LONGWOOD GARDENS

Using Applied Climate Science Modeling to Develop Forest Management Strategies

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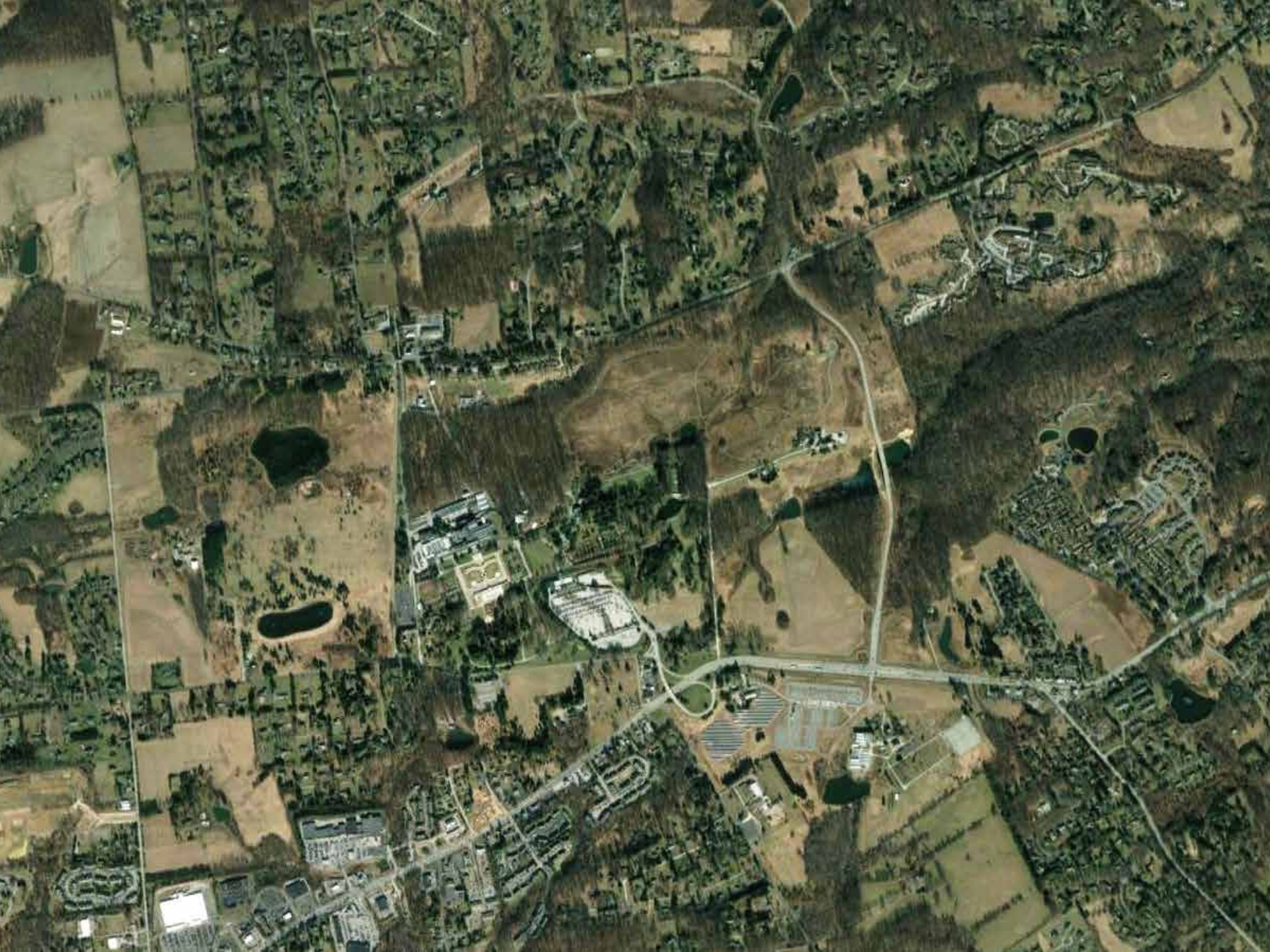
Associate Director, Land Stewardship and Ecology

ADAPTATION PLANNING AND PRACTICES FOR
WATER SUPPLY RESERVOIR FORESTS IN THE MID-ATLANTIC

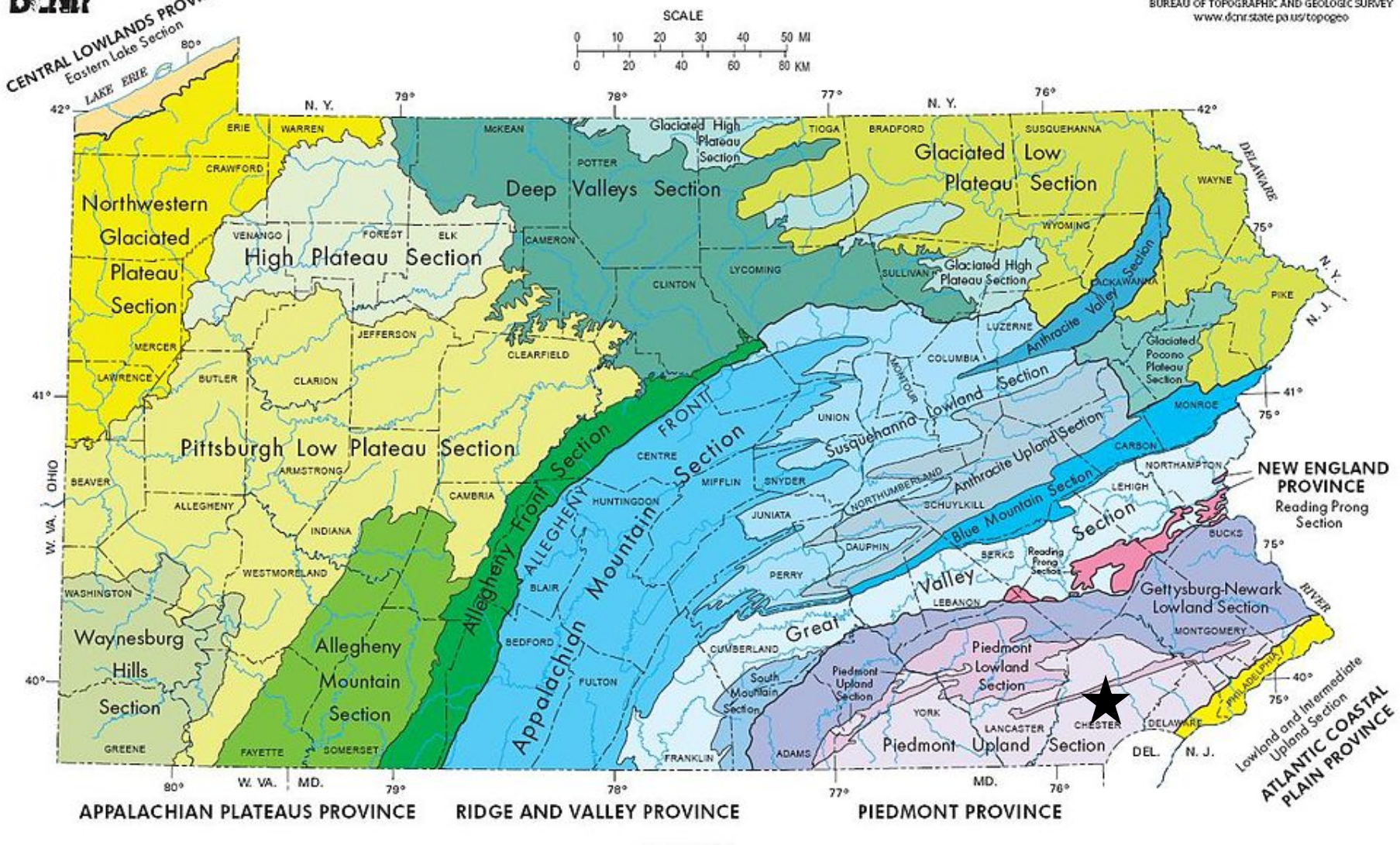
NORTH POINT STATE PARK, EDGEMERE, MD JANUARY 30, 2020



