DCNR Climate Change Adaptation Plan

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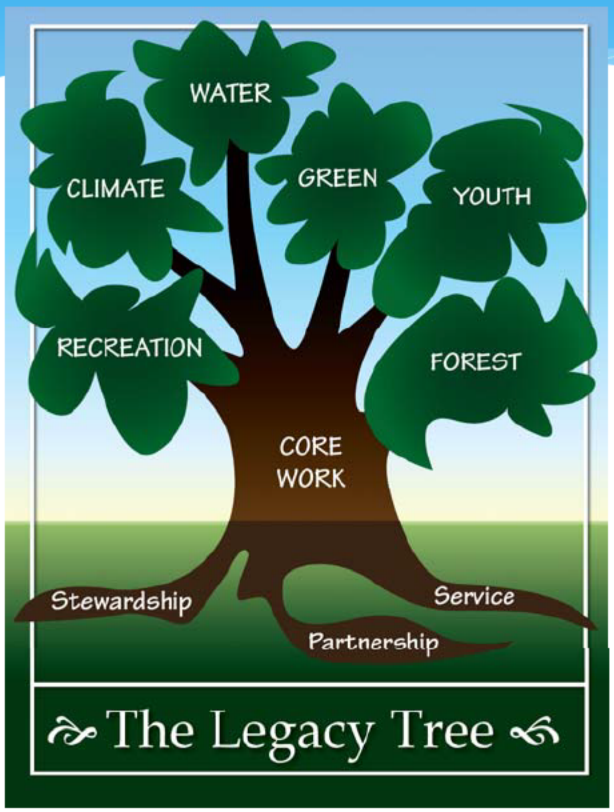
pennsylvania
DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
www.dcnr.state.pa.us

DCNR's Climate Change Position Statement



Climate change is real and is impacting the Commonwealth's ecological and recreational resources. As the state's leading conservation agency, DCNR will use the best available science to develop and implement climate change adaptation and mitigation strategies within each of its bureaus to minimize these impacts and serve as a role model for the citizens of Pennsylvania.

Northern Institute of Applied Climate Science

Climate

Carbon

Provides **practical** information, resources, and **technical assistance** related to forests and climate change

Regional multi-institutional partnership among:

