Climate and Health Species List for Boston Region Urban Trees

This list was compiled to show some of the types of benefits and concerns when selecting trees to reduce climate change vulnerability, reduce carbon dioxide in the atmosphere, and provide benefits to human health. **It is meant to inform tree selection, but should not be considered a recommended species list.** Urban and landscape planting decisions must consider native species benefits, natural and future ranges under climate change, "right tree, right place" growing site conditions related to soil type, moisture availability and root space, and overall site goals. While this list identifies some species with climate and health benefits, or low climate vulnerability and low health disservices, it is not a comprehensive list of species available for the Boston Region.

Certain species may or may not be suitable for planting for your specific site or needs. **Species that are considered invasive and species that have elevated pest and disease susceptibility are identified with asterisks.** Other considerations you may wish to discuss with an urban forestry professional include: species size and longevity, branching and rooting habits, wildlife and pollinator benefits, and encouraging species diversity.
Contact the Massachusetts Department of Conservation and Recreation Urban and Community Forestry program for further guidance on area specific species recommendations and other urban and community forestry topics.

Climate Vulnerability

Trees can be vulnerable to a variety of climate-related stressors such as intense heat, drought, flooding, and changing pest and disease patterns. Climate vulnerability is a function of the impacts of climate change on a species and its adaptive capacity. Species with negative impacts on habitat suitability and low adaptive capacity will have high vulnerability and vice versa. ***The following factors were used to determine climate vulnerability:***

- **Hardiness and heat zone tolerance:** Tree species ranges were recorded from government, university, and arboretum websites. Species tolerance ranges were compared to current and projected heat and hardiness zones for the Boston region using downscaled climate models.[1]

- **Habitat suitability modeling projections:** Modeled projections for native species were summarized from the Climate Change Atlas website under low and high emissions for the 1-degree latitude/longitude grid cell that covers the Boston region (east of 71 & 70W and south of 42N).[2-4]

- **Adaptability:** Adaptability scores were generated for each species based on literature describing its tolerance to disturbances such as drought, flooding, pests, and disease, as well as its growth requirements such as shade tolerance, soil needs, and ease of nursery propagation. Scores were assigned to Boston region species using methods developed in an urban forest vulnerability assessment for Chicago.[5]

Current and projected USDA Hardiness Zones and AHS Heat Zones for the Boston region. Hardiness zone is determined by the average lowest temperature over a 30 year period. Heat zones are determined by the number of days above 86°F.

Time period	Hardiness Zone Range - Boston Region		Heat Zone Range - Boston Region	
1980–2009	6 to 7		4	
	Low emissions	**High emissions**	**Low emissions**	**High emissions**
2010–2039	6 to 7	7	5	6
2040–2069	7	8	6	7 to 8
2070–2099	7	8 to 9	6 to 7	8 to 9

Carbon

Trees provide benefits by reducing greenhouse gases in the atmosphere by directly storing carbon in their leaves, wood, and roots, and by helping to reduce energy use for heating and cooling. Benefits provided by each species were modeled for the city of Providence, RI and binned into categories based on their relative carbon benefits to one another using methods developed for the i-Tree Species Selector.[6] *The following factors were combined to assess carbon benefits:*

- **Carbon storage:** the total of all carbon stored during the average lifespan for the species. Larger trees tend to store more carbon.
- **Carbon sequestration rate:** carbon absorption per year. Species that gain a lot of growth per year will have higher sequestration rates.
- **Carbon savings from energy use:** the total amount of carbon saved from reduced heating and cooling energy use. Large shade trees tend to reduce cooling energy use and large conifers tend to reduce heating energy use.

Human health

Trees can reduce risks to human health that may be faced under a changing climate, such as heat stress and reduced air quality, by providing shade, cooling through transpiration, and absorption of pollutants. Benefits provided by each species were modeled for the city of Providence, RI and binned into categories based on their relative health benefits to one another using methods developed for the i-Tree Species Selector.[6] *The following factors were combined to assess human health benefits:*

- **Leaf area:** the maximum leaf area reached over the species' lifespan. Trees with greater leaf area provide more shade and can typically absorb more pollutants.
- **Transpiration:** average transpiration rate per year, which is influenced in part by tree size and differences in water use efficiency. Trees that transpire more can be better at evaporative cooling and mitigating flooding.
- **Pollutants removed:** weighted sum of the pollutants NO_3, O_3, PM2.5 and SO_2 removed over a species' lifespan.