MAP 13

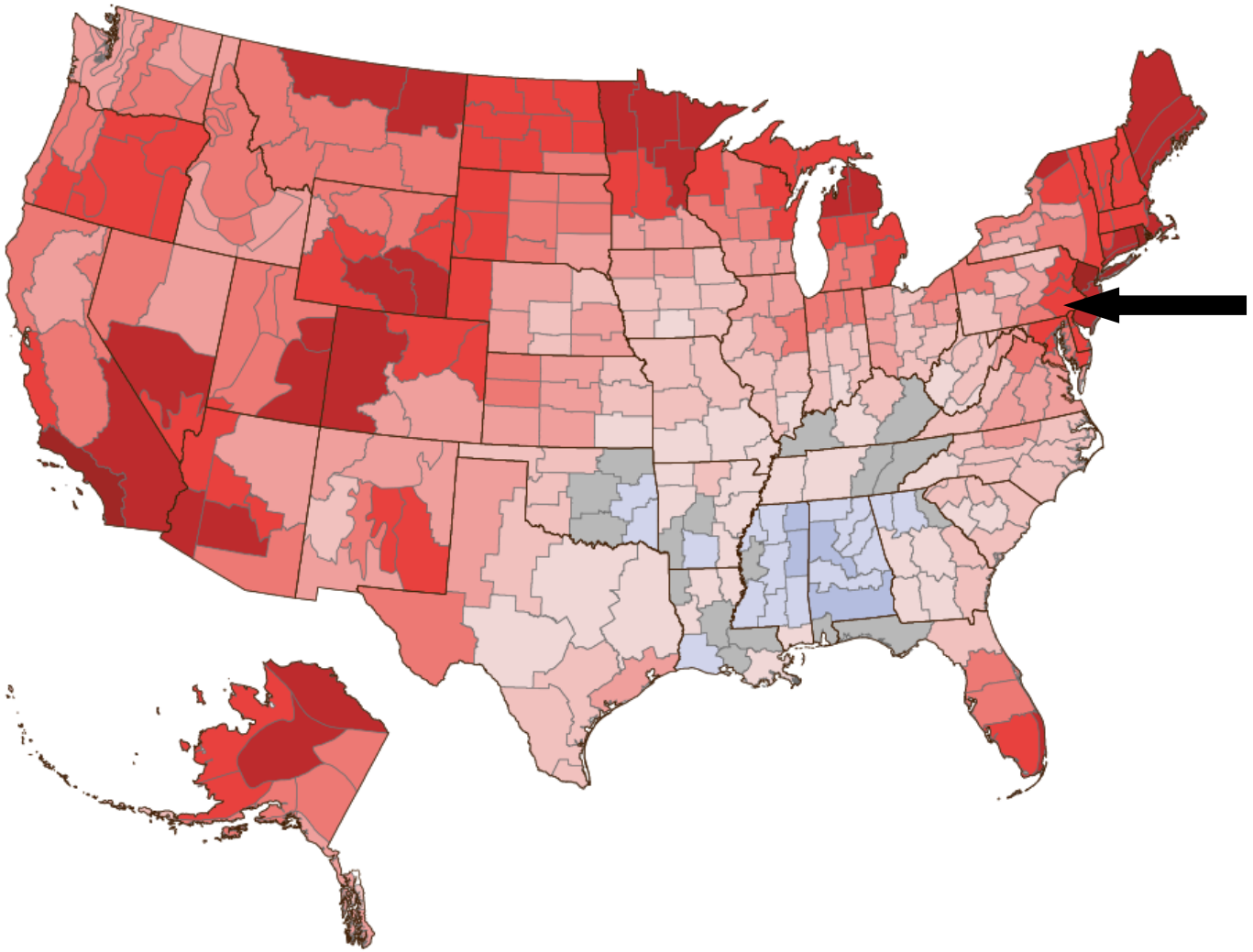
PHYSIOGRAPHIC PROVINCES OF PENNSYLVANIA

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF
CONSERVATION AND NATURAL RESOURCES
BUREAU OF TOPOGRAPHIC AND GEOLOGIC SURVEY
www.dcnr.state.pa.us/topogeo



Compiled by W. D. Sevon, Fourth Edition, 2000.

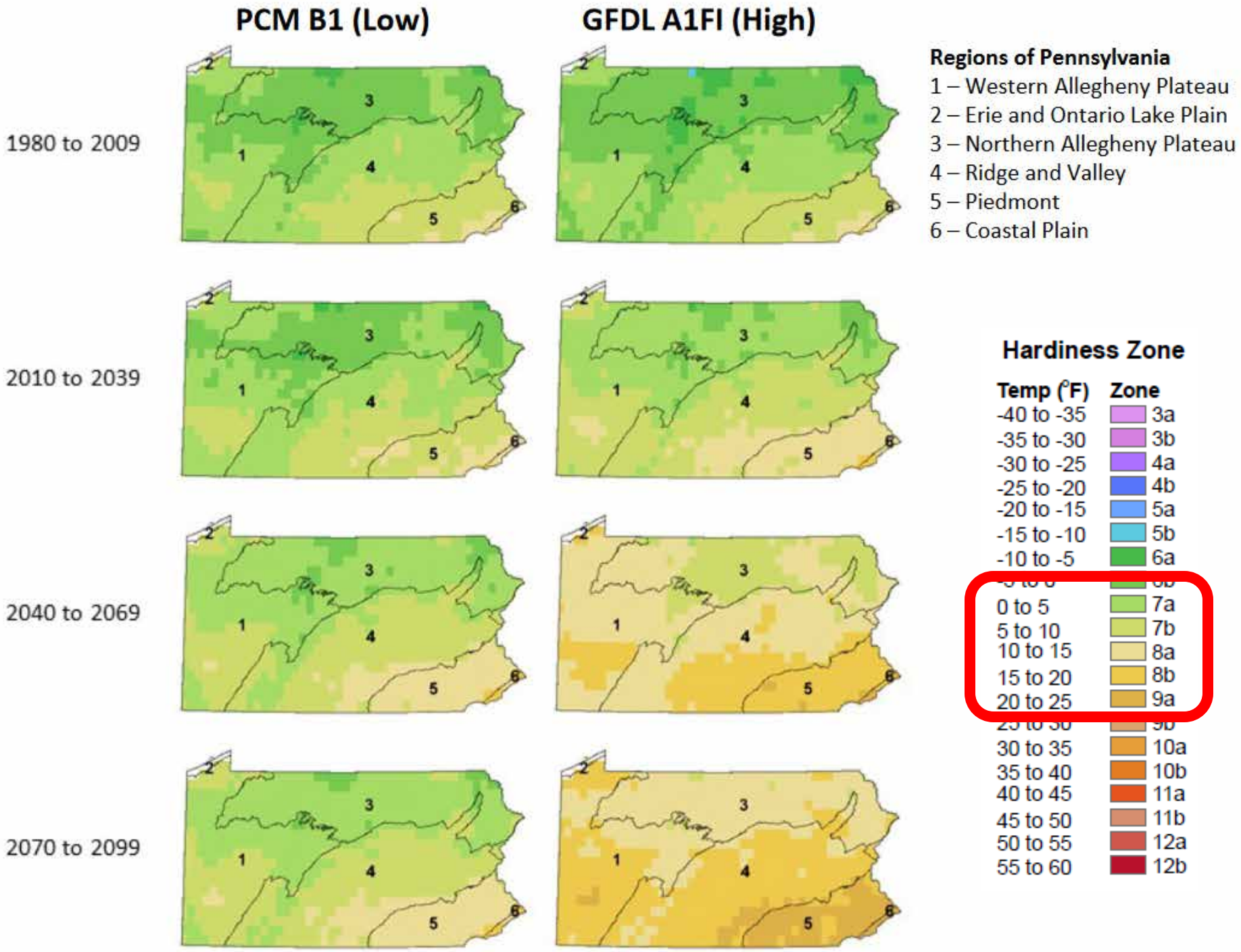
Rate of Temperature Change in the United States, 1901–2015



