

| | | | |
|----------------|---------|---------|-----------|
| | sq. km | sq. mi | FIA Plots |
| Area of Region | 6,191.0 | 2,390.4 | 240 |

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 | 19 | 10 | Increase | 14 | 13 | Very Good | 4 | 4 | Likely | 0 | 0 |
| Hickory | 0 | | | Medium | 19 | 32 | No Change | 1 | 1 | Good | 6 | 6 | Infill | 3 | 2 |
| Maple | 5 | Abundant | 7 | Low | 15 | 12 | Decrease | 14 | 15 | Fair | 7 | 7 | Migrate | 6 | 11 |
| Oak | 1 | Common | 12 | FIA | 3 | | New | 20 | 22 | Poor | 6 | 6 | | 9 | 13 |
| Pine | 2 | Rare | 13 | | | | Unknown | 7 | 5 | Very Poor | 6 | 5 | | | |
| Other | 22 | Absent | 23 | | | | | | | FIA Only | 1 | 1 | | | |
| | 32 | | 55 | | 56 | 54 | | 56 | 56 | Unknown | 4 | 2 | | | |
| | | | | | | | | | | | 34 | 31 | | | |

Potential Changes in Climate Variables

Temperature (°F)

| | Scenario | 2009 | 2039 | 2069 | 2099 | |
|--------------------------|----------|------|------|------|------|--|
| Annual Average | CCSM45 | 43.4 | 45.1 | 47.1 | 47.3 | |
| | CCSM85 | 43.4 | 45.7 | 48.1 | 51.2 | |
| | GFDL45 | 43.4 | 46.5 | 49.4 | 50.9 | |
| | GFDL85 | 43.4 | 46.6 | 50.8 | 55.7 | |
| | HAD45 | 43.4 | 46.3 | 49.3 | 50.9 | |
| HAD85 | 43.4 | 46.6 | 50.7 | 55.7 | | |
| Growing Season (May—Sep) | CCSM45 | 60.3 | 62.2 | 63.7 | 64.0 | |
| | CCSM85 | 60.3 | 62.4 | 64.6 | 67.9 | |
| | GFDL45 | 60.3 | 63.8 | 66.7 | 68.3 | |
| | GFDL85 | 60.3 | 63.6 | 68.0 | 73.1 | |
| | HAD45 | 60.3 | 63.0 | 65.6 | 67.7 | |
| HAD85 | 60.3 | 62.9 | 67.4 | 72.5 | | |
| Coldest Month Average | CCSM45 | 16.5 | 17.7 | 19.2 | 19.9 | |
| | CCSM85 | 16.5 | 18.9 | 20.3 | 22.5 | |
| | GFDL45 | 16.5 | 19.0 | 21.5 | 22.8 | |
| | GFDL85 | 16.5 | 20.2 | 22.8 | 25.2 | |
| | HAD45 | 16.5 | 19.1 | 21.4 | 22.2 | |
| HAD85 | 16.5 | 20.2 | 22.6 | 25.8 | | |
| Warmest Month Average | CCSM45 | 66.6 | 68.6 | 69.5 | 69.5 | |
| | CCSM85 | 66.6 | 68.8 | 70.4 | 72.0 | |
| | GFDL45 | 66.6 | 69.8 | 71.5 | 72.7 | |
| | GFDL85 | 66.6 | 69.6 | 72.5 | 75.2 | |
| | HAD45 | 66.6 | 69.6 | 70.7 | 72.0 | |
| HAD85 | 66.6 | 69.4 | 71.7 | 74.9 | | |

Precipitation (in)

| | Scenario | 2009 | 2039 | 2069 | 2099 | |
|--------------------------|----------|------|------|------|------|--|
| Annual Total | CCSM45 | 48.6 | 48.7 | 46.9 | 54.5 | |
| | CCSM85 | 48.6 | 50.2 | 50.0 | 51.8 | |
| | GFDL45 | 48.6 | 52.1 | 55.4 | 53.6 | |
| | GFDL85 | 48.6 | 51.5 | 53.4 | 54.7 | |
| | HAD45 | 48.6 | 51.3 | 57.0 | 54.9 | |
| HAD85 | 48.6 | 52.6 | 54.0 | 56.1 | | |
| Growing Season (May—Sep) | CCSM45 | 18.5 | 19.0 | 17.4 | 19.9 | |
| | CCSM85 | 18.5 | 19.5 | 19.2 | 18.5 | |
| | GFDL45 | 18.5 | 17.3 | 17.6 | 16.7 | |
| | GFDL85 | 18.5 | 18.5 | 17.3 | 15.9 | |
| | HAD45 | 18.5 | 19.3 | 20.5 | 20.4 | |
| HAD85 | 18.5 | 18.5 | 20.0 | 20.6 | | |

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>.

