

HUC 020402 Lower Delaware

HUC 6 Watershed Climate Change Atlas Tree Species

Current and Potential Future Habitat, Capability, and Migration

USDA Forest Service
Northern Research Station
Landscape Change Research Group
Iverson, Peters, Prasad, Matthews

	sq. km	sq. mi	FIA Plots
Area of Region	17,434	6,731.3	222

Species Information

The columns below provide brief summaries of the species associated with the region and described in the table on the next pages. Definitions are provided in the Excel file for this region.

Genus	Species	Abundance		Model		Potential Change in Habitat Suitability		Capability to Cope or Persist		Migration Potential					
				Reliability	Adaptability	Scenario RCP45	Scenario RCP85	Scenario RCP45	Scenario RCP85	SHIFT RCP45	SHIFT RCP85				
Ash	2			High	23	24	Increase	22	25	Very Good	3	3	Likely	2	2
Hickory	5			Medium	42	62	No Change	22	17	Good	23	21	Infill	27	27
Maple	6	Abundant	1	Low	34	18	Decrease	21	23	Fair	8	12	Migrate	9	12
Oak	14	Common	21	FIA	12		New	27	28	Poor	15	13			
Pine	7	Rare	55				Unknown	19	18	Very Poor	15	16			
Other	43	Absent	31							FIA Only	6	6			
	77		108		111	104		111	111	Unknown	7	6			
											77	77			

Potential Changes in Climate Variables

Temperature (°F)

Scenario	2009	2039	2069	2099		
Annual	CCSM45	46.6	47.8	49.2	49.3	
Average	CCSM85	46.6	48.0	49.6	51.6	
	GFDL45	46.6	48.8	50.3	51.0	
	GFDL85	46.6	48.7	51.1	53.7	
	HAD45	46.6	48.3	50.4	51.4	
	HAD85	46.6	48.3	50.9	53.9	
Growing Season	CCSM45	57.4	58.6	59.7	60.0	
	CCSM85	57.4	58.7	60.3	62.7	
May—Sep	GFDL45	57.4	59.8	61.5	62.5	
	GFDL85	57.4	59.9	62.5	65.4	
	HAD45	57.4	59.2	61.1	62.3	
	HAD85	57.4	58.9	61.9	65.1	
Coldest Month	CCSM45	30.5	31.9	32.9	33.2	
	CCSM85	30.5	32.2	33.0	34.2	
Average	GFDL45	30.5	32.7	33.2	33.7	
	GFDL85	30.5	32.6	33.4	34.5	
	HAD45	30.5	31.4	32.9	33.1	
	HAD85	30.5	32.0	33.1	34.6	
Warmest Month	CCSM45	61.4	62.8	63.4	63.5	
	CCSM85	61.4	62.9	64.0	65.2	
Average	GFDL45	61.4	63.4	64.6	65.4	
	GFDL85	61.4	64.2	65.6	67.4	
	HAD45	61.4	63.6	64.6	65.2	
	HAD85	61.4	63.4	65.1	67.2	

Precipitation (in)

Scenario	2009	2039	2069	2099		
Annual	CCSM45	31.2	33.2	34.6	36.4	
Total	CCSM85	31.2	33.9	35.2	38.4	
	GFDL45	31.2	35.0	37.4	37.5	
	GFDL85	31.2	33.4	37.3	38.6	
	HAD45	31.2	33.2	34.0	33.6	
	HAD85	31.2	35.6	33.0	34.8	
Growing Season	CCSM45	14.0	16.6	17.0	18.2	
	CCSM85	14.0	16.1	16.8	18.0	
May—Sep	GFDL45	14.0	15.2	16.2	17.0	
	GFDL85	14.0	14.6	16.1	16.7	
	HAD45	14.0	15.2	14.2	13.4	
	HAD85	14.0	15.5	13.5	13.4	

NOTE: For the six climate variables, four 30-year periods are used to indicate six potential future trajectories. The period ending in 2009 is based on modeled observations from the PRISM Climate Group and the three future periods were obtained from the NASA NEX-DCP30 dataset. Future climate projections from three models under two emission scenarios show estimates of each climate variable within the region. The three models are CCSM4, GFDL CM3, and HadGEM2-ES and the emission scenarios are the 4.5 and 8.5 RCP. The average value for the region is reported, even though locations within the region may vary substantially based on latitude, elevation, land-use, or other factors.