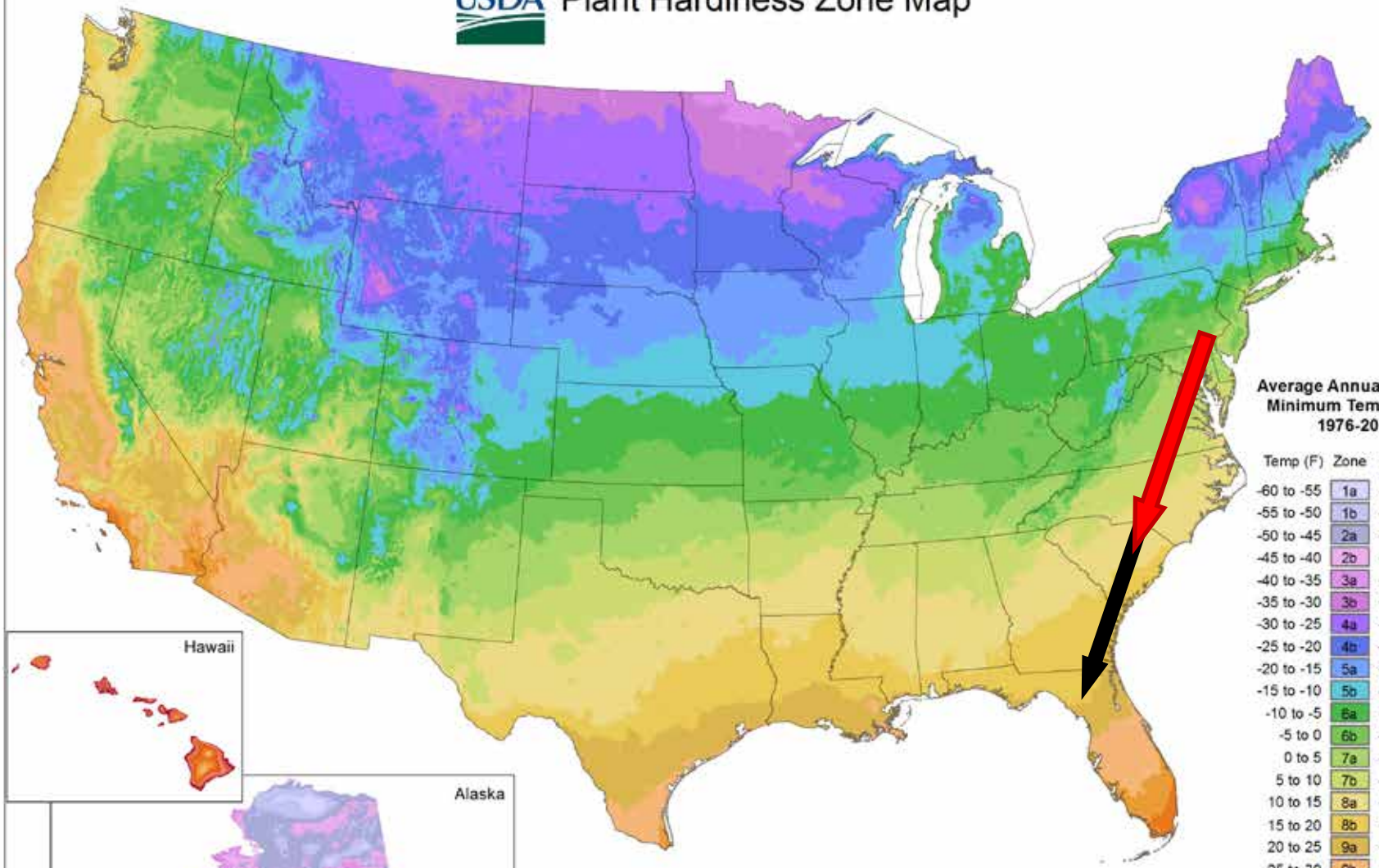
Rate of temperature change (°F per century):

-3.5 -3 -2 -1 0 1 2 3 3.5

Gray interval: -0.1 to 0.1°F


PCM B1 (Low)
GFDL A1FI (High)
1980 to 2009
2010 to 2039
2040 to 2069
2070 to 2099
Regions of Pennsylvania
1 – Western Allegheny Plateau
2 – Erie and Ontario Lake Plain
3 – Northern Allegheny Plateau
4 – Ridge and Valley
5 – Piedmont
6 – Coastal Plain
Hardiness Zone
Temp (°F) Zone
-40 to -35 3a
-35 to -30 3b
-30 to -25 4a
-25 to -20 4b
-20 to -15 5a
-15 to -10 5b
-10 to -5 6a
0 to 5 7a
5 to 10 7b
10 to 15 8a
15 to 20 8b
20 to 25 9a
30 to 35 10a
35 to 40 10b
40 to 45 11a
45 to 50 11b
50 to 55 12a
55 to 60 12b

