

One x One Degree
Climate Change Atlas Tree Species
 Current and Potential Future Habitat, Capability, and Migration

| | | | |
|----------------|---------|---------|-----------|
| | sq. km | sq. mi | FIA Plots |
| Area of Region | 8,686.5 | 3,353.9 | 413 |

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 | Scenario | Scenario | Scenario | SHIFT | SHIFT | |
| | | | | | | RCP45 | RCP85 | RCP45 | RCP85 | RCP45 | RCP85 | |
| Ash | 3 | | | High | 16 | 19 | Increase | 13 | 14 | Very Good | 6 | 4 |
| Hickory | 1 | | | Medium | 22 | 32 | No Change | 14 | 12 | Good | 11 | 14 |
| Maple | 5 | Abundant | 5 | Low | 20 | 11 | Decrease | 13 | 14 | Fair | 8 | 9 |
| Oak | 6 | Common | 24 | FIA | 6 | | New | 15 | 16 | Poor | 11 | 9 |
| Pine | 4 | Rare | 17 | | | | Unknown | 9 | 8 | Very Poor | 2 | 2 |
| Other | 27 | Absent | 18 | | | | | | | FIA Only | 4 | 4 |
| | 46 | | 64 | | 64 | 62 | | 64 | 64 | Unknown | 3 | 2 |
| | | | | | | | | | | | 45 | 44 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | 11 | 14 |

Potential Changes in Climate Variables

Temperature (°F)

| | Scenario | 2009 | 2039 | 2069 | 2099 | |
|--------------------------|----------|------|------|------|------|--|
| Annual Average | CCSM45 | 42.4 | 44.1 | 47.3 | 47.4 | |
| | CCSM85 | 42.4 | 45.1 | 48.2 | 51.8 | |
| | GFDL45 | 42.4 | 45.6 | 48.2 | 49.6 | |
| | GFDL85 | 42.4 | 45.8 | 49.3 | 54.5 | |
| | HAD45 | 42.4 | 45.6 | 49.3 | 51.2 | |
| | HAD85 | 42.4 | 46.1 | 50.4 | 56.1 | |
| Growing Season (May—Sep) | CCSM45 | 62.6 | 64.4 | 67.1 | 67.3 | |
| | CCSM85 | 62.6 | 65.3 | 68.3 | 72.5 | |
| | GFDL45 | 62.6 | 66.4 | 69.5 | 71.6 | |
| | GFDL85 | 62.6 | 66.8 | 70.8 | 76.7 | |
| | HAD45 | 62.6 | 65.9 | 68.8 | 71.1 | |
| | HAD85 | 62.6 | 65.9 | 70.4 | 76.2 | |
| Coldest Month (Average) | CCSM45 | 9.9 | 11.4 | 14.0 | 14.3 | |
| | CCSM85 | 9.9 | 11.7 | 13.9 | 16.5 | |
| | GFDL45 | 9.9 | 13.3 | 15.2 | 15.6 | |
| | GFDL85 | 9.9 | 13.8 | 15.6 | 18.8 | |
| | HAD45 | 9.9 | 11.3 | 15.7 | 15.6 | |
| | HAD85 | 9.9 | 15.1 | 18.2 | 21.9 | |
| Warmest Month (Average) | CCSM45 | 68.9 | 71.0 | 72.6 | 73.1 | |
| | CCSM85 | 68.9 | 72.2 | 74.2 | 76.8 | |
| | GFDL45 | 68.9 | 72.5 | 74.1 | 75.7 | |
| | GFDL85 | 68.9 | 73.4 | 75.5 | 79.0 | |
| | HAD45 | 68.9 | 72.6 | 74.1 | 75.7 | |
| | HAD85 | 68.9 | 73.3 | 75.6 | 79.6 | |

Precipitation (in)

| | Scenario | 2009 | 2039 | 2069 | 2099 | |
|--------------------------|----------|------|------|------|------|--|
| Annual Total | CCSM45 | 32.4 | 33.7 | 33.0 | 33.2 | |
| | CCSM85 | 32.4 | 31.8 | 32.0 | 32.7 | |
| | GFDL45 | 32.4 | 35.7 | 37.1 | 35.0 | |
| | GFDL85 | 32.4 | 35.5 | 38.5 | 36.9 | |
| | HAD45 | 32.4 | 34.3 | 33.9 | 34.5 | |
| | HAD85 | 32.4 | 33.6 | 34.8 | 36.6 | |
| Growing Season (May—Sep) | CCSM45 | 20.0 | 20.3 | 19.1 | 19.6 | |
| | CCSM85 | 20.0 | 19.4 | 18.7 | 18.0 | |
| | GFDL45 | 20.0 | 21.8 | 22.1 | 20.2 | |
| | GFDL85 | 20.0 | 21.8 | 22.3 | 19.9 | |
| | HAD45 | 20.0 | 20.0 | 18.5 | 18.9 | |
| | HAD85 | 20.0 | 19.4 | 17.7 | 18.1 | |

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.