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Common Name	Scientific Name	Range	MR	%Cell	FIAsum	FIAiv	ChngCl45	ChngCl85	Adap	Abund	Capabil45	Capabil85	SHIFT45	SHIFT85	SSO	N
red maple	Acer rubrum	WDH	High	74.4	768.8	11.8	No change	No change	High	Abundant	Very Good	Very Good			1	1
pitch pine	Pinus rigida	NSH	High	16.5	494.2	15.1	Lg. dec.	Lg. dec.	Medium	Common	Poor	Poor			0	2
white oak	Quercus alba	WDH	Medium	37.7	474.7	10.8	No change	No change	High	Common	Good	Good			1	3
sweetgum	Liquidambar styraciflua	WDH	High	27.4	408.1	16.1	Sm. inc.	Sm. inc.	Medium	Common	Good	Good	Infill ++	Infill ++	1	4
black cherry	Prunus serotina	WDL	Medium	56.1	349.5	8.4	Sm. dec.	Sm. dec.	Low	Common	Poor	Poor			0	5
yellow-poplar	Liriodendron tulipifera	WDH	High	47.6	331.5	11.2	No change	Sm. dec.	High	Common	Good	Fair			1	6
chestnut oak	Quercus prinus	NDH	High	29.7	252.5	6.2	No change	Sm. dec.	High	Common	Good	Fair			1	7
blackgum	Nyssa sylvatica	WDL	Medium	49.6	231.7	4.0	No change	No change	High	Common	Good	Good			1	8
black oak	Quercus velutina	WDH	High	37.5	217.5	6.7	Sm. inc.	Sm. inc.	Medium	Common	Good	Good			1	9
white ash	Fraxinus americana	WDL	Medium	38.1	212.0	10.2	Sm. dec.	Sm. dec.	Low	Common	Poor	Poor			0	10
black walnut	Juglans nigra	WDH	Low	32.3	177.0	12.5	Sm. dec.	Lg. dec.	Medium	Common	Poor	Poor			0	11
scarlet oak	Quercus coccinea	WDL	Medium	27.6	169.1	4.9	Sm. dec.	Sm. dec.	Medium	Common	Poor	Poor			0	12
northern red oak	Quercus rubra	WDH	Medium	34.4	147.3	5.3	No change	No change	High	Common	Good	Good			1	13
American holly	Ilex opaca	NSL	Medium	15.1	137.3	5.4	No change	No change	Medium	Common	Fair	Fair	Infill +	Infill +	1	14
sassafras	Sassafras albidum	WSL	Low	50.8	97.4	2.5	No change	Sm. dec.	Medium	Common	Fair	Poor			1	15
sweet birch	Betula lenta	NDH	High	20.5	96.8	4.5	Lg. dec.	Lg. dec.	Low	Common	Very Poor	Very Poor			0	16
Virginia pine	Pinus virginiana	NDH	High	8.3	90.4	5.9	No change	No change	Medium	Common	Fair	Fair	Infill +	Infill +	1	17
American beech	Fagus grandifolia	WDH	High	25.7	78.6	5.1	Sm. inc.	Sm. inc.	Medium	Common	Good	Good	Infill ++	Infill ++	1	18
loblolly pine	Pinus taeda	WDH	High	7	74.1	4.5	Lg. inc.	Lg. inc.	Medium	Common	Very Good	Very Good	Infill ++	Infill ++	2	19
black locust	Robinia pseudoacacia	NDH	Low	17.4	63.7	7.3	Sm. inc.	Sm. inc.	Medium	Common	Good	Good			1	20
southern red oak	Quercus falcata	WDL	Medium	12.9	60.2	3.2	Lg. inc.	Lg. inc.	High	Common	Very Good	Very Good	Infill ++	Infill ++	2	21
Atlantic white-cedar	Chamaecyparis thyoides	NSH	Low	3.7	56.2	16.1	Sm. dec.	Sm. dec.	Low	Rare	Very Poor	Very Poor			2	22
Norway maple	Acer platanoides	NSL	FIA	18	53.6	8.0	Unknown	Unknown	NA	Common	NNIS	NNIS			0	23