Forest Service U.S. Department of Agriculture

ncasi

Michigan Technological University 1885

The University of Vermont

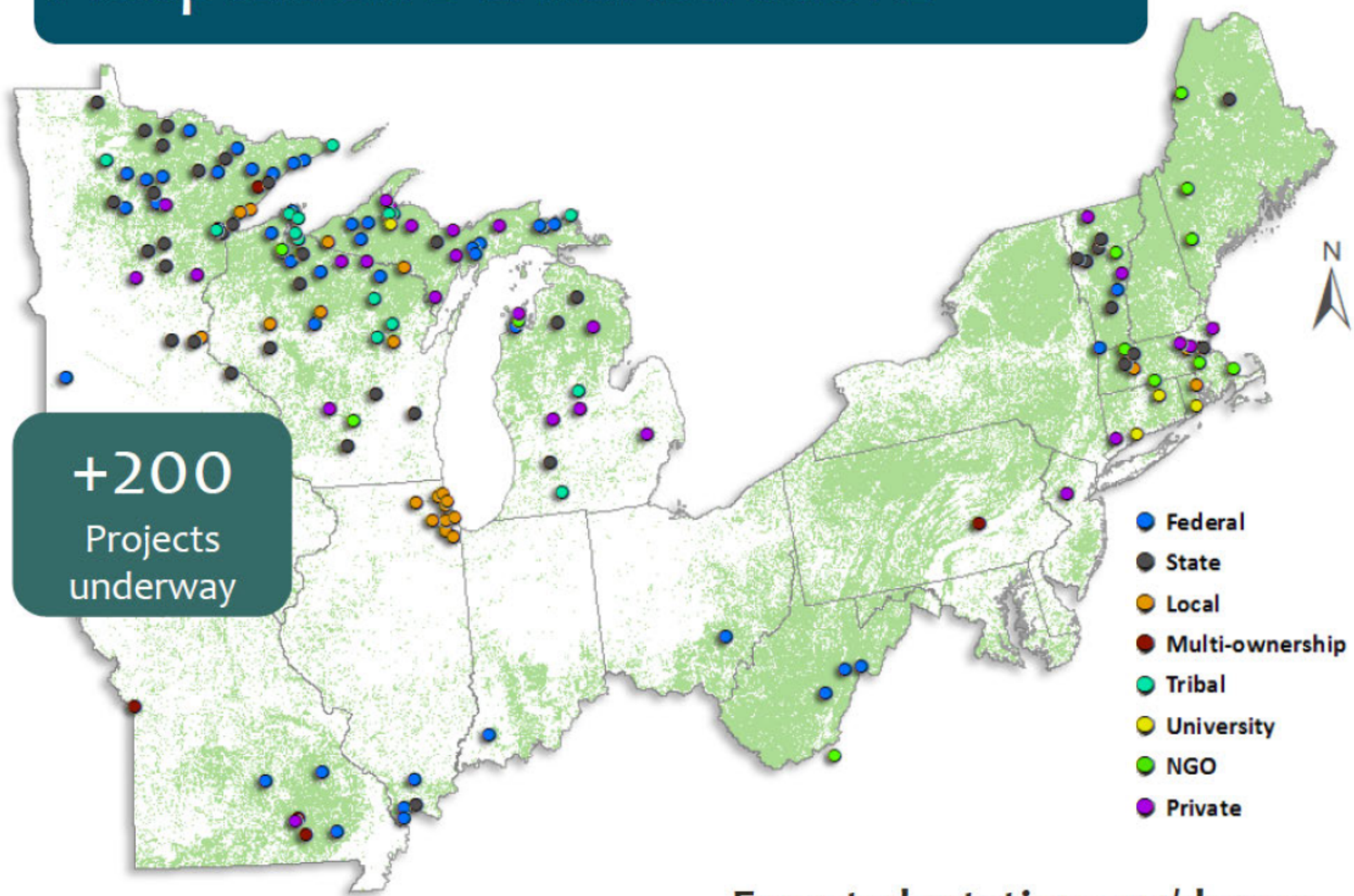
The Trust for Public Land

University of Minnesota

Great Lakes Indian Fish & Wildlife Commission

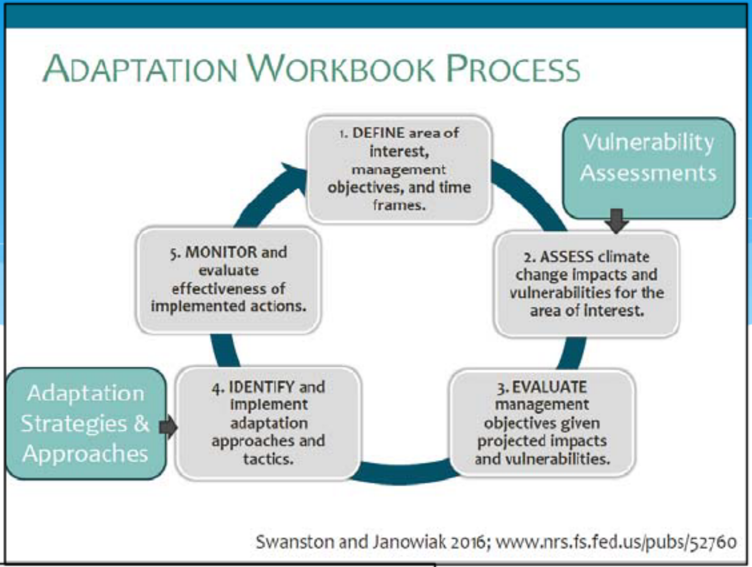
NIACS
Northern Institute of Applied Climate Science