Cite as: Iverson, L.R.; Prasad, A.M.; Peters, M.P.; Matthews, S.N. 2019. Facilitating Adaptive Forest Management under Climate Change: A Spatially Specific Synthesis of 125 Species for Habitat Changes and Assisted Migration over the Eastern United States. *Forests*. 10(11): 989. <https://doi.org/10.3390/f10110989>.

Current and Potential Future Habitat, Capability, and Migration

| 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 | 94.4 | 1524.7 | 12.4 | No change | Sm. dec. | High | Abundant | Very Good | Good | | | 1 | 1 |
| quaking aspen | Populus tremuloides | WDH | High | 89 | 1439.4 | 11.9 | Sm. dec. | Sm. dec. | Medium | Abundant | Fair | Fair | | | 0 | 2 |
| sugar maple | Acer saccharum | WDH | High | 77.7 | 973.4 | 9.3 | Sm. dec. | Sm. dec. | High | Abundant | Good | Good | | | 1 | 3 |
| northern red oak | Quercus rubra | WDH | Medium | 78.4 | 844.7 | 9.1 | No change | Sm. dec. | High | Abundant | Very Good | Good | | | 1 | 4 |
| American basswood | Tilia americana | WSL | Medium | 75.8 | 537.4 | 5.9 | No change | Sm. dec. | Medium | Abundant | Good | Fair | | | 1 | 5 |
| paper birch | Betula papyrifera | WDH | High | 86.1 | 435.2 | 3.7 | No change | No change | Medium | Common | Fair | Fair | | | 1 | 6 |
| American elm | Ulmus americana | WDH | Medium | 74.2 | 414.9 | 3.8 | Sm. inc. | Sm. inc. | Medium | Common | Good | Good | | | 1 | 7 |
| black ash | Fraxinus nigra | WSH | Medium | 63 | 397.5 | 4.7 | No change | No change | Low | Common | Poor | Poor | | | 0 | 8 |
| red pine | Pinus resinosa | NSH | Medium | 28.4 | 396.0 | 9.8 | Sm. inc. | Sm. inc. | Low | Common | Fair | Fair | | | 1 | 9 |
| black cherry | Prunus serotina | WDL | Medium | 68.5 | 356.0 | 3.6 | Lg. inc. | Sm. inc. | Low | Common | Good | Fair | | | 1 | 10 |
| bigtooth aspen | Populus grandidentata | NSL | Medium | 57.7 | 352.9 | 4.5 | No change | Sm. dec. | Medium | Common | Fair | Poor | | | 1 | 11 |
| white oak | Quercus alba | WDH | Medium | 59.1 | 343.4 | 4.9 | Sm. inc. | Sm. inc. | High | Common | Very Good | Very Good | | | 1 | 12 |
| northern pin oak | Quercus ellipsoidalis | NSH | Medium | 28.4 | 326.8 | 7.7 | Sm. inc. | No change | High | Common | Very Good | Good | | | 1 | 13 |
| eastern white pine | Pinus strobus | WDH | High | 45.5 | 326.1 | 5.3 | Sm. inc. | Sm. inc. | Low | Common | Fair | Fair | | | 1 | 14 |
| bur oak | Quercus macrocarpa | NDH | Medium | 52.3 | 305.7 | 4.2 | Sm. inc. | Sm. inc. | High | Common | Very Good | Very Good | | | 1 | 15 |
| tamarack (native) | Larix laricina | NSH | High | 23.5 | 246.6 | 6.6 | No change | No change | Low | Common | Poor | Poor | | | 0 | 16 |
| eastern hophornbeam; ironw | Ostrya virginiana | WSL | Low | 77.2 | 221.8 | 2.1 | No change | No change | High | Common | Good | Good | | | 1 | 17 |
| boxelder | Acer negundo | WSH | Low | 15.4 | 215.4 | 6.8 | No change | No change | High | Common | Good | Good | | | 1 | 18 |
| green ash | Fraxinus pennsylvanica | WSH | Low | 59 | 195.4 | 2.7 | Sm. inc. | Lg. inc. | Medium | Common | Good | Very Good | | | 1 | 19 |
| balsam fir | Abies balsamea | NDH | High | 38.7 | 185.3 | 3.6 | Sm. dec. | No change | Low | Common | Poor | Poor | | | 0 | 20 |
| white ash | Fraxinus americana | WDL | Medium | 70.1 | 164.0 | 2.0 | Lg. inc. | Lg. inc. | Low | Common | Good | Good | | | 1 | 21 |
| yellow birch | Betula alleghaniensis | NDL | High | 43.2 | 122.1 | 2.0 | Sm. dec. | No change | Medium | Common | Poor | Fair | | | 1 | 22 |
