

Park Hemlock – HWA Program

Delaware Water Gap NRA – PA & NJ
National Park Service
U.S. Department of the Interior



17 years of Integrated Research, Monitoring, and Management of HWA and Hemlock Ecosystems

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Ecologist

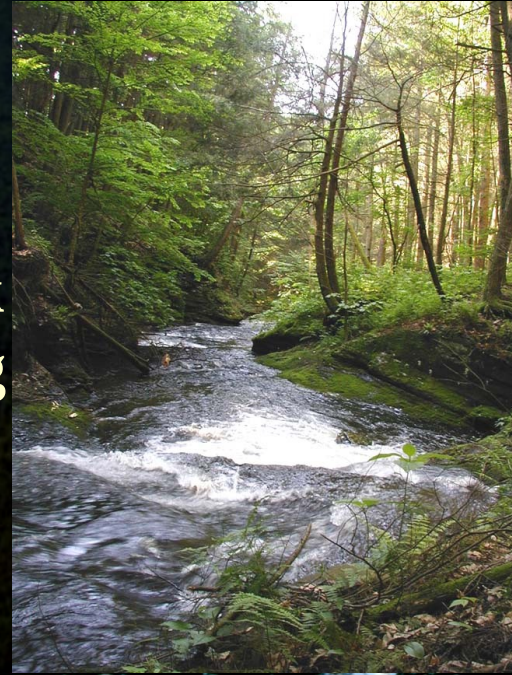
Delaware Water Gap National Recreation Area

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- 28,000 hectare park
- 2,200 hectares hemlock forest ~ “Outstanding Natural Features”
- HWA detected 1989
- Program started 1993



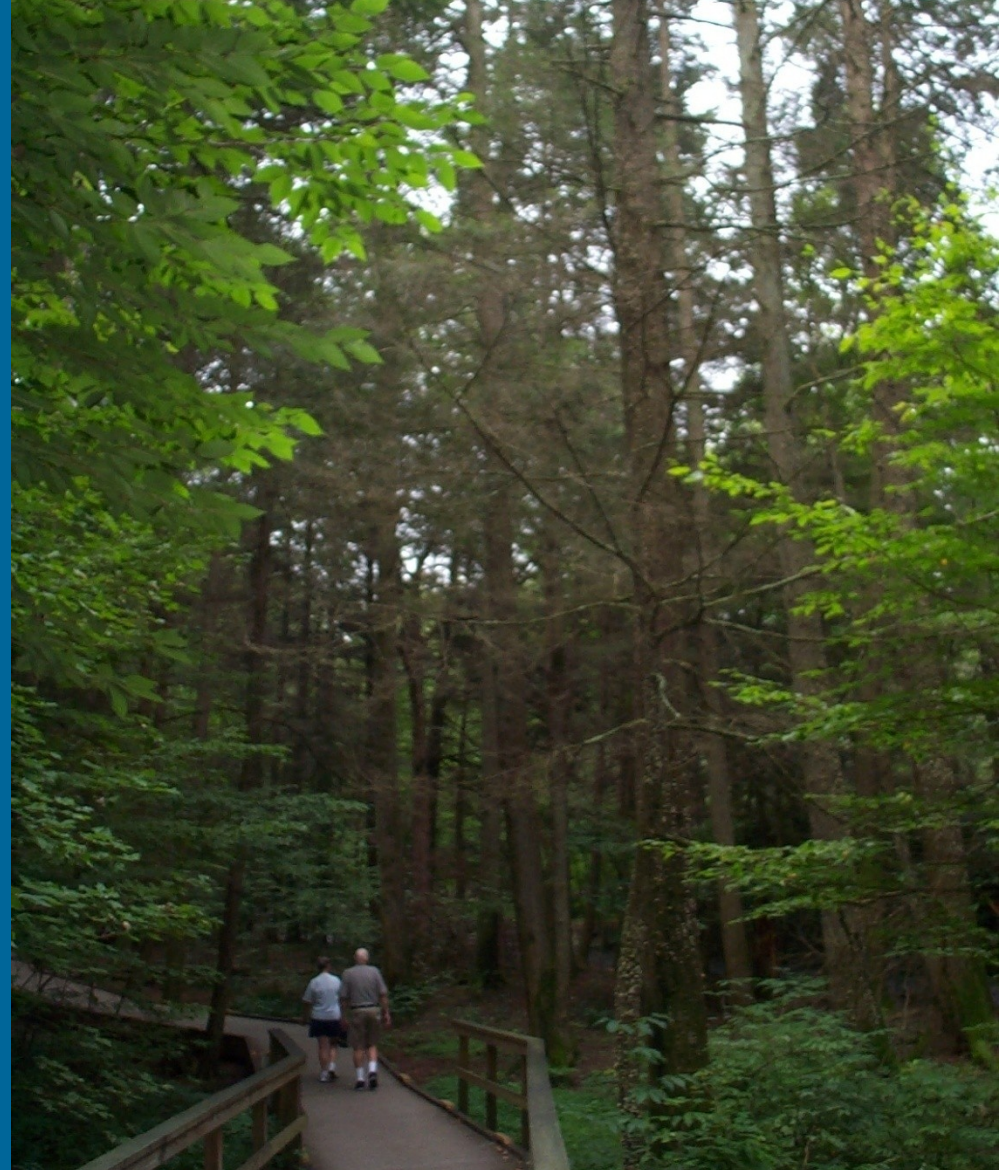
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Management Concerns