Some trees may need to be considered for their potential negative effects on human health. In particular, some trees produce allergenic pollen or volatile organic compounds such as isoprene or monoterpenes that can reduce air quality. Isoprene and monoterpene emissions for each species were modeled for the city of Providence, RI and binned into categories based on their relative health benefits to one another using methods developed for the i-Tree Species Selector.[6] Allergenicity was based on Ogren Plant Allergy Scale.[7] *The following factors were combined to assess human health disservices:*

- **Allergenicity:** how likely the tree is to cause allergies. Wind-pollinated trees tend to be more allergenic.
- **Isoprene emissions:** total emissions of isoprene over a species' lifespan. Certain species of broadleaved trees, such as oaks, are known for high isoprene emissions.
- **Monoterpene emissions:** total emissions of monoterpences over a species' lifespan. Some species, and many conifers in particular, can be high emitters of monoterpenes.

Scientific Name	Common Name	Climate Vulnerability	Health Disservices	Carbon Benefit	Health Benefit
Abies balsamea	Balsam fir	Moderate-high	Low-moderate	Low	Low-moderate
Abies concolor	White fir	Moderate-high	Low-moderate	Low	Low-moderate
Acer buergerianum	Trident maple	Low-moderate	Moderate-high	Low	Low-moderate
Acer campestre	Hedge maple	Moderate-high	Moderate-high	Low	Low-moderate
Acer griseum	Paperbark maple	High	Moderate-high	Low	Low-moderate
Acer pensylvanicum	Striped maple	Moderate-high	Moderate-high	Low	Low-moderate
Acer platanoides	Norway maple	Moderate	Moderate-high	Moderate	Low-moderate
Acer rubrum	Red maple	Low-moderate	Moderate-high	High	Moderate
Acer saccharinum	Silver maple	Low-moderate	Moderate-high	Moderate-high	Moderate
Acer saccharum	Sugar maple	Moderate-high	Moderate-high	Moderate-high	Low-moderate
*Acer tataricum ginnala***	Amur maple**	Moderate-high	Low-moderate	Low	Moderate
Acer truncatum	Shantung maple, Purpleblow maple	Moderate	Moderate-high	Low	Low-moderate
Aesculus hippocastanum	European horsechestnut	Moderate-high	Moderate	Moderate-high	Moderate
Aesculus x carnea	Red horsechestnut	Low-moderate	Moderate	High	Low-moderate
Amelanchier laevis	Allegheny serviceberry	Low	Low	Low	Low
Asimina triloba	Pawpaw	Low-moderate	Low	Low	Low-moderate
Betula alleghaniensis	Yellow birch	Moderate	Moderate	Moderate-high	Moderate
Betula lenta	Sweet birch	Moderate-high	Moderate	High	Moderate
Betula nigra	River birch	Low-moderate	Moderate	Moderate-high	Moderate
Betula papyrifera	Paper birch	Moderate-high	Moderate	Moderate	High

Important considerations key:

**Invasive species **Species has elevated pest and disease susceptibility

Scientific Name	Common Name	Climate Vulnerability	Health Disservices	Carbon Benefit	Health Benefit
Betula populifolia	Gray birch	High	Moderate	Low	Moderate
Carpinus betulus	Common hornbeam, European hornbeam	Moderate	Moderate	Low	Low-moderate
Carpinus caroliniana	Musclewood, American hornbeam	Low	Moderate	Low	Low-moderate
Carya cordiformis	Bitternut hickory	Low-moderate	Moderate-high	Moderate	Moderate-high
Carya glabra	Pignut hickory	Low-moderate	Moderate-high	Moderate	Moderate-high
Carya illinoinensis	Pecan	Moderate	Moderate-high	Moderate	Low-moderate
Carya laciniosa	Shellbark hickory	Moderate	Moderate-high	Moderate	Moderate
Carya ovata	Shagbark hickory	Moderate-high	Moderate-high	Moderate	Moderate
Carya texana	Black hickory	Moderate	Moderate-high	Moderate-high	Moderate
Castanea dentata	American chestnut	High	Moderate	Moderate	Moderate
Catalpa speciosa	Northern catalpa	High	Low-moderate	Moderate	Low-moderate
Celtis laevigata	Sugarberry	Low-moderate	Moderate	Low	Low-moderate
Celtis occidentalis	Common hackberry	Low	Moderate	Low	Moderate
Cercidiphyllum japonicum	Katsura tree	High	Moderate-high	Low-moderate	Moderate-high
Cercis canadensis	Eastern redbud	Moderate-high	Low-moderate	Low-moderate	Low-moderate
Chamaecyparis thyoides	Atlantic white cedar	Moderate	Moderate	Low	Moderate
Chionanthus virginicus	White fringetree	Low	Low-moderate	Low	Low-moderate
Cladrastis kentukea	Yellowwood	Moderate-high	Low-moderate	Moderate	Low-moderate
Cornus florida	Flowering dogwood	Low-moderate	Low-moderate	Low	Low