| white spruce | Picea glauca | NSL | Medium | 20.2 | 121.0 | 5.3 | Sm. dec. | No change | Medium | Common | Poor | Fair | | | 1 | 23 |
| jack pine | Pinus banksiana | NSH | Medium | 13.9 | 108.0 | 5.5 | Sm. dec. | Sm. dec. | High | Common | Fair | Fair | | | 1 | 24 |
| black spruce | Picea mariana | NSH | High | 12.3 | 99.6 | 4.9 | Lg. dec. | Lg. dec. | Medium | Common | Poor | Poor | | | 0 | 25 |
| silver maple | Acer saccharinum | NSH | Low | 5.2 | 68.3 | 11.1 | No change | No change | High | Common | Good | Good | Infill ++ | Infill ++ | 1 | 26 |
| American hornbeam; musclev | Carpinus caroliniana | WSL | Low | 49.1 | 65.4 | 1.0 | Sm. dec. | Sm. dec. | Medium | Common | Poor | Poor | | | 0 | 27 |
| bitternut hickory | Carya cordiformis | WSL | Low | 31.3 | 55.3 | 1.4 | Sm. inc. | Sm. inc. | High | Common | Very Good | Very Good | | | 1 | 28 |
| eastern hemlock | Tsuga canadensis | NSH | High | 13.6 | 51.3 | 2.6 | Sm. inc. | No change | Low | Common | Fair | Poor | Infill + | Infill + | 1 | 29 |
| black oak | Quercus velutina | WDH | High | 5.3 | 41.8 | 7.1 | Lg. inc. | Lg. inc. | Medium | Rare | Good | Good | Infill ++ | Infill ++ | 2 | 30 |
| northern white-cedar | Thuja occidentalis | WSH | High | 6.9 | 36.0 | 1.9 | No change | Lg. inc. | Medium | Rare | Poor | Good | Infill + | Infill ++ | 2 | 31 |
| chokecherry | Prunus virginiana | NSLX | FIA | 20.3 | 16.9 | 0.7 | Unknown | Unknown | Medium | Rare | FIA Only | FIA Only | | | 0 | 32 |
| black maple | Acer nigrum | NSH | Low | 1.8 | 16.4 | 4.7 | Sm. dec. | Lg. dec. | High | Rare | Poor | Poor | | | 0 | 33 |
| slippery elm | Ulmus rubra | WSL | Low | 5.4 | 12.9 | 1.3 | No change | No change | Medium | Rare | Poor | Poor | Infill + | Infill + | 1 | 34 |
| Ohio buckeye | Aesculus glabra | NSL | Low | 0.2 | 12.0 | 1.5 | Sm. dec. | Sm. dec. | Medium | Rare | Very Poor | Very Poor | | | 0 | 35 |
| butternut | Juglans cinerea | NSLX | FIA | 4.8 | 11.5 | 0.6 | Unknown | Unknown | Low | Rare | FIA Only | FIA Only | | | 0 | 36 |
| pin cherry | Prunus pennsylvanica | NSL | Low | 8.7 | 6.7 | 0.3 | Lg. dec. | Very Lg. dec. | Medium | Rare | Very Poor | Lost | | | 0 | 37 |
| serviceberry | Amelanchier spp. | NSL | Low | 13.8 | 6.4 | 0.5 | Very Lg. dec. | Lg. dec. | Medium | Rare | Lost | Very Poor | | | 0 | 38 |
| black walnut | Juglans nigra | WDH | Low | 2.7 | 4.4 | 0.9 | Lg. inc. | Lg. inc. | Medium | Rare | Good | Good | Infill ++ | Infill ++ | 2 | 39 |
| swamp white oak | Quercus bicolor | NSL | Low | 4.9 | 4.3 | 0.7 | No change | Lg. inc. | Medium | Rare | Poor | Good | | Infill ++ | 2 | 40 |
| Scots pine | Pinus sylvestris | NSH | FIA | 0.9 | 4.2 | 0.6 | Unknown | Unknown | NA | Rare | NNIS | NNIS | | | 0 | 41 |
| Norway spruce | Picea abies | NSH | FIA | 0.8 | 1.2 | 0.7 | Unknown | Unknown | NA | Rare | NNIS | NNIS | | | 0 | 42 |
| hackberry | Celtis occidentalis | WDH | Medium | 1.2 | 0.9 | 0.8 | No change | Lg. inc. | High | Rare | Fair | Good | | | 2 | 43 |
| wild plum | Prunus americana | NSLX | FIA | 1.2 | 0.8 | 0.7 | Unknown | Unknown | Medium | Rare | FIA Only | FIA Only | | | 0 | 44 |
| balsam poplar | Populus balsamifera | NSH | Medium | 1.2 | 0.8 | 0.7 | Very Lg. dec. | Very Lg. dec. | Medium | Rare | Lost | Lost | | | 0 | 45 |
| rock elm | Ulmus thomasii | NSLX | FIA | 1.2 | 0.3 | 0.2 | Unknown | Unknown | Low | Rare | FIA Only | FIA Only | | | 0 | 46 |
| eastern redcedar | Juniperus virginiana | WDH | Medium | 0 | 0 | 0 | New Habitat | New Habitat | Medium | Absent | New Habitat | New Habitat | Migrate ++ | Migrate ++ | 3 | 47 |