Adaptation Demonstrations



Forestadaptation.org/demos

Climate Adaptation Planning Process



- More than 80 DCNR staff
- Bureaus:
  - Forestry
  - State Parks
  - Facility Design & Construction
  - Recreation & Conservation
  - Topographic & Geologic Survey
- Topical areas:
  - Riparian buffers
  - Emergency management
  - Communication

# of Vulnerabilities

- Forestry – 16
- Facility Design and Construction – 13
- State Parks – 9
- Recreation and Conservation – 4
- Geologic Survey – 3

Vulnerabilities

- Staff training and capacity
- Public outreach and communication
- Resource management and planning
- Changing forest composition
- Habitat connectivity
- Resilience to flooding
- Lake and stream resilience
- Invasive species
- Emergency management
- Human health & safety
- Forest pests
- Rare species
- Drinking and wastewater facilities
- Changing recreational demands and seasons
- Increased wildfire risk

Changing Recreational Demands and Seasons

Increased demand for water-based summer recreation

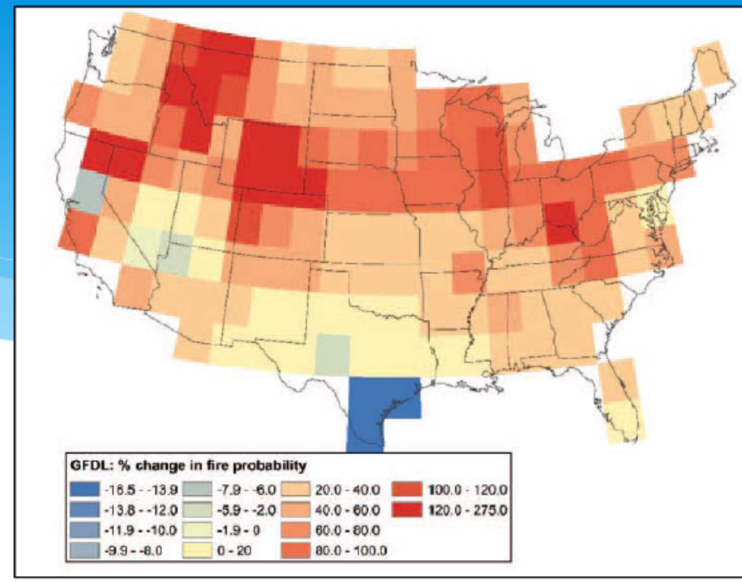
Decreased winter recreation

Fluctuating lake levels

Loss of cold-water fisheries

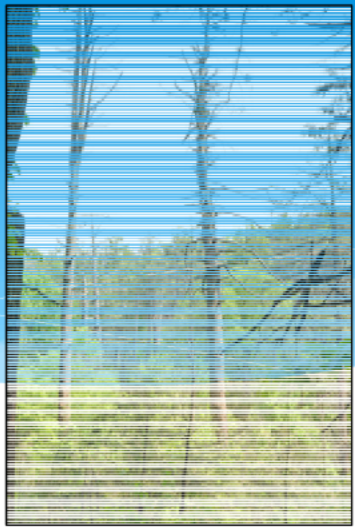
Infrastructure Impacts

Increased Wildfire Risk



- Add more trained firefighters and equipment
- Increase drought monitoring and fire modeling to predict risk
- Use prescribed fire to control fuel loads in wildland-urban interface areas and to make ecosystems more resilient to wildfires.

Forests Pests & Invasives



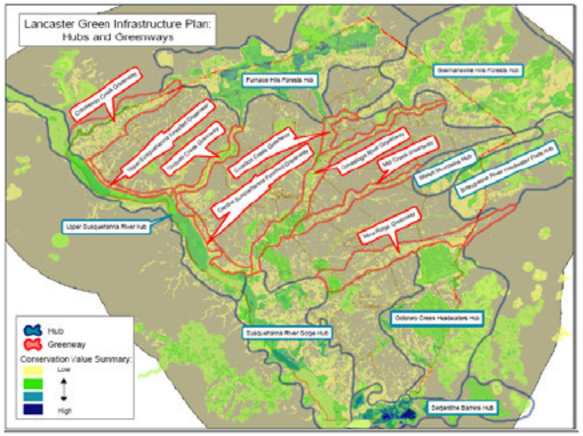
- Incorporate climate change considerations into pest response plans and monitoring.

