Evaluating Silvicultural Approaches at the Ecosystem Level

Pre-work for Day 2

Part of the workshop discussion that you will participate in tomorrow will be about developing silvicultural approaches for coping with climate change at a finer scale of management. The goal is for you to use your expertise and experience in stand-level management to reach a variety of silvicultural objectives. To do this, workshop participants will work in small groups in one of four ecoregion sections located in the northeastern and north-central United States. Information on the ecoregion section that you will be working in is included in your workshop materials.

If possible, please take a few minutes to think about some of the forests that are (or could be) located in this area. Include some reflection on specific types of forests that you have a particular interest in, such as:

- *How would you describe the forest or ecosystem (e.g., species composition, tree age and size, stand origin, stand structure, disturbance history and susceptibility, etc.)?*
- *What are the key aspects of how the forest is managed (e.g., management history, objectives, etc.)*
- *What features of this forest may be particularly important in the context of climate change?*
- *How might changes in climate such as higher temperatures, more or less precipitation, or increased extreme events affect the success of various components of the forest?*

Tomorrow, groups will think about the impacts of climate change on some of these forests and develop potential silvicultural approaches to both short- and long-term management that may help forests adapt to anticipated changes.

Current Conditions

Forest Type:

Current Conditions (e.g., species composition, tree age and size, stand origin, stand structure, disturbance history and susceptibility, etc.):

Current management (e.g., management history, objectives, etc.):

Additional features that may be particularly important in the context of climate change (e.g., southern extent of species range, potential invasives that may become more prevalent, etc.):

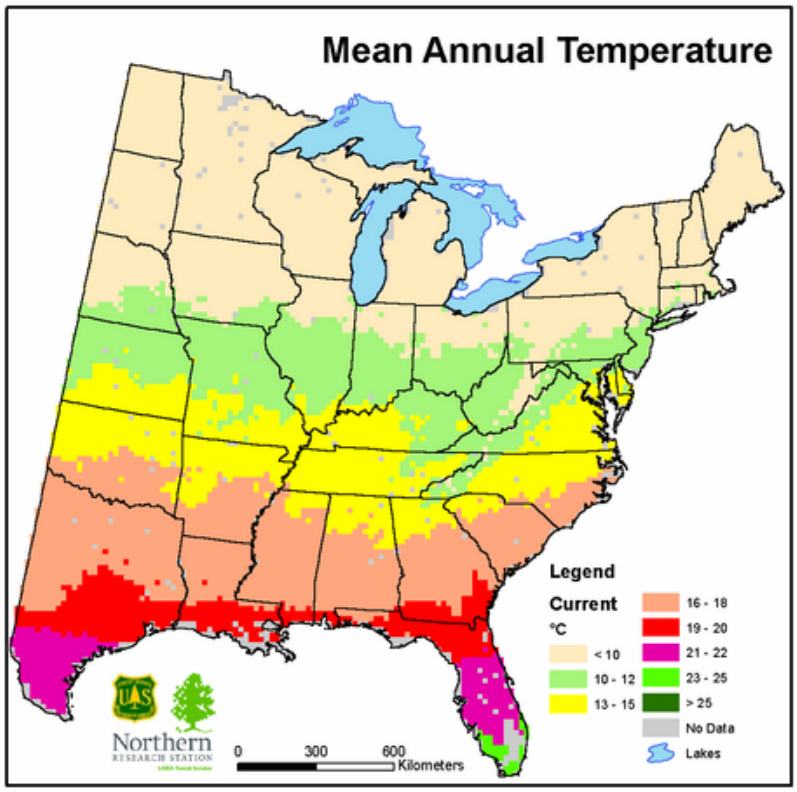
Presuming the range of projected changes in temperature and precipitation regimes, what silvicultural approaches would you consider using to manage the forest that you have selected? Which of the General Strategies best encompass the approaches you've identified?

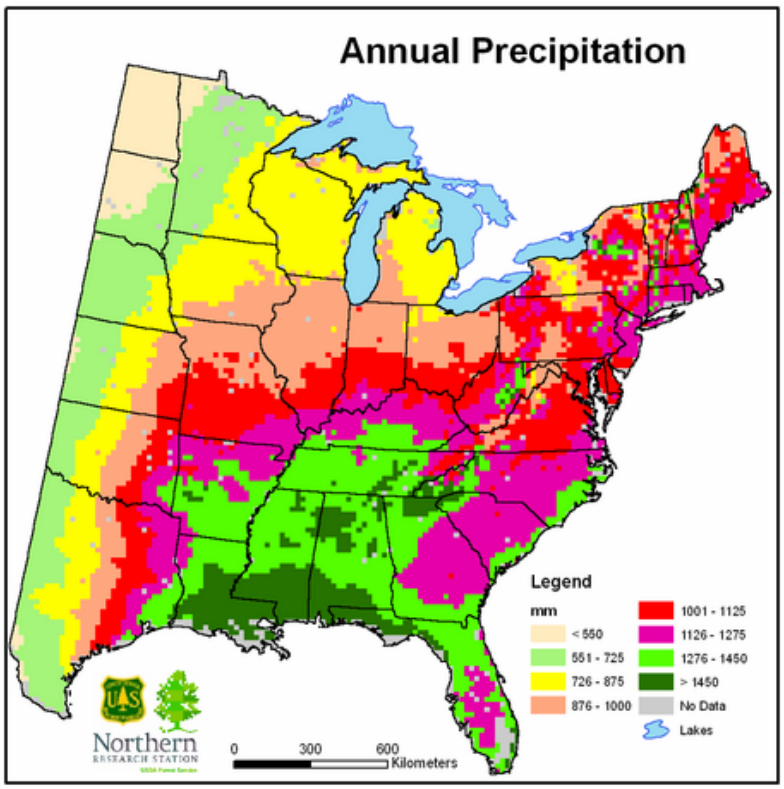
Silvicultural Approach	**Related General Strategies**

Silvicultural Approach	**Related General Strategies**

Silvicultural Approach	**Related General Strategies**

Current Climate from the Climate Change Tree Atlas

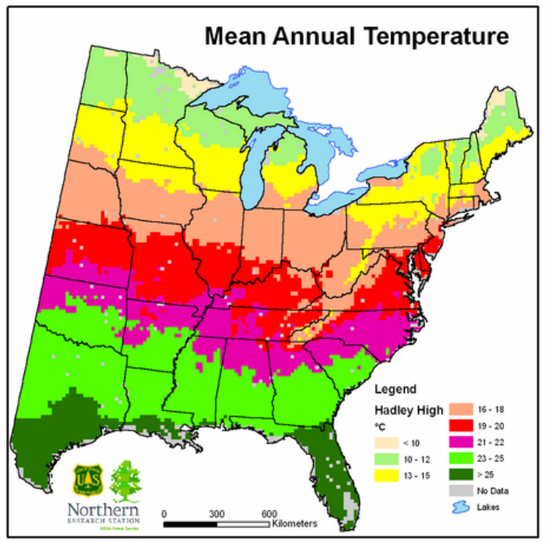




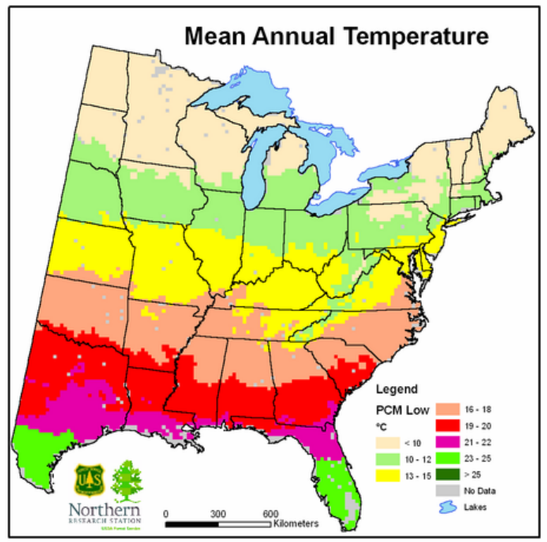
Source: Prasad, A. M., L. R. Iverson., S. Matthews., M. Peters. 2007-ongoing. A Climate Change Atlas for 134 Forest Tree Species of the Eastern United States [database]. http://www.nrs.fs.fed.us/atlas/tree, Northern Research Station, USDA Forest Service, Delaware, Ohio. [Accessed 10 September 2008]

Climate Scenarios used in the Climate Change Tree Atlas

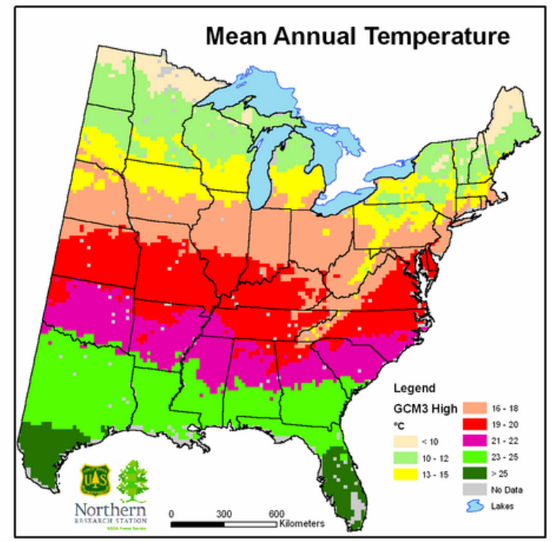
HadCM3 Model
High Emissions (A1fi)



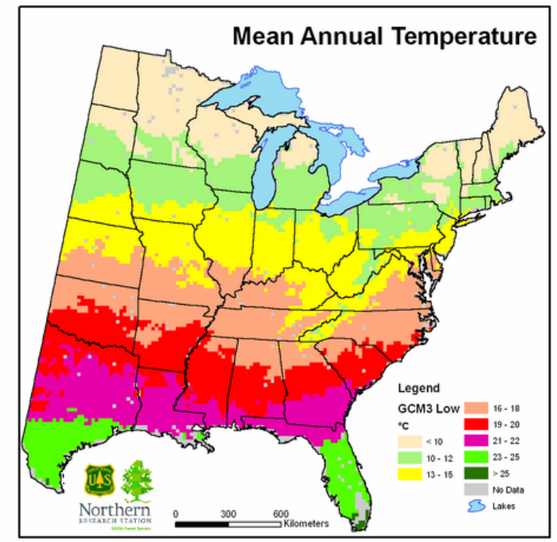
PCM Model
Low Emissions (B1)

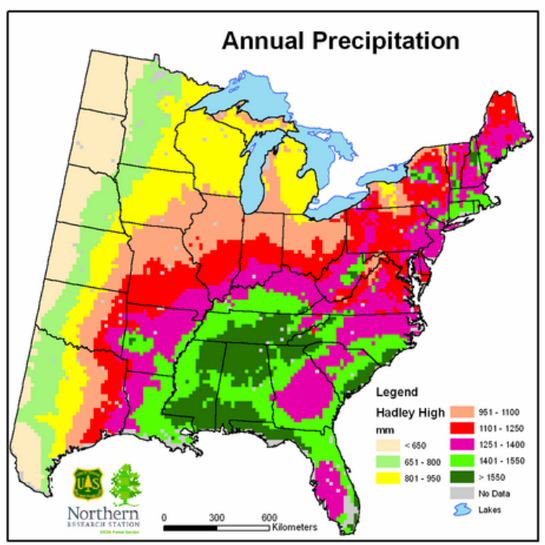


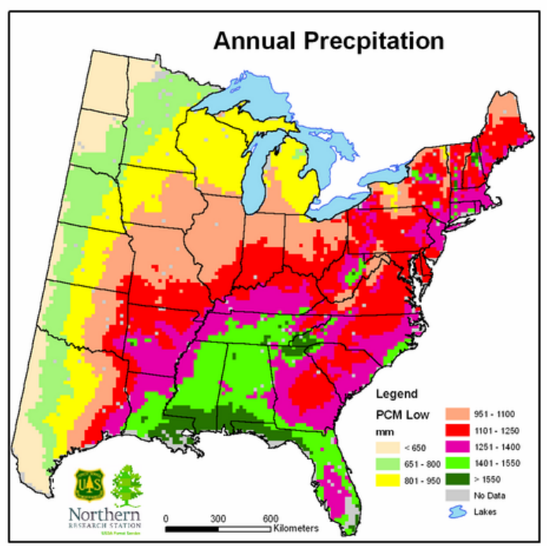
Average of 3 Global Climate Models
High Emissions (A1fi)

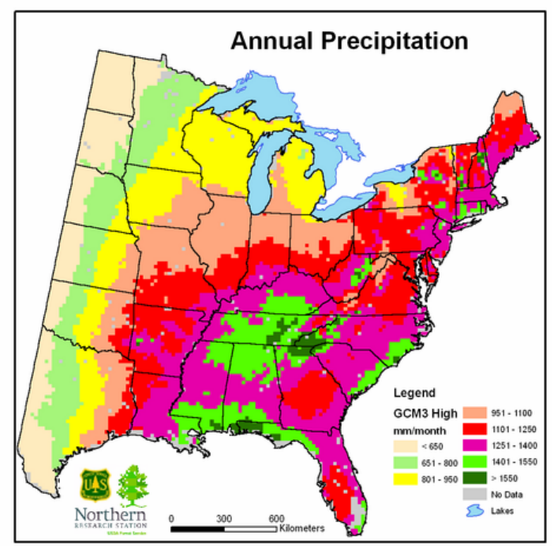


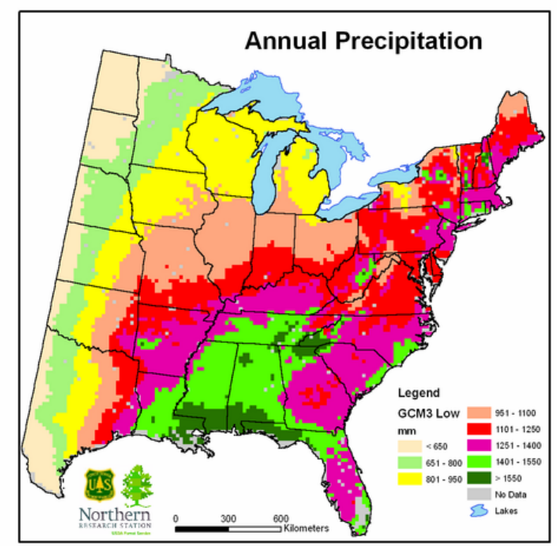
Average of 3 Global Climate Models
Low Emissions (B1)









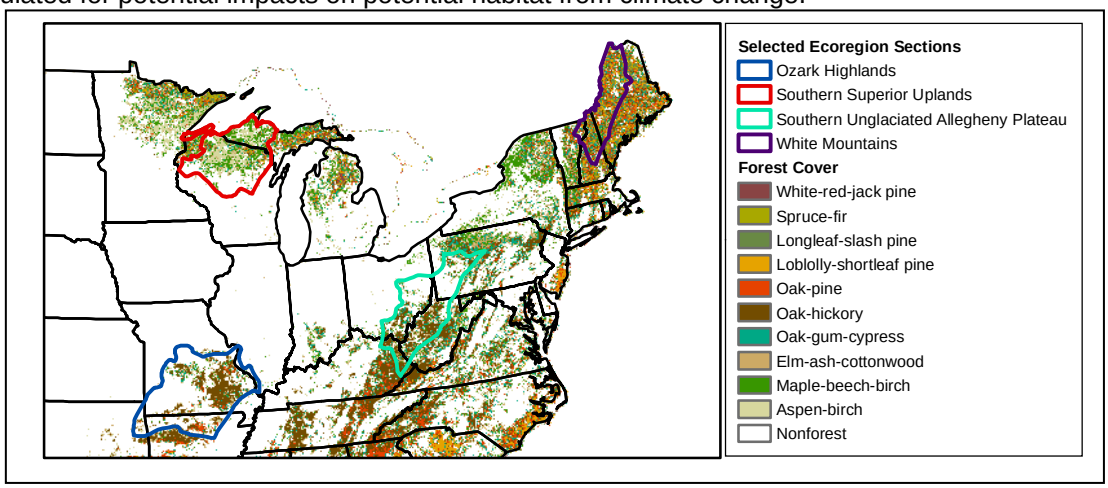


Source: Prasad, A. M., L. R. Iverson., S. Matthews., M. Peters. 2007-ongoing. A Climate Change Atlas for 134 Forest Tree Species of the Eastern United States [database]. http://www.nrs.fs.fed.us/atlas/tree, Northern Research Station, USDA Forest Service.