Section 211C

EcoMap 2007
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 |
|-----------------------------|-------------------------|-------|--------|-------|--------|-------|-------------|---------------|--------|----------|-------------|-------------|----------|------------|-----|----|
| balsam fir | Abies balsamea | NDH | High | 91.9 | 2492.1 | 16.9 | Lg. dec. | Lg. dec. | Low | Abundant | Poor | Poor | | | 0 | 1 |
| red spruce | Picea rubens | NDH | High | 92.7 | 1627.0 | 10.8 | Lg. dec. | Lg. dec. | Low | Abundant | Poor | Poor | | | 0 | 2 |
| red maple | Acer rubrum | WDH | High | 94.9 | 1469.4 | 10.4 | Sm. inc. | Sm. inc. | High | Abundant | Very Good | Very Good | | | 1 | 3 |
| eastern white pine | Pinus strobus | WDH | High | 84.8 | 903.7 | 7.7 | Sm. inc. | No change | Low | Abundant | Good | Fair | | | 1 | 4 |
| northern white-cedar | Thuja occidentalis | WSH | High | 66.5 | 883.5 | 8.9 | Sm. dec. | Sm. dec. | Medium | Abundant | Fair | Fair | | | 0 | 5 |
| paper birch | Betula papyrifera | WDH | High | 85.6 | 672.3 | 4.4 | Sm. dec. | Sm. dec. | Medium | Abundant | Fair | Fair | | | 0 | 6 |
| black spruce | Picea mariana | NSH | High | 44.7 | 554.6 | 7.4 | Lg. dec. | Lg. dec. | Medium | Abundant | Fair | Fair | | | 0 | 7 |
| white spruce | Picea glauca | NSL | Medium | 57.5 | 470.1 | 3.9 | Sm. dec. | Sm. dec. | Medium | Common | Poor | Poor | | | 0 | 8 |
| tamarack (native) | Larix laricina | NSH | High | 43.7 | 458.8 | 8.1 | Lg. dec. | Lg. dec. | Low | Common | Very Poor | Very Poor | | | 0 | 9 |
| eastern hemlock | Tsuga canadensis | NSH | High | 43.3 | 384.6 | 6.4 | Sm. inc. | Sm. inc. | Low | Common | Fair | Fair | | | 1 | 10 |
| gray birch | Betula populifolia | NSL | Low | 64.7 | 332.8 | 3.7 | Sm. dec. | Sm. dec. | Medium | Common | Poor | Poor | | | 0 | 11 |
| quaking aspen | Populus tremuloides | WDH | High | 45.2 | 302.9 | 3.4 | Sm. inc. | Sm. inc. | Medium | Common | Good | Good | | | 1 | 12 |
| bigtooth aspen | Populus grandidentata | NSL | Medium | 40.1 | 212.3 | 3.4 | Sm. inc. | Sm. inc. | Medium | Common | Good | Good | | | 1 | 13 |
| yellow birch | Betula alleghaniensis | NDL | High | 59.2 | 204.9 | 2.6 | Sm. inc. | Sm. inc. | Medium | Common | Good | Good | | | 1 | 14 |
| northern red oak | Quercus rubra | WDH | Medium | 23.4 | 189.5 | 5.7 | Lg. inc. | Lg. inc. | High | Common | Very Good | Very Good | | | 1 | 15 |
| American beech | Fagus grandifolia | WDH | High | 33.8 | 170.3 | 4.0 | Lg. inc. | Lg. inc. | Medium | Common | Very Good | Very Good | | | 1 | 16 |
| chokecherry | Prunus virginiana | NSLX | FIA | 6 | 106.5 | 5.5 | Unknown | Unknown | Medium | Common | FIA Only | FIA Only | | | 0 | 17 |
| sugar maple | Acer saccharum | WDH | High | 24 | 105.1 | 3.2 | Lg. inc. | Lg. inc. | High | Common | Very Good | Very Good | | | 1 | 18 |
| red pine | Pinus resinosa | NSH | Medium | 22.3 | 85.6 | 3.3 | No change | Sm. dec. | Low | Common | Poor | Poor | Infill + | Infill + | 0 | 19 |
| white ash | Fraxinus americana | WDL | Medium | 22.5 | 49.5 | 1.6 | Lg. inc. | Lg. inc. | Low | Rare | Fair | Fair | | | 1 | 20 |
| striped maple | Acer pensylvanicum | NSL | Medium | 42.9 | 42.3 | 0.8 | Lg. dec. | Lg. dec. | Medium | Rare | Very Poor | Very Poor | | | 0 | 21 |
| eastern hophornbeam; ironw | Ostrya virginiana | NSL | Low | 10.4 | 23.2 | 1.2 | Lg. inc. | Lg. inc. | High | Rare | Good | Good | | | 1 | 22 |
| black ash | Fraxinus nigra | WSH | Medium | 3.9 | 18.4 | 0.7 | Sm. dec. | Sm. dec. | Low | Rare | Very Poor | Very Poor | | | 2 | 23 |