- Manage for diversity of species and forest types in landscapes impacted by pests and invasives.

- Evaluate whether manipulating density, structure, or species composition improves a forest's ability to resist biological stressors.

- Investigate new methods of invasives control, including biocontrol agents.

Habitat Connectivity & Landscape-Scale Conservation



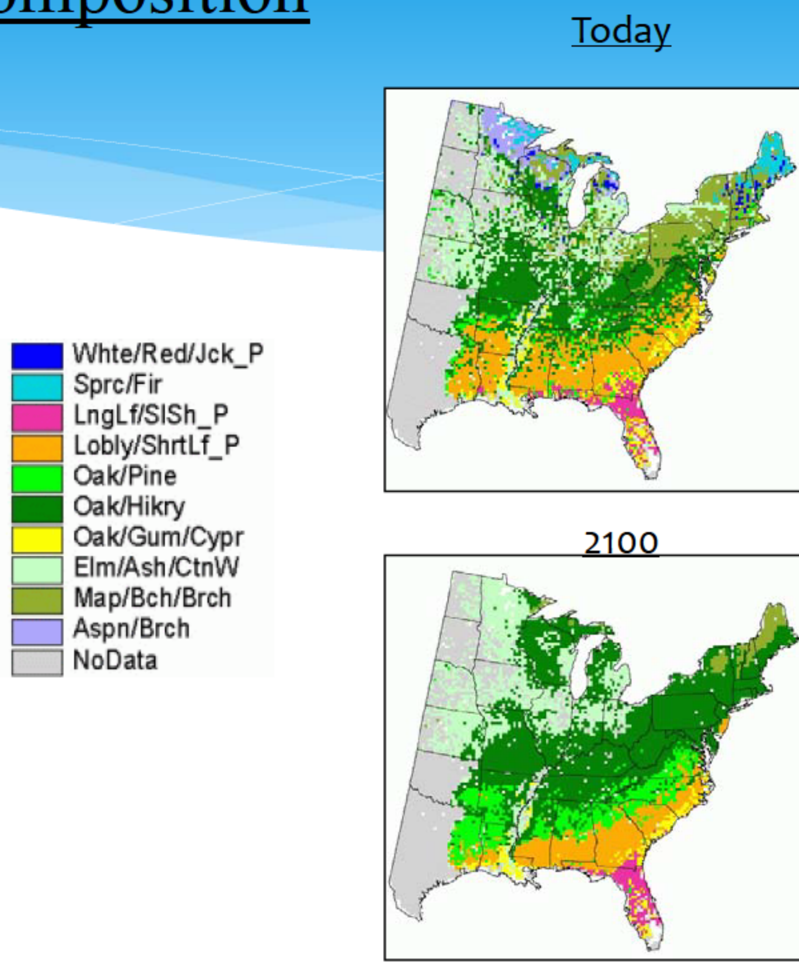
- Conserve key tracts of land that increase connectivity and provide migration corridors.
- Prioritize grant funding that addresses climate change impacts on species, natural communities, and connecting parcels that facilitate the movement of species.
- Maintain or create refugia, areas that could potentially resist climatic changes.
- Conserve biological legacies and unique ecological sites.

Impacts on Aquatic Habitats

- Ensure culverts, bridges, and stream crossings connect cold-water stream communities.
- Restore hydrologic connectivity between riparian areas and the surrounding landscape.
- Plant species along riparian corridors that are better adapted to future climate conditions.
- Monitor lake and stream temperatures, water levels, and chemistry for climate change impacts.