USDA Plant Hardiness Zone Map



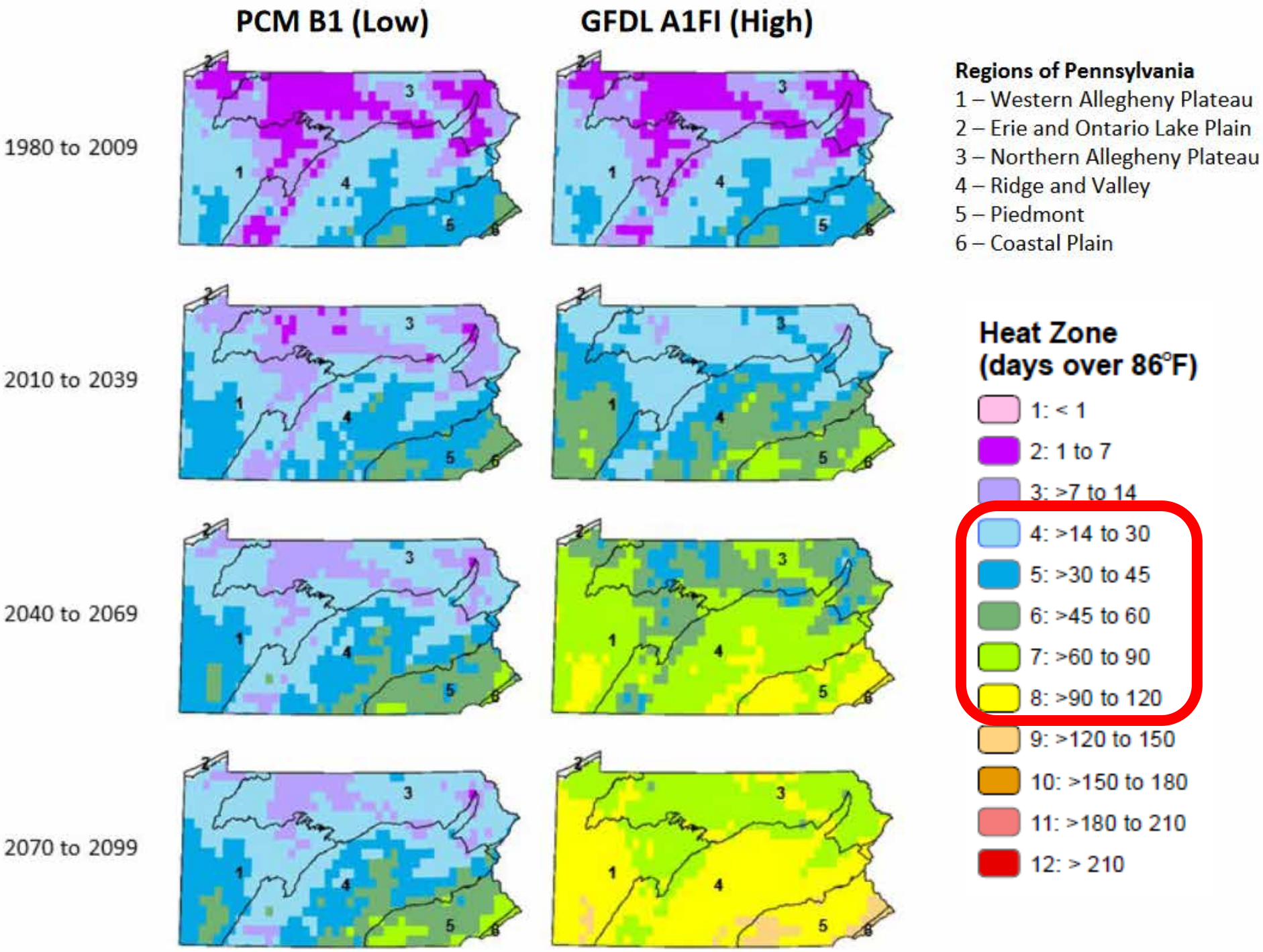
Average Annual Extreme Minimum Temperature 1976-2005

Temp (F)	Zone	Temp (C)
-60 to -55	1a	-51.1 to -48.3
-55 to -50	1b	-48.3 to -45.6
-50 to -45	2a	-45.6 to -42.8
-45 to -40	2b	-42.8 to -40
-40 to -35	3a	-40 to -37.2
-35 to -30	3b	-37.2 to -34.4
-30 to -25	4a	-34.4 to -31.7
-25 to -20	4b	-31.7 to -28.9
-20 to -15	5a	-28.9 to -26.1
-15 to -10	5b	-26.1 to -23.3
-10 to -5	6a	-23.3 to -20.6
-5 to 0	6b	-20.6 to -17.8
0 to 5	7a	-17.8 to -15
5 to 10	7b	-15 to -12.2
10 to 15	8a	-12.2 to -9.4
15 to 20	8b	-9.4 to -6.7
20 to 25	9a	-6.7 to -3.9
25 to 30	9b	-3.9 to -1.1
30 to 35	10a	-1.1 to 1.7
35 to 40	10b	1.7 to 4.4
40 to 45	11a	4.4 to 7.2
45 to 50	11b	7.2 to 10
50 to 55	12a	10 to 12.8
55 to 60	12b	12.8 to 15.6
60 to 65	13a	15.6 to 18.3
65 to 70	13b	18.3 to 21.1

Agricultural Research Service

Oregon State University

Mapping by the PRISM Climate Group, Oregon State University, http://prism.oregonstate.edu, 2012


PCM B1 (Low)
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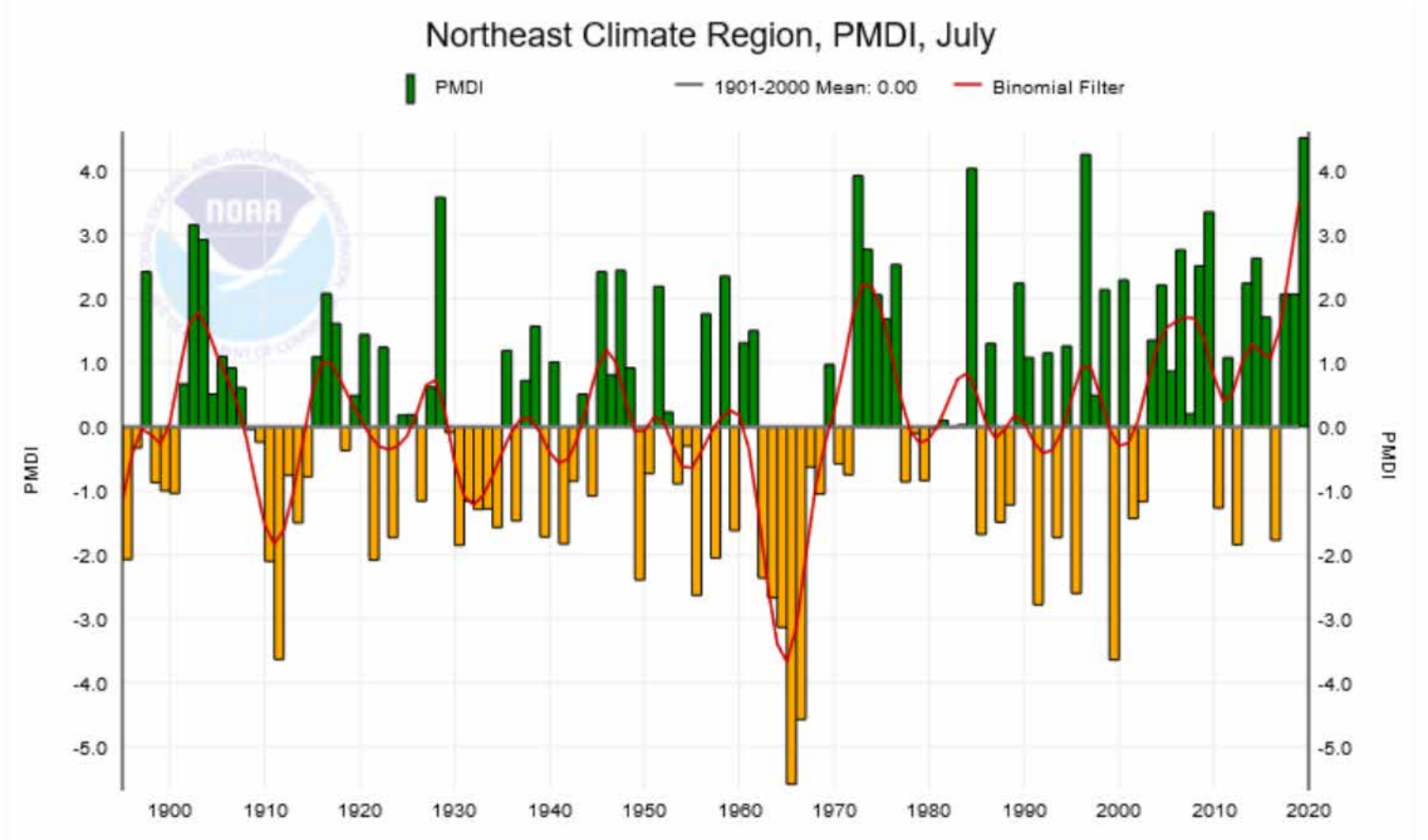
2070 to 2099
Regions of Pennsylvania
1 – Western Allegheny Plateau
2 – Erie and Ontario Lake Plain
3 – Northern Allegheny Plateau
4 – Ridge and Valley
5 – Piedmont
6 – Coastal Plain
Heat Zone
(days over 86°F)
1: < 1
2: 1 to 7
3: >7 to 14
4: >14 to 30
5: >30 to 45
6: >45 to 60
7: >60 to 90
8: >90 to 120
9: >120 to 150
10: >150 to 180
11: >180 to 210
12: > 210