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Cornus kousa	Kousa dogwood	Moderate	Moderate	Low	Low
Cornus mas	Cornelian cherry dogwood	Moderate-high	Low-moderate	Low	Low
Corylus colurna	Turkish filbert	Moderate-high	Low-moderate	High	Moderate
Cotinus obovatus	American smoketree	Moderate-high	Low	Low	Low
Crataegus crus-galli	Cockspur hawthorn	Moderate-high	Low-moderate	Low	Low
Crataegus laevigata	English hawthorn	Moderate-high	Low-moderate	Low	Low
Crataegus monogyna	Common hawthorn	Moderate-high	Low-moderate	Low	Low
Diospyros virginiana	Common persimmon	Low	Low-moderate	Moderate	Low
Eucommia ulmoides	Hardy Rubber Tree	Moderate	Low-moderate	Moderate	Moderate
*Fagus grandifolia*******	American beech******	Low-moderate	Low-moderate	Moderate-high	Moderate-high
Fraxinus americana	White ash	Moderate	Moderate	High	Low-moderate
*Fraxinus pennsylvanica*******	Green ash******	Low-moderate	Moderate	Moderate	Moderate
Ginkgo biloba	Ginkgo	Low	Moderate	Low-moderate	Moderate
Gleditsia triacanthos*	Honeylocust*	Moderate-high	Low	Moderate	Low-moderate
Gymnocladus dioicus	Kentucky coffeetree	Moderate	Low	Low-moderate	Low-moderate
Halesia tetraptera, Halesia carolina	Carolina silverbell	Moderate-high	Low	Low	Moderate
Ilex opaca	American holly	Low	Low	Low	Moderate
*Juglans cinerea*******	Butternut******	High	Low	Low-moderate	Moderate
Juglans nigra	Black walnut	Low-moderate	Moderate-high	Moderate	Moderate
Juniperus virginiana	Eastern redcedar	Low-moderate	Moderate-high	Low	Moderate
Koelreuteria paniculata*	Goldenrain tree*	Low	Low-moderate	Moderate	Low-moderate

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Liquidambar styraciflua	Sweetgum	Low-moderate	Moderate	Moderate	Moderate
Liriodendron tulipifera	Tuliptree	Moderate	Low-moderate	Moderate-high	High
Maackia amurensis	Amur maackia	Moderate	Moderate	Moderate	Low
Maclura pomifera	Osage-orange	Low	Low-moderate	Low	Low-moderate
Magnolia acuminata	Cucumbertree	Moderate	Moderate	High	Moderate
Magnolia virginiana	Sweet bay magnolia	Moderate-high	Moderate	High	Low-moderate
Malus sylvestris	Crabapple	Moderate-high	Moderate	Moderate	Moderate
Metasequoia glyptostroboides	Dawn redwood	Low-moderate	Low	Low-moderate	Moderate
Morus rubra	Red mulberry	Low-moderate	Moderate-high	Low	Moderate
Nyssa sylvatica	Black tupelo, Black gum	Low	Moderate	High	Moderate
Ostrya virginiana	Ironwood	Low	Low-moderate	Low-moderate	Moderate
Oxydendrum arboreum	Sourwood	Low	Low-moderate	Low	Low
Parrotia persica	Persian ironwood	Moderate	Moderate-high	Low	Low-moderate
Picea abies*	Norway spruce*	Moderate-high	Low-moderate	Low-moderate	Moderate-high
Picea glauca	White spruce	Moderate-high	Low-moderate	Low-moderate	Moderate
Picea omorika	Serbian spruce	Moderate-high	Low-moderate	High	Moderate-high
Picea rubens	Red spruce	Moderate-high	Low-moderate	Moderate	Moderate
Pinus cembra	Swiss stone pine	Moderate	Low-moderate	Moderate-high	Low-moderate
Pinus clausa	Sand pine	Moderate	Low-moderate	Low-moderate	Low-moderate
Pinus echinata	Shortleaf pine	Moderate	Low-moderate	Low-moderate	Low-moderate
Pinus palustris	Longleaf pine	Low-moderate	Low-moderate	Low-moderate	Low-moderate

