



Potential Impacts of Emerald Ash Borer Outbreak on Virginia's Municipal Street Trees

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Presentation Overview

- Urban forests of U.S. and VA
- EAB impacts on urban forests
- Research methods
- Research results to date
- Research implications and future work
- Q & A



Urban Forests of U.S. and VA

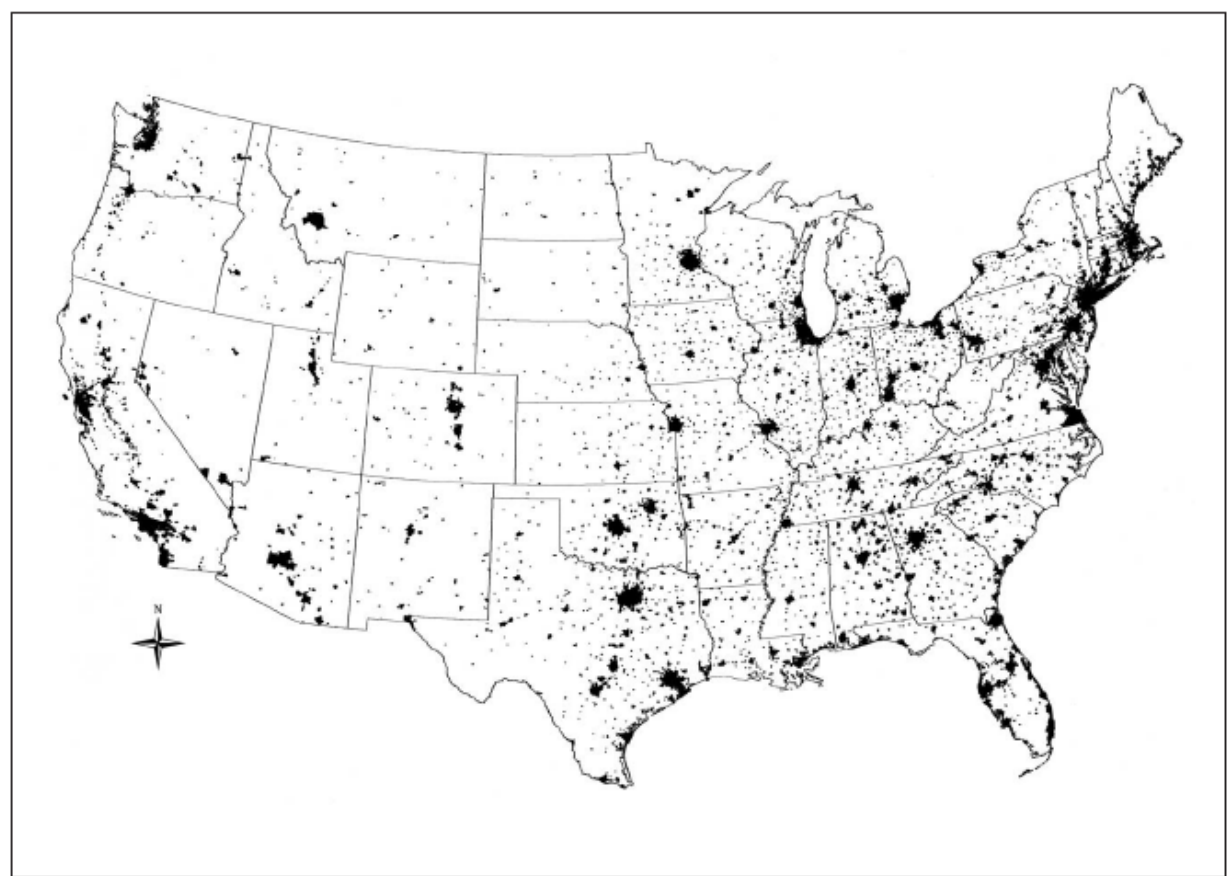


Figure 1. Urban areas in the conterminous United States. Source: Dwyer et al. 2000.

- 3.5% of total U.S. land area (109,000 sq. miles)
- 75% of total U.S. population (225 million people)

Urban Forests of U.S. and VA

State	Urban trees (thousands)	Urban trees per capita	Urban tree cover	Proportion of state tree cover	Urban area ^a (km ²)	Urban proportion of state
Georgia	232,906	49	55.3%	4.7%	8,338	5.4%
Alabama	205,847	69	48.2	4.7	8,487	6.3
Ohio	191,113	22	38.3	7.0	9,923	8.5
Florida	169,587	13	18.4	5.5	18,407	10.8
Tennessee	163,783	49	43.9	5.1	7,382	6.8
Virginia	156,545	27	35.3	4.9	8,869	8.0
Illinois	155,544	14	33.7	5.5	9,165	6.1
California	148,612	5	10.9	2.2	27,348	6.4
New Jersey	143,869	20	41.4	22.3	6,916	30.6
Texas	140,709	8	10.5	3.6	26,573	3.8
Wyoming	1,392	3	3.6	.1	797	.3
US total ^b	3,820,491	17	27.1	2.8	281,000 ^c	3.5