https://www.ncdc.noaa.gov/cag/regional/time-series/101/pmdi/1/7/1895-2019

ham County Park, Chester County PA

Southern Pine beetle affecting Pitch Pine in 2017

Climate Adaptation Strategies

Precipitation
Pests
Storms
Temperature extremes

- Staffing needs
- The next 100 years

Climate Change Response Framework

Home | Our Approach | Projects | Demos | Products | Partners | Resources | Contact

Central Appalachians

Central Hardwoods

Mid-Atlantic

New England

Northwoods

Urban

Use the Adaptation Workbook

Longwood Gardens: Planning Future Plantings in a Changing Climate

Start-Up | Planning | Action | Evaluation

Longwood Gardens is in the beginning phases of planning for climate change. We are assessing the species on the property and will propose which species should be phased out and which should be introduced.

Longwood Gardens is analyzing the species to be planted in the gardens for cold hardiness, heat tolerance and longevity. Located in the mid-Atlantic, the seasonal temperatures and rainfall are more apt to change quickly. Many species are at the limit of their range in this area. Selecting wisely will provide less unwanted, unexpected changes in the future.

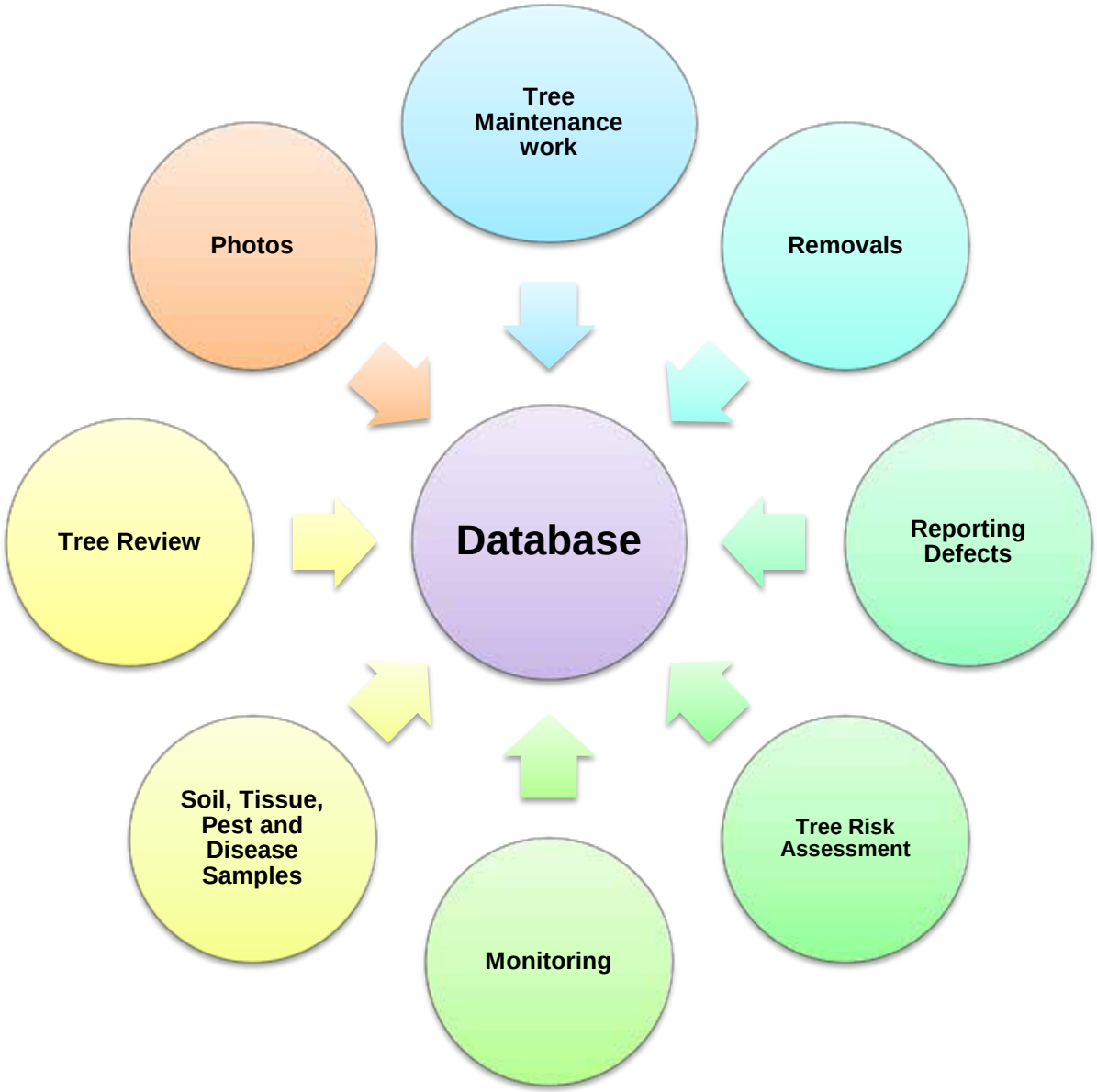
Project Area

Longwood Gardens is a 1,077 acre parcel situated in southern Chester County, Pennsylvania. The property is mixed use. The gardens proper encompass 400 acres. There are more than 9,000 identified and tagged trees. These trees represent many taxa from around the world. There are several successional forest plots of different ages on the property as well.