eastern white pine	Pinus strobus	WDH	High	11	49.3	6.2	Sm. dec.	Lg. dec.	Low	Rare	Very Poor	Very Poor			0	24
eastern redcedar	Juniperus virginiana	WDH	Medium	11.3	48.7	6.8	Lg. inc.	Lg. inc.	Medium	Rare	Good	Good	Infill ++	Infill ++	1	25
boxelder	Acer negundo	WSH	Low	20.1	45.0	5.6	No change	No change	High	Rare	Fair	Fair	Infill +	Infill +	1	26
willow oak	Quercus phellos	NSL	Low	9	44.5	3.2	No change	No change	Medium	Rare	Poor	Poor	Infill +	Infill +	2	27
mockernut hickory	Carya alba	WDL	Medium	16.8	40.1	3.6	Lg. inc.	Lg. inc.	High	Rare	Good	Good			1	28
green ash	Fraxinus pennsylvanica	WSH	Low	8.9	37.5	6.4	No change	No change	Medium	Rare	Poor	Poor	Infill +	Infill +	1	29
pignut hickory	Carya glabra	WDL	Medium	14.8	36.4	2.4	Lg. inc.	Lg. inc.	Medium	Rare	Good	Good	Infill ++	Infill ++	1	30
silver maple	Acer saccharinum	NSH	Low	6.5	35.5	9.6	No change	No change	High	Rare	Fair	Fair	Infill +	Infill +	1	31
black willow	Salix nigra	NSH	Low	4.2	32.7	7.6	Sm. dec.	No change	Low	Rare	Very Poor	Very Poor			2	32
shortleaf pine	Pinus echinata	WDH	High	2.2	31.7	12.9	No change	Sm. inc.	Medium	Rare	Poor	Fair	Infill +	Infill +	2	33
ailanthus	Ailanthus altissima	NSL	FIA	10.3	23.0	3.9	Unknown	Unknown	NA	Rare	NNIS	NNIS			0	34
eastern cottonwood	Populus deltoides	NSH	Low	3.8	21.5	15.4	Sm. dec.	Sm. dec.	Medium	Rare	Very Poor	Very Poor			2	35
pin oak	Quercus palustris	NSH	Low	18.1	21.0	5.5	Sm. inc.	Sm. inc.	Low	Rare	Poor	Poor	Infill +	Infill +	1	36
sugar maple	Acer saccharum	WDH	High	5.9	20.3	5.3	Sm. inc.	Sm. inc.	High	Rare	Good	Good	Infill ++	Infill ++	2	37
shagbark hickory	Carya ovata	WSL	Medium	7.9	17.7	2.8	No change	No change	Medium	Rare	Poor	Poor	Infill +	Infill +	2	38
gray birch	Betula populifolia	NSL	Low	3.9	15.7	2.2	Sm. dec.	Sm. dec.	Medium	Rare	Very Poor	Very Poor			0	39
bigtooth aspen	Populus grandidentata	NSL	Medium	4.5	15.4	1.9	Lg. dec.	Lg. dec.	Medium	Rare	Very Poor	Very Poor			2	40
sweetbay	Magnolia virginiana	NSL	Medium	6.6	15.1	1.3	Sm. inc.	Sm. inc.	Medium	Rare	Fair	Fair	Infill +	Infill +	2	41
common persimmon	Diospyros virginiana	NSL	Low	4.9	14.9	2.7	No change	No change	High	Rare	Fair	Fair	Infill +	Infill +	2	42
American hornbeam; muscle	Carpinus caroliniana	WSL	Low	5.1	13.5	3.3	No change	Sm. inc.	Medium	Rare	Poor	Fair	Infill +	Infill +	1	43
swamp chestnut oak	Quercus michauxii	NSL	Low	6.5	12.6	1.8	No change	No change	Medium	Rare	Poor	Poor	Infill +	Infill +	2	44
eastern hemlock	Tsuga canadensis	NSH	High	4	11.4	1.9	No change	No change	Low	Rare	Very Poor	Very Poor			2	45
flowering dogwood	Cornus florida	WDL	Medium	12.2	8.4	1.1	Lg. inc.	Lg. inc.	Medium	Rare	Good	Good			1	46
slippery elm	Ulmus rubra	WSL	Low	4.3	8.3	4.4	No change	No change	Medium	Rare	Poor	Poor	Infill +	Infill +	1	47