Description of Climate Change Tree Atlas Information

Species Tables

Four ecoregion sections in the eastern US were selected (see figure), and 134 tree species were modeled and tabulated for potential impacts on potential habitat from climate change.



Potential suitable habitat was modeled using four climate scenarios: the Hadley GCM/high emissions, the Parallel GCM/low emissions, and the average of the three GCMs (Hadley, Parallel, and Geophysical Fluid Dynamics Lab) for high and low emissions.

Importance Values

The importance values for species range from 0 to 100 and are related to the abundance of a particular species within a 20x20 km (400 km^2) cell. These importance values are determined using >100,000 Forest Inventory Analysis (FIA) plots from over all of the Eastern U.S. and modeled using Regression Tree Analysis of 38 environmental predictors. Area-weighted importance value (AWIV) is the sum of all importance values for an area of interest. Modeled changes in habitat suitability are expressed as a percent change from the current AWIV; a value >1 indicates an increase in AWIV and a value <1 indicates a decrease. “Infinite” indicates that the species may have newly suitable habitat in the ecoregion by 2100, while “no change” indicates no change from current (usually AWIV equals 0 now and 0 in the future).

Model Reliability[1]

Each species model had a Model Reliability rating of High, Medium, or Low, as assigned according to a formula calculated from the output of Regression Trees, Bagging Trees, and Random Forest models. Regression Tree Analysis (RTA) estimates the Importance Value (IV) from predictors and provides aids to interpretation for stable models; Bagging Trees (BT) evaluates the stability of 30 individual runs of RTA; and Random Forests (RF) creates current estimates of IV (by generating 1000 sub-models with random subsets of predictor variables and observations). Random Forest, using future scenarios of climate, was then used to estimate the potential future IV (suitable habitat). These techniques are described in the following papers.

Prasad, A. M., L. R. Iverson, and A. Liaw. 2006. Newer classification and regression tree techniques: bagging and random forests for ecological prediction. Ecosystems 9:181-199. http://www.treesearch.fs.fed.us/pubs/22432

Iverson, Louis R; Prasad, Anantha M.; Schwartz, Mark W. 2005. Predicting Potential Changes in Suitable Habitat and Distribution by 2100 for Tree Species of the Eastern United States J. Agric. Meteorol. 61(1): 29-37. http://www.treesearch.fs.fed.us/pubs/20686

Recent Publications

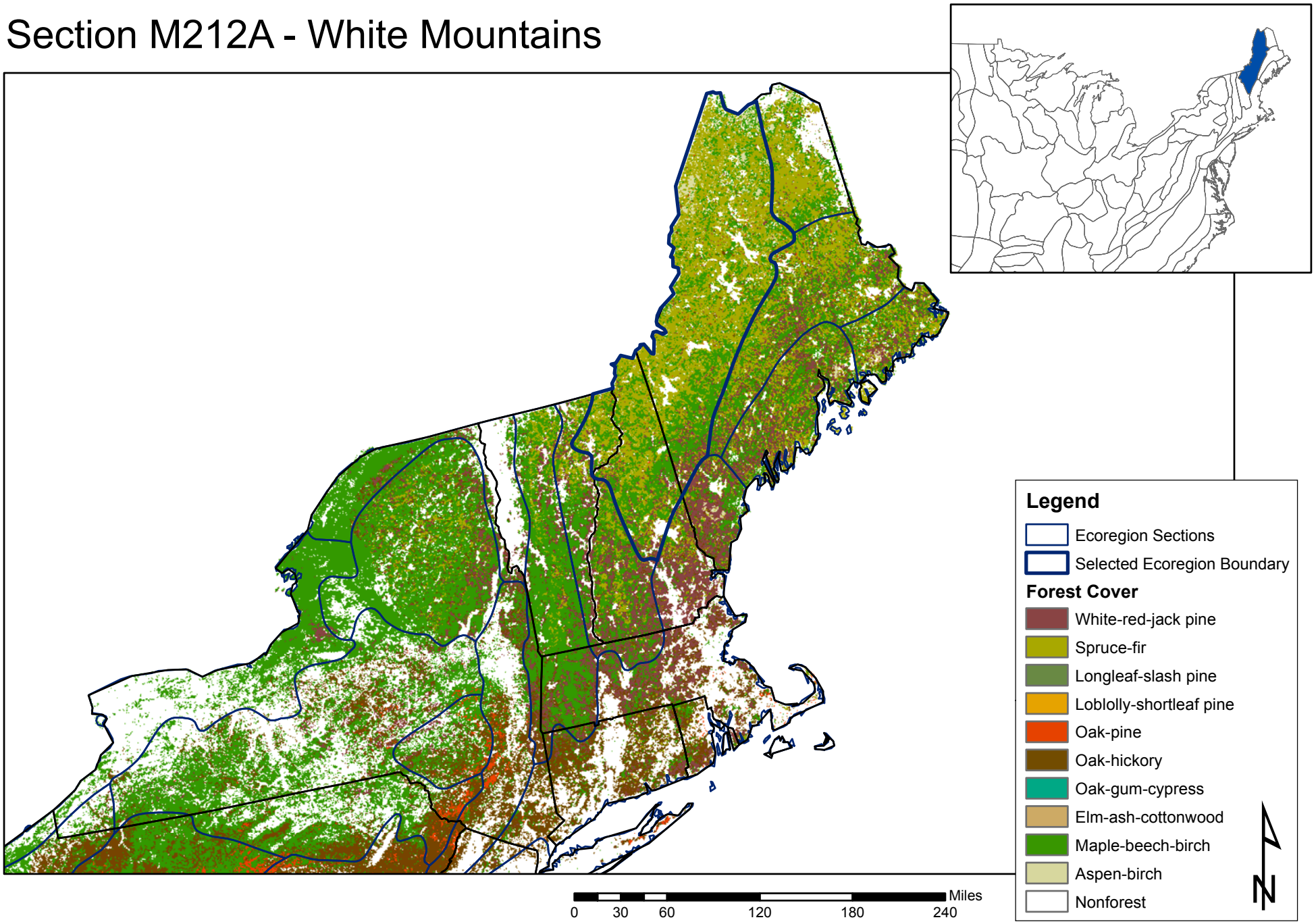
Iverson, Louis R.; Prasad, Anantha M.; Matthews, Stephen N.; Peters, Matthew 2008. Estimating potential habitat for 134 eastern US tree species under six climate scenarios Forest Ecology and Management. 254: 390-406. http://www.treesearch.fs.fed.us/pubs/13412

Iverson, L.R.; Prasad, A.; Matthews, S. 2008. Modeling potential climate change impacts on the trees of the northeastern United States. Mitig. Adapt. Strat. Glob. Change 13:487-516. http://www.treesearch.fs.fed.us/pubs/15295.

Prasad, A. M., L. R. Iverson., S. Matthews., M. Peters. 2007-ongoing. A Climate Change Atlas for 134 Forest Tree Species of the Eastern United States [database]. http://www.nrs.fs.fed.us/atlas/tree, Northern Research Station, USDA Forest Service, Delaware, Ohio.

[1]Excerpted from: M. Peters and L. Iverson. Pennsylvania Climate Change Impacts. June 5, 2008.

Section M212A - White Mountains



Section M212A--White Mountains

Geomorphology. The Section is part of the New England geomorphic Province. It is a glacially scoured, maturely dissected, irregular highland characterized by clusters of low, rounded mountains and scattered monadnocks. Highest elevations occur in a wide belt trending southwest to northeast through the Section, ending in central Maine. Glacial features are most evident in the Section's southern half and include cirques carved into the high peaks and U-shaped valleys, as well as kames, eskers, and drumlins. Mass wasting, fluvial erosion, transport and deposition are the primary geomorphic processes. General elevation ranges from 1,000 to 4,000 ft (300 to 1,200 m); isolated peaks are greater than 5,000 ft (1,500 m); local relief ranges from 1,000 to 3,000 ft (300 to 900 m). Gentle slopes cover 20 to 50 percent of the area; 75 percent of gentle slopes occur in the lowland. Subenvelop elevation ranges from 200 to 1,800 (60 to 550 m).

Lithology and Stratigraphy. Thin, stony Pleistocene till and stratified drift mantle the bedrock except in the Connecticut River valley, where lacustrine sediments and terraces are thick. In the northern half of the Section, bedrock is mostly Devonian and Silurian sedimentary rocks which become metamorphosed to quartzite, slate, and schist toward the southwest. The mountainous belt is underlain by Paleozoic igneous rocks (granite, diorite, gabbro, rhyolite, and basalt) that either intrude or both intrude and cover lower Paleozoic schists, and by Proterozoic and Cambrian gneiss. Much younger Mesozoic granites occur at the southern end, intruding the most abundant rock types there, gneiss and amphibolite.

Soil Taxa. Haplorthods, Haplaquepts, and Dystrochrepts with frigid temperature regime and udic and aquic moisture regimes comprise most of the soils. Cryorthods and Cryaquods with cryic temperature regime and udic and aquic moisture regimes are common at the highest elevations.

Potential Natural Vegetation. Kuchler vegetation types include northern hardwood, northern hardwood-spruce, and northeastern spruce-fir forest. Regionally-defined important vegetation types include northern hardwood-conifer, montane spruce-fir, lowland spruce-fir, alpine krummholz, and alpine meadow. Robbin's cinquefoil is a Federally listed plant, unique to alpine communities of the Presidential Range in New Hampshire.

Fauna. Spruce grouse, black-backed woodpecker, gray-cheeked thrush, long-tailed shrew, red squirrel, snowshoe hare, and moose characterize the colder conifer sites. Ruffed grouse, pileated woodpecker, broad-winged hawk, mourning warbler, chestnut-sided warbler, red-eyed vireo, barred owl, rose-breasted grosbeak, masked shrew, northern bog lemming, northern flying squirrel, and white-tailed deer characterize the hardwood-conifer sites. Eastern woodland caribou, wolverine, mountain lion, and timber wolf were extirpated. A few lynxes, bobcats, coyotes, black bears (seasonally), and humans are the larger predators today. Pine martens are increasing and fishers are common. Spotted salamander, redback salamander, wood frog, northern leopard frog, mink frog, and eastern garter snake characterize a smaller herpetofaunal component compared to warmer and more southerly Sections in Maine and New Hampshire. The common loon, osprey, and otter commonly use the larger lakes, rivers, and flowages in the Section. Beech provides the primary source of hard mast in the Section.

Climate. Mean annual precipitation is 36 to 70 in (910 to 1,780 mm); total annual snowfall ranges from 96 to 160 in (2,440 to 4,060 mm). Rain and snowfall increase locally with elevation. Mean annual temperature ranges from is 37 to 45 oF (3 to 7 oC). The growing season lasts for 80 to 130 days.

Surface Water Characteristics. Perennial streams provide an abundance of water. The area contains the major drainage divide in New England. The Section includes the headwaters of numerous streams including the St. John, Penobscot, Kennebec, Androscoggin, Connecticut, and Merrimack Rivers.

Ecological Section descriptions from:
Ecological Subregions of the United States. 1994. W. H. McNab and P.E. Avers, compilers. Available online: http://www.fs.fed.us/land/pubs/ecoregions/ Last accessed 8 September 2008.

Drainage networks have deranged, rectangular, and dendritic patterns which developed as stream courses imposed from the Cenozoic were modified during the Pleistocene. For example, the Connecticut River flows across the trend of bedrock units, while the Androscoggin River skirts a major granitic pluton which the Presumpscot River drains. Stream gradients in the St. John River network are generally low; stream gradients for the other rivers are moderate to steep. Average annual runoff ranges from 16 to 24 in (410 to 610 mm) generally and from 16 to 50 in (410 to 1,270 mm) in the more rugged terrain of Maine and New Hampshire. Runoff increases locally with elevation. Maximum monthly streamflows occur in March and April. Extreme peak flows can occur any time of year and are usually associated with hurricanes or rain-on-snow events. Minimum monthly flows occur in August, September, and October. The Section contains numerous lakes, a number of which are between 10 to 45 mi2 (26 to 117 km2) in size. The largest is Moosehead Lake which is roughly 120 mi2 (310 km2).

Disturbance Regimes. Montane forests in this region lack significant fire regimes and are characterized by large blowdown disturbances resulting from hurricanes or other severe wind events and smaller area, single tree phenomena. Higher elevation forests are often characterized by an even-aged windthrow disturbance phenomenon known as fir-waves. Insect and disease disturbances have resulted from gypsy moth, spruce budworm, spruce beetle, severe beech bark disease, and butternut canker. At higher elevations, spruce decline is related to severe winter injury and soil cation depletion. Forest composition at lower elevations has been influenced by agriculture dating from the colonial period and subsequent farm abandonment since about 1870, as well as by selective logging of certain species, particularly conifers. Although regionally the distribution of modern and pre-settlement forest types matches well, 250 years of land use activity has affected forest structure and composition across the landscape. The land has been both selectively and intensively logged throughout this century and the last. Forest land has been cleared of trees and farmed since the time of early settlement. Beginning around 1870, land unprofitable for agriculture was abandoned and often allowed to revert to forest land.

Land Use. More than 90 percent of this area is forested. Most of the remaining area consists of isolated farms and small residential developments. The dominant land use is recreation. Production of wood for lumber and pulp is also important.