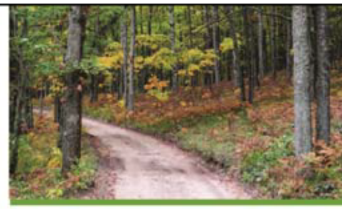
Changing Forest Composition

- Enhance species and structural diversity.
- Facilitate forest community changes:
  - Favor species adapted to future conditions
  - Manage for species with wide moisture and temperature tolerances
  - Establish new mixes of native species
- Consider assisted migration when needed and only after stringent scientific review.
- Permit the use of seeds and germplasm from across a wider geographic range.



FUTURE HEAT ZONES

The heat zone map is based on number of days exceeding 86 °F (30 °C) and can be used as an indicator of heat stress on organisms.



HEAT ZONES (DAYS EXCEEDING 86 °F)

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

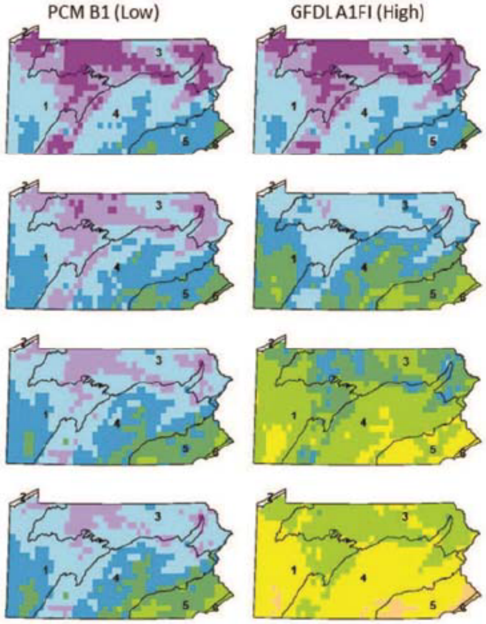
PCM B1 (Low) | GFDL A1FI (High)

1980 to 2009

2010 to 2039

2040 to 2069

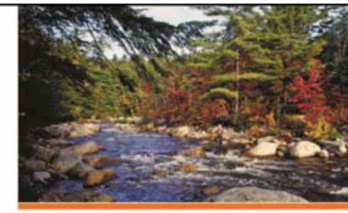
2070 to 2099



1 – Western Allegheny Plateau
2- Erie and Ontario Lake Plain
3 – Northern Allegheny Plateau
4 – Ridge and Valley
5 – Piedmont
6 – Coastal Plain

FUTURE HARDINESS ZONES

The plant hardiness zone map is based on minimum annual temperature and can be used as an indicator of cold-tolerance of plants. Average minimum temperatures break subzones into increments of 5°F.



HARDINESS ZONES (°F)

6a (-10 to -5) | 6b (-5 to 0) | 7a (0 to 5 | 7b (5 to 10) | 8a (10 to 15) | 8b (15 to 20 | 9a (20 to 25) | 9b (25 to 30)

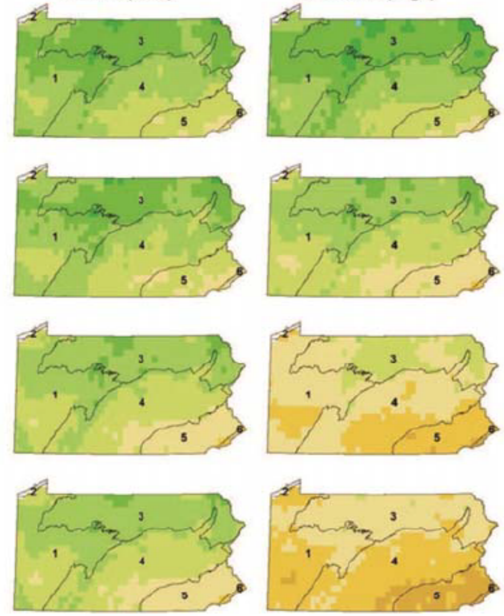
PCM B1 (Low) | GFDL A1FI (High)

1980 to 2009

2010 to 2039

2040 to 2069

2070 to 2099



1 – Western Allegheny Plateau
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CLIMATE CHANGE PROJECTIONS FOR INDIVIDUAL TREE SPECIES

RIDGE AND VALLEY (PENNSYLVANIA SUBREGION 4)

Pennsylvania's forests will be affected by a changing climate during this century. A team of forest managers and researchers created an assessment that describes the vulnerability of forests in the Mid-Atlantic region (https://forestadaptation.org/mid-atlantic/vulnerability-assessment). This handout is summarized from the full assessment, but focuses on one region in Pennsylvania. Model results for additional regions can be found online at (https://forestadaptation.org/PA-DISTRIB).