| mountain maple | Acer spicatum | NSL | Low | 9.4 | 16.9 | 1.5 | Lg. dec. | Lg. dec. | High | Rare | Poor | Poor | | | 1 | 24 |
| serviceberry | Amelanchier spp. | NSL | Low | 14.9 | 13.8 | 0.5 | Lg. dec. | Lg. dec. | Medium | Rare | Very Poor | Very Poor | | | 0 | 25 |
| American mountain-ash | Sorbus americana | NSL | Low | 9 | 11.2 | 0.6 | Lg. dec. | Lg. dec. | Low | Rare | Very Poor | Very Poor | | | 0 | 26 |
| pin cherry | Prunus pensylvanica | NSL | Low | 11 | 10.8 | 0.7 | Lg. dec. | Very Lg. dec. | Medium | Rare | Very Poor | Lost | | | 0 | 27 |
| black cherry | Prunus serotina | WDL | Medium | 5.9 | 8.7 | 1.3 | Lg. inc. | Lg. inc. | Low | Rare | Fair | Fair | Infill + | Infill + | 1 | 28 |
| Norway maple | Acer platanoides | NSL | FIA | 0.7 | 2.6 | 0.7 | Unknown | Unknown | NA | Rare | NNIS | NNIS | | | 0 | 29 |
| American elm | Ulmus americana | WDH | Medium | 2.4 | 2.2 | 0.6 | Sm. inc. | Lg. inc. | Medium | Rare | Fair | Good | Infill + | | 2 | 30 |
| American basswood | Tilia americana | WSL | Medium | 1.7 | 0.8 | 0.5 | Lg. inc. | Lg. inc. | Medium | Rare | Good | Good | | | 2 | 31 |
| Norway spruce | Picea abies | NSH | FIA | 1 | 0.5 | 0.2 | Unknown | Unknown | NA | Rare | NNIS | NNIS | | | 0 | 32 |
| eastern redcedar | Juniperus virginiana | WDH | Medium | 0 | 0 | 0 | New Habitat | New Habitat | Medium | Absent | New Habitat | New Habitat | | Migrate ++ | 3 | 33 |
| pitch pine | Pinus rigida | NSH | High | 0 | 0 | 0 | New Habitat | New Habitat | Medium | Absent | New Habitat | New Habitat | | Migrate + | 3 | 34 |
| Virginia pine | Pinus virginiana | NDH | High | 0 | 0 | 0 | New Habitat | New Habitat | Medium | Absent | New Habitat | New Habitat | | | 0 | 35 |
| sweet birch | Betula lenta | NDH | High | 0 | 0 | 0 | New Habitat | New Habitat | Low | Absent | New Habitat | New Habitat | | Migrate + | 3 | 36 |
| American hornbeam; muscle | Carpinus caroliniana | WSL | Low | 0 | 0 | 0 | New Habitat | New Habitat | Medium | Absent | New Habitat | New Habitat | | Migrate + | 3 | 37 |
| pignut hickory | Carya glabra | WDL | Medium | 0 | 0 | 0 | New Habitat | New Habitat | Medium | Absent | New Habitat | New Habitat | | Migrate + | 3 | 38 |
| shagbark hickory | Carya ovata | WSL | Medium | 0 | 0 | 0 | New Habitat | New Habitat | Medium | Absent | New Habitat | New Habitat | | Migrate + | 3 | 39 |
| mockernut hickory | Carya alba | WDL | Medium | 0 | 0 | 0 | New Habitat | New Habitat | High | Absent | New Habitat | New Habitat | | | 0 | 40 |
| flowering dogwood | Cornus florida | WDL | Medium | 0 | 0 | 0 | Unknown | New Habitat | Medium | Absent | Unknown | New Habitat | | | 0 | 41 |
| green ash | Fraxinus pennsylvanica | WSH | Low | 0 | 0 | 0 | New Habitat | New Habitat | Medium | Absent | New Habitat | New Habitat | | Migrate + | 3 | 42 |
| American holly | Ilex opaca | NSL | Medium | 0 | 0 | 0 | Unknown | Unknown | Medium | Absent | Unknown | Unknown | | | 0 | 43 |
| black walnut | Juglans nigra | WDH | Low | 0 | 0 | 0 | New Habitat | New Habitat | Medium | Absent | New Habitat | New Habitat | | | 3 | 44 |
| yellow-poplar | Liriodendron tulipifera | WDH | High | 0 | 0 | 0 | New Habitat | New Habitat | High | Absent | New Habitat | New Habitat | | | 3 | 45 |
| cucumbertree | Magnolia acuminata | NSL | Low | 0 | 0 | 0 | Unknown | New Habitat | Medium | Absent | Unknown | New Habitat | | | 0 | 46 |
| mountain or Fraser magnolia | Magnolia fraseri | NSL | Low | 0 | 0 | 0 | Unknown | Unknown | Low | Modeled | Unknown | Unknown | | | 0 | 47 |