- hazardous trees
- esthetics
- recreation
- native biodiversity
- ecosystem functions
- fire



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Annual Monitoring

- track HWA infestations & hemlock tree health

Ecological Research: intensive & extensive

- ✓ document hemlock ecosystems & biodiversity
- document ecosystem & biodiversity changes

Management

- maintain, mitigate, & restore hemlock forests

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Program Summary

YEAR

PROGRAM ACTIVITY	'93	'94	'95	'96	'97	'98	'99	'00	'01	'02	'03	'04	'05	'06	'07
14. Res. Breeding Birds, Hem. vs Hardwood															
15. Res. Amphibians, Hemlock vs Hardwood															
16. Res. Vegetation in 10 Hemlock Stands															
17. Research Dendrochronology															
18. Research Imidacloprid Efficacy															
19. Release biocontrol: Japanese lady beetles															
20. Release biocontrol: Chinese lady beetles															
21. Release biocontrol: N. American beetles															
22. Cut Hazardous Trees															
23. Apply Systemic Insecticides															
24. Suppress Invasive Plants															
25. Install Deer Fences															

Nature Precedings : doi:10.1038/npre.2011.5520.1 : Posted 7 Jan 2011



Annual Monitoring

- **Tree crown conditions (1993 on...)**
- **HWA infestation levels (1995 – 2008)**
- **Branch new growth (1995 – 2008)**

- **81 permanent plots, 10 hemlock trees/plot**
- **7 hemlock stands,**
 - 2 stands for Intensive Ecological Studies: 36 & 24 plots**

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**Measure: Percent of previous years shoots
that (a) have HWA, (b) produced new growth**

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Extensive Ecological Research

- Compare hemlock vs. hardwood forests
- USGS-BRD, 1997
- 3 Types: benches, ravines, mid-slopes
- Pair with hardwood stands
- 14 hemlock/hardwood pairs
- study stream fish, macroinvertebrates...

2010, start monitoring 14 hemlock stands:

- HWA infestation levels
- Branch new growth
- Tree crown conditions



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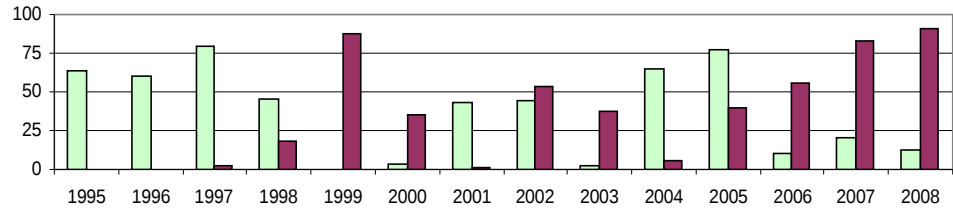
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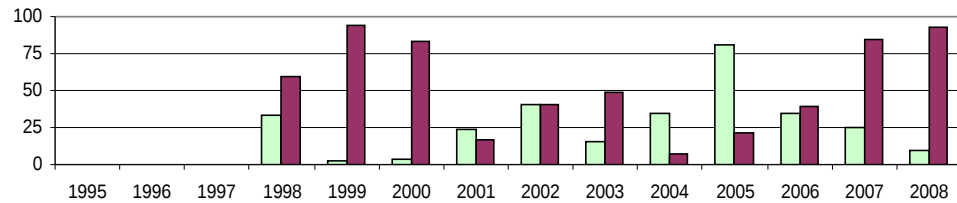
Monitoring Results