TREE SPECIES INFORMATION:

The DISTRIB model of the Climate Change Tree Atlas uses inputs of tree abundance, climate, and environmental attributes to simulate current and future species habitat under two climate scenarios. Results for "low" and "high" climate scenarios can be compared on page 2 of this handout.

Remember that models are just tools, and they're not perfect. Output from DISTRIB does not consider many biological or disturbance factors which favor or limit tree establishment, growth, or mortality. For example, the susceptibility of ash species to emerald ash borer is causing widespread mortality and it will likely do even worse than the model suggests. For the 30 most common species, we present such factors not included in the model that may cause species to do better or worse than models suggest.

Despite their limitations, models provide useful information about future expectations. It's important to think of these projections as indicators of potential change in the amount of suitable habitat for a species, but that human choices and other factors will continue to influence tree distribution, movement, and forest composition at individual sites.

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NIACS Northern Institute of Applied Climate Science

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SPECIES	ADDITIONAL CONSIDERATIONS
LIKELY TO DECREASE	
American basswood	Tolerates shade, susceptible to fire
American beech	Susceptible to beech diseases, very shade tolerant
American mountain-ash	Requires specific habitat, intolerant of fire and shade
Atlantic white-cedar	Requires specific habitat, intolerant of fire and drought
Balsam poplar	Vegetative resprout following fire
Bigtooth aspen	Early-sucessional colonizer, susceptible to drought
Black ash	Narrow requirements; Emerald ash borer causes mortality
Black spruce	Prone to sawfly and budworm attacks, drought-sensitve
Butternut	Prone to butternut canker, drought-sensitive
Chokecherry	Shade intolerant, sensitive to browsing and competition
Eastern hemlock	Hemlock woolly adelgid causes widespread mortality
MAY DECREASE	
Black cherry	Susceptible to insects and fire, somewhat drought-tolerant
Chestnut oak	Establishes from seed or sprout, adapted to fire
Cucumber tree	Susceptible to fire topkill
NO CHANGE	
Black locust	Early colonizer, but susceptible to locust borer & heart rot
MIXED MODEL RESULTS	
American chestnut	prone to chestnut blight; intolerant of fire
American hornbeam	Tolerates shade, susceptible to fire and drought
Black willow	Intolerant of shade, fire, and drought
Bur oak	Drought-tolerant, fire-resistant, adaptS to a variety of sites
Eastern cottonwood	Intolerant of shade, fire, defoliators and cankers
MAY INCREASE	
American elm	Grows on a variety of sites, Dutch elm disease
Black oak	Drought tolerant, susceptible to insect pests and diseases
Boxelder	Widespread and tolerant of drought and shade
Chinkapin oak	Tolerates a gradient of temperatures, very adaptable species
Eastern hophornbeam	Grows across a variety of sites, tolerates shade
LIKELY TO INCREASE	
Bear oak; scrub oak	Shade intolerant, susceptible to fire topkill and flood
Bitternut hickory	Drought-tolerant, susceptible to insects and fire topkill
Black walnut	Good disperser, but intolerant of shade and drought
Blackgum	Shade tolerant, fire adapted
Persimmon	Shade tolerant

SOURCE: Prasad, AM; Iverson, LR; Peters, MP; Matthews, SN. 2014. Climate change tree atlas. Northern Research Station, U.S. Forest Service, Delaware, OH. http://www.nrs.fs.fed.us/atlas.