One x One Degree
Climate Change Atlas Tree Species

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

Current and Potential Future Habitat, Capability, and Migration

| Common Name | Scientific Name | Range | MR | %Cell | FIAsum | FIAiv | ChngCl45 | ChngCl85 | Adap | Abund | Capabil45 | Capabil85 | SHIFT45 | SHIFT85 | SSO | N |
|--------------------|-------------------------|-------|--------|-------|--------|-------|-------------|-------------|--------|--------|-------------|-------------|-----------|-----------|-----|----|
| mountain maple | Acer spicatum | NSL | Low | 0 | 0 | 0 | New Habitat | Unknown | High | Absent | New Habitat | Unknown | | | 3 | 48 |
| pignut hickory | Carya glabra | WDL | Medium | 0 | 0 | 0 | New Habitat | New Habitat | Medium | Absent | New Habitat | New Habitat | | | 3 | 49 |
| shagbark hickory | Carya ovata | WSL | Medium | 0 | 0 | 0 | New Habitat | New Habitat | Medium | Absent | New Habitat | New Habitat | Migrate + | Migrate + | 3 | 50 |
| black hickory | Carya texana | NDL | High | 0 | 0 | 0 | New Habitat | New Habitat | Medium | Absent | New Habitat | New Habitat | | | 0 | 51 |
| mockernut hickory | Carya alba | WDL | Medium | 0 | 0 | 0 | New Habitat | New Habitat | High | Absent | New Habitat | New Habitat | | | 3 | 52 |
| sugarberry | Celtis laevigata | NDH | Medium | 0 | 0 | 0 | Unknown | New Habitat | Medium | Absent | Unknown | New Habitat | | | 0 | 53 |
| American beech | Fagus grandifolia | WDH | High | 0 | 0 | 0 | New Habitat | New Habitat | Medium | Absent | New Habitat | New Habitat | Migrate + | Migrate + | 3 | 54 |
| yellow-poplar | Liriodendron tulipifera | WDH | High | 0 | 0 | 0 | New Habitat | New Habitat | High | Absent | New Habitat | New Habitat | | | 3 | 55 |
| bigleaf magnolia | Magnolia macrophylla | NSL | Low | 0 | 0 | 0 | Unknown | Unknown | Medium | Absent | Unknown | Unknown | | | 0 | 56 |
| red mulberry | Morus rubra | NSL | Low | 0 | 0 | 0 | Unknown | New Habitat | Medium | Absent | Unknown | New Habitat | | Likely + | 3 | 57 |
| blackgum | Nyssa sylvatica | WDL | Medium | 0 | 0 | 0 | New Habitat | New Habitat | High | Absent | New Habitat | New Habitat | | | 3 | 58 |
| sycamore | Platanus occidentalis | NSL | Low | 0 | 0 | 0 | New Habitat | New Habitat | Medium | Absent | New Habitat | New Habitat | | | 3 | 59 |
| eastern cottonwood | Populus deltoides | NSH | Low | 0 | 0 | 0 | New Habitat | New Habitat | Medium | Absent | New Habitat | New Habitat | | Migrate + | 3 | 60 |
| blackjack oak | Quercus marilandica | NSL | Medium | 0 | 0 | 0 | New Habitat | New Habitat | High | Absent | New Habitat | New Habitat | | | 0 | 61 |
| post oak | Quercus stellata | WDH | High | 0 | 0 | 0 | New Habitat | New Habitat | High | Absent | New Habitat | New Habitat | | | 3 | 62 |
| black locust | Robinia pseudoacacia | NDH | Low | 0 | 0 | 0 | New Habitat | New Habitat | Medium | Absent | New Habitat | New Habitat | Likely + | Likely + | 3 | 63 |
| black willow | Salix nigra | NSH | Low | 0 | 0 | 0 | New Habitat | New Habitat | Low | Absent | New Habitat | New Habitat | Migrate + | Migrate + | 3 | 64 |