Section 211C

EcoMap 2007

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

| Common Name | Scientific Name | Range | MR | %Cell | FIAsum | FIAiv | ChngCl45 | ChngCl85 | Adap | Abund | Capabil45 | Capabil85 | SHIFT45 | SHIFT85 | SSO | N |
|-----------------|------------------------------|-------|--------|-------|--------|-------|-------------|-------------|--------|--------|-------------|-------------|-----------|------------|-----|----|
| blackgum | <i>Nyssa sylvatica</i> | WDL | Medium | 0 | 0 | 0 | New Habitat | New Habitat | High | Absent | New Habitat | New Habitat | | Migrate + | 3 | 48 |
| sycamore | <i>Platanus occidentalis</i> | NSL | Low | 0 | 0 | 0 | New Habitat | New Habitat | Medium | Absent | New Habitat | New Habitat | | | 0 | 49 |
| white oak | <i>Quercus alba</i> | WDH | Medium | 0 | 0 | 0 | New Habitat | New Habitat | High | Absent | New Habitat | New Habitat | Migrate + | Migrate ++ | 3 | 50 |
| swamp white oak | <i>Quercus bicolor</i> | NSL | Low | 0 | 0 | 0 | New Habitat | New Habitat | Medium | Absent | New Habitat | New Habitat | | | 3 | 51 |
| scarlet oak | <i>Quercus coccinea</i> | WDL | Medium | 0 | 0 | 0 | New Habitat | New Habitat | Medium | Absent | New Habitat | New Habitat | Migrate + | Migrate ++ | 3 | 52 |
| chestnut oak | <i>Quercus prinus</i> | NDH | High | 0 | 0 | 0 | New Habitat | New Habitat | High | Absent | New Habitat | New Habitat | | | 3 | 53 |
| black oak | <i>Quercus velutina</i> | WDH | High | 0 | 0 | 0 | New Habitat | New Habitat | Medium | Absent | New Habitat | New Habitat | Migrate + | Migrate ++ | 3 | 54 |
| black locust | <i>Robinia pseudoacacia</i> | NDH | Low | 0 | 0 | 0 | New Habitat | New Habitat | Medium | Absent | New Habitat | New Habitat | | Migrate + | 3 | 55 |
| sassafras | <i>Sassafras albidum</i> | WSL | Low | 0 | 0 | 0 | New Habitat | New Habitat | Medium | Absent | New Habitat | New Habitat | | | 3 | 56 |