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paulownia	Paulownia tomentosa	NSL	FIA	4.4	8.3	28.0	Unknown	Unknown	NA	Rare	NNIS	NNIS			0	48
American elm	Ulmus americana	WDH	Medium	12.6	8.2	1.8	Lg. inc.	Lg. inc.	Medium	Rare	Good	Good	Infill ++	Infill ++	2	49
water oak	Quercus nigra	WDH	High	0.7	7.5	0.7	Lg. inc.	Lg. inc.	Medium	Rare	Good	Good			2	50
white mulberry	Morus alba	NSL	FIA	1.3	6.7	5.8	Unknown	Unknown	NA	Rare	NNIS	NNIS			0	51
post oak	Quercus stellata	WDH	High	2.8	6.6	0.9	Lg. inc.	Lg. inc.	High	Rare	Good	Good			2	52
bitternut hickory	Carya cordiformis	WSL	Low	6.7	5.9	4.5	Sm. inc.	Lg. inc.	High	Rare	Good	Good	Infill ++	Infill ++	1	53
sycamore	Platanus occidentalis	NSL	Low	9	5.5	2.7	Lg. inc.	Lg. inc.	Medium	Rare	Good	Good	Infill ++	Infill ++	2	54
bear oak; scrub oak	Quercus ilicifolia	NSL	FIA	2.5	5.4	0.5	Unknown	Unknown	Medium	Rare	FIA Only	FIA Only			0	55
hackberry	Celtis occidentalis	WDH	Medium	3.2	5.4	8.6	No change	No change	High	Rare	Fair	Fair	Infill +	Infill +	2	56
Osage-orange	Maclura pomifera	NDH	Medium	6	5.0	7.3	Sm. dec.	Sm. dec.	High	Rare	Poor	Poor	Infill +		2	57
pin cherry	Prunus pensylvanica	NSL	Low	0.7	4.7	1.5	Very Lg. dec.	Lg. dec.	Medium	Rare	Lost	Very Poor			0	58
red mulberry	Morus rubra	NSL	Low	2.6	4.3	12.9	Lg. dec.	Lg. dec.	Medium	Rare	Very Poor	Very Poor			2	59
blackjack oak	Quercus marilandica	NSL	Medium	0.7	3.6	0.3	Sm. inc.	Lg. inc.	High	Rare	Good	Good			2	60
white spruce	Picea glauca	NSL	Medium	0.6	3.5	6.2	Sm. dec.	Sm. dec.	Medium	Rare	Very Poor	Very Poor			0	61
Norway spruce	Picea abies	NSH	FIA	4.8	3.4	2.8	Unknown	Unknown	NA	Rare	NNIS	NNIS			0	62
river birch	Betula nigra	NSL	Low	2.5	2.9	3.3	No change	Lg. inc.	Medium	Rare	Poor	Good		Infill ++	2	63
American basswood	Tilia americana	WSL	Medium	5	1.8	1.2	Lg. inc.	Sm. inc.	Medium	Rare	Good	Fair	Infill ++	Infill +	2	64
sand hickory	Carya pallida	NSL	FIA	1.4	1.3	0.5	Unknown	Unknown	NA	Rare	FIA Only	FIA Only			0	65
Kentucky coffeetree	Gymnocladus dioicus	NSLX	FIA	0.6	1.2	2.1	Unknown	Unknown	Medium	Rare	FIA Only	FIA Only			0	66
serviceberry	Amelanchier spp.	NSL	Low	3.9	1.1	0.2	Lg. dec.	Sm. dec.	Medium	Rare	Very Poor	Very Poor			0	67
tamarack (native)	Larix laricina	NSH	High	0.5	1.0	0.3	Lg. dec.	Lg. dec.	Low	Rare	Very Poor	Very Poor			0	68
eastern hophornbeam; ironw	Ostrya virginiana	WSL	Low	2.7	1.0	0.5	Lg. inc.	Lg. inc.	High	Rare	Good	Good			2	69
chokecherry	Prunus virginiana	NSLX	FIA	0.4	0.8	0.9	Unknown	Unknown	Medium	Rare	FIA Only	FIA Only			0	70
yellow birch	Betula alleghaniensis	NDL	High	3.2	0.6	1.1	Lg. dec.	Lg. dec.	Medium	Rare	Very Poor	Very Poor			0	71