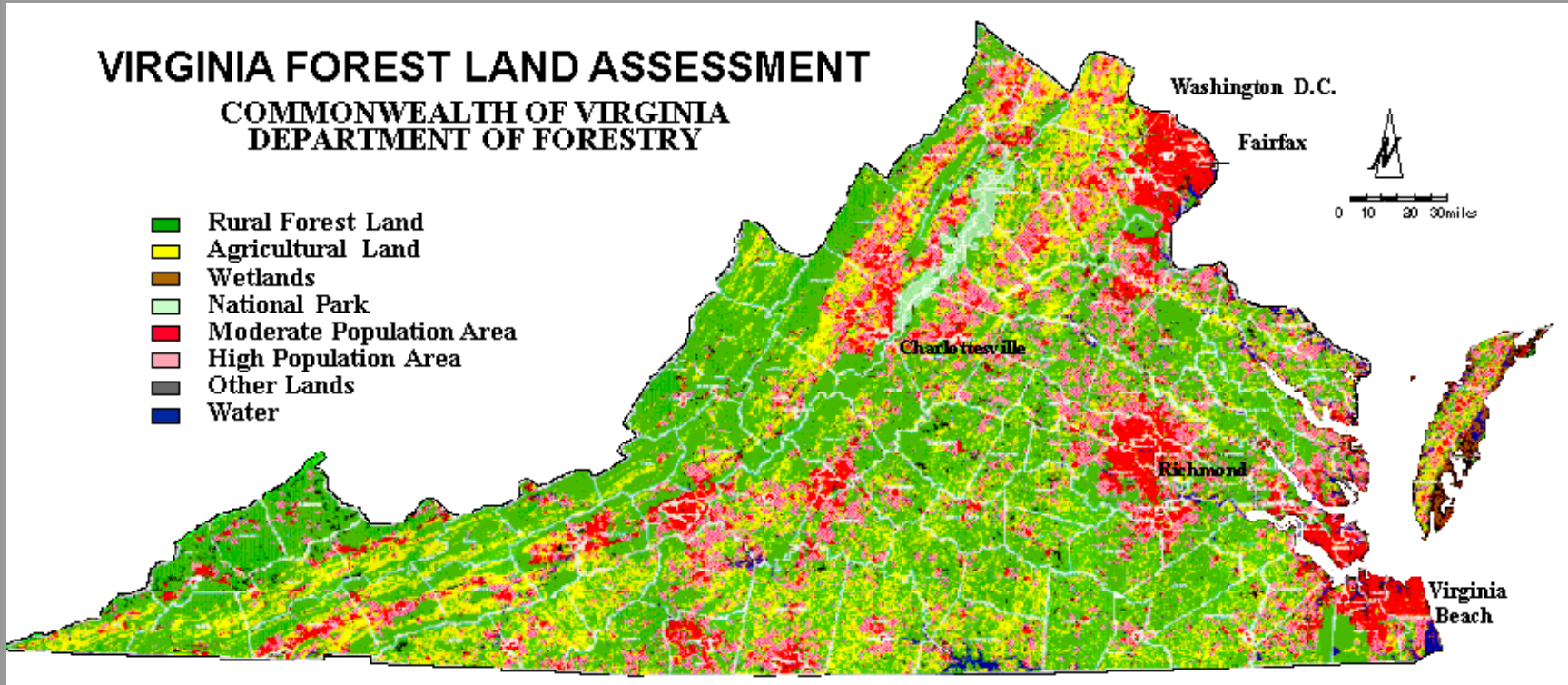
^aIncludes land and water.

^bUS total includes the District of Columbia but not Alaska and Hawaii.

^cIncludes 492 square kilometers that crossed state borders and could not be assigned to an individual state.

- 3.8 billion urban trees in U.S.
- Avg. 2.8% of state tree cover
 - Avg. 14% (NJ, MA, CT, MD, DE)
- 60 million plus street trees in U.S. (Kielbaso 1990)

Urban Forests of U.S. and VA



R. Liu, VA Dept. of Forestry, 1995

- Urban area: 8% (3,424 sq. miles)
- Urban trees: 157 million
- 4.9% of state tree cover
- Street trees: 2.35 million