Leslie Brandt – US Forest Service

Climate Adaptation Strategies

- Assessment
- Prioritization
- Management Planning


Tree Maintenance work
Photos
Removals
Tree Review
Database
Reporting Defects
Soil, Tissue, Pest and Disease Samples
Tree Risk Assessment
Monitoring

- Inventory
- Condition

1. *Chasmanthium latifolium* (Wild-oats)

2. *Parrotia persica* (Persian Parrotia)

3. *Fagus sylvatica* 'Pendula' (Weeping Beech)

4. *Skimmia reevesiana* (Reeves Skimmia)

5. *Hamamelis × intermedia* 'Arnold Promise' (Witch-hazel)

6. *Tsuga canadensis* (Pendula Group) (Weeping Hemlock)

7. *Magnolia grandiflora* (Southern Magnolia)

8. *Acer palmatum* 'Ornatum' (Dissectum Group) (Threadleaf Japanese Maple)

9. *Acer griseum* (Paperbark Maple)

MAP HELP

Center the Items | Print Map Only

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Fagus sylvatica f. *purpurea*

Copper Beech

Longwood Gardens
Plant EXPLORER

Plant Records Reporting Tool
Click to Submit

Accession Number: L-0330*A

Click For Taxon Level Data On *Fagus sylvatica* f. *purpurea*

Locations and Measurements | Field Checks | Map | Images

LIN. NUM. L-0330

RECD. AS Fagus sylvatica f. purpurea

HOW RECD. PT

RECD. QTY. 1

ORIGINAL PLANT SOURCE UNKNOWN SOURCE

SPEC. ACC. CHARS. DH (Disaster Preparedness High Priority)

SPEC. PL. CHARS. Christmas Lights; Christmas Lights; Christmas Lights; Christmas Lights; Christmas Lights; Christmas Lights; Christmas Lights; Christmas Lights; Christmas Lights; Christmas Lights

SPEC. PL. CHAR. NOTES Christmas 2016; Christmas 2015; Christmas 2014; Christmas 2013; Christmas 2012; Christmas 2011; Christmas 2010; Christmas 2009; Christmas 2008; Christmas 2007

Location History - L-0330*A *Fagus sylvatica* f. *purpurea*

Loc. Code	Date	Location	Quad.	Chg. Type	Num Plts.
QUAD_J09	11/06/06	QUAD_J09	J09	A	1
QUAD_J09		QUAD_J09		N	1
QUAD_J09	07/27/04	QUAD_J09	J16	R	3

Measurements - L-0330*A *Fagus sylvatica* f. *purpurea*

Measured By	Date Measured	Ht.	DBH	Circ.	Spr.
Scott Wade	10/05/17	74.0'	45.3"	142.3"	96.0'
Rick Patton	02/02/09	75.8'	42.7"	134.1"	79.5'
Jeremy	10/26/06	70.0'			60.0'

Expand Table ↓

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Field Checks - L-0330*A *Fagus sylvatica* f. *purpurea*

Cond.	Check Date	Repro. Stat.	Veg. Stat.	S.	C.	Check Note	Check By
alive	10/05/17					per tree assessment	Scott Wade
alive	04/18/17					sprayed: agrifos, pentrabark, and tengard	Ipm Intern
alive	09/06/16	D					Phenology Team

Expand Table ↓

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L-0330*A

Fagus sylvatica f. purpurea

Arborist

02 JUN 2011

L-0330*A

Fagus sylvatica f. purpurea

25 APR 2013

L-0330*A

Fagus sylvatica f. purpurea

02 OCT 2009

L-0330*A

Fagus sylvatica f. purpurea

02 FEB 2009

L-0330*A

Fagus sylvatica f. purpurea

Scott Wade

05 OCT 2017

^Top of Page

- 8,101 trees assessed and identified since 2009
- 1,843 trees reassessed (2017-2018)
- 1 National Champion: cucumber magnolia
- 1 Northeast height champion: tulip poplar 163.3 feet tall
- 185 State champions (1-6th)

	2010	2011	2012	2013	2014	2015	2016	2017	Total (2006-2017)
Total removed	94	105	91	113	392^	246^	157	152	1,350
Accessioned trees planted	190	106	126	158	767	419	426*	350	2,542 +1,192