HWA *Infestations* *& Branch* *Growth* *1995 – 2008*

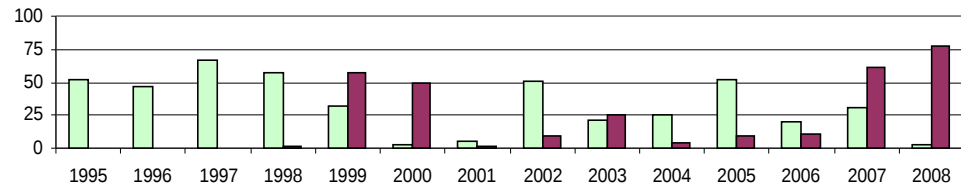
biological controls
not effective (yet)



Donkeys Corner

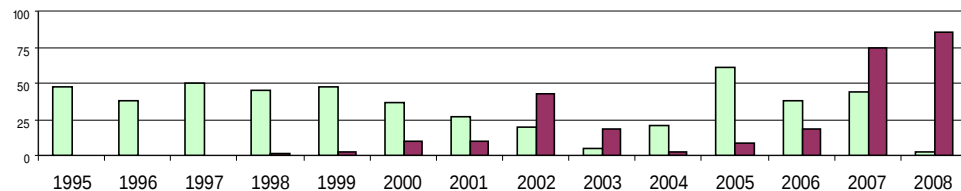


VanCampens



Adams Creek

□ New Growth ■ HWA

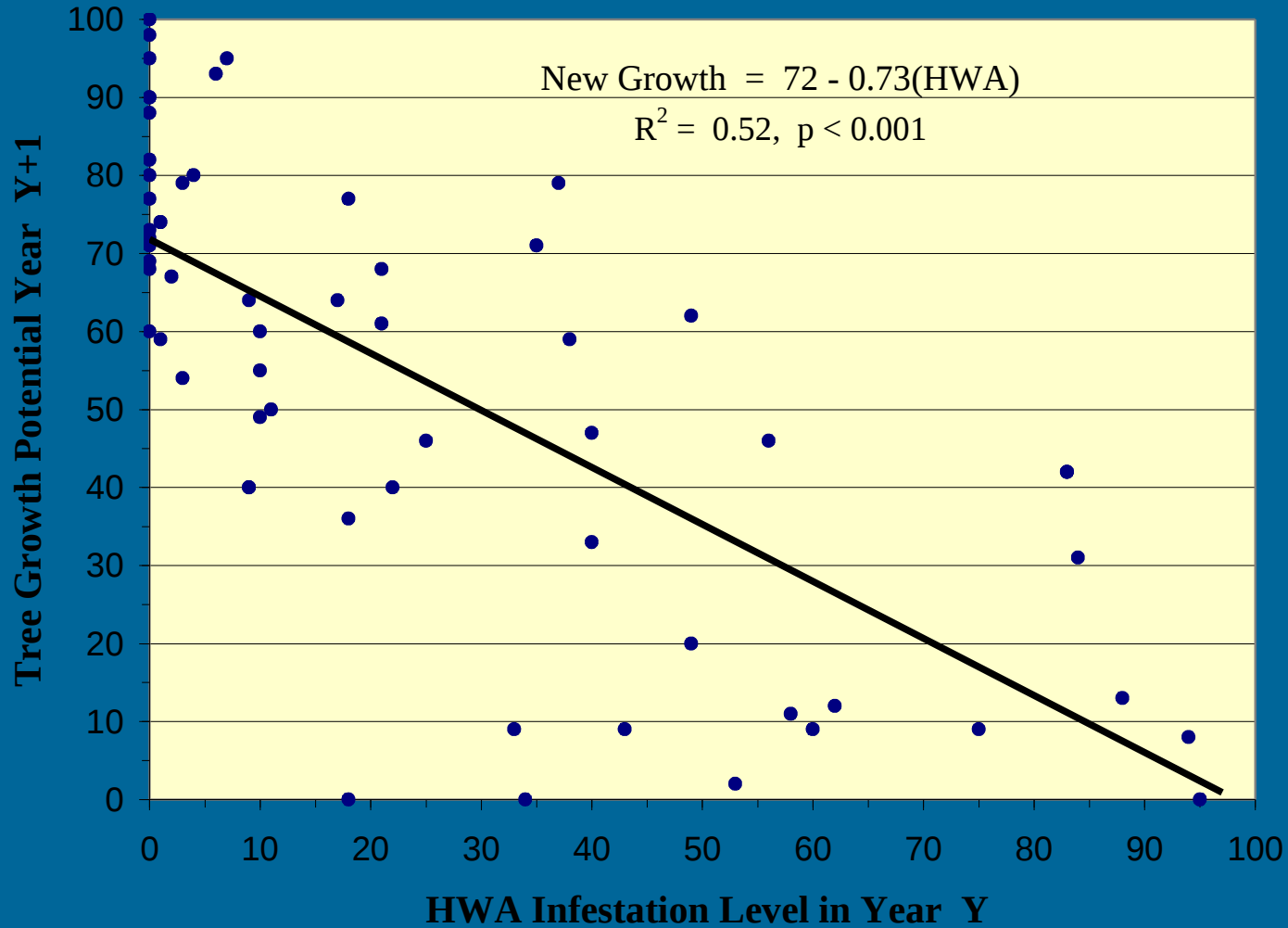