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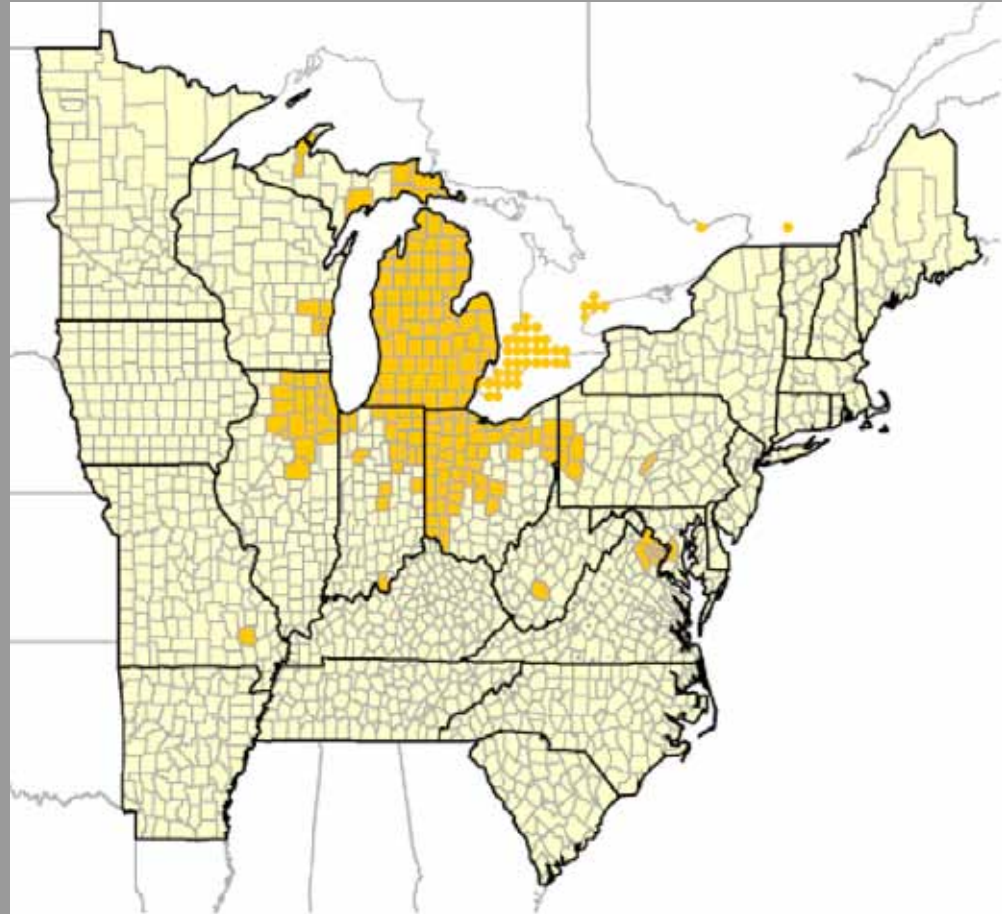
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EAB Impacts on Urban Forests

- 10 U.S. states
- 2 CAN provinces
- 53 M native ash trees killed by 2007¹
- +38 M trees in urban areas of 25 states impacted by 2019¹
- Cost to manage urban ash: \$9.8 B¹



¹Kovacs et al. 2010. *Ecological Economics* 69:569-578.



EAB Impacts on Urban Forests

- Many ash trees in urban areas of Mid-West
- Ash are common street trees
 - Adaptive
 - Fast-growing
 - Attractive
 - Cheap
- SD: 36% of street trees²
- OH: 4.3 M urban ash trees³



²Ball et al. 2007. *Arboriculture & Urban Forestry* 33(5):350-359.

³Sydnor et al. 2007. *Arboriculture & Urban Forestry* 33(1):48-54.



EAB Impacts on Urban Forests

How many ash trees in VA urban areas?*

- Ash density:
1.62-22.01 trees/ha
- Ash abundance:
0.51-6.97 M trees

Developed land, canopy cover, and ash (*Fraxinus* sp.) density for selected cities and regions in the eastern United States.

Areas	Developed land (ha)	Canopy cover (ha)	Ash trees per ha developed land	Ash trees per ha canopy cover
Cities				
Atlanta, GA	24,846	8418	1.57	4.62
Baltimore, MD	18,593	1219	16.03	244.44
Boston, MA	11,357	663	2.35	40.18
Chicago, IL	57,162	1338	6.77	289.37
Indianapolis, IN	72,360	8417	2.05	17.65
Livonia, MI	8859	981	2.61	23.58
Milwaukee, WI	23,142	822	4.08	114.92
Minneapolis, MN	13,733	1243	14.58	161.06
Morgantown, WV	1745	309	22.01	124.22
Palatine, IL	3300	303	7.94	86.47
Philadelphia, PA	29,854	1310	4.36	99.27
Syracuse, NY	5912	467	1.13	14.24
Troy, MI	8273	940	7.03	61.83
Urbana, IL	2477	145	3.40	58.13
Washington, DC	13,362	9797	2.40	3.27
Wilmington, DE	2522	99	1.62	41.20
Mean	18,594	2279	6.25	86.53
Regions				
MI, OH, IN ^a	919,470	85,139	6.60	71.28
MI ^b	339,773	35,118	11.06	107.04
OH ^c	673,000	59,900	6.41	72.03