FUTURE PROJECTIONS

The DISTRIB model uses Forest Inventory and Analysis (FIA) data to calculate an Importance Value (IV) for each species on the landscape in order to evaluate potential IV's at the end of this century (2070 – 2099). Those changes are classified in the table below as:

- ▲ **INCREASE** *Projected increase of >20% by 2100*
- ● **NO CHANGE** *Little change (<20%) projected by 2100*
- ▼ **DECREASE** *Projected decrease of >20% by 2100*
- ★ **NEW HABITAT** *Tree Atlas projects new habitat for species not currently present*

ADAPTABILITY

Factors not included in the Tree Atlas model, such as the ability to respond favorably to disturbance, may make a species more or less able to adapt to future stressors. Specific considerations are provided on page 1 for the 30 most abundant species.

- \+ high *Species may perform better than modeled*
- o medium
- \- low *Species may perform worse than modeled*

SPECIES	FIA IV	MODEL RELIABILITY	LOW CLIMATE CHANGE (PCM B1)	HIGH CLIMATE CHANGE (GFDL A1FI)	ADAPT
American basswood	98	M	▼	▼	o
American beech	286	H	▼	▼	o
American chestnut	55	M	▲	●	o
American elm	87	M	●	▲	o
American hornbeam	56	M	▼	▲	o
American mountain-ash	1	M	▼	▼	-
Atlantic white-cedar	1	L	▼	▼	-
Balsam poplar	2	H	▼	▼	o
Bear oak; scrub oak	111	L	▲	▲	o
Bigtooth aspen	123	H	▼	▼	o
Bitternut hickory	27	L	▲	▲	+
Black ash	1	H	▼	▼	-
Black cherry	1129	H	●	▼	-
Black locust	217	L	●	●	o
Black maple	1	L	▼	▼	-
Black oak	361	H	●	▲	o
Black spruce	4	H	▼	▼	o
Black walnut	90	M	▲	▲	o
Black willow	4	L	▼	▲	-
Blackgum	352	H	▲	▲	+
Boxelder	79	M	●	▲	+
Bur oak	2	M	▼	▲	+
Butternut	15	L	▼	▼	-
Chestnut oak	1160	M	●	▼	+
Chinkapin oak	2	M	●	▲	o
Chokecherry	57	L	▼	▼	o
Cucumbertree	13	L	●	▼	o
Eastern cottonwood	367	H	▼	▲	-
Eastern hemlock	134	M	▼	▼	+
Eastern hophornbeam	26	M	●	▲	o
Eastern redbud	49	M	▲	▲	o
Eastern redcedar	274	H	▲	▼	o
Eastern white pine	203	H	●	▼	o
Flowering dogwood	59	M	▲	▼	o
Gray birch	51	M	●	●	o
Green ash	23	M	●	▲	+
Hackberry	2	L	●	▲	+
Honeylocust	2	H	●	▲	o
Jack pine	114	H	▼	▼	+
Mockernut hickory	2	H	▲	▲	+

SPECIES	FIA IV	MODEL RELIABILITY	LOW CLIMATE CHANGE (PCM B1)	HIGH CLIMATE CHANGE (GFDL A1FI)	ADAPT
Northern red oak	881	H	●	▼	+
Osage-orange	1	M	●	▲	+
Paper birch	11	H	▼	▼	o
Pawpaw	5	L	●	●	o
Persimmon	2	M	▲	▲	+
Pignut hickory	128	H	▲	▲	o
Pin cherry	43	M	▼	▼	o
Pin oak	17	L	●	▲	-
Pitch pine	96	H	●	●	o
Quaking aspen	54	H	▼	▼	o
Red maple	2021	H	●	▼	+
Red mulberry	6	L	●	▲	o
Red pine	40	M	▼	▼	o
Red spruce	9	H	▼	▼	-
River birch	7	L	●	▲	o
Sassafras	449	H	▲	●	o
Scarlet oak	187	H	▲	▲	o
Serviceberry	166	M	●	▼	o
Shagbark hickory	45	M	●	▲	o
Shellbark hickory	1	L	▼	▲	o
Shingle oak	4	M	●	▲	o
Shortleaf pine	2	H	●	▲	o
Silver maple	27	M	▼	▲	+
Slippery elm	94	M	●	▲	o
Sourwood	0	H	★	★	+
Southern red oak	1	H	●	▲	+
Striped maple	220	H	●	▼	o
Sugar maple	515	H	●	▼	+
Swamp white oak	12	L	●	▼	o
Sweet birch	826	H	●	▼	-
Sweetgum	1	H	●	▲	o
Sycamore	38	M	▲	▲	o
Table mountain pine	7	M	▼	●	+
Tamarack (native)	16	H	●	▼	-
Virginia pine	117	H	●	▲	o
White ash	844	H	●	▼	-
White oak	502	H	●	▲	+
White spruce	17	M	●	●	o
Yellow birch	81	H	▼	▼	o
Yellow-poplar	224	H	▲	▼	+