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Effect of HWA on New Growth



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2010 HWA Infestations & Branch Growth at 14 Hemlock Stands



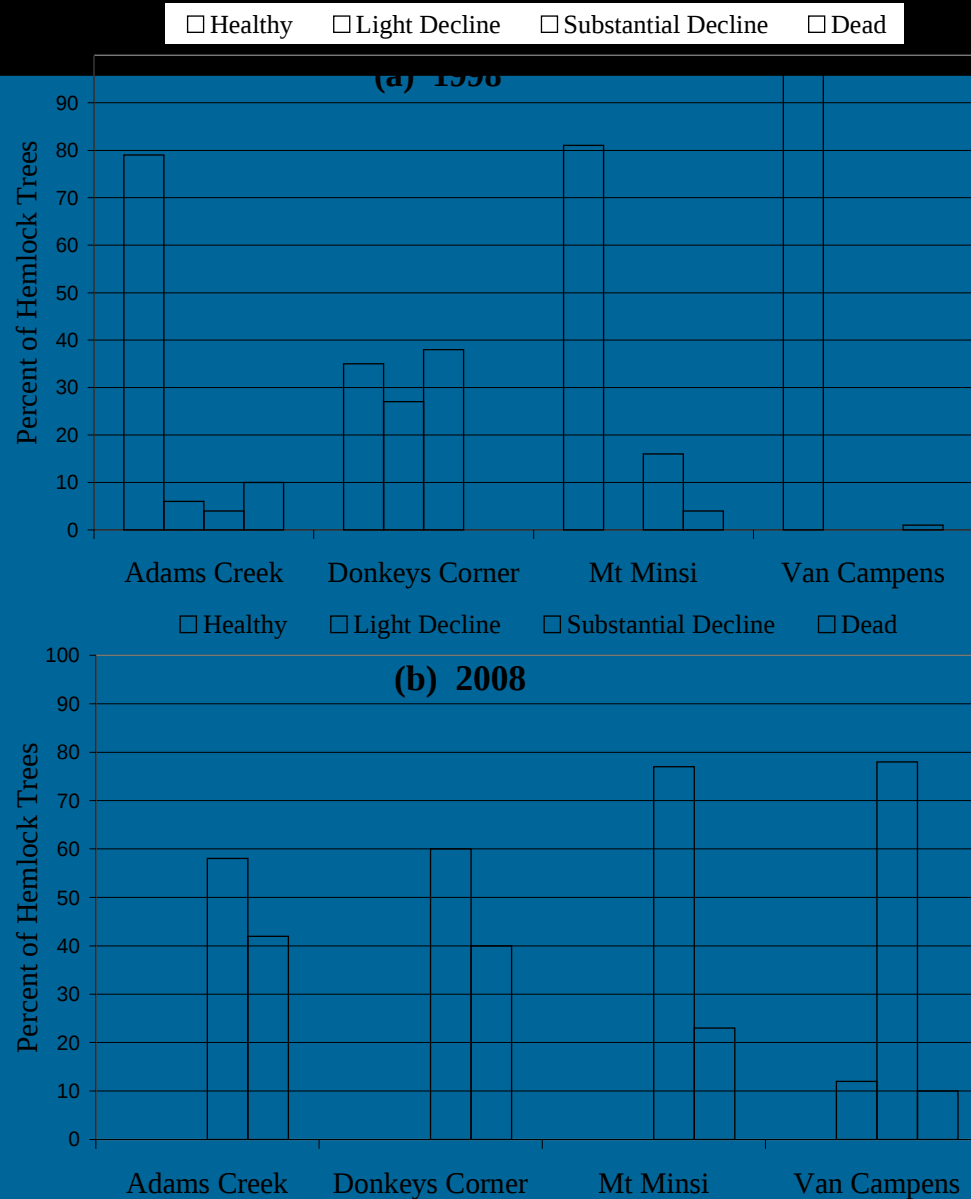
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Tree Condition Monitoring Results

1998 cf. 2008

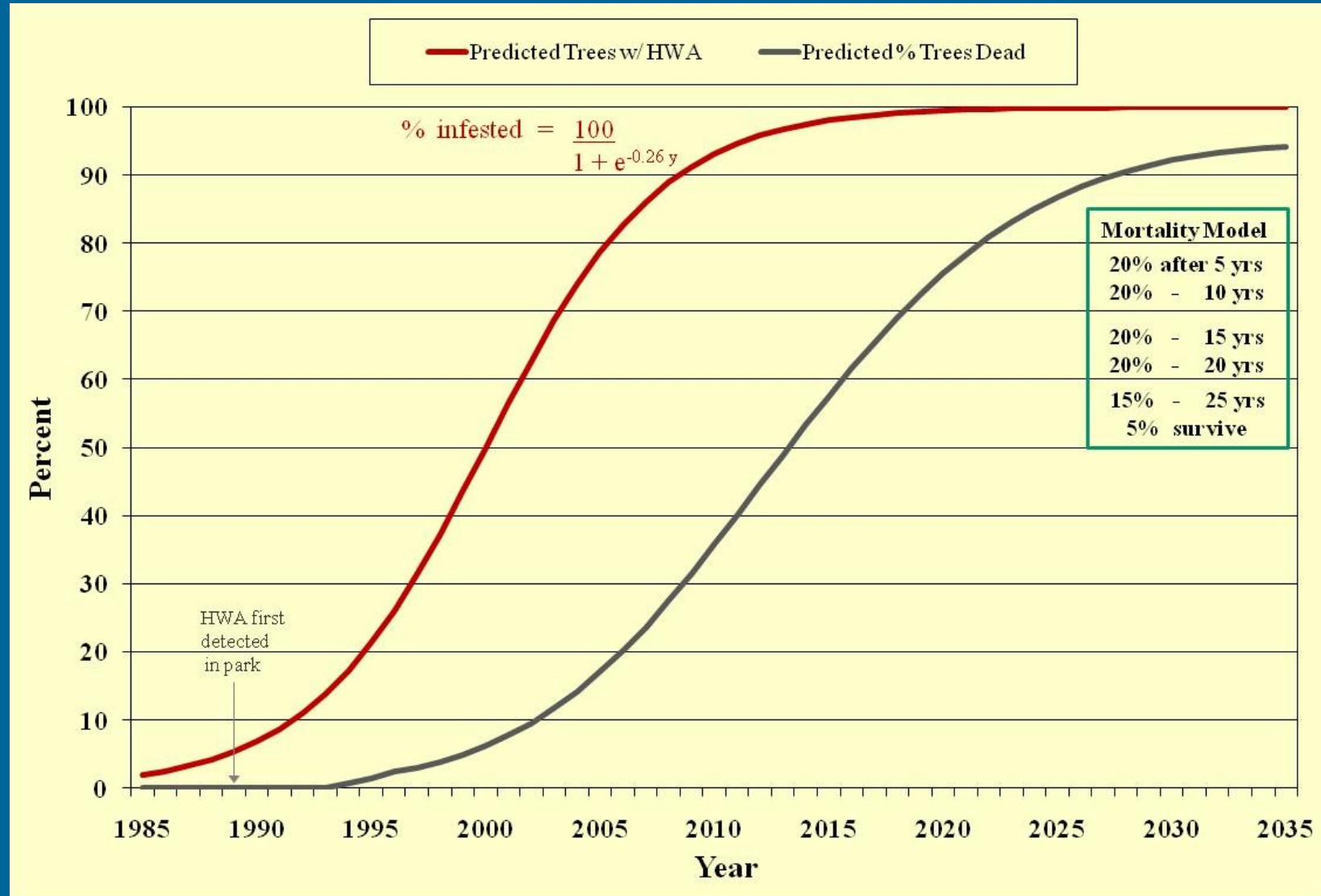


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HWA infestation & hemlock mortality: Logistic Model

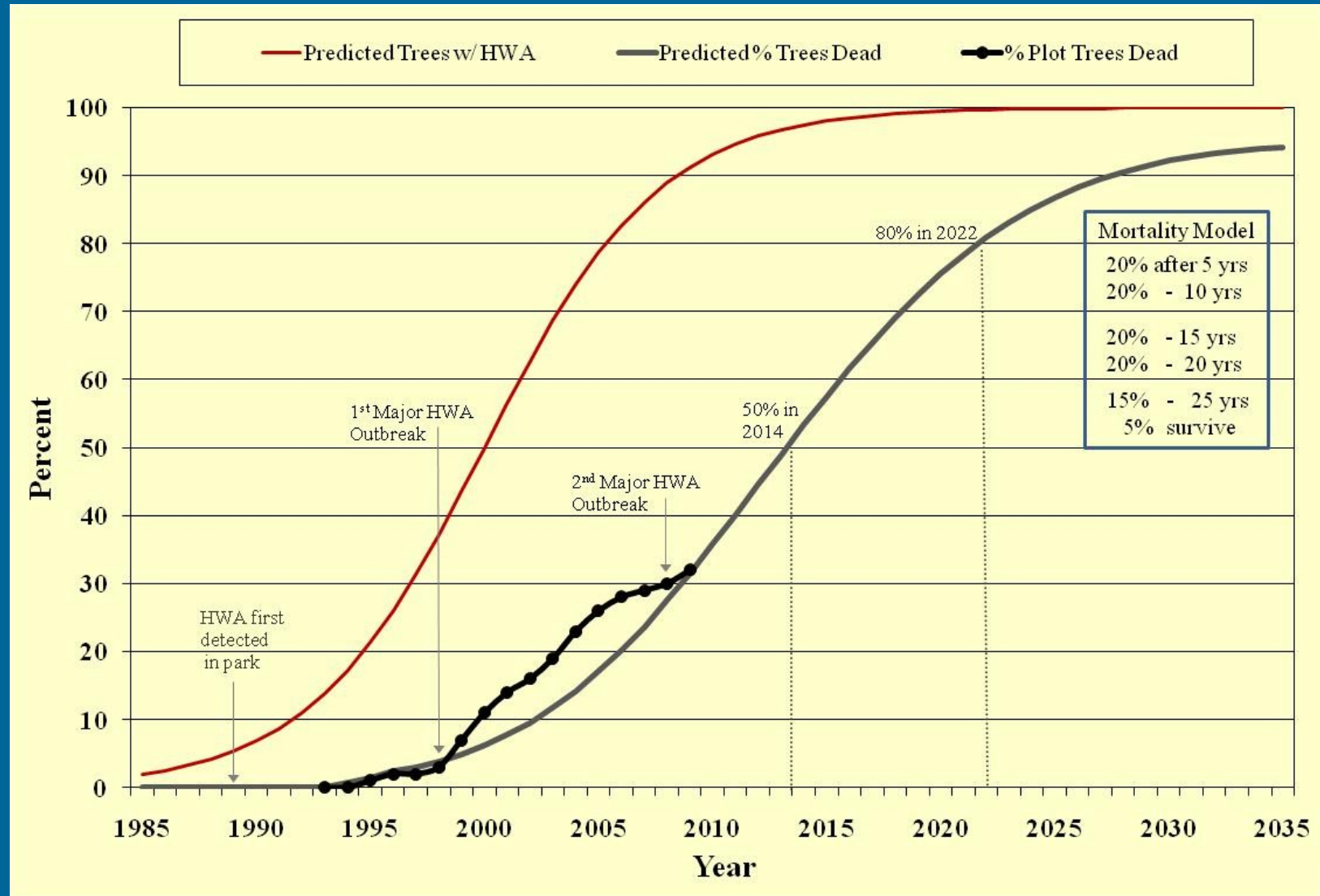


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Hemlock Mortality: Data *cf.* Logistic Model

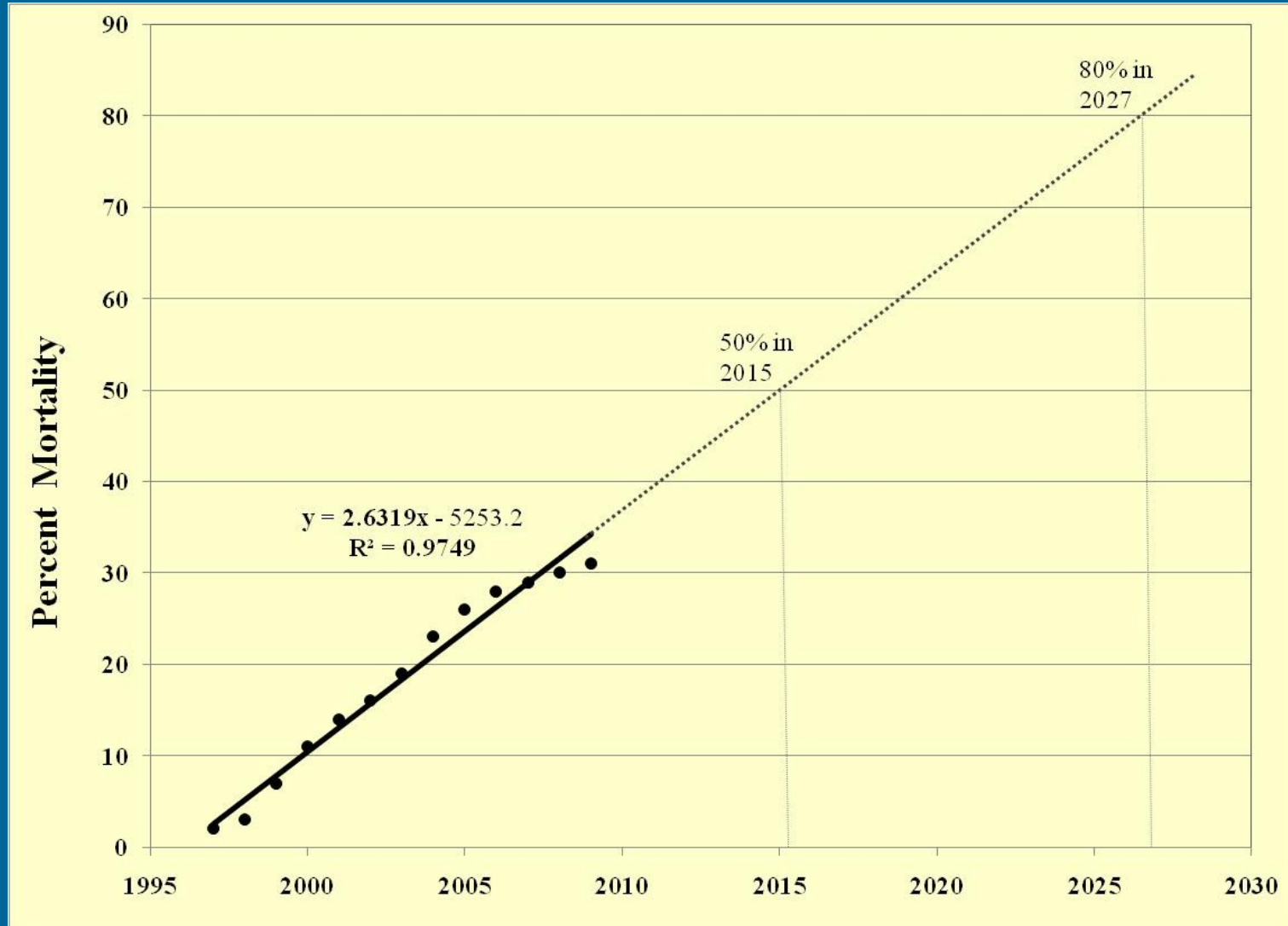


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Predicting Hemlock Mortality: Linear Regression



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Systemic Insecticide Treatments

- **One tree at a time!**
10,000 + trees to date



Soil Tablets



Soil Injections



Tree Injections

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HWA Biocontrol Releases

**Japanese
lady beetles**

75,700

14 sites

2000-2004



**Chinese
lady beetles**

4,500

2 sites

2006-2007



**North American
beetles**

5,800

4 sites

2006-2009



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Invasive Plant Suppression (500 acres +/-)

- “Tree-from-hell”
- Japanese barberry
- Garlic mustard
- Multiflora rose



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October 2002

Cutting Trees



May 2006

Planting Trees



November 2009

Repairing Deer Fences



November 2009