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Scientific Name	Common Name	Climate Vulnerability	Health Disservices	Carbon Benefit	Health Benefit
Pinus resinosa	Red pine	High	Low-moderate	Moderate	Low-moderate
Pinus rigida	Pitch pine	High	Low-moderate	Moderate	Low-moderate
Pinus serotina	Pond pine	Moderate	Low-moderate	Low-moderate	Low-moderate
Pinus strobus	Eastern white pine	Moderate-high	Low-moderate	Low-moderate	Moderate
Pinus taeda	Loblolly pine	Low-moderate	Low-moderate	Moderate	High
Pinus virginiana	Virginia pine	High	Low-moderate	Moderate	Low-moderate
Plantanus x acerifolia	London planetree	Moderate-high	Low-moderate	Moderate-high	High
Platanus occidentalis	American sycamore	Low-moderate	Low-moderate	Moderate	High
Populus deltoides	Eastern cottonwood	Low	Moderate-high	High	Moderate
Populus grandidentata	Bigtooth aspen	High	Moderate-high	High	Moderate
Populus tremuloides	Quaking aspen	High	Moderate-high	Moderate-high	Moderate-high
Prunus persica	Peach	Low-moderate	Low-moderate	Moderate	Moderate
Prunus sargentii	Sargent cherry	Moderate-high	Low-moderate	Moderate-high	Moderate
Prunus serotina	Black cherry	Moderate	Low-moderate	High	Moderate
Prunus serrulata	Japanese cherry	Moderate-high	Low-moderate	Low	Low
Prunus virginiana	Chokecherry	Moderate-high	Low-moderate	Low	Moderate
Prunus x yedoensis	Yoshino cherry	High	Low-moderate	Low	Low-moderate
Pyrus calleryana*	Callery pear*	Low-moderate	Low-moderate	Moderate	Moderate
Quercus alba	White oak	Low-moderate	High	Moderate-high	Moderate
Quercus bicolor	Swamp white oak	Moderate	High	Moderate	Moderate
Quercus coccinea	Scarlet oak	Low	High	High	Moderate

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Quercus falcata	Southern red oak	Low-moderate	High	Moderate	Moderate
Quercus imbricaria	Shingle oak	Moderate	High	Low-moderate	Moderate-high
Quercus laevis	Turkey oak	Low-moderate	High	Low-moderate	Moderate-high
Quercus macrocarpa	Bur oak	Moderate	High	Moderate-high	Moderate
Quercus marilandica	Blackjack oak	Moderate	High	Low	Moderate
Quercus michauxii	Swamp chestnut oak	Low-moderate	High	Moderate	Moderate-high
Quercus muehlenbergii	Chinkapin oak	Moderate-high	High	Moderate	Moderate
Quercus nigra	Water oak	Low-moderate	High	Moderate	Moderate
Quercus pagoda	Cherrybark oak	Low-moderate	High	Moderate	Moderate
Quercus palustris	Pin oak	Moderate-high	High	Moderate	High
Quercus phellos	Willow oak	Low	High	High	High
Quercus prinus	Chestnut oak	Moderate	High	Moderate-high	Moderate
Quercus robur	English oak	Moderate-high	High	Moderate	Moderate
Quercus rubra	Northern red oak	Moderate	High	High	Low-moderate
Quercus shumardii	Shumard oak	Low	High	Moderate	Moderate
Quercus stellata	Post oak	Moderate	High	Moderate	Moderate
Quercus velutina	Black oak	Low-moderate	High	High	Moderate
Robinia pseudoacacia	Black locust	Moderate-high	Moderate	Moderate	Low
Salix babylonica v. matsudana	Corkscrew willow	Low-moderate	High	Moderate	Moderate-high
Salix nigra	Black willow	Moderate	High	High	Moderate
Sassafras albidum	Sassafras	Low-moderate	Moderate	High	Moderate

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Scientific Name	Common Name	Climate Vulnerability	Health Disservices	Carbon Benefit	Health Benefit
Taxodium distichum	Bald cypress	Low	Low	Moderate	Moderate
Thuja occidentalis	Northern white cedar, Arborvitae	Moderate-high	Moderate-high	Low	Moderate
Tilia americana	American linden, Basswood	Moderate-high	Low-moderate	Moderate	Moderate
Tilia cordata	Littleleaf linden	Moderate	Low-moderate	Moderate	Low-moderate
Tilia tomentosa	Silver linden	Low-moderate	Low-moderate	Low-moderate	Moderate
Tsuga canadensis	Eastern hemlock	High	Low-moderate	Low-moderate	Moderate
Ulmus alata	Winged elm	Low-moderate	Moderate	High	Moderate
Ulmus americana	American elm	Low-moderate	Moderate	Moderate-high	Moderate
Ulmus crassifolia	Cedar elm	Low	Moderate	High	Low-moderate
Ulmus parvifolia	Chinese elm	Low	Moderate	High	Low-moderate
Ulmus rubra	Slippery elm	Low-moderate	Moderate	High	Low-moderate
Zelkova serrata	Japanese zelkova	Moderate	Moderate	Moderate	Low-moderate

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