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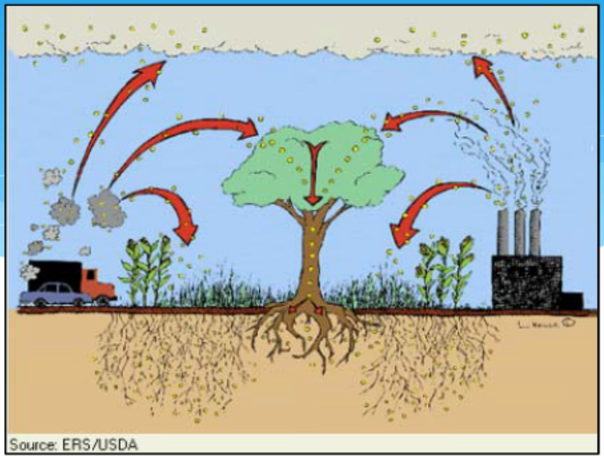
Mitigation Strategies

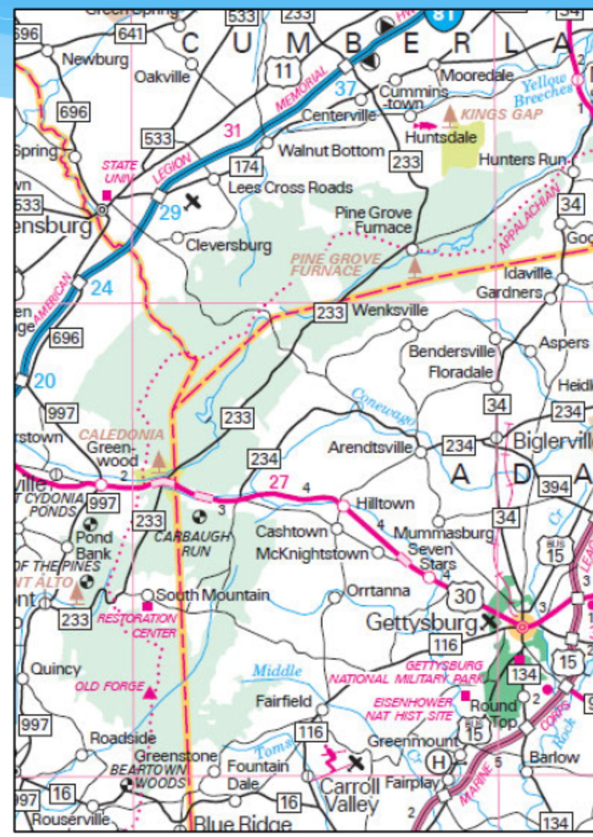
- Carbon sequestration
  - Forest
  - Geologic

- Energy conservation & sustainable design
  - Sustainable site selection
  - Energy reduction strategies
  - Increase use of solar and geothermal technologies



South Mountain Pilot Project

- Michaux State Forest
- Caledonia State Park
- Pine Grove Furnace State Park
- King's Gap Environmental Education Center



Questions?