Historical Trees

1800 series trees = 307

- Sugar maple = 35
- Tulip poplar = 119
- Canada hemlock = 50

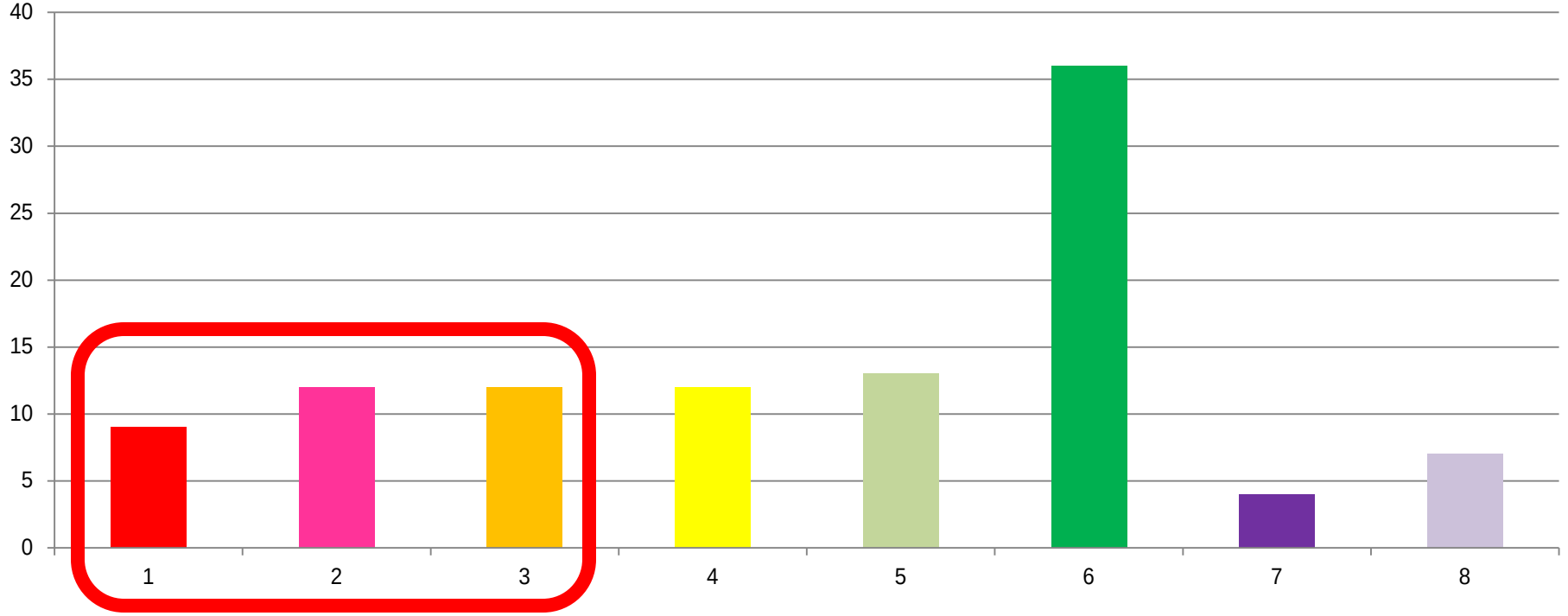
‘L’ series trees = 1,394

- Sugar maple = 46
- Tulip poplar = 71
- Canada hemlock = 146
- White pine = 157

	A	B	C	D
1	**Three-model comparison for the Piedmont Region**			
2	**Species**	**Model**	**PCM B1 (mild scenario)**	**GFDL A1FI (harsh scenario)**
3	American basswood	Tree Atlas	No Change	No Change
4	American beech	Linkages	No Change	Large Decrease
5		Landis BA	No Change	Increase
6		Landis TPA	No Change	Decrease
7		Tree Atlas	No Change	Large Decrease
8	American chestnut	Tree Atlas	No Change	No Change
9	American elm	Tree Atlas	No Change	Increase
10	American holly	Tree Atlas	Increase	Large Increase
11	American hornbeam (musclewood)	Tree Atlas	No Change	No Change
12	Atlantic white-cedar	Tree Atlas	Large Decrease	Large Decrease
13	Baldcypress	Tree Atlas	No Change	Increase
14	Balsam fir	Linkages	-	Extirpated
15		Landis BA	No Change	No Change
16		Landis TPA	Decrease	Decrease
17		Tree Atlas	Large Decrease	Extirpated
18	Bear oak (scrub oak)	Tree Atlas	Large Increase	Large Increase
19	Bigtooth aspen	Tree Atlas	Small decrease	Large Decrease
20	Bitternut hickory	Tree Atlas	Small increase	Large increase
21	Black ash	Tree Atlas	Large Decrease	Large Decrease
22	Black cherry	Linkages	No Change	Large Decrease
23		Landis BA	No Change	Small increase
24		Landis TPA	No Change	Small increase
25		Tree Atlas	Small decrease	Large Decrease
26	Black hickory	Tree Atlas	Small increase	Large increase
27	Black locust	Tree Atlas	No change	No change
28		Linkages	No Change	Decrease

Leslie Brandt, US Forest Service

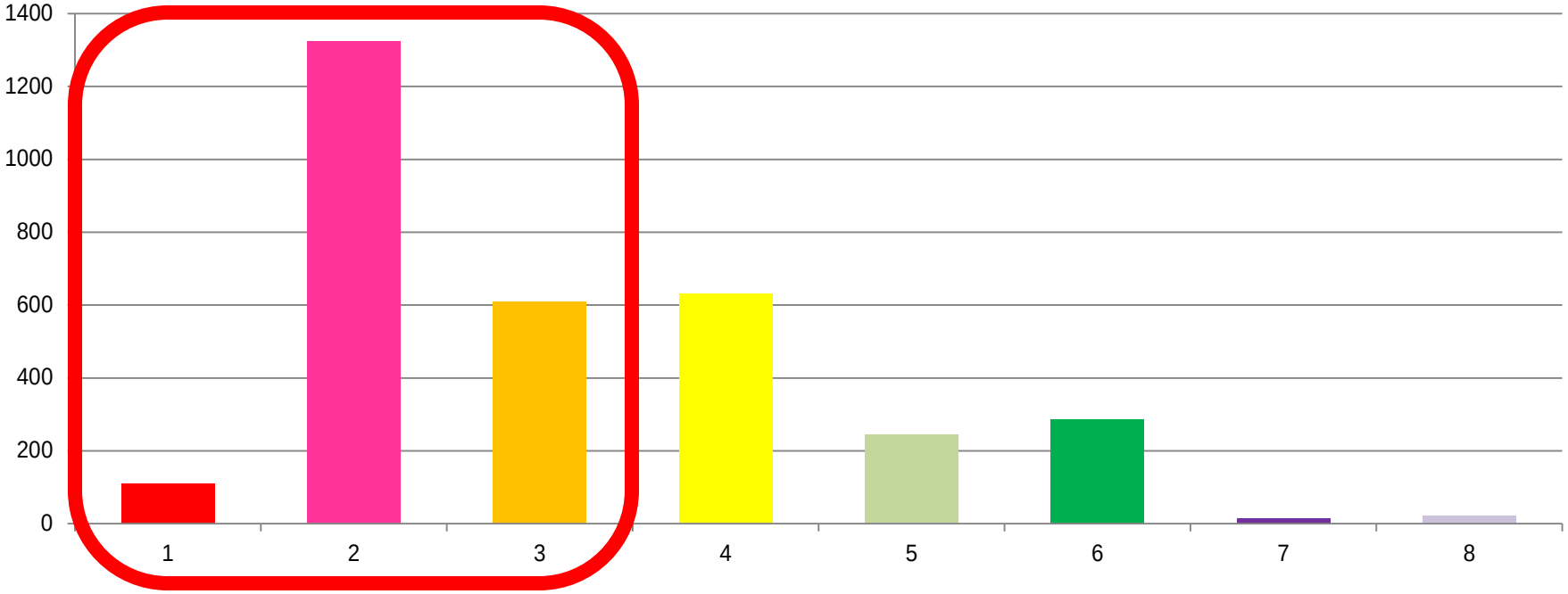
Number of accessioned tree species by climate change model category



1. suitable habitat eliminated
2. large decrease
3. small decrease
4. not much change
5. small increase
6. large increase
7. potentially new species
8. potentially new species under harshest scenario

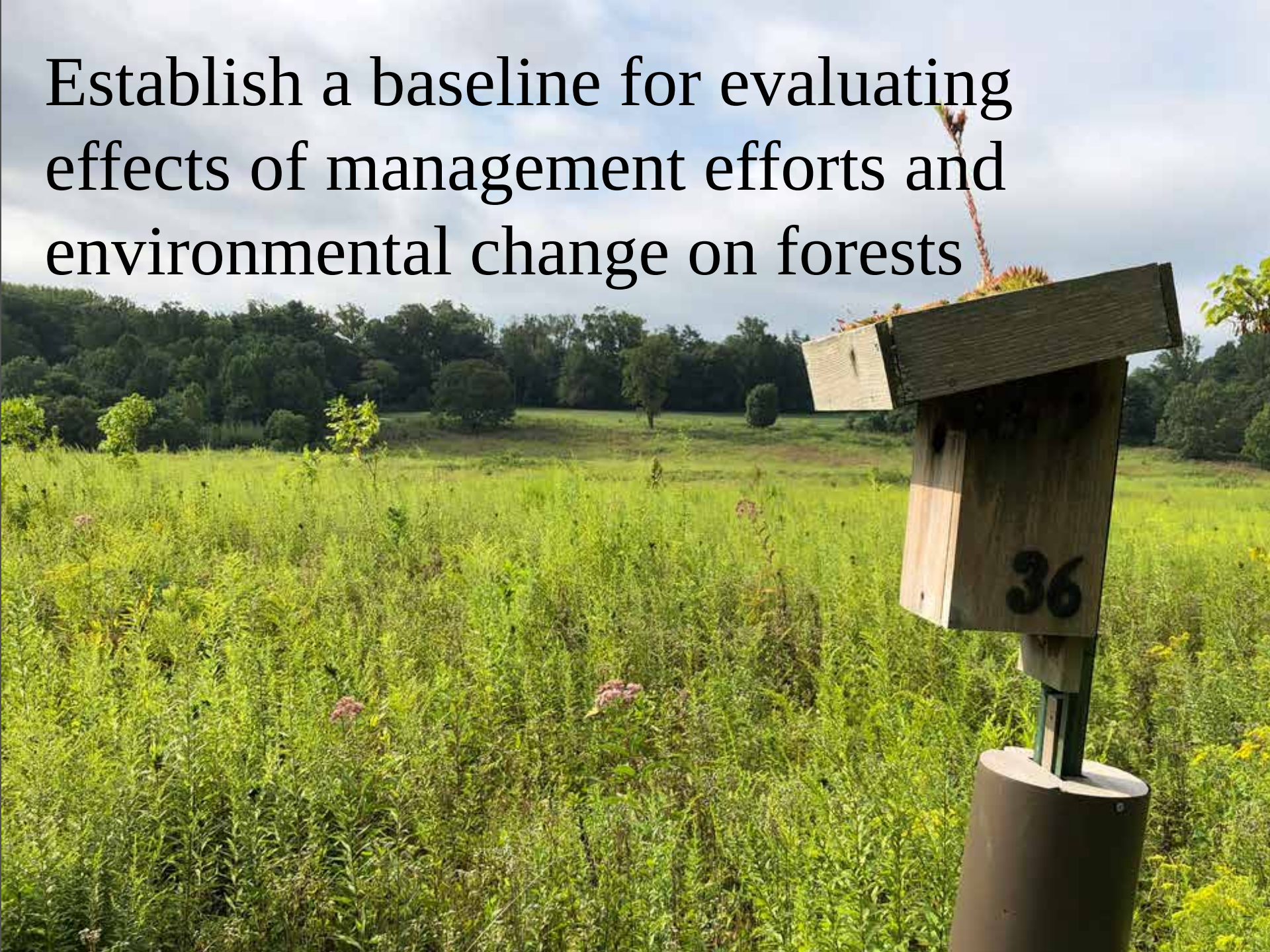
- 105 species modeled
- 36% of modeled Longwood tree species are high to medium high risk