striped maple	Acer pensylvanicum	NSL	Medium	0.1	0.5	0.1	Lg. dec.	Lg. dec.	Medium	Rare	Very Poor	Very Poor			0	72
butternut	Juglans cinerea	NSLX	FIA	0.5	0.3	0.5	Unknown	Unknown	Low	Rare	FIA Only	FIA Only			0	73
laurel oak	Quercus laurifolia	NDH	Medium	2.5	0.2	1.2	Lg. inc.	Lg. inc.	Medium	Rare	Good	Good			2	74
Scots pine	Pinus sylvestris	NSH	FIA	1.4	0.1	0.3	Unknown	Unknown	NA	Rare	NNIS	NNIS			0	75
red pine	Pinus resinosa	NSH	Medium	0.1	0.1	0.0	Lg. dec.	Lg. dec.	Low	Rare	Very Poor	Very Poor			0	76
American chestnut	Castanea dentata	NSLX	FIA	1.4	0.0	0.1	Unknown	Unknown	Medium	Rare	FIA Only	FIA Only			0	77
slash pine	Pinus elliotii	NDH	High	0	0	0	New Habitat	New Habitat	Medium	Absent	New Habitat	New Habitat			3	78
longleaf pine	Pinus palustris	NSH	Medium	0	0	0	New Habitat	New Habitat	Medium	Absent	New Habitat	New Habitat			3	79
pond pine	Pinus serotina	NSH	Medium	0	0	0	New Habitat	New Habitat	Low	Absent	New Habitat	New Habitat	Likely +	Likely +	3	80
bald cypress	Taxodium distichum	NSH	Medium	0	0	0	New Habitat	New Habitat	Medium	Absent	New Habitat	New Habitat	Migrate ++	Migrate ++	3	81
pond cypress	Taxodium ascendens	NSH	Medium	0	0	0	New Habitat	New Habitat	Medium	Absent	New Habitat	New Habitat			3	82
florida maple	Acer barbatum	NSL	Low	0	0	0	New Habitat	New Habitat	High	Absent	New Habitat	New Habitat			3	83
pawpaw	Asimina triloba	NSL	Low	0	0	0	Unknown	Unknown	Medium	Modeled	Unknown	Unknown			0	84
cittamwood/gum bumelia	Sideroxylon lanuginosum ssp.	NSL	Low	0	0	0	New Habitat	New Habitat	High	Absent	New Habitat	New Habitat			0	85
water hickory	Carya aquatica	NSL	Medium	0	0	0	New Habitat	New Habitat	Medium	Absent	New Habitat	New Habitat			3	86
pecan	Carya illinoensis	NSH	Low	0	0	0	New Habitat	New Habitat	Low	Absent	New Habitat	New Habitat		Migrate +	3	87
black hickory	Carya texana	NDL	High	0	0	0	New Habitat	New Habitat	Medium	Absent	New Habitat	New Habitat			0	88
sugarberry	Celtis laevigata	NDH	Medium	0	0	0	New Habitat	New Habitat	Medium	Absent	New Habitat	New Habitat		Migrate ++	3	89
eastern redbud	Cercis canadensis	NSL	Low	0	0	0	New Habitat	New Habitat	Medium	Absent	New Habitat	New Habitat	Migrate +	Migrate +	3	90
black ash	Fraxinus nigra	WSH	Medium	0	0	0	Unknown	Unknown	Low	Modeled	Unknown	Unknown			0	91
loblolly-bay	Gordonia lasianthus	NSH	Medium	0	0	0	New Habitat	New Habitat	Medium	Absent	New Habitat	New Habitat	Migrate +	Migrate +	3	92
silverbell	Halesia spp.	NSL	Low	0	0	0	Unknown	Unknown	Medium	Absent	Unknown	Unknown			0	93
bigleaf magnolia	Magnolia macrophylla	NSL	Low	0	0	0	Unknown	Unknown	Medium	Absent	Unknown	Unknown			0	94