Cultural Ecology. Native American hunter-gatherer economic activities were prevalent within the area as long ago as 10,000 years. Settlements were small and short term. Historically, the area was occupied by Eastern Abnaki Tribal groups. European settlement occurred as early as the 17th century and increased during the following centuries. Nineteenth century timber harvesting resulted in a largely deforested landscape by the early 20th century. Harvest of restored second growth timber continues into the present. Tourism and winter and summer recreational activities, began in the 19th century and continue to thrive today. Combined, they are considered the area's number one economic sector.

Compiled by Northeastern Forest Experiment Station, Northeastern Area State and Private Forestry, and the Eastern Region. (http://www.fs.fed.us/land/pubs/ecoregions/ch15.html#M212A)

Ecological Section descriptions from:
Ecological Subregions of the United States. 1994. W. H. McNab and P.E. Avers, compilers. Available online: http://www.fs.fed.us/land/pubs/ecoregions/ Last accessed 8 September 2008.

Potential Changes in Area-Weighted Importance Values for Tree Species
Section M212A - White Mountains

--- Sorted by Scientific Name ---

FIA Code	Scientific Name	Model Reliability	Current Area-weighted Importance Value	Percent Change Area-weighted Importance Value			
				PCM Model Low emissions	Average of 3 GCM Models Low emissions	Average of 3 GCM Models High emissions	HAD Model High emissions
12	Abies balsamea	High	2011	-41	-59	-84	-85
311	Acer barbatum	Medium	0	No Change	No Change	No Change	No Change
313	Acer negundo	Medium	0	No Change	Infinite	Infinite	Infinite
314	Acer nigrum	Low	0	No Change	No Change	No Change	No Change
315	Acer pensylvanicum	High	330	-18	-30	-52	-58
316	Acer rubrum	High	1082	23	24	19	-11
317	Acer saccharinum	Medium	13	138	215	1131	1431
318	Acer saccharum	High	1090	-3	-6	-28	-35
319	Acer spicatum	High	148	-60	-73	-100	-100
331	Aesculus glabra	Low	0	No Change	No Change	No Change	Infinite
332	Aesculus octandra	Medium	0	No Change	No Change	No Change	No Change
356	Amelanchier sp.	Medium	19	105	200	205	216
367	Asimina triloba	Low	0	No Change	No Change	Infinite	Infinite
371	Betula alleghaniensis	High	792	-20	-33	-68	-68
372	Betula lenta	High	1	7200	9400	23500	17900
373	Betula nigra	Low	5	-100	-100	-100	60
375	Betula papyrifera	High	754	-36	-39	-80	-91
379	Betula populifolia	Medium	41	37	49	44	34
381	Bumelia lanuginosa	Low	0	No Change	No Change	No Change	No Change
391	Carpinus caroliniana	Medium	0	Infinite	Infinite	Infinite	Infinite
401	Carya aquatica	Medium	0	No Change	No Change	No Change	No Change
402	Carya cordiformis	Low	0	No Change	Infinite	Infinite	Infinite
403	Carya glabra	High	0	Infinite	Infinite	Infinite	Infinite
404	Carya illinoensis	Low	0	No Change	No Change	Infinite	Infinite
405	Carya laciniosa	Low	0	No Change	No Change	Infinite	Infinite
407	Carya ovata	Medium	0	Infinite	Infinite	Infinite	Infinite
408	Carya texana	High	0	No Change	No Change	Infinite	Infinite
409	Carya tomentosa	High	0	No Change	No Change	Infinite	Infinite
421	Castanea dentata	Medium	0	No Change	No Change	No Change	No Change
452	Catalpa speciosa	Low	0	No Change	No Change	No Change	No Change
461	Celtis laevigata	Medium	0	No Change	No Change	Infinite	Infinite
462	Celtis occidentalis	Medium	0	Infinite	Infinite	Infinite	Infinite
471	Cercis canadensis	Medium	0	No Change	No Change	Infinite	Infinite
43	Chamaecyparis thyoides	Low	0	No Change	No Change	No Change	No Change
491	Cornus florida	High	0	Infinite	Infinite	Infinite	Infinite
521	Diospyros virginiana	Medium	0	No Change	No Change	Infinite	Infinite
531	Fagus grandifolia	High	823	-3	-4	-38	-50
541	Fraxinus americana	High	160	101	123	171	154
543	Fraxinus nigra	High	89	-26	-11	4	-10
544	Fraxinus pennsylvanica	Medium	0	No Change	No Change	Infinite	Infinite
546	Fraxinus quadrangulata	Low	0	No Change	No Change	No Change	No Change
551	Gleditsia aquatica	Low	0	No Change	No Change	No Change	No Change
552	Gleditsia triacanthos	Low	0	No Change	Infinite	Infinite	Infinite
555	Gordonia lasianthus	Medium	0	No Change	No Change	No Change	No Change
571	Gymnocladus dioicus	Low	0	No Change	No Change	No Change	No Change
580	Halesia sp.	Medium	0	No Change	No Change	No Change	No Change
591	Ilex opaca	High	0	No Change	No Change	No Change	No Change
601	Juglans cinerea	Low	0	No Change	No Change	No Change	No Change
602	Juglans nigra	Medium	0	Infinite	Infinite	Infinite	Infinite
68	Juniperus virginiana	Medium	0	Infinite	Infinite	Infinite	Infinite
71	Larix laricina	High	31	-13	84	45	29
611	Liquidambar styraciflua	High	0	No Change	No Change	Infinite	Infinite
621	Liriodendron tulipifera	High	0	Infinite	Infinite	Infinite	Infinite
641	Maclura pomifera	Medium	0	No Change	No Change	Infinite	Infinite
651	Magnolia acuminata	High	0	No Change	No Change	No Change	No Change
652	Magnolia grandiflora	Medium	0	No Change	No Change	No Change	No Change
654	Magnolia macrophylla	Low	0	No Change	No Change	No Change	No Change
653	Magnolia virginiana	High	0	No Change	No Change	No Change	No Change
682	Morus rubra	Low	0	Infinite	Infinite	Infinite	Infinite
691	Nyssa aquatica	Medium	0	No Change	No Change	No Change	No Change
694	Nyssa biflora	High	0	No Change	No Change	No Change	No Change
692	Nyssa ogeche	Medium	0	No Change	No Change	No Change	No Change
693	Nyssa sylvatica	High	0	Infinite	Infinite	Infinite	Infinite
701	Ostrya virginiana	Medium	89	16	25	83	187

711	Oxydendrum arboreum	High	0	No Change	No Change	No Change	Infinite
721	Persea borbonia	High	0	No Change	No Change	No Change	No Change
94	Picea glauca	Medium	162	-28	-38	-46	-57
95	Picea mariana	High	223	-61	-77	-100	-100
97	Picea rubens	High	1094	-48	-60	-69	-69
105	Pinus banksiana	High	1	-100	400	2800	6200
107	Pinus clausa	Medium	0	No Change	No Change	No Change	No Change
110	Pinus echinata	High	0	No Change	No Change	Infinite	Infinite
111	Pinus elliottii	High	0	No Change	No Change	No Change	No Change
115	Pinus glabra	Medium	0	No Change	No Change	No Change	No Change
121	Pinus palustris	High	0	Infinite	Infinite	Infinite	Infinite
123	Pinus pungens	Medium	0	No Change	No Change	No Change	No Change
125	Pinus resinosa	Medium	34	-15	35	559	341
126	Pinus rigida	High	4	-100	-100	175	375
128	Pinus serotina	High	0	No Change	No Change	No Change	No Change
129	Pinus strobus	High	375	25	21	59	8
131	Pinus taeda	High	0	No Change	Infinite	Infinite	Infinite
132	Pinus virginiana	High	0	No Change	No Change	Infinite	Infinite
722	Planera aquatica	Low	0	No Change	No Change	No Change	No Change
731	Platanus occidentalis	Medium	0	No Change	No Change	Infinite	Infinite
741	Populus balsamifera	High	20	-30	-70	-100	-100
742	Populus deltoides	Low	0	Infinite	Infinite	Infinite	Infinite
743	Populus grandidentata	High	83	33	39	58	4
746	Populus tremuloides	High	261	12	28	-16	-49
766	Prunus americana	Low	0	No Change	No Change	No Change	Infinite
761	Prunus pensylvanica	Medium	120	-6	-6	-45	-71
762	Prunus serotina	High	127	128	164	313	215
763	Prunus virginiana	Low	6	17	33	283	183
802	Quercus alba	High	2	3200	7650	20550	29950
804	Quercus bicolor	Low	0	No Change	No Change	No Change	Infinite
806	Quercus coccinea	High	0	Infinite	Infinite	Infinite	Infinite
808	Quercus durandii	Low	0	No Change	No Change	No Change	No Change
809	Quercus ellipsoidalis	Medium	0	No Change	Infinite	Infinite	Infinite
812	Quercus falcata var. falcata	High	0	No Change	No Change	Infinite	Infinite
813	Quercus falcata var. pagodaefolia	Medium	0	No Change	No Change	No Change	No Change
816	Quercus ilicifolia	Low	0	No Change	No Change	No Change	No Change
817	Quercus imbricaria	Medium	0	No Change	No Change	Infinite	Infinite
842	Quercus incana	Medium	0	No Change	No Change	No Change	No Change
819	Quercus laevis	High	0	No Change	No Change	No Change	Infinite
820	Quercus laurifolia	High	0	No Change	No Change	No Change	No Change
822	Quercus lyrata	Medium	0	No Change	No Change	No Change	No Change
823	Quercus macrocarpa	Medium	0	No Change	Infinite	Infinite	Infinite
824	Quercus marilandica	Medium	0	No Change	No Change	Infinite	Infinite
825	Quercus michauxii	Medium	0	No Change	No Change	No Change	No Change
826	Quercus muehlenbergii	Medium	0	No Change	No Change	Infinite	Infinite
827	Quercus nigra	High	0	No Change	No Change	No Change	No Change
828	Quercus nuttallii	Low	0	No Change	No Change	No Change	No Change
830	Quercus palustris	Medium	0	No Change	Infinite	Infinite	Infinite
831	Quercus phellos	Medium	0	No Change	No Change	No Change	No Change
832	Quercus prinus	High	0	Infinite	Infinite	Infinite	Infinite
833	Quercus rubra	High	93	292	411	511	478
834	Quercus shumardii	Low	0	No Change	No Change	No Change	Infinite
835	Quercus stellata	High	0	No Change	No Change	Infinite	Infinite
837	Quercus velutina	High	1	4500	9700	29600	45400
838	Quercus virginiana	Medium	0	No Change	No Change	No Change	No Change
901	Robinia psuedoacacia	Low	0	Infinite	Infinite	Infinite	Infinite
921	Salix amygdaloides	Low	0	No Change	No Change	No Change	No Change
922	Salix nigra	Low	0	Infinite	Infinite	Infinite	Infinite
931	Sassafras albidum	High	0	Infinite	Infinite	Infinite	Infinite
935	Sorbus americana	Medium	12	-100	-100	-100	-100
221	Taxodium distichum	Medium	0	No Change	No Change	No Change	No Change
222	Taxodium distichum var.nutans	High	0	No Change	No Change	No Change	No Change
241	Thuja occidentalis	High	434	-42	-50	-69	-73
951	Tilia americana	Medium	15	233	413	620	1120
261	Tsuga canadensis	High	309	87	99	73	40
971	Ulmus alata	High	0	No Change	No Change	Infinite	Infinite
972	Ulmus americana	Medium	33	152	294	718	1061
973	Ulmus crassifolia	Low	0	No Change	No Change	No Change	Infinite
975	Ulmus rubra	Medium	0	Infinite	Infinite	Infinite	Infinite
977	Ulmus thomasii	Low	0	No Change	No Change	No Change	No Change

Data courtesy of L. Iverson and the Climate Change Tree Atlas (http://www.nrs.fs.fed.us/atlas/tree/tree_atlas.html)

Potential Changes in Area-Weighted Importance Values for Tree Species
Section M212A - White Mountains

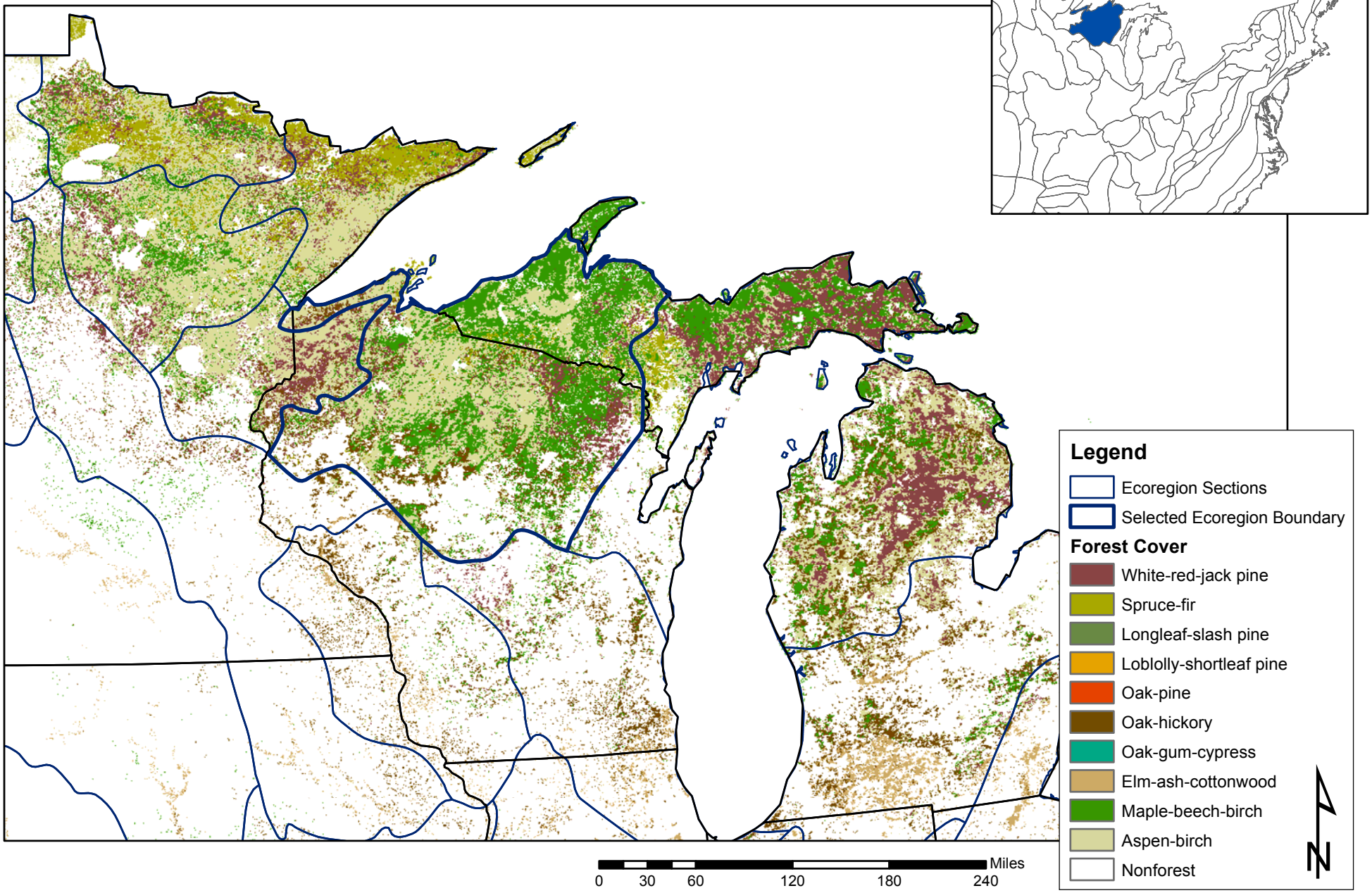
--- Sorted by Current Area-weighted Importance Value ---

