manion c 1991, Prentice-Hall, Inc., Englewood Cliffs, NJ).

Decline Disease Spiral



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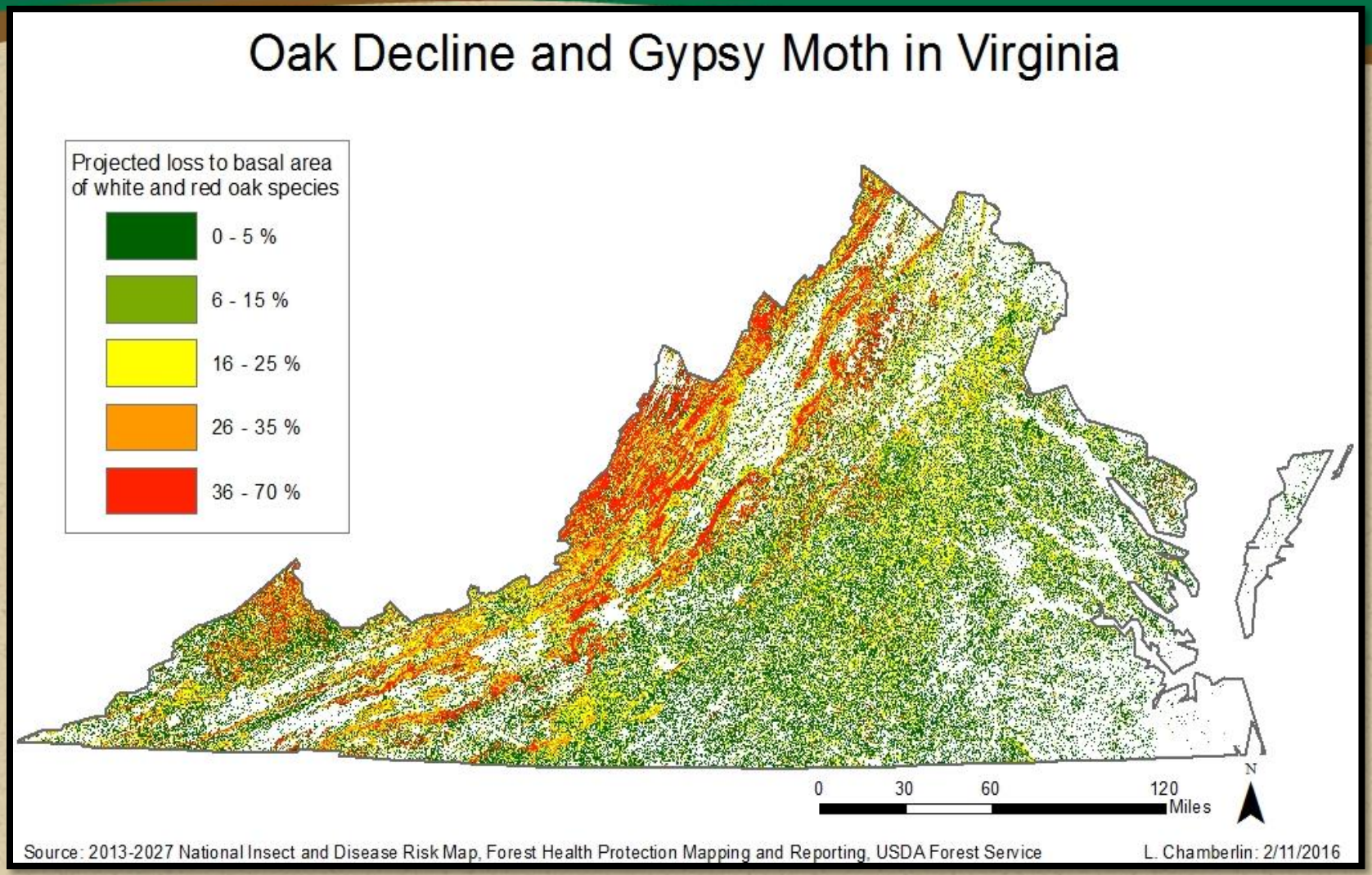
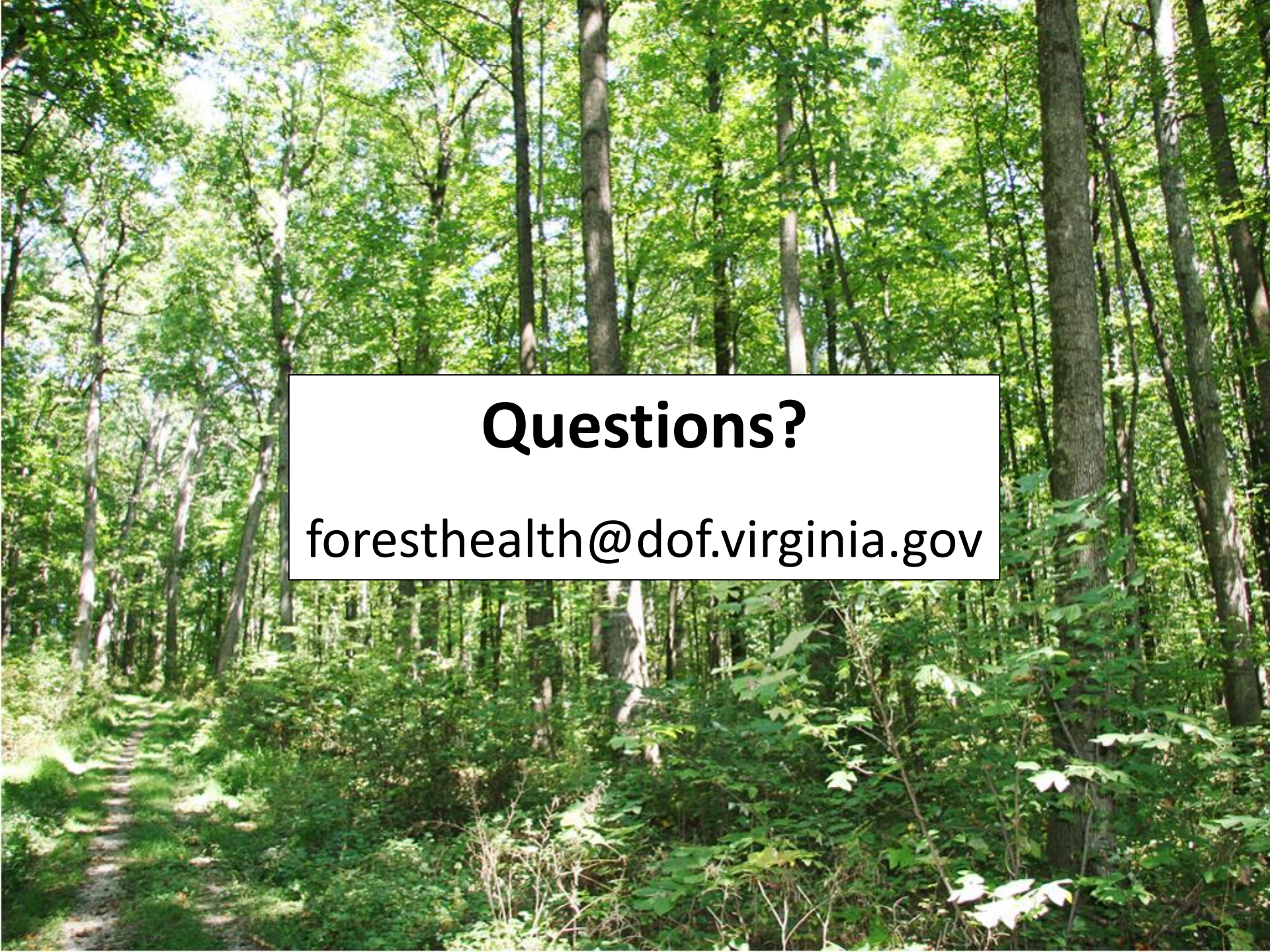
Oak Decline


Oak Decline and Gypsy Moth in Virginia
Projected loss to basal area of white and red oak species
0 - 5 %
6 - 15 %
16 - 25 %
26 - 35 %
36 - 70 %
0
30
60
120
Miles
N
Source: 2013-2027 National Insect and Disease Risk Map, Forest Health Protection Mapping and Reporting, USDA Forest Service
L. Chamberlin: 2/11/2016

Summary

- Fall Cankerworm is a significant native pest with periodic outbreaks
- Fall Cankerworm has been the most common recurring defoliator in VA for the last 65 years
- Multiple consecutive years of defoliation can lead to tree mortality, especially if oak trees are already declining


Questions?
foresthealth@dof.virginia.gov