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water tupelo	<i>Nyssa aquatica</i>	NSH	Medium	0	0	0	New Habitat	New Habitat	Low	Absent	New Habitat	New Habitat	Migrate +	Migrate +	3	95
swamp tupelo	<i>Nyssa biflora</i>	NDH	Medium	0	0	0	New Habitat	New Habitat	Low	Absent	New Habitat	New Habitat	Migrate ++	Migrate ++	3	96
sourwood	<i>Oxydendrum arboreum</i>	NDL	High	0	0	0	New Habitat	New Habitat	High	Absent	New Habitat	New Habitat	Migrate +	Migrate +	3	97
redbay	<i>Persea borbonia</i>	NSL	Low	0	0	0	New Habitat	New Habitat	High	Absent	New Habitat	New Habitat	Migrate +	Migrate +	3	98
water elm	<i>Planera aquatica</i>	NSL	Low	0	0	0	New Habitat	New Habitat	Medium	Absent	New Habitat	New Habitat			0	99
balsam poplar	<i>Populus balsamifera</i>	NSH	Medium	0	0	0	Unknown	Unknown	Medium	Modeled	Unknown	Unknown			0	100
quaking aspen	<i>Populus tremuloides</i>	WDH	High	0	0	0	Unknown	Unknown	Medium	Absent	Unknown	Unknown			0	101
swamp white oak	<i>Quercus bicolor</i>	NSL	Low	0	0	0	New Habitat	New Habitat	Medium	Absent	New Habitat	New Habitat	Likely +	Likely +	3	102
cherrybark oak; swamp red o	<i>Quercus pagoda</i>	NSL	Medium	0	0	0	New Habitat	New Habitat	Medium	Absent	New Habitat	New Habitat	Migrate +	Migrate ++	3	103
turkey oak	<i>Quercus laevis</i>	NSH	Medium	0	0	0	New Habitat	New Habitat	High	Absent	New Habitat	New Habitat			3	104
overcup oak	<i>Quercus lyrata</i>	NSL	Medium	0	0	0	New Habitat	New Habitat	Low	Absent	New Habitat	New Habitat		Migrate +	3	105
chinkapin oak	<i>Quercus muehlenbergii</i>	NSL	Medium	0	0	0	New Habitat	New Habitat	Medium	Absent	New Habitat	New Habitat			3	106
Nuttall oak	<i>Quercus texana</i>	NSH	Medium	0	0	0	New Habitat	New Habitat	High	Absent	New Habitat	New Habitat			0	107
live oak	<i>Quercus virginiana</i>	NDH	High	0	0	0	New Habitat	New Habitat	Medium	Absent	New Habitat	New Habitat			0	108
bluejack oak	<i>Quercus incana</i>	NSL	Low	0	0	0	Unknown	New Habitat	Medium	Absent	Unknown	New Habitat			3	109
winged elm	<i>Ulmus alata</i>	WDL	Medium	0	0	0	New Habitat	New Habitat	Medium	Absent	New Habitat	New Habitat	Migrate +	Migrate ++	3	110
cedar elm	<i>Ulmus crassifolia</i>	NDH	Medium	0	0	0	New Habitat	New Habitat	Low	Absent	New Habitat	New Habitat			0	111