FIA Code	Scientific Name	Model Reliability	Current Area-weighted Importance Value	Percent Change Area-weighted Importance Value			
				PCM Model Low emissions	Average of 3 GCM Models Low emissions	Average of 3 GCM Models High emissions	HAD Model High emissions
12	Abies balsamea	High	2011	-41	-59	-84	-85
97	Picea rubens	High	1094	-48	-60	-69	-69
318	Acer saccharum	High	1090	-3	-6	-28	-35
316	Acer rubrum	High	1082	23	24	19	-11
531	Fagus grandifolia	High	823	-3	-4	-38	-50
371	Betula alleghaniensis	High	792	-20	-33	-68	-68
375	Betula papyrifera	High	754	-36	-39	-80	-91
241	Thuja occidentalis	High	434	-42	-50	-69	-73
129	Pinus strobus	High	375	25	21	59	8
315	Acer pensylvanicum	High	330	-18	-30	-52	-58
261	Tsuga canadensis	High	309	87	99	73	40
746	Populus tremuloides	High	261	12	28	-16	-49
95	Picea mariana	High	223	-61	-77	-100	-100
94	Picea glauca	Medium	162	-28	-38	-46	-57
541	Fraxinus americana	High	160	101	123	171	154
319	Acer spicatum	High	148	-60	-73	-100	-100
762	Prunus serotina	High	127	128	164	313	215
761	Prunus pensylvanica	Medium	120	-6	-6	-45	-71
833	Quercus rubra	High	93	292	411	511	478
543	Fraxinus nigra	High	89	-26	-11	4	-10
701	Ostrya virginiana	Medium	89	16	25	83	187
743	Populus grandidentata	High	83	33	39	58	4
379	Betula populifolia	Medium	41	37	49	44	34
125	Pinus resinosa	Medium	34	-15	35	559	341
972	Ulmus americana	Medium	33	152	294	718	1061
71	Larix laricina	High	31	-13	84	45	29
741	Populus balsamifera	High	20	-30	-70	-100	-100
356	Amelanchier sp.	Medium	19	105	200	205	216
951	Tilia americana	Medium	15	233	413	620	1120
317	Acer saccharinum	Medium	13	138	215	1131	1431
935	Sorbus americana	Medium	12	-100	-100	-100	-100
763	Prunus virginiana	Low	6	17	33	283	183
373	Betula nigra	Low	5	-100	-100	-100	60
126	Pinus rigida	High	4	-100	-100	175	375
802	Quercus alba	High	2	3200	7650	20550	29950
372	Betula lenta	High	1	7200	9400	23500	17900
105	Pinus banksiana	High	1	-100	400	2800	6200
837	Quercus velutina	High	1	4500	9700	29600	45400
311	Acer barbatum	Medium	0	No Change	No Change	No Change	No Change
313	Acer negundo	Medium	0	No Change	Infinite	Infinite	Infinite
314	Acer nigrum	Low	0	No Change	No Change	No Change	No Change
331	Aesculus glabra	Low	0	No Change	No Change	No Change	Infinite
332	Aesculus octandra	Medium	0	No Change	No Change	No Change	No Change
367	Asimina triloba	Low	0	No Change	No Change	Infinite	Infinite
381	Bumelia lanuginosa	Low	0	No Change	No Change	No Change	No Change
391	Carpinus caroliniana	Medium	0	Infinite	Infinite	Infinite	Infinite
401	Carya aquatica	Medium	0	No Change	No Change	No Change	No Change
402	Carya cordiformis	Low	0	No Change	Infinite	Infinite	Infinite
403	Carya glabra	High	0	Infinite	Infinite	Infinite	Infinite
404	Carya illinoensis	Low	0	No Change	No Change	Infinite	Infinite
405	Carya laciniosa	Low	0	No Change	No Change	Infinite	Infinite
407	Carya ovata	Medium	0	Infinite	Infinite	Infinite	Infinite
408	Carya texana	High	0	No Change	No Change	Infinite	Infinite
409	Carya tomentosa	High	0	No Change	No Change	Infinite	Infinite
421	Castanea dentata	Medium	0	No Change	No Change	No Change	No Change
452	Catalpa speciosa	Low	0	No Change	No Change	No Change	No Change
461	Celtis laevigata	Medium	0	No Change	No Change	Infinite	Infinite
462	Celtis occidentalis	Medium	0	Infinite	Infinite	Infinite	Infinite
471	Cercis canadensis	Medium	0	No Change	No Change	Infinite	Infinite
43	Chamaecyparis thyoides	Low	0	No Change	No Change	No Change	No Change
491	Cornus florida	High	0	Infinite	Infinite	Infinite	Infinite
521	Diospyros virginiana	Medium	0	No Change	No Change	Infinite	Infinite
544	Fraxinus pennsylvanica	Medium	0	No Change	No Change	Infinite	Infinite
546	Fraxinus quadrangulata	Low	0	No Change	No Change	No Change	No Change

551	Gleditsia aquatica	Low	0	No Change	No Change	No Change	No Change
552	Gleditsia triacanthos	Low	0	No Change	Infinite	Infinite	Infinite
555	Gordonia lasianthus	Medium	0	No Change	No Change	No Change	No Change
571	Gymnocladus dioicus	Low	0	No Change	No Change	No Change	No Change
580	Halesia sp.	Medium	0	No Change	No Change	No Change	No Change
591	Ilex opaca	High	0	No Change	No Change	No Change	No Change
601	Juglans cinerea	Low	0	No Change	No Change	No Change	No Change
602	Juglans nigra	Medium	0	Infinite	Infinite	Infinite	Infinite
68	Juniperus virginiana	Medium	0	Infinite	Infinite	Infinite	Infinite
611	Liquidambar styraciflua	High	0	No Change	No Change	Infinite	Infinite
621	Liriodendron tulipifera	High	0	Infinite	Infinite	Infinite	Infinite
641	Maclura pomifera	Medium	0	No Change	No Change	Infinite	Infinite
651	Magnolia acuminata	High	0	No Change	No Change	No Change	No Change
652	Magnolia grandiflora	Medium	0	No Change	No Change	No Change	No Change
654	Magnolia macrophylla	Low	0	No Change	No Change	No Change	No Change
653	Magnolia virginiana	High	0	No Change	No Change	No Change	No Change
682	Morus rubra	Low	0	Infinite	Infinite	Infinite	Infinite
691	Nyssa aquatica	Medium	0	No Change	No Change	No Change	No Change
694	Nyssa biflora	High	0	No Change	No Change	No Change	No Change
692	Nyssa ogeche	Medium	0	No Change	No Change	No Change	No Change
693	Nyssa sylvatica	High	0	Infinite	Infinite	Infinite	Infinite
711	Oxydendrum arboreum	High	0	No Change	No Change	No Change	Infinite
721	Persea borbonia	High	0	No Change	No Change	No Change	No Change
107	Pinus clausa	Medium	0	No Change	No Change	No Change	No Change
110	Pinus echinata	High	0	No Change	No Change	Infinite	Infinite
111	Pinus elliottii	High	0	No Change	No Change	No Change	No Change
115	Pinus glabra	Medium	0	No Change	No Change	No Change	No Change
121	Pinus palustris	High	0	Infinite	Infinite	Infinite	Infinite
123	Pinus pungens	Medium	0	No Change	No Change	No Change	No Change
128	Pinus serotina	High	0	No Change	No Change	No Change	No Change
131	Pinus taeda	High	0	No Change	Infinite	Infinite	Infinite
132	Pinus virginiana	High	0	No Change	No Change	Infinite	Infinite
722	Planera aquatica	Low	0	No Change	No Change	No Change	No Change
731	Platanus occidentalis	Medium	0	No Change	No Change	Infinite	Infinite
742	Populus deltoides	Low	0	Infinite	Infinite	Infinite	Infinite
766	Prunus americana	Low	0	No Change	No Change	No Change	Infinite
804	Quercus bicolor	Low	0	No Change	No Change	No Change	Infinite
806	Quercus coccinea	High	0	Infinite	Infinite	Infinite	Infinite
808	Quercus durandii	Low	0	No Change	No Change	No Change	No Change
809	Quercus ellipsoidalis	Medium	0	No Change	Infinite	Infinite	Infinite
812	Quercus falcata var. falcata	High	0	No Change	No Change	Infinite	Infinite
813	Quercus falcata var. pagodaefolia	Medium	0	No Change	No Change	No Change	No Change
816	Quercus ilicifolia	Low	0	No Change	No Change	No Change	No Change
817	Quercus imbricaria	Medium	0	No Change	No Change	Infinite	Infinite
842	Quercus incana	Medium	0	No Change	No Change	No Change	No Change
819	Quercus laevis	High	0	No Change	No Change	No Change	Infinite
820	Quercus laurifolia	High	0	No Change	No Change	No Change	No Change
822	Quercus lyrata	Medium	0	No Change	No Change	No Change	No Change
823	Quercus macrocarpa	Medium	0	No Change	Infinite	Infinite	Infinite
824	Quercus marilandica	Medium	0	No Change	No Change	Infinite	Infinite
825	Quercus michauxii	Medium	0	No Change	No Change	No Change	No Change
826	Quercus muehlenbergii	Medium	0	No Change	No Change	Infinite	Infinite
827	Quercus nigra	High	0	No Change	No Change	No Change	No Change
828	Quercus nuttallii	Low	0	No Change	No Change	No Change	No Change
830	Quercus palustris	Medium	0	No Change	Infinite	Infinite	Infinite
831	Quercus phellos	Medium	0	No Change	No Change	No Change	No Change
832	Quercus prinus	High	0	Infinite	Infinite	Infinite	Infinite
834	Quercus shumardii	Low	0	No Change	No Change	No Change	Infinite
835	Quercus stellata	High	0	No Change	No Change	Infinite	Infinite
838	Quercus virginiana	Medium	0	No Change	No Change	No Change	No Change
901	Robinia psuedoacacia	Low	0	Infinite	Infinite	Infinite	Infinite
921	Salix amygdaloides	Low	0	No Change	No Change	No Change	No Change
922	Salix nigra	Low	0	Infinite	Infinite	Infinite	Infinite
931	Sassafras albidum	High	0	Infinite	Infinite	Infinite	Infinite
221	Taxodium distichum	Medium	0	No Change	No Change	No Change	No Change
222	Taxodium distichum var.nutans	High	0	No Change	No Change	No Change	No Change
971	Ulmus alata	High	0	No Change	No Change	Infinite	Infinite
973	Ulmus crassifolia	Low	0	No Change	No Change	No Change	Infinite
975	Ulmus rubra	Medium	0	Infinite	Infinite	Infinite	Infinite
977	Ulmus thomasii	Low	0	No Change	No Change	No Change	No Change

Data courtesy of L. Iverson and the Climate Change Tree Atlas (http://www.nrs.fs.fed.us/atlas/tree/tree_atlas.html)

Section 212J - Southern Superior Uplands



Section 212J--Southern Superior Uplands

Geomorphology. This Section comprises the eastern two-thirds of the Superior Upland geomorphic province. About half the Section is level to gently rolling lowlands (glacial ground moraines) and flat laustrine plain; the rest is hillier uplands with escarpments. The lowlands and plains are intermittently overlain by low, undulating ridges (glacial end moraines) and by other mounded or hummocky glacial features (e.g., kames and eskers). Kettled glacial outwash plains are common. Most prominent of the uplands are linear "ranges" trending southwest-northeast along the Superior shore. Drainage is dendritic with only minor entrenchment. Geomorphic processes operating in the Section are lake-shore and fluvial erosion, transport and deposition. Elevation ranges from 600 to 1,980 ft (183 to 603 m). Local relief is generally 100 to 600 ft (30 to 183 m).

Lithology and Stratigraphy. Most of this Section is covered by Pleistocene (Wisconsinan) till and/or stratified drift, up to 500 ft (150 m) thick but much thinner on the uplands. Lacustrine deposits (stratified sand, silt, clay, marl, peat, and muck) occur primarily along Lake Superior. Beneath the drift, bedrock is composed mostly of Proterozoic igneous rocks, both felsic and mafic volcanics and plutonics. Volcanics underlie the most prominent highlands, the "ranges." Proterozoic metamorphics also occur. quartzite, slate, schist, gneiss, marble, greenstone, and amphibolite. Proterozoic shale and sandstone crop out along the Superior shore. Archean metavolcanics and granite form bedrock in the northeast corner of the Section. Bedrock outcrops are common in the upland areas.

Soil Taxa. Dominant soils include Spodosols, Entisols, Alfisols, Inceptisols, and Histosols with frigid temperature regime, and xeric, udic, and aquic moisture regimes. Parent materials are dominantly acid, except for calcareous materials associated with the Lake Superior clay plain and the Green Bay lobe.

Potential Natural Vegetation. Kuchler vegetation types are maple-beech-birch, aspen-birch, spruce-fir forests. More recent vegetation classification is more specific. Acer-Tsuga Series and Acer-Series occur on mesic landforms; Tsuga Series occur on dry-mesic landforms; Pinus Series occur on xeric landforms; and Tsuga-Thuja Series occur on wetland landforms.

Fauna. Typical species include coniferous and mixed forest warblers. Tennessee, Nashville, northern parula, magnolia, Cape May, yellow-rumped Blackburnian, pine, and black-throated green warblers. Primary predators include Great Plains wolf, lynx, and fisher. Browsers include moose, white-tailed deer, snowshoe hare, and porcupine. Other mammals include artic shrew, least chipmunk, and northern flying squirrel. Typical herps include red-backed salamander, northern red-bellied snake, wood frog, and wood turtle. Typical fish include brook trout, northern pike, smallmouth bass, white sucker, sculpin, common shiner, and creek chub. Extirpated species reintroduced are the marten, fisher, peregrine falcon, moose, and wolf. The wolverine, mountain lion, woodland caribou, and bison remain expatriates. Unique species to this Section are the Wisconsin River muskellunge and lake trout.

Climate. Average annual precipitation ranges from 26 to 36 in (660 to 910 mm) occurring largely during the summer period. Considerable lake-effect snowfall occurs across this Section, ranging from 60 to 400 in (1,530 to 1,016 mm) from Lake Superior. Temperature ranges from 37 to 43 oF (3 to 6 oC). Most of the Section has a humid-continental climatic regime, with an average annual temperature range from about 39 to 45 oF (4 to 7 oC). Climate along Lake Superior is modified maritime continental, with an average annual temperature range of 37 to 43 oF (3 to 6 oC). The average temperature ranges from 9 oF (January) to 68 oF (July). Most of the Section has 80 to 145 days of average freeze-free period. Along Lake Superior, it is 100 to 140 days.