Number of accessioned individual trees by climate change model category

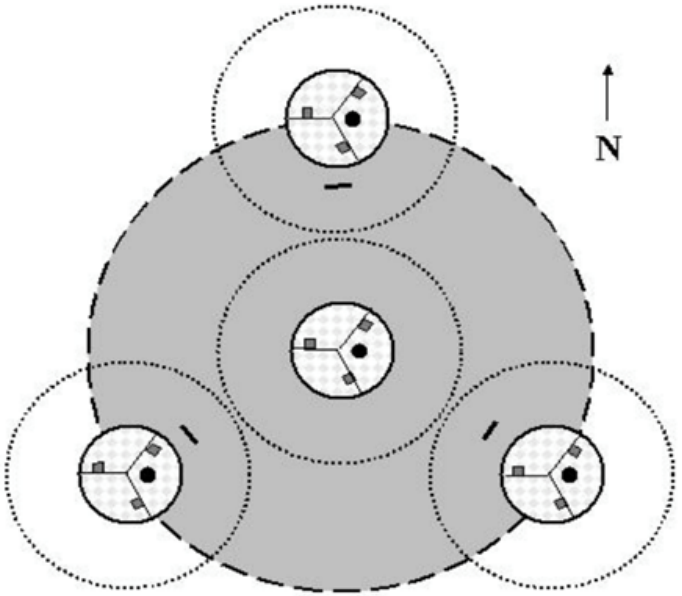


1. suitable habitat eliminated
2. large decrease
3. small decrease
4. not much change
5. small increase
6. large increase
7. potentially new species
8. potentially new species under harshest scenario

41% of Longwood trees are high to medium high risk (3,623 trees)


Establish a baseline for evaluating effects of management efforts and environmental change on forests
36

Phase 2/Phase 3 Plot Design



Subplot	24.0 ft	(7.32 m) radius
Microplot	6.8 ft	(2.07 m) radius
Annular plot	58.9 ft	(17.95 m) radius
Lichens plot	120.0 ft	(36.60 m) radius
Vegetation plot	1.0 m^2	area
Soil Sampling	(point sample)	
Down Woody Debris	24.0 ft	(7.32 m) transects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mble

Pennsylvania Natural Heritage Program

Plant Community Classification

Plant communities are groups of plants sharing a common environment that interact with each other, animal populations, and the physical environment. The types of plant communities found in an area can tell us a lot about that landscape. Plant community surveys provide information about plant species presence, the structure and composition of the plant community, soil chemistry, geology, presence of wildlife habitat, and quality of the entire landscape. These data can be used to create comprehensive, wide-scale land management and conservation plans.

PNHP's plant community classification system, Terrestrial and Palustrine Plant Communities of Pennsylvania 2nd Ed. , includes information on over 100 natural plant communities found in Pennsylvania. Community descriptions include plant species and their associated soil types, geology, related plant communities, and range. Information from the PNHP classification system has been incorporated into NatureServe's National Vegetation Classification and other national projects.

Using the Classification

Palustrine Communities

Terrestrial Communities

pawpaw (*Asimina triloba*)

Model Reliability: Low

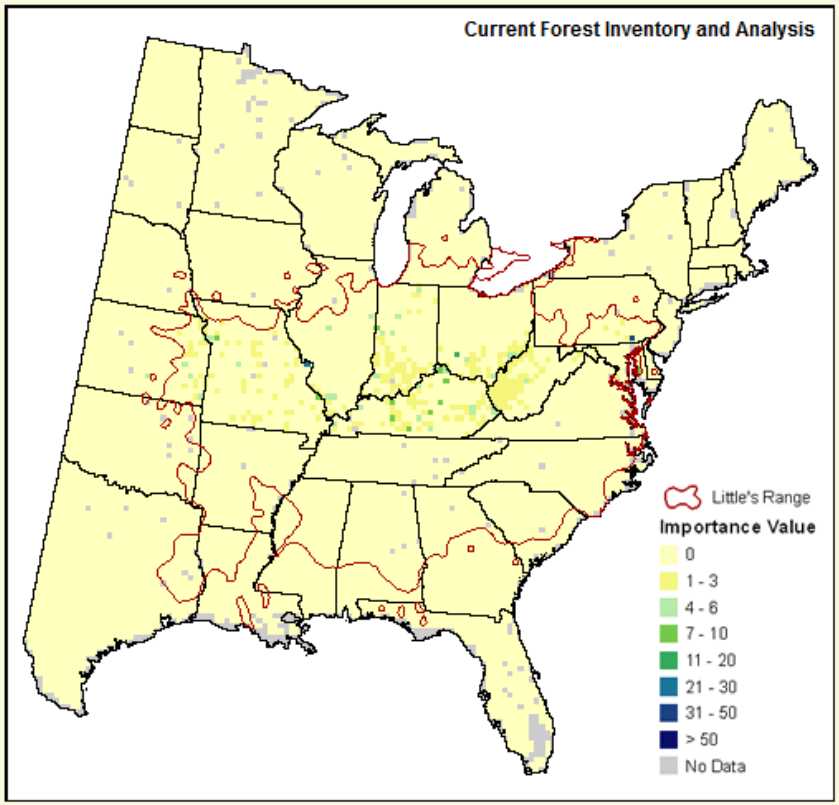
Current Distribution | Projected Future Habitat | Predictor Maps

Current Distribution Maps for pawpaw

Help »

Current Forest Inventory and Analysis

Compare Two Species



Cautions & Model Info

Notice:

This is an updated version of the Climate Change Tree Atlas. You can view the previous pawpaw page, or browse the previous Tree Atlas.

About pawpaw

Family: Annonaceae
Guild: shade tolerant
Functional Lifeform: small deciduous tree

- Life History and Disturbance Response
- Silvics Manual
- Photos of pawpaw in USDA Plants Database
- View current and modeled pawpaw distributions in Google Earth (142 KB)

Download Google Earth for free

Climate Change Adaptability

Summary of Predicted Changes

Range and Niche Maps

Predictor Analysis

Search for Trees & Birds:

LONGWOOD GARDENS

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