EAB Impacts on Urban Forests

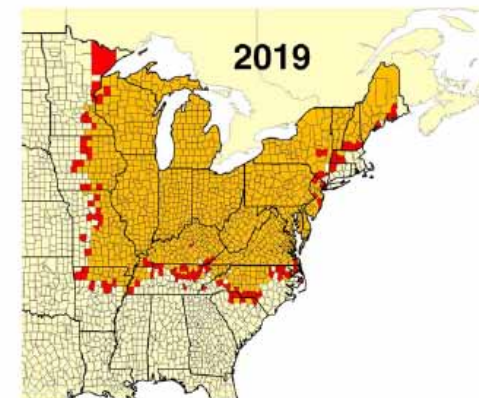
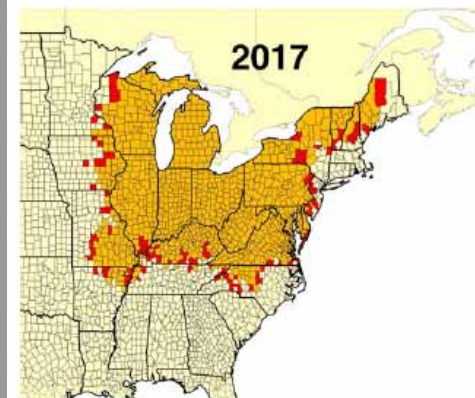
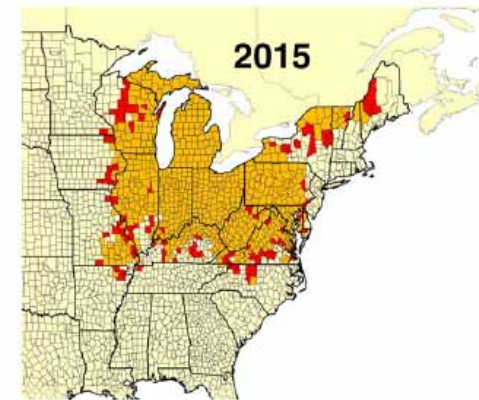
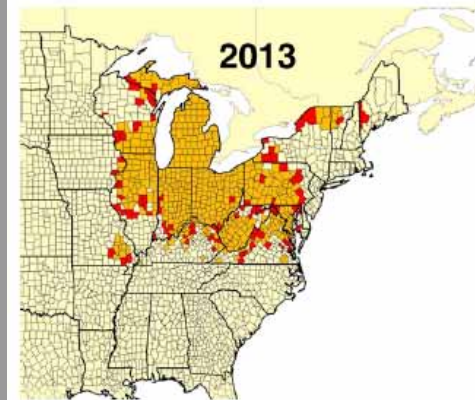
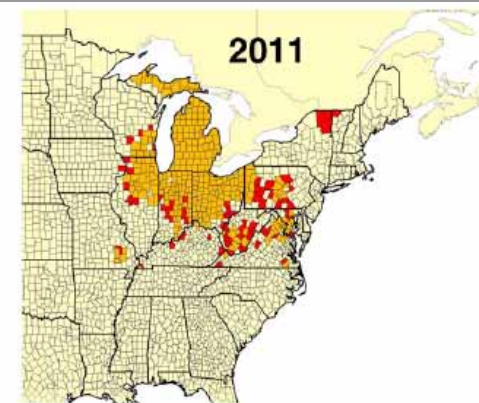
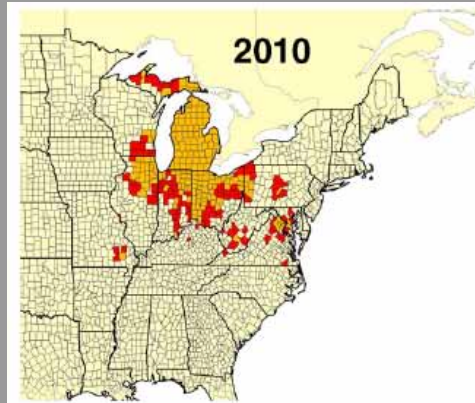
How many ash trees in VA urban areas?*

- Ash density:
1.62-22.01 trees/ha
- Ash abundance:
0.51-6.97 M trees

How quickly will it spread through VA?

What will be the impact on VA urban areas?*

- 1 M treated/removed
- \$641 M





Unanswered Questions

How abundant are native ash species as street trees in Virginia?

How many street trees do Virginia localities stand to lose from EAB outbreak?

What will be the impact of native ash losses on ecosystem services provided by street trees?

How much will it cost Virginia localities to remove and replace these trees?

How can Virginia localities use this information to prepare for EAB outbreak?



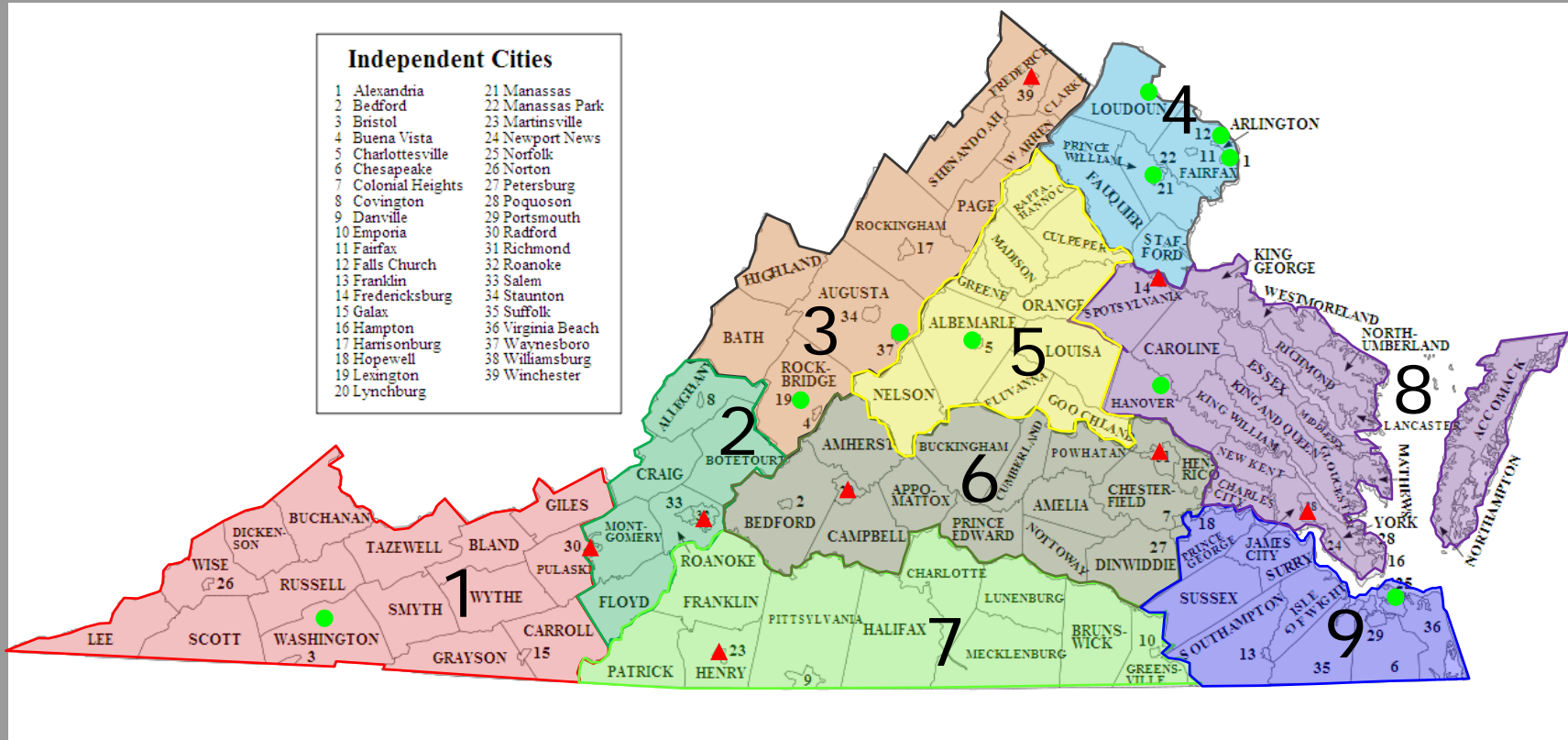
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Research Methods



132 Major Localities Queried

Tree City USA	(44)
Independent City (Not TCU)	(16)
County Seat (Not TCU)	(72)

Data Compiled To Date

Existing Inventory ●	(10)
Sample Inventory ▲	(8)

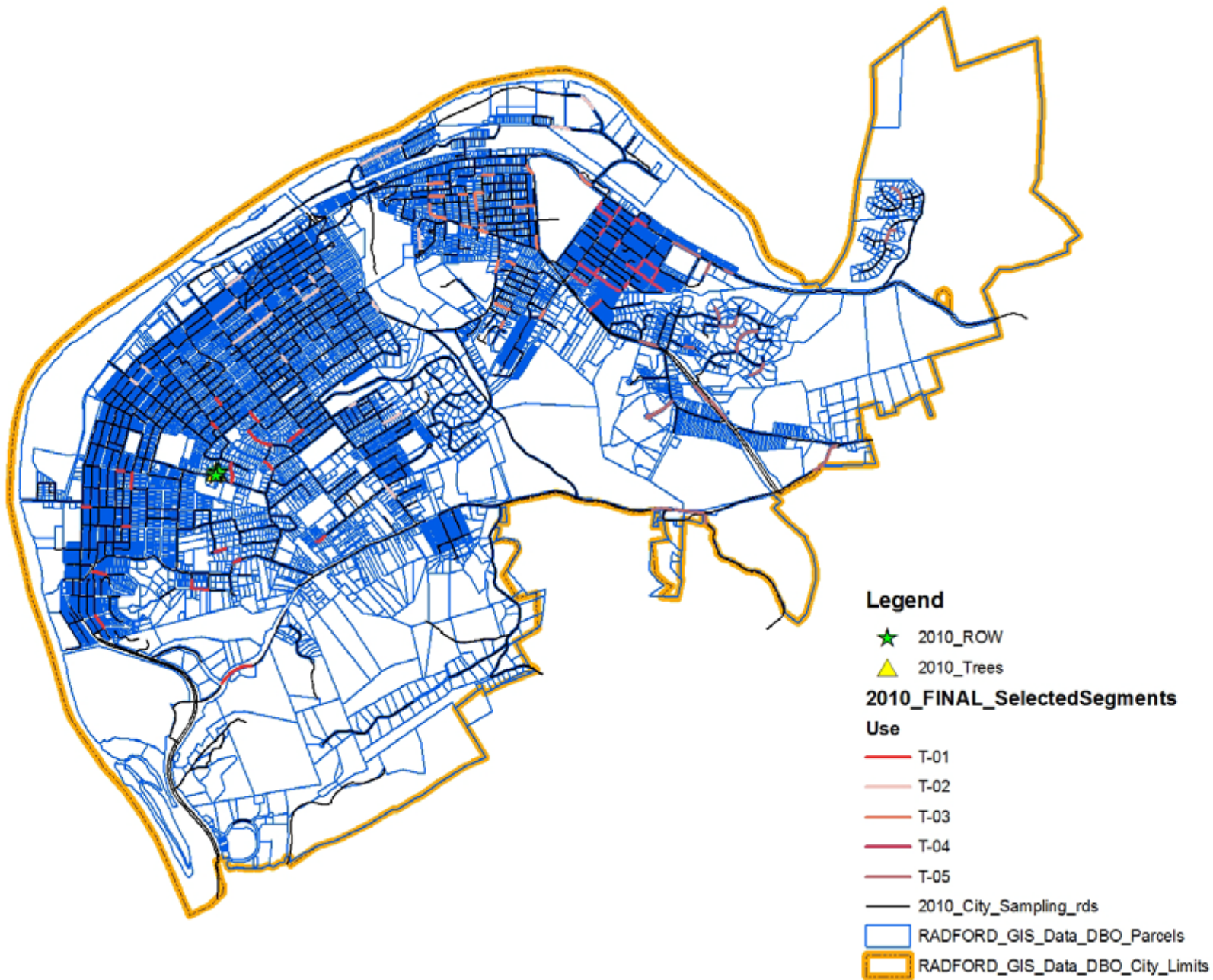


Research Methods

- i-Tree Streets
- Peer-reviewed, state-of-art software developed by USFS and Davey Resource Group
- Analyzes complete or sample inventory data
- Statistical estimates of:
 - Tree abundance
 - Size distribution
 - Species composition
- Empirical modeling of:
 - Ecosystem services
 - Real estate contribution
 - Monetary value

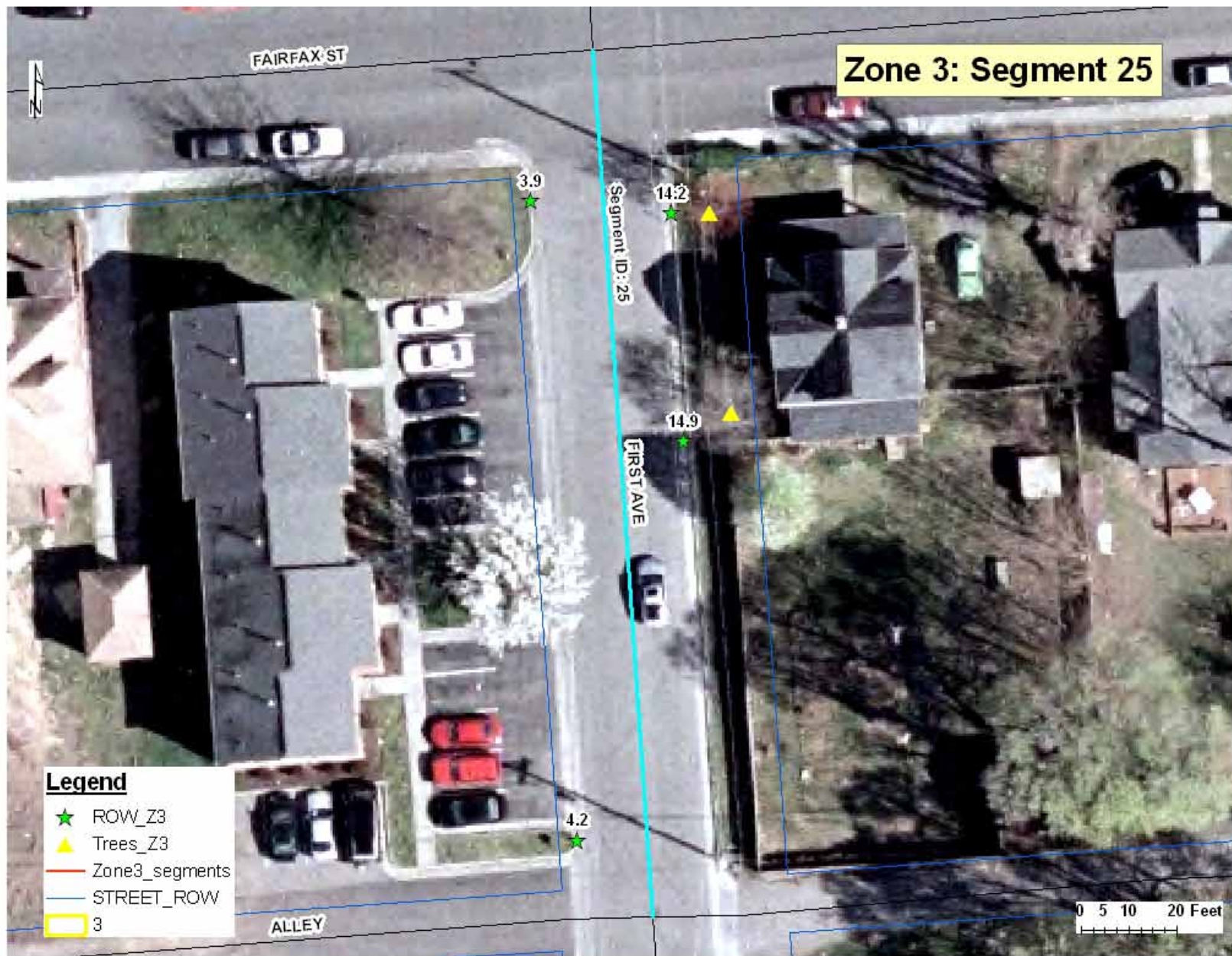


Research Methods





Research Methods





Research Methods

- All self-supporting woody plants within ROW:
 - >8' tall
 - or
 - Single-stemmed within 1' of ground
- Only trees >4" DBH on forested segments
- Tree Attributes:

Species	Ownership
DBH	Land Use
Condition	Site Type
- Inventories analyzed both with and without native ash trees in the datasets





Presentation Overview

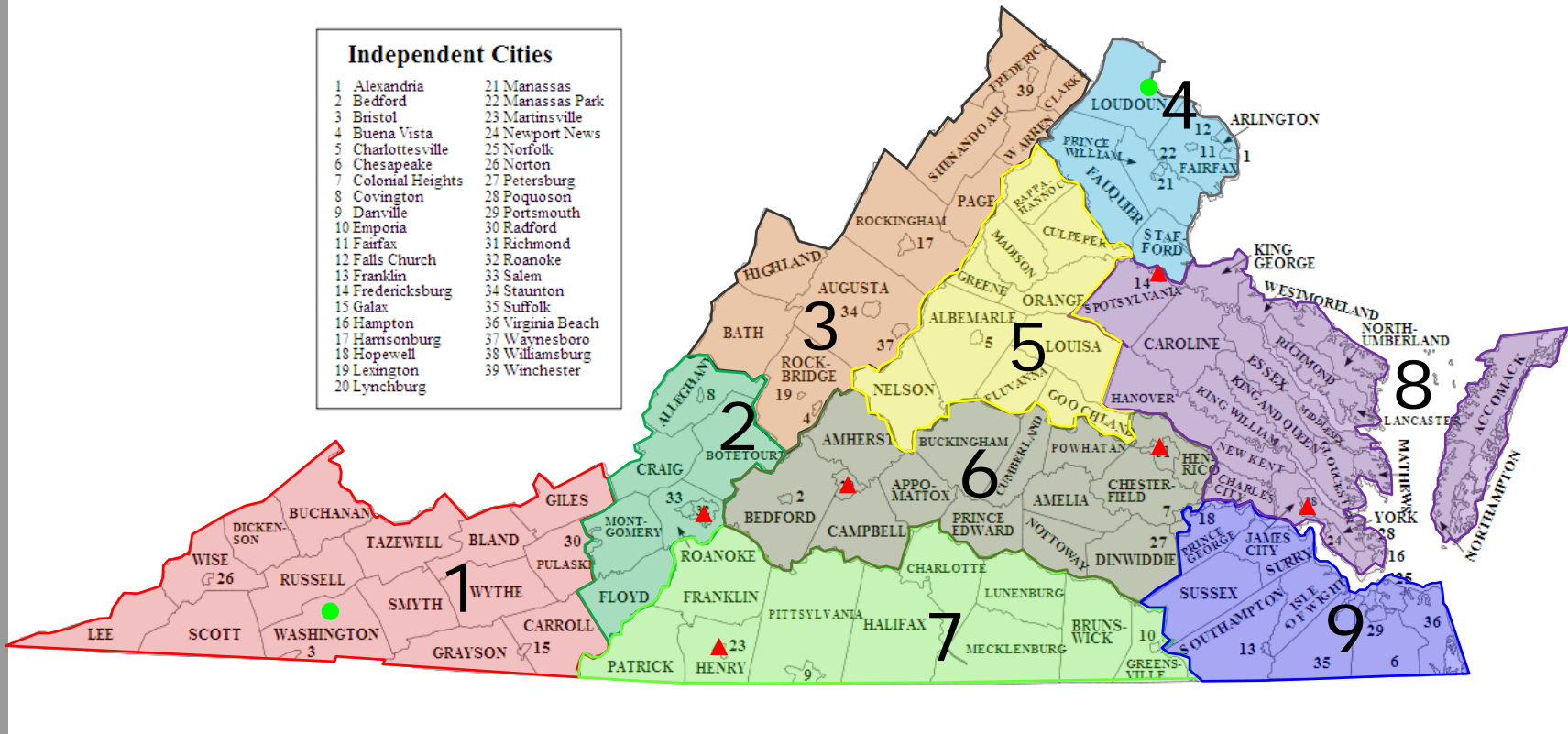
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Research Results to Date

Independent Cities

1 Alexandria	21 Manassas
2 Bedford	22 Manassas Park
3 Bristol	23 Martinsville
4 Buena Vista	24 Newport News
5 Charlottesville	25 Norfolk
6 Chesapeake	26 Norton
7 Colonial Heights	27 Petersburg
8 Covington	28 Poquoson
9 Danville	29 Portsmouth
10 Emporia	30 Radford
11 Fairfax	31 Richmond
12 Falls Church	32 Roanoke
13 Franklin	33 Salem
14 Fredericksburg	34 Staunton
15 Galax	35 Suffolk
16 Hampton	36 Virginia Beach
17 Hamisburg	37 Waynesboro
18 Hopewell	38 Williamsburg
19 Lexington	39 Winchester
20 Lynchburg	



Inventories Analyzed to Date

Abingdon (C)	Martinsville (S)
Fredericksburg (S)	Richmond (S)
Leesburg (C)	Roanoke (S)
Lynchburg (S)	Williamsburg (S)





Research Results to Date

Municipal Street Tree Population Summary

Municipality	Native Ash Present		Native Ash Absent		# Ash	% Ash
	Population Estimate	SE	Population Estimate	SE		
Abingdon	1,193	-	1,151	-	42	3.5
Fredericksburg	20,104	1,845	19,847	1,816	257	1.3
Leesburg	3,068	-	3,000	-	68	2.2
Lynchburg	27,086	2,353	26,801	2,343	285	1.1
Martinsville	3,420	451	3,410	451	10	0.3
Richmond	47,540	3,675	46,206	3,658	1,334	2.8
Roanoke	52,133	5,430	50,867	5,240	1,266	2.4
Williamsburg	5,991	801	5,981	801	10	0.2
Total	160,535		157,263		3,272	2.1

Research Results to Date

Lost Ecosystem Services

Municipality	Energy Conserv.		Stormwater Mitig.		Carbon Storage		Annual Net Benefits
	MWh	\$	Gallons	\$	lb	\$	\$
Abingdon	7.8	818	381,718	3,778	776,746	5,825	6,574
Fredericksburg	12	1,379	454,406	4,499	705,249	5,290	49,694
Leesburg	5	12,866	3.189 M	31,577	4,831 M	36,235	6,041
Lynchburg	33.5	3,745	1.401 M	13,872	2.367 M	177,595	35,381
Martinsville	0.2	17	2,445	24	1,888	14	203
Richmond	175.3	19,658	6.976 M	69,074	11.245 M	84,343	174,280
Roanoke	328.2	64,692	4.440 M	120,353	22.531 M	116,486	288,599
Williamsburg	1.4	169	55,922	554	81,238	609	1,502
Total		103,344		243,731		426,397	562,274



Research Results to Date



Species Dominance						
Municipality	#1 Species		#2 Species		#3 Species	
	Name	% Total	Name	% Total	Name	% Total
Abingdon	<i>C. florida</i>	13.3	<i>P. strobus</i>	9.6	<i>A. saccharum</i>	7.1
Fredericksburg	<i>A. rubrum</i>	18.9	<i>A. saccharum</i>	15	<i>A. x freemanii</i>	7.3
Leesburg	<i>C. kousa</i>	13.9	<i>A. rubrum</i>	8.1	<i>P. abies</i>	6.4
Lynchburg	<i>A. rubrum</i>	8.9	<i>C. florida</i>	6.2	<i>x C. leylandii</i>	4.5
Martinsville	<i>C. florida</i>	9.5	<i>Lagerstroemia</i> <i>spp.</i>	7.6	<i>A. rubrum</i>	7.3
Richmond	<i>A. saccharum</i>	12.4	<i>Q. phellos</i>	9.3	<i>Lagerstroemia</i> <i>spp.</i>	8.8
Roanoke	<i>A. saccharum</i>	8.6	<i>A. altissima</i>	6.6	<i>U. pumila</i>	5.8
Williamsburg	<i>P. taeda</i>	12	<i>Lagerstroemia</i> <i>spp.</i>	10.3	<i>J. virginiana</i>	6.3

Research Results to Date



Potential Management Costs

Municipality	Ash removal		Ash replacement		Total
	#	\$	#	\$	\$
Abingdon	42	42,000	42	10,500	52,500
Fredericksburg	257	257,000	257	64,250	321,250
Leesburg	68	68,000	68	17,000	85,000
Lynchburg	285	285,000	285	71,250	356,250
Martinsville	10	10,000	10	2,500	12,500
Richmond	1,334	1,334,000	1,334	333,500	1,667,500
Roanoke	1,266	1,266,000	1,266	316,500	1,582,500
Williamsburg	10	10,000	10	2,500	12,500
Total	3,272	3,272,000	3,272	818,000	4,090,000

Total potential loss of \$4.562 M in benefits and restoration



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Research Implications & Future Work

- Native ash do not appear to be as common as street trees in Virginia as in the mid-western U.S.
- Despite low ash abundance, impacts in VA will still be considerable, particularly to remove and replace trees
- Results will be shared with localities to aid preparation for EAB outbreak
- Localities must better management street tree species composition to minimize risk from invasive pests
- More precise calculations of ash treatment, removal, and replacement costs are needed
- Additional Virginia street tree inventories will be obtained and conducted over the next two years



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Coming Soon!

On-line EAB short course on Nat. Plant Diagnostic Network