Ecological Section descriptions from:
Ecological Subregions of the United States. 1994. W. H. McNab and P.E. Avers, compilers. Available online: http://www.fs.fed.us/land/pubs/ecoregions/ Last accessed 8 September 2008.

Surface Water Characteristics. Numerous lakes, streams, springs, spring ponds, and wetlands have formed in the glacial landscape. The drainage network is relatively immature; stream density is relatively low. Within this Section, two major watersheds begin. St. Lawrence (Lake Superior and Lake Michigan) and Mississippi River watershed. Low-gradient streams and rivers characterize most of the Section. High flows during the spring and fall and low-flow during summer periods characterize most streams and rivers that flow into Lake Superior. Streams are underlain by deep till, outwash, lacustrine, sandstone, and various igneous and metemorphic bedrock types. Lakes are largely associated with collapsed till of moraines and outwash plains.

Disturbance Regimes. Light to medium (10 to 40 percent canopy removal) windfall disturbance dominates in northern hardwoods on mesic landforms. In pine and mixed-pine cover types on xeric and dry mesic landforms, fire is the dominant disturbance, occurring at about 50 to 250 year intervals. Widespread thunderstorm downbursts occur at only about 1,200 to 2,000 year intervals.

Land Use. Extensive clearcutting was followed by catastrophic, hot slash fires in the late 19th and early early 20th centuries. European settlement brought moderate amounts of agricultural clearing (much of which was later abandoned), new species, and suppression of wildfire. Early successional species such as paper birch, big tooth and trembling aspens, and red maple have increased in abundance, while hemlock has been reduced due to a combination of logging, post-logging fire, and deer browsing. The current land cover is dominantly forest vegetation. Dominant land uses are outdoor recreation, wildlife habitat, and production of wood fiber.

Cultural Ecology. Ten thousand years ago small, mobile Paleo-Indian groups hunted large game such as barren ground caribou and gathered a variety of plants typical of the mosaic boreal forest-tundra. During the warm and dry conditions of the Hypsithermal Climatic episode beginning around 8,000 B.C., small game hunting-gathering Archaic populations were drawn to the fisheries, deer, elk and plants of the Lake Superior and Lake Michigan basins. Increasing moisture associated with the Little Climatic Optimum, 200 B.C., marked significant population increases in the Woodland Native American culture. During 2,000 years of Woodland development, Indian groups focused on a variety of food collection strategies, including horticulture. Europeans ventured into the area by the mid to late 17th century. Mining greatly increased the influx of Europeans during the first half of the 19th century; and following the Civil War, logging became a dominant industry. Euro-American settlement escalated by the beginning of the 20th century, ushering in modern social and economic trends.

Compiled by Eastern Region. (http://www.fs.fed.us/land/pubs/ecoregions/ch14.html#212J)

Ecological Section descriptions from:
Ecological Subregions of the United States. 1994. W. H. McNab and P.E. Avers, compilers. Available online: http://www.fs.fed.us/land/pubs/ecoregions/ Last accessed 8 September 2008.

Potential Changes in Area-Weighted Importance Values for Tree Species
Section 212J - Southern Superior Uplands

--- Sorted by Scientific Name ---

				Percent Change Area-weighted Importance Value			
FIA Code	Scientific Name	Model Reliability	Current Area-weighted Importance Value	PCM Model Low emissions	Average of 3 GCM Models Low emissions	Average of 3 GCM Models High emissions	HAD Model High emissions
12	Abies balsamea	High	1389	-71	-84	-90	-89
311	Acer barbatum	Medium	0	No Change	No Change	No Change	No Change
313	Acer negundo	Medium	59	281	539	878	1086
314	Acer nigrum	Low	0	No Change	No Change	No Change	No Change
315	Acer pensylvanicum	High	14	-36	-21	-50	-64
316	Acer rubrum	High	2128	-2	-14	-42	-45
317	Acer saccharinum	Medium	46	448	804	963	1002
318	Acer saccharum	High	2714	-36	-51	-70	-73
319	Acer spicatum	High	33	-100	-100	-100	-100
331	Aesculus glabra	Low	0	No Change	Infinite	Infinite	Infinite
332	Aesculus octandra	Medium	0	No Change	No Change	No Change	No Change
356	Amelanchier sp.	Medium	0	No Change	Infinite	No Change	No Change
367	Asimina triloba	Low	0	No Change	No Change	No Change	No Change
371	Betula alleghaniensis	High	492	-48	-68	-83	-83
372	Betula lenta	High	0	Infinite	Infinite	Infinite	Infinite
373	Betula nigra	Low	0	Infinite	Infinite	Infinite	Infinite
375	Betula papyrifera	High	1156	-47	-55	-86	-85
379	Betula populifolia	Medium	0	No Change	Infinite	Infinite	Infinite
381	Bumelia lanuginosa	Low	0	No Change	No Change	No Change	No Change
391	Carpinus caroliniana	Medium	97	76	81	93	94
401	Carya aquatica	Medium	0	No Change	No Change	No Change	No Change
402	Carya cordiformis	Low	68	135	243	299	301
403	Carya glabra	High	0	Infinite	Infinite	Infinite	Infinite
404	Carya illinoensis	Low	0	No Change	No Change	Infinite	Infinite
405	Carya laciniosa	Low	0	No Change	No Change	Infinite	Infinite
407	Carya ovata	Medium	14	1736	2486	2771	2593
408	Carya texana	High	0	No Change	No Change	Infinite	Infinite
409	Carya tomentosa	High	0	Infinite	Infinite	Infinite	Infinite
421	Castanea dentata	Medium	0	No Change	No Change	No Change	No Change
452	Catalpa speciosa	Low	0	No Change	No Change	Infinite	Infinite
461	Celtis laevigata	Medium	0	No Change	No Change	Infinite	Infinite
462	Celtis occidentalis	Medium	0	Infinite	Infinite	Infinite	Infinite
471	Cercis canadensis	Medium	0	No Change	Infinite	Infinite	Infinite
43	Chamaecyparis thyoides	Low	0	No Change	No Change	No Change	No Change
491	Cornus florida	High	0	Infinite	Infinite	Infinite	Infinite
521	Diospyros virginiana	Medium	0	No Change	No Change	Infinite	Infinite
531	Fagus grandifolia	High	75	261	225	156	148
541	Fraxinus americana	High	246	76	66	102	95
543	Fraxinus nigra	High	707	-22	-25	-45	-43
544	Fraxinus pennsylvanica	Medium	149	-4	26	134	150
546	Fraxinus quadrangulata	Low	0	No Change	No Change	No Change	No Change
551	Gleditsia aquatica	Low	0	No Change	No Change	No Change	No Change
552	Gleditsia triacanthos	Low	0	Infinite	Infinite	Infinite	Infinite
555	Gordonia lasianthus	Medium	0	No Change	No Change	No Change	No Change
571	Gymnocladus dioicus	Low	0	No Change	No Change	No Change	No Change
580	Halesia sp.	Medium	0	No Change	No Change	No Change	No Change
591	Ilex opaca	High	0	No Change	No Change	No Change	No Change
601	Juglans cinerea	Low	16	119	231	-100	-100
602	Juglans nigra	Medium	0	Infinite	Infinite	Infinite	Infinite
68	Juniperus virginiana	Medium	0	Infinite	Infinite	Infinite	Infinite
71	Larix laricina	High	389	-12	-20	-40	-40
611	Liquidambar styraciflua	High	0	No Change	No Change	Infinite	Infinite
621	Liriodendron tulipifera	High	0	Infinite	Infinite	Infinite	Infinite
641	Maclura pomifera	Medium	1	700	3500	17700	19300
651	Magnolia acuminata	High	0	No Change	No Change	No Change	No Change
652	Magnolia grandiflora	Medium	0	No Change	No Change	No Change	No Change
654	Magnolia macrophylla	Low	0	No Change	No Change	No Change	No Change
653	Magnolia virginiana	High	0	No Change	No Change	No Change	No Change
682	Morus rubra	Low	0	Infinite	Infinite	Infinite	Infinite
691	Nyssa aquatica	Medium	0	No Change	No Change	No Change	No Change
694	Nyssa biflora	High	0	No Change	No Change	No Change	No Change
692	Nyssa ogeche	Medium	0	No Change	No Change	No Change	No Change
693	Nyssa sylvatica	High	0	No Change	No Change	Infinite	Infinite

701	Ostrya virginiana	Medium	284	17	37	68	77
711	Oxydendrum arboreum	High	0	No Change	No Change	No Change	No Change
721	Persea borbonia	High	0	No Change	No Change	No Change	No Change
94	Picea glauca	Medium	293	-62	-57	-68	-68
95	Picea mariana	High	563	-81	-91	-92	-92
97	Picea rubens	High	26	15	0	8	27
105	Pinus banksiana	High	461	-16	-14	-36	-26
107	Pinus clausa	Medium	0	No Change	No Change	No Change	No Change
110	Pinus echinata	High	0	No Change	No Change	No Change	No Change
111	Pinus elliottii	High	0	No Change	No Change	No Change	No Change
115	Pinus glabra	Medium	0	No Change	No Change	No Change	No Change
121	Pinus palustris	High	0	No Change	No Change	No Change	No Change
123	Pinus pungens	Medium	0	No Change	No Change	No Change	No Change
125	Pinus resinosa	Medium	430	9	23	-23	-25
126	Pinus rigida	High	0	No Change	No Change	No Change	No Change
128	Pinus serotina	High	0	No Change	No Change	No Change	No Change
129	Pinus strobus	High	414	18	41	-47	-55
131	Pinus taeda	High	0	No Change	No Change	Infinite	Infinite
132	Pinus virginiana	High	0	No Change	No Change	No Change	No Change
722	Planera aquatica	Low	0	No Change	No Change	No Change	No Change
731	Platanus occidentalis	Medium	0	No Change	No Change	Infinite	Infinite
741	Populus balsamifera	High	95	-63	-45	-43	7
742	Populus deltoides	Low	8	925	2300	6075	6000
743	Populus grandidentata	High	456	-3	-18	-67	-71
746	Populus tremuloides	High	2839	-51	-49	-83	-82
766	Prunus americana	Low	0	No Change	Infinite	Infinite	Infinite
761	Prunus pensylvanica	Medium	23	-35	91	-100	-100
762	Prunus serotina	High	358	189	177	76	39
763	Prunus virginiana	Low	72	26	74	-97	-93
802	Quercus alba	High	218	239	317	365	343
804	Quercus bicolor	Low	0	Infinite	Infinite	Infinite	Infinite
806	Quercus coccinea	High	0	Infinite	No Change	Infinite	Infinite
808	Quercus durandii	Low	0	No Change	No Change	No Change	No Change
809	Quercus ellipsoidalis	Medium	163	7	39	16	28
812	Quercus falcata var. falcata	High	0	No Change	No Change	No Change	No Change
813	Quercus falcata var. pagodaefolia	Medium	0	No Change	No Change	No Change	No Change
816	Quercus ilicifolia	Low	0	No Change	No Change	No Change	No Change
817	Quercus imbricaria	Medium	0	No Change	Infinite	Infinite	Infinite
842	Quercus incana	Medium	0	No Change	No Change	No Change	No Change
819	Quercus laevis	High	0	No Change	No Change	No Change	No Change
820	Quercus laurifolia	High	0	No Change	No Change	No Change	No Change
822	Quercus lyrata	Medium	0	No Change	No Change	No Change	No Change
823	Quercus macrocarpa	Medium	250	77	115	173	204
824	Quercus marilandica	Medium	0	No Change	No Change	Infinite	Infinite
825	Quercus michauxii	Medium	0	No Change	No Change	No Change	No Change
826	Quercus muehlenbergii	Medium	0	No Change	Infinite	Infinite	Infinite
827	Quercus nigra	High	0	No Change	No Change	No Change	No Change
828	Quercus nuttallii	Low	0	No Change	No Change	No Change	No Change
830	Quercus palustris	Medium	0	Infinite	Infinite	Infinite	Infinite
831	Quercus phellos	Medium	0	No Change	No Change	No Change	No Change
832	Quercus prinus	High	0	No Change	Infinite	Infinite	Infinite
833	Quercus rubra	High	674	59	83	21	12
834	Quercus shumardii	Low	0	No Change	No Change	No Change	No Change
835	Quercus stellata	High	0	No Change	Infinite	Infinite	Infinite
837	Quercus velutina	High	110	353	485	820	850
838	Quercus virginiana	Medium	0	No Change	No Change	No Change	No Change
901	Robinia psuedoacacia	Low	0	Infinite	Infinite	Infinite	Infinite
921	Salix amygdaloides	Low	0	No Change	No Change	Infinite	Infinite
922	Salix nigra	Low	5	2960	5740	8020	8680
931	Sassafras albidum	High	0	Infinite	Infinite	Infinite	Infinite
935	Sorbus americana	Medium	0	No Change	No Change	No Change	No Change
221	Taxodium distichum	Medium	0	No Change	No Change	No Change	No Change
222	Taxodium distichum var.nutans	High	0	No Change	No Change	No Change	No Change
241	Thuja occidentalis	High	571	-40	-62	-74	-74
951	Tilia americana	Medium	590	10	27	10	5
261	Tsuga canadensis	High	332	-2	-29	-65	-65
971	Ulmus alata	High	0	No Change	No Change	No Change	Infinite
972	Ulmus americana	Medium	578	60	83	150	148
973	Ulmus crassifolia	Low	0	No Change	No Change	Infinite	Infinite
975	Ulmus rubra	Medium	13	1692	2969	3562	3746
977	Ulmus thomasii	Low	32	-25	-25	-41	-53

Data courtesy of L. Iverson and the Climate Change Tree Atlas (http://www.nrs.fs.fed.us/atlas/tree/tree_atlas.html)

Potential Changes in Area-Weighted Importance Values for Tree Species
Section 212J - Southern Superior Uplands

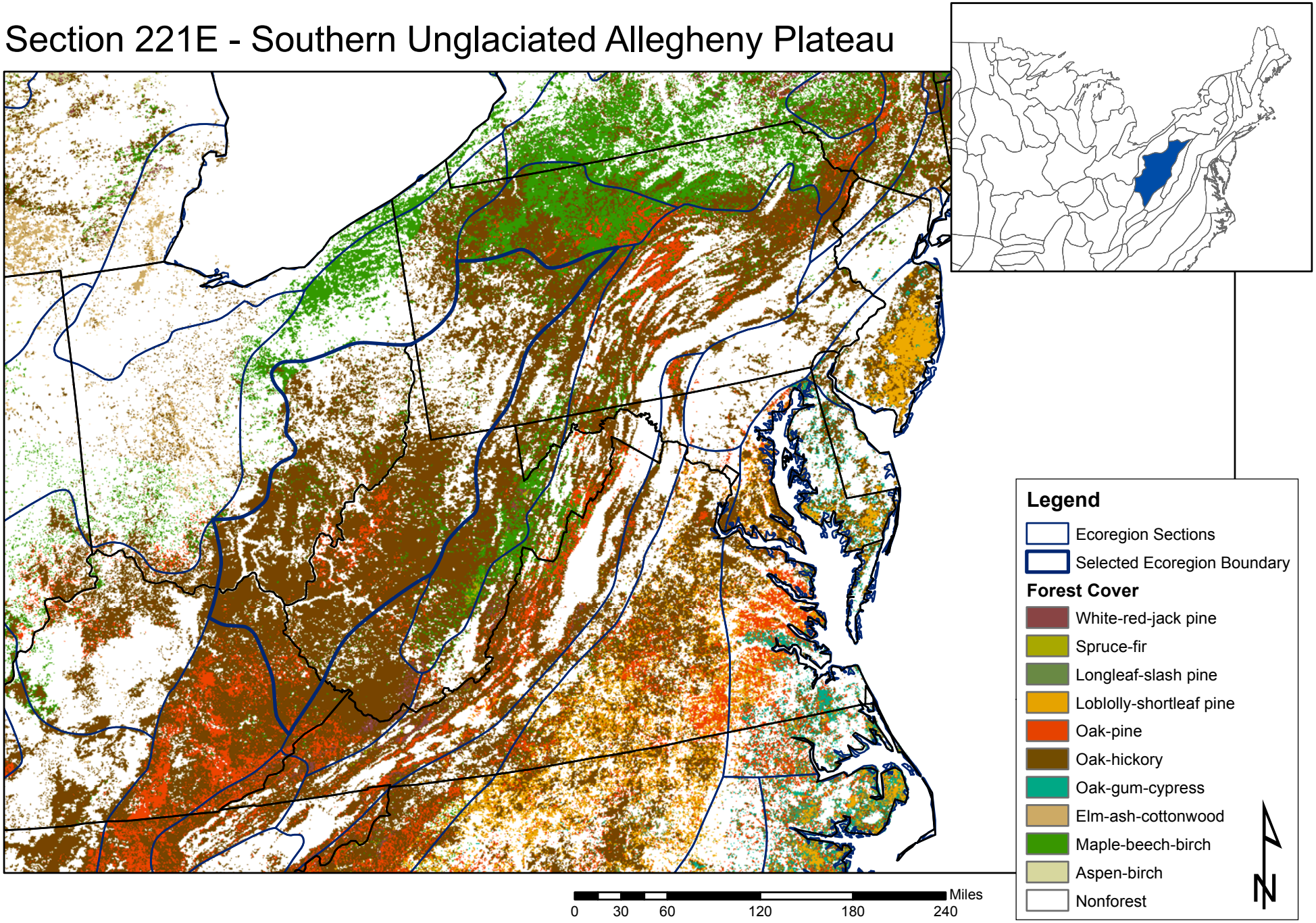
--- Sorted by Current Area-weighted Importance Value ---

				Percent Change Area-weighted Importance Value			
FIA Code	Scientific Name	Model Reliability	Current Area-weighted Importance Value	PCM Model Low emissions	Average of 3 GCM Models Low emissions	Average of 3 GCM Models High emissions	HAD Model High emissions
746	Populus tremuloides	High	2839	-51	-49	-83	-82
318	Acer saccharum	High	2714	-36	-51	-70	-73
316	Acer rubrum	High	2128	-2	-14	-42	-45
12	Abies balsamea	High	1389	-71	-84	-90	-89
375	Betula papyrifera	High	1156	-47	-55	-86	-85
543	Fraxinus nigra	High	707	-22	-25	-45	-43
833	Quercus rubra	High	674	59	83	21	12
951	Tilia americana	Medium	590	10	27	10	5
972	Ulmus americana	Medium	578	60	83	150	148
241	Thuja occidentalis	High	571	-40	-62	-74	-74
95	Picea mariana	High	563	-81	-91	-92	-92
371	Betula alleghaniensis	High	492	-48	-68	-83	-83
105	Pinus banksiana	High	461	-16	-14	-36	-26
743	Populus grandidentata	High	456	-3	-18	-67	-71
125	Pinus resinosa	Medium	430	9	23	-23	-25
129	Pinus strobus	High	414	18	41	-47	-55
71	Larix laricina	High	389	-12	-20	-40	-40
762	Prunus serotina	High	358	189	177	76	39
261	Tsuga canadensis	High	332	-2	-29	-65	-65
94	Picea glauca	Medium	293	-62	-57	-68	-68
701	Ostrya virginiana	Medium	284	17	37	68	77
823	Quercus macrocarpa	Medium	250	77	115	173	204
541	Fraxinus americana	High	246	76	66	102	95
802	Quercus alba	High	218	239	317	365	343
809	Quercus ellipsoidalis	Medium	163	7	39	16	28
544	Fraxinus pennsylvanica	Medium	149	-4	26	134	150
837	Quercus velutina	High	110	353	485	820	850
391	Carpinus caroliniana	Medium	97	76	81	93	94
741	Populus balsamifera	High	95	-63	-45	-43	7
531	Fagus grandifolia	High	75	261	225	156	148
763	Prunus virginiana	Low	72	26	74	-97	-93
402	Carya cordiformis	Low	68	135	243	299	301
313	Acer negundo	Medium	59	281	539	878	1086
317	Acer saccharinum	Medium	46	448	804	963	1002
319	Acer spicatum	High	33	-100	-100	-100	-100
977	Ulmus thomasii	Low	32	-25	-25	-41	-53
97	Picea rubens	High	26	15	0	8	27
761	Prunus pensylvanica	Medium	23	-35	91	-100	-100
601	Juglans cinerea	Low	16	119	231	-100	-100
315	Acer pensylvanicum	High	14	-36	-21	-50	-64
407	Carya ovata	Medium	14	1736	2486	2771	2593
975	Ulmus rubra	Medium	13	1692	2969	3562	3746
742	Populus deltoides	Low	8	925	2300	6075	6000
922	Salix nigra	Low	5	2960	5740	8020	8680
641	Maclura pomifera	Medium	1	700	3500	17700	19300
311	Acer barbatum	Medium	0	No Change	No Change	No Change	No Change
314	Acer nigrum	Low	0	No Change	No Change	No Change	No Change
331	Aesculus glabra	Low	0	No Change	Infinite	Infinite	Infinite
332	Aesculus octandra	Medium	0	No Change	No Change	No Change	No Change
356	Amelanchier sp.	Medium	0	No Change	Infinite	No Change	No Change
367	Asimina triloba	Low	0	No Change	No Change	No Change	No Change
372	Betula lenta	High	0	Infinite	Infinite	Infinite	Infinite
373	Betula nigra	Low	0	Infinite	Infinite	Infinite	Infinite
379	Betula populifolia	Medium	0	No Change	Infinite	Infinite	Infinite
381	Bumelia lanuginosa	Low	0	No Change	No Change	No Change	No Change
401	Carya aquatica	Medium	0	No Change	No Change	No Change	No Change
403	Carya glabra	High	0	Infinite	Infinite	Infinite	Infinite
404	Carya illinoensis	Low	0	No Change	No Change	Infinite	Infinite
405	Carya laciniosa	Low	0	No Change	No Change	Infinite	Infinite
408	Carya texana	High	0	No Change	No Change	Infinite	Infinite
409	Carya tomentosa	High	0	Infinite	Infinite	Infinite	Infinite
421	Castanea dentata	Medium	0	No Change	No Change	No Change	No Change
452	Catalpa speciosa	Low	0	No Change	No Change	Infinite	Infinite

461	Celtis laevigata	Medium	0	No Change	No Change	Infinite	Infinite
462	Celtis occidentalis	Medium	0	Infinite	Infinite	Infinite	Infinite
471	Cercis canadensis	Medium	0	No Change	Infinite	Infinite	Infinite
43	Chamaecyparis thyoides	Low	0	No Change	No Change	No Change	No Change
491	Cornus florida	High	0	Infinite	Infinite	Infinite	Infinite
521	Diospyros virginiana	Medium	0	No Change	No Change	Infinite	Infinite
546	Fraxinus quadrangulata	Low	0	No Change	No Change	No Change	No Change
551	Gleditsia aquatica	Low	0	No Change	No Change	No Change	No Change
552	Gleditsia triacanthos	Low	0	Infinite	Infinite	Infinite	Infinite
555	Gordonia lasianthus	Medium	0	No Change	No Change	No Change	No Change
571	Gymnocladus dioicus	Low	0	No Change	No Change	No Change	No Change
580	Halesia sp.	Medium	0	No Change	No Change	No Change	No Change
591	Ilex opaca	High	0	No Change	No Change	No Change	No Change
602	Juglans nigra	Medium	0	Infinite	Infinite	Infinite	Infinite
68	Juniperus virginiana	Medium	0	Infinite	Infinite	Infinite	Infinite
611	Liquidambar styraciflua	High	0	No Change	No Change	Infinite	Infinite
621	Liriodendron tulipifera	High	0	Infinite	Infinite	Infinite	Infinite
651	Magnolia acuminata	High	0	No Change	No Change	No Change	No Change
652	Magnolia grandiflora	Medium	0	No Change	No Change	No Change	No Change
654	Magnolia macrophylla	Low	0	No Change	No Change	No Change	No Change
653	Magnolia virginiana	High	0	No Change	No Change	No Change	No Change
682	Morus rubra	Low	0	Infinite	Infinite	Infinite	Infinite
691	Nyssa aquatica	Medium	0	No Change	No Change	No Change	No Change
694	Nyssa biflora	High	0	No Change	No Change	No Change	No Change
692	Nyssa ogeche	Medium	0	No Change	No Change	No Change	No Change
693	Nyssa sylvatica	High	0	No Change	No Change	Infinite	Infinite
711	Oxydendrum arboreum	High	0	No Change	No Change	No Change	No Change
721	Persea borbonia	High	0	No Change	No Change	No Change	No Change
107	Pinus clausa	Medium	0	No Change	No Change	No Change	No Change
110	Pinus echinata	High	0	No Change	No Change	No Change	No Change
111	Pinus elliottii	High	0	No Change	No Change	No Change	No Change
115	Pinus glabra	Medium	0	No Change	No Change	No Change	No Change
121	Pinus palustris	High	0	No Change	No Change	No Change	No Change
123	Pinus pungens	Medium	0	No Change	No Change	No Change	No Change
126	Pinus rigida	High	0	No Change	No Change	No Change	No Change
128	Pinus serotina	High	0	No Change	No Change	No Change	No Change
131	Pinus taeda	High	0	No Change	No Change	Infinite	Infinite
132	Pinus virginiana	High	0	No Change	No Change	No Change	No Change
722	Planera aquatica	Low	0	No Change	No Change	No Change	No Change
731	Platanus occidentalis	Medium	0	No Change	No Change	Infinite	Infinite
766	Prunus americana	Low	0	No Change	Infinite	Infinite	Infinite
804	Quercus bicolor	Low	0	Infinite	Infinite	Infinite	Infinite
806	Quercus coccinea	High	0	Infinite	No Change	Infinite	Infinite
808	Quercus durandii	Low	0	No Change	No Change	No Change	No Change
812	Quercus falcata var. falcata	High	0	No Change	No Change	No Change	No Change
813	Quercus falcata var. pagodaefolia	Medium	0	No Change	No Change	No Change	No Change
816	Quercus ilicifolia	Low	0	No Change	No Change	No Change	No Change
817	Quercus imbricaria	Medium	0	No Change	Infinite	Infinite	Infinite
842	Quercus incana	Medium	0	No Change	No Change	No Change	No Change
819	Quercus laevis	High	0	No Change	No Change	No Change	No Change
820	Quercus laurifolia	High	0	No Change	No Change	No Change	No Change
822	Quercus lyrata	Medium	0	No Change	No Change	No Change	No Change
824	Quercus marilandica	Medium	0	No Change	No Change	Infinite	Infinite
825	Quercus michauxii	Medium	0	No Change	No Change	No Change	No Change
826	Quercus muehlenbergii	Medium	0	No Change	Infinite	Infinite	Infinite
827	Quercus nigra	High	0	No Change	No Change	No Change	No Change
828	Quercus nuttallii	Low	0	No Change	No Change	No Change	No Change
830	Quercus palustris	Medium	0	Infinite	Infinite	Infinite	Infinite
831	Quercus phellos	Medium	0	No Change	No Change	No Change	No Change
832	Quercus prinus	High	0	No Change	Infinite	Infinite	Infinite
834	Quercus shumardii	Low	0	No Change	No Change	No Change	No Change
835	Quercus stellata	High	0	No Change	Infinite	Infinite	Infinite
838	Quercus virginiana	Medium	0	No Change	No Change	No Change	No Change
901	Robinia psuedoacacia	Low	0	Infinite	Infinite	Infinite	Infinite
921	Salix amygdaloides	Low	0	No Change	No Change	Infinite	Infinite
931	Sassafras albidum	High	0	Infinite	Infinite	Infinite	Infinite
935	Sorbus americana	Medium	0	No Change	No Change	No Change	No Change
221	Taxodium distichum	Medium	0	No Change	No Change	No Change	No Change
222	Taxodium distichum var.nutans	High	0	No Change	No Change	No Change	No Change
971	Ulmus alata	High	0	No Change	No Change	No Change	Infinite
973	Ulmus crassifolia	Low	0	No Change	No Change	Infinite	Infinite

Data courtesy of L. Iverson and the Climate Change Tree Atlas (http://www.nrs.fs.fed.us/atlas/tree/tree_atlas.html)

Section 221E - Southern Unglaciated Allegheny Plateau



Section 221E--Southern Unglaciated Allegheny Plateau

Geomorphology. This Section comprises part of the Appalachian Plateaus geomorphic province. It is a maturely dissected plateau characterized by high hills, sharp ridges, and narrow valleys. An exception is the broad Teays Valley, created by a major, preglacial river. The valley was dammed by an ice sheet during the Pleistocene and abandoned by the river after the melt. Local relief in the Section exceeds 2000 ft (610 m) along the New River Gorge, but is generally much less. Drainage is dendritic; mass wasting, karst solution, and fluvial erosion, and transport and deposition are the primary geomorphic processes operating. A notable but very minor landform is anthropogenic. lands that have been strip-mined exhibit hummocky or gouged topography. Elevation ranges from 650 to 1,300 ft (200 to 400 m). Local relief is generally about 160 to 325 ft (50 to 100 m).

Lithology and Stratigraphy. Bedrock is overlain by Quaternary residuum on the ridges and hilltops, colluvium on the slopes, andeither or both alluvium and Pleistocene lacustrine materials in the valleys. The youngest bedrock units lie at the center of the Section, in a large southwest to northeast trending oval, and consist of Permian sandstone, siltstone, and shale with minor limestone and coal. Exposed around the Permian oval are units of the Pennsylvanian System, similar in lithology to the Permian rocks but containing major coal beds. The Mississippian sandstone, shale, and limestone are exposed around the margins of the Pennsylvanian outcrop. Devonian black shale with minor sandstone composition crops out around the southwest and northern margins of the Section. This outcrop pattern describes a structural basin, one which was subsiding through most of the Paleozoic Era.

Soil Taxa. Udalfs, Udults, and Ochrepts dominate, in combination with mesic soil temperature regime, an udic soil moisture regime, and mixed or illitic mineralogy. Soils formed in parent materials divided into five groups: residual material, which developed in place by the weathering of underlying bedrock; colluvial material which weathered from bedrock strata transported by water and gravity to the lower slopes; alluvium, lacustrine sediments, and outwash deposited by water; loess deposited by wind; and mine spoil in areas that have been strip-mined for coal.

Potential Natural Vegetation. Kuchler types are mapped as mixed mesophytic forest and Appalachian oak forest. Other recognized communities include mixed oak forest, oak-hickory-chestnut forest, oak-pine forest, hemlock forest, beech forest, floodplain forest and swamp forest.

Fauna. Current mammal populations are typified by the white-tailed deer, gray fox, woodchuck, opossum, gray squirrel, white-footed mouse, and short-tailed shrew; more rare are the hairy-tailed mole, smoky shrew, and the rare eastern woodrat. The bison, elk, black bear, mountain lion, timber wolf, and bobcat, once common historically, were extirpated (except for small numbers of black bear and bobcat). Common birds in this Section include the wild turkey, ruffed grouse, barred owl, pileated woodpecker, eastern phoebe, blue-gray gnatcatcher, Acadian flycatcher, white-eyed vireo, ovenbird, Kentucky warbler, yellow-breasted chat, and summer tanager. Some amphibians and reptiles which typify this Section include the red-spotted newt, dusky salamander, fence lizard, American toad, wood frog, box turtle, snapping turtle, painted turtle, ringneck snake, northern water snake, black rat snake, and copperhead. Rare reptiles include the timber rattlesnake and green salamander.

Prior to 1850, the Ohio River and its tributaries in this Section contained large numbers of fishes and mussels. Historic records show large catches of muskellunge, sturgeon, catfish, buffalo, drum, spotted bass, walleye, and sauger occurred. The fish assemblage in this Section is typical of the headwater stream to large river habitats, while southern redbelly dace, creek chub, barred fantail darter, and greenside darter are common in smaller streams. Black basses, sunfish, sauger, and catfish, the hybrid saugeye, and striped bass are common in the Ohio River and lower portions of its tributaries. Largemouth bass, bluegill, channel catfish, and crappie are found in the large, man-made reservoirs in this Section. One numerous mussel populations have decreased greatly; many are on State and Federal threatened and endangered species lists.

Ecological Section descriptions from:
Ecological Subregions of the United States. 1994. W. H. McNab and P.E. Avers, compilers. Available online: http://www.fs.fed.us/land/pubs/ecoregions/ Last accessed 8 September 2008.

Climate. Precipitation averages 35 to 45 in (900 to 1,150 mm); it occurs mainly during summer, winter, and spring. Rain on snow is common during winter and early spring. Summers are dry with low humidity. Temperature averages 52 oF (11 oC). The growing season 120 to 180 days

Surface Water Characteristics. Although not covered by ice, this Section was dramatically affected by glaciers. Three major preglacial streams drain the area and many of their tributaries were eventually blocked by the advancing ice sheets. Lakes were created in the valleys, into which considerable sediments were deposited, which later drained as ice sheets receded. The present drainage system is the result of complicated drainage re-arrangements over long periods of time, with the elimination of all natural lakes in the Section and the creation of of a new master drainage system of the Section to the Ohio River. This Section is characterized by a relatively high density of streams, with gradients ranging from high, steep headwaters streams to low gradient rivers that flow into the Ohio River. Some streams are underlain by relatively shallow silt, sand, or gravel alluvium, while others in the preglacial valleys are filled with deep glacial deposits. Bedrock is frequently exposed and consists of limestone, siltstone, sandstone, shale, and numerous coal seams. Small springs are numerous, but most are ephemeral. Natural streamflow and water quality characteristics have been greatly modified by oil, gas, and coal extraction activities.

Disturbance Regimes. Historically, low-intensity fires probably occurred at a given site at five to 10 year intervals. Fires of higher intensity occurred at intervals of up to 50 years. Dry ridges and slopes facing south to west burned more frequently than moist creek bottoms and slopes facing north to east. Annual spring flooding occured annually to some degree along major rivers. The forests were probably affected locally by insect and tree diseases. Climatic-influenced disturbances included winter ice storms, occasional tornadoes, and periodic flooding along major river floodplains. Natural disturbances to the streams and rivers incude floods and droughts. Man-made disturbances to streams include channelization, construction of locks and dams, and input of industrial waste, sewage, mining wastes, and soil.

Land Use. About half of this area is forested, and the sale of wood fiber is important in some parts. Urban expansion, including industrial developments, is increasing along the Ohio River and its major tributaries. Since the time of settlement, lands which are level enough for agriculture have been cleared, especially on ridgetops and creek bottoms. Sites with either or both poor soils and severe erosion were abandoned and left to natural succession or planted with trees or grasses and forbs. Most slopes have been repeatedly logged. Strip mining for coal and oil and gas exploration and production continue throughout the Section.

Cultural Ecology. Paleo-Indians, nomadic peoples who hunted Pleistocene megafauna, were the first humans to reach the Ohio Territory approximately 12,000 years ago. Continual glacial recession and a warming climate resulted in a more deciduous and diverse environment. During the Archaic Period (about 8,500 to 1,000 B.C.) floral resources and a variety of small game animals were exploited. Rudimentary horticultural activities and early ceremonialism began to emerge. The Woodland Period (about 1,000 B.C. to 1,000 A.D.) was characterized by more sedentary lifestyles which involved the development of agricultural practices. Extensive trade networks of local and exotic resources were established. Later a shift occurred toward large settlements dependent on maize agriculture. The Fort Ancient Period (about 1,000 to 1,600 A.D.) was typified by increased sedentary culture. Large floodplain villages often organized around central plazas, upland hunting camps, and an influx of southern Mississippian influences. Europeans reached the Ohio Territory around 1,650 A.D. Settlement initially consisted of farming communities; later, emphasis shifted to extractive industries such as coal, iron ore, clay, oil and gas, and, sandstone.

Compiled by Eastern Region. (http://www.fs.fed.us/land/pubs/ecoregions/ch16.html#221E)

Ecological Section descriptions from:
Ecological Subregions of the United States. 1994. W. H. McNab and P.E. Avers, compilers. Available online: http://www.fs.fed.us/land/pubs/ecoregions/ Last accessed 8 September 2008.

Potential Changes in Area-Weighted Importance Values for Tree Species
Section 221E - Southern Unglaciated Allegheny Plateau

--- Sorted by Scientific Name ---

				Percent Change Area-weighted Importance Value			
FIA Code	Scientific Name	Model Reliability	Current Area-weighted Importance Value	PCM Model Low emissions	Average of 3 GCM Models Low emissions	Average of 3 GCM Models High emissions	HAD Model High emissions
12	Abies balsamea	High	0	No Change	No Change	No Change	No Change
311	Acer barbatum	Medium	0	No Change	No Change	No Change	No Change
313	Acer negundo	Medium	129	-4	3	30	23
314	Acer nigrum	Low	15	-60	-93	-100	-93
315	Acer pensylvanicum	High	19	-79	-95	-100	-100
316	Acer rubrum	High	2092	-33	-57	-72	-70
317	Acer saccharinum	Medium	58	0	12	317	324
318	Acer saccharum	High	1417	-10	-51	-89	-94
319	Acer spicatum	High	0	Infinite	Infinite	Infinite	Infinite
331	Aesculus glabra	Low	5	-100	-100	-100	-100
332	Aesculus octandra	Medium	101	3	-5	-11	-8
356	Amelanchier sp.	Medium	94	-21	-28	-38	-39
367	Asimina triloba	Low	101	-4	-52	-81	-80
371	Betula alleghaniensis	High	28	-93	-96	-100	-100
372	Betula lenta	High	172	-41	-69	-87	-88
373	Betula nigra	Low	0	Infinite	No Change	Infinite	Infinite
375	Betula papyrifera	High	0	No Change	No Change	No Change	No Change
379	Betula populifolia	Medium	0	No Change	No Change	No Change	No Change
381	Bumelia lanuginosa	Low	0	No Change	No Change	No Change	No Change
391	Carpinus caroliniana	Medium	273	-4	-14	-13	-8
401	Carya aquatica	Medium	0	No Change	No Change	No Change	No Change
402	Carya cordiformis	Low	5	2580	3600	7240	8480
403	Carya glabra	High	535	14	-6	-38	-38
404	Carya illinoensis	Low	0	No Change	Infinite	Infinite	Infinite
405	Carya laciniosa	Low	0	No Change	No Change	No Change	No Change
407	Carya ovata	Medium	141	79	95	133	128
408	Carya texana	High	0	Infinite	Infinite	Infinite	Infinite
409	Carya tomentosa	High	518	18	23	31	36
421	Castanea dentata	Medium	0	No Change	No Change	No Change	No Change
452	Catalpa speciosa	Low	0	No Change	No Change	Infinite	Infinite
461	Celtis laevigata	Medium	0	Infinite	Infinite	Infinite	Infinite
462	Celtis occidentalis	Medium	29	314	500	786	797
471	Cercis canadensis	Medium	208	39	41	24	30
43	Chamaecyparis thyoides	Low	0	No Change	No Change	No Change	No Change
491	Cornus florida	High	1077	13	-2	-43	-44
521	Diospyros virginiana	Medium	49	257	376	759	784
531	Fagus grandifolia	High	595	-12	-47	-66	-69
541	Fraxinus americana	High	1047	-27	-48	-61	-61
543	Fraxinus nigra	High	0	No Change	No Change	No Change	No Change
544	Fraxinus pennsylvanica	Medium	53	175	230	313	315
546	Fraxinus quadrangulata	Low	0	No Change	No Change	No Change	No Change
551	Gleditsia aquatica	Low	0	No Change	No Change	Infinite	Infinite
552	Gleditsia triacanthos	Low	23	91	174	1035	1122
555	Gordonia lasianthus	Medium	0	No Change	No Change	No Change	No Change
571	Gymnocladus dioicus	Low	0	No Change	No Change	No Change	No Change
580	Halesia sp.	Medium	0	No Change	No Change	No Change	No Change
591	Ilex opaca	High	0	No Change	No Change	No Change	No Change
601	Juglans cinerea	Low	0	No Change	No Change	No Change	No Change
602	Juglans nigra	Medium	323	12	2	-49	-60
68	Juniperus virginiana	Medium	104	496	597	663	633
71	Larix laricina	High	0	No Change	No Change	No Change	No Change
611	Liquidambar styraciflua	High	4	2725	3675	8575	11400
621	Liriodendron tulipifera	High	1051	-4	-52	-72	-72
641	Maclura pomifera	Medium	33	36	18	670	730
651	Magnolia acuminata	High	47	15	-4	-32	-28
652	Magnolia grandiflora	Medium	0	No Change	No Change	No Change	No Change
654	Magnolia macrophylla	Low	0	No Change	No Change	No Change	No Change
653	Magnolia virginiana	High	0	No Change	No Change	No Change	No Change
682	Morus rubra	Low	5	240	1240	6180	6520
691	Nyssa aquatica	Medium	0	No Change	No Change	No Change	No Change
694	Nyssa biflora	High	0	No Change	No Change	No Change	No Change
692	Nyssa ogeche	Medium	0	No Change	No Change	No Change	No Change
693	Nyssa sylvatica	High	402	30	18	20	26
701	Ostrya virginiana	Medium	264	-2	-6	38	48

711	Oxydendrum arboreum	High	181	-12	-45	-52	-49
721	Persea borbonia	High	0	No Change	No Change	No Change	No Change
94	Picea glauca	Medium	0	No Change	No Change	No Change	No Change
95	Picea mariana	High	0	No Change	No Change	No Change	No Change
97	Picea rubens	High	0	No Change	No Change	No Change	No Change
105	Pinus banksiana	High	0	No Change	No Change	No Change	No Change
107	Pinus clausa	Medium	0	No Change	No Change	No Change	No Change
110	Pinus echinata	High	36	1078	2233	4700	5139
111	Pinus elliottii	High	0	No Change	No Change	Infinite	Infinite
115	Pinus glabra	Medium	0	No Change	No Change	No Change	No Change
121	Pinus palustris	High	0	No Change	No Change	Infinite	Infinite
123	Pinus pungens	Medium	0	No Change	No Change	No Change	No Change
125	Pinus resinosa	Medium	2	-100	-100	-100	-100
126	Pinus rigida	High	38	-66	-79	-76	-76
128	Pinus serotina	High	0	No Change	No Change	No Change	No Change
129	Pinus strobus	High	185	-39	-83	-99	-99
131	Pinus taeda	High	0	Infinite	Infinite	Infinite	Infinite
132	Pinus virginiana	High	332	5	-40	-36	-33
722	Planera aquatica	Low	0	No Change	No Change	No Change	No Change
731	Platanus occidentalis	Medium	203	5	9	8	7
741	Populus balsamifera	High	0	No Change	No Change	No Change	No Change
742	Populus deltoides	Low	1	100	200	16500	19500
743	Populus grandidentata	High	234	-86	-99	-100	-100
746	Populus tremuloides	High	33	-100	-100	-100	-100
766	Prunus americana	Low	0	No Change	No Change	No Change	No Change
761	Prunus pensylvanica	Medium	8	-100	-100	-100	-100
762	Prunus serotina	High	1818	-60	-78	-81	-82
763	Prunus virginiana	Low	27	-89	-100	-100	-100
802	Quercus alba	High	1096	37	55	5	-5
804	Quercus bicolor	Low	0	No Change	No Change	No Change	No Change
806	Quercus coccinea	High	314	18	-7	-51	-56
808	Quercus durandii	Low	0	No Change	No Change	No Change	No Change
809	Quercus ellipsoidalis	Medium	0	No Change	No Change	No Change	No Change
812	Quercus falcata var. falcata	High	0	Infinite	Infinite	Infinite	Infinite
813	Quercus falcata var. pagodaefolia	Medium	0	No Change	No Change	No Change	No Change
816	Quercus ilicifolia	Low	0	No Change	No Change	No Change	No Change
817	Quercus imbricaria	Medium	0	Infinite	Infinite	Infinite	Infinite
842	Quercus incana	Medium	0	No Change	No Change	No Change	No Change
819	Quercus laevis	High	0	No Change	No Change	No Change	No Change
820	Quercus laurifolia	High	0	No Change	No Change	No Change	No Change
822	Quercus lyrata	Medium	0	No Change	No Change	No Change	No Change
823	Quercus macrocarpa	Medium	0	No Change	No Change	Infinite	Infinite
824	Quercus marilandica	Medium	0	Infinite	Infinite	Infinite	Infinite
825	Quercus michauxii	Medium	0	No Change	No Change	No Change	No Change
826	Quercus muehlenbergii	Medium	16	1069	1181	1113	1075
827	Quercus nigra	High	0	No Change	Infinite	Infinite	Infinite
828	Quercus nuttallii	Low	0	No Change	No Change	No Change	Infinite
830	Quercus palustris	Medium	2	0	350	50	250
831	Quercus phellos	Medium	0	No Change	No Change	Infinite	Infinite
832	Quercus prinus	High	620	-18	-44	-56	-55
833	Quercus rubra	High	714	-15	-18	-11	-33
834	Quercus shumardii	Low	0	Infinite	Infinite	Infinite	Infinite
835	Quercus stellata	High	56	1511	3338	5671	5805
837	Quercus velutina	High	652	41	122	99	67
838	Quercus virginiana	Medium	0	No Change	No Change	No Change	No Change
901	Robinia psuedoacacia	Low	492	-47	-58	-59	-62
921	Salix amygdaloides	Low	0	No Change	No Change	No Change	No Change
922	Salix nigra	Low	1	3200	7100	10000	10200
931	Sassafras albidum	High	833	-1	-19	-43	-47
935	Sorbus americana	Medium	0	No Change	No Change	No Change	No Change
221	Taxodium distichum	Medium	0	No Change	No Change	No Change	No Change
222	Taxodium distichum var.nutans	High	0	No Change	No Change	No Change	No Change
241	Thuja occidentalis	High	0	No Change	No Change	No Change	No Change
951	Tilia americana	Medium	140	-41	-81	-91	-91
261	Tsuga canadensis	High	106	-61	-80	-90	-89
971	Ulmus alata	High	0	Infinite	Infinite	Infinite	Infinite
972	Ulmus americana	Medium	608	-29	-31	-24	-23
973	Ulmus crassifolia	Low	0	No Change	Infinite	Infinite	Infinite
975	Ulmus rubra	Medium	430	-21	-31	-53	-53
977	Ulmus thomasii	Low	0	No Change	Infinite	No Change	No Change

Data courtesy of L. Iverson and the Climate Change Tree Atlas (http://www.nrs.fs.fed.us/atlas/tree/tree_atlas.html)

Potential Changes in Area-Weighted Importance Values for Tree Species
Section 221E - Southern Unglaciated Allegheny Plateau

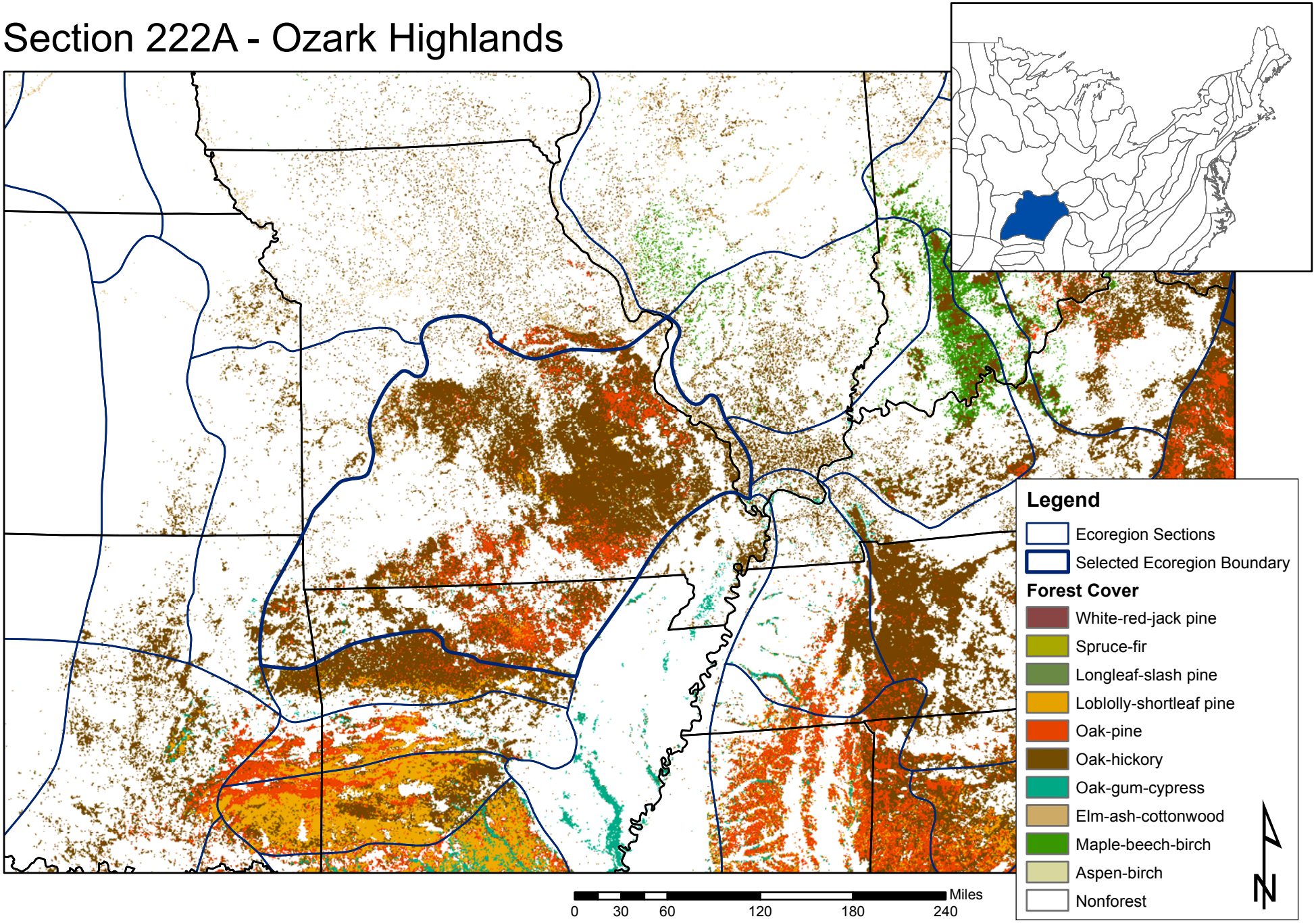
--- Sorted by Current Area-weighted Importance Value ---

				Percent Change Area-weighted Importance Value			
FIA Code	Scientific Name	Model Reliability	Current Area-weighted Importance Value	PCM Model Low emissions	Average of 3 GCM Models Low emissions	Average of 3 GCM Models High emissions	HAD Model High emissions
316	Acer rubrum	High	2092	-33	-57	-72	-70
762	Prunus serotina	High	1818	-60	-78	-81	-82
318	Acer saccharum	High	1417	-10	-51	-89	-94
802	Quercus alba	High	1096	37	55	5	-5
491	Cornus florida	High	1077	13	-2	-43	-44
621	Liriodendron tulipifera	High	1051	-4	-52	-72	-72
541	Fraxinus americana	High	1047	-27	-48	-61	-61
931	Sassafras albidum	High	833	-1	-19	-43	-47
833	Quercus rubra	High	714	-15	-18	-11	-33
837	Quercus velutina	High	652	41	122	99	67
832	Quercus prinus	High	620	-18	-44	-56	-55
972	Ulmus americana	Medium	608	-29	-31	-24	-23
531	Fagus grandifolia	High	595	-12	-47	-66	-69
403	Carya glabra	High	535	14	-6	-38	-38
409	Carya tomentosa	High	518	18	23	31	36
901	Robinia psuedoacacia	Low	492	-47	-58	-59	-62
975	Ulmus rubra	Medium	430	-21	-31	-53	-53
693	Nyssa sylvatica	High	402	30	18	20	26
132	Pinus virginiana	High	332	5	-40	-36	-33
602	Juglans nigra	Medium	323	12	2	-49	-60
806	Quercus coccinea	High	314	18	-7	-51	-56
391	Carpinus caroliniana	Medium	273	-4	-14	-13	-8
701	Ostrya virginiana	Medium	264	-2	-6	38	48
743	Populus grandidentata	High	234	-86	-99	-100	-100
471	Cercis canadensis	Medium	208	39	41	24	30
731	Platanus occidentalis	Medium	203	5	9	8	7
129	Pinus strobus	High	185	-39	-83	-99	-99
711	Oxydendrum arboreum	High	181	-12	-45	-52	-49
372	Betula lenta	High	172	-41	-69	-87	-88
407	Carya ovata	Medium	141	79	95	133	128
951	Tilia americana	Medium	140	-41	-81	-91	-91
313	Acer negundo	Medium	129	-4	3	30	23
261	Tsuga canadensis	High	106	-61	-80	-90	-89
68	Juniperus virginiana	Medium	104	496	597	663	633
332	Aesculus octandra	Medium	101	3	-5	-11	-8
367	Asimina triloba	Low	101	-4	-52	-81	-80
356	Amelanchier sp.	Medium	94	-21	-28	-38	-39
317	Acer saccharinum	Medium	58	0	12	317	324
835	Quercus stellata	High	56	1511	3338	5671	5805
544	Fraxinus pennsylvanica	Medium	53	175	230	313	315
521	Diospyros virginiana	Medium	49	257	376	759	784
651	Magnolia acuminata	High	47	15	-4	-32	-28
126	Pinus rigida	High	38	-66	-79	-76	-76
110	Pinus echinata	High	36	1078	2233	4700	5139
641	Maclura pomifera	Medium	33	36	18	670	730
746	Populus tremuloides	High	33	-100	-100	-100	-100
462	Celtis occidentalis	Medium	29	314	500	786	797
371	Betula alleghaniensis	High	28	-93	-96	-100	-100
763	Prunus virginiana	Low	27	-89	-100	-100	-100
552	Gleditsia triacanthos	Low	23	91	174	1035	1122
315	Acer pensylvanicum	High	19	-79	-95	-100	-100
826	Quercus muehlenbergii	Medium	16	1069	1181	1113	1075
314	Acer nigrum	Low	15	-60	-93	-100	-93
761	Prunus pensylvanica	Medium	8	-100	-100	-100	-100
331	Aesculus glabra	Low	5	-100	-100	-100	-100
402	Carya cordiformis	Low	5	2580	3600	7240	8480
682	Morus rubra	Low	5	240	1240	6180	6520
611	Liquidambar styraciflua	High	4	2725	3675	8575	11400
125	Pinus resinosa	Medium	2	-100	-100	-100	-100
830	Quercus palustris	Medium	2	0	350	50	250
742	Populus deltoides	Low	1	100	200	16500	19500
922	Salix nigra	Low	1	3200	7100	10000	10200
12	Abies balsamea	High	0	No Change	No Change	No Change	No Change
311	Acer barbatum	Medium	0	No Change	No Change	No Change	No Change

319	Acer spicatum	High	0	Infinite	Infinite	Infinite	Infinite
373	Betula nigra	Low	0	Infinite	No Change	Infinite	Infinite
375	Betula papyrifera	High	0	No Change	No Change	No Change	No Change
379	Betula populifolia	Medium	0	No Change	No Change	No Change	No Change
381	Bumelia lanuginosa	Low	0	No Change	No Change	No Change	No Change
401	Carya aquatica	Medium	0	No Change	No Change	No Change	No Change
404	Carya illinoensis	Low	0	No Change	Infinite	Infinite	Infinite
405	Carya laciniosa	Low	0	No Change	No Change	No Change	No Change
408	Carya texana	High	0	Infinite	Infinite	Infinite	Infinite
421	Castanea dentata	Medium	0	No Change	No Change	No Change	No Change
452	Catalpa speciosa	Low	0	No Change	No Change	Infinite	Infinite
461	Celtis laevigata	Medium	0	Infinite	Infinite	Infinite	Infinite
43	Chamaecyparis thyoides	Low	0	No Change	No Change	No Change	No Change
543	Fraxinus nigra	High	0	No Change	No Change	No Change	No Change
546	Fraxinus quadrangulata	Low	0	No Change	No Change	No Change	No Change
551	Gleditsia aquatica	Low	0	No Change	No Change	Infinite	Infinite
555	Gordonia lasianthus	Medium	0	No Change	No Change	No Change	No Change
571	Gymnocladus dioicus	Low	0	No Change	No Change	No Change	No Change
580	Halesia sp.	Medium	0	No Change	No Change	No Change	No Change
591	Ilex opaca	High	0	No Change	No Change	No Change	No Change
601	Juglans cinerea	Low	0	No Change	No Change	No Change	No Change
71	Larix laricina	High	0	No Change	No Change	No Change	No Change
652	Magnolia grandiflora	Medium	0	No Change	No Change	No Change	No Change
654	Magnolia macrophylla	Low	0	No Change	No Change	No Change	No Change
653	Magnolia virginiana	High	0	No Change	No Change	No Change	No Change
691	Nyssa aquatica	Medium	0	No Change	No Change	No Change	No Change
694	Nyssa biflora	High	0	No Change	No Change	No Change	No Change
692	Nyssa ogeche	Medium	0	No Change	No Change	No Change	No Change
721	Persea borbonia	High	0	No Change	No Change	No Change	No Change
94	Picea glauca	Medium	0	No Change	No Change	No Change	No Change
95	Picea mariana	High	0	No Change	No Change	No Change	No Change
97	Picea rubens	High	0	No Change	No Change	No Change	No Change
105	Pinus banksiana	High	0	No Change	No Change	No Change	No Change
107	Pinus clausa	Medium	0	No Change	No Change	No Change	No Change
111	Pinus elliottii	High	0	No Change	No Change	Infinite	Infinite
115	Pinus glabra	Medium	0	No Change	No Change	No Change	No Change
121	Pinus palustris	High	0	No Change	No Change	Infinite	Infinite
123	Pinus pungens	Medium	0	No Change	No Change	No Change	No Change
128	Pinus serotina	High	0	No Change	No Change	No Change	No Change
131	Pinus taeda	High	0	Infinite	Infinite	Infinite	Infinite
722	Planera aquatica	Low	0	No Change	No Change	No Change	No Change
741	Populus balsamifera	High	0	No Change	No Change	No Change	No Change
766	Prunus americana	Low	0	No Change	No Change	No Change	No Change
804	Quercus bicolor	Low	0	No Change	No Change	No Change	No Change
808	Quercus durandii	Low	0	No Change	No Change	No Change	No Change
809	Quercus ellipsoidalis	Medium	0	No Change	No Change	No Change	No Change
812	Quercus falcata var. falcata	High	0	Infinite	Infinite	Infinite	Infinite
813	Quercus falcata var. pagodaefolia	Medium	0	No Change	No Change	No Change	No Change
816	Quercus ilicifolia	Low	0	No Change	No Change	No Change	No Change
817	Quercus imbricaria	Medium	0	Infinite	Infinite	Infinite	Infinite
842	Quercus incana	Medium	0	No Change	No Change	No Change	No Change
819	Quercus laevis	High	0	No Change	No Change	No Change	No Change
820	Quercus laurifolia	High	0	No Change	No Change	No Change	No Change
822	Quercus lyrata	Medium	0	No Change	No Change	No Change	No Change
823	Quercus macrocarpa	Medium	0	No Change	No Change	Infinite	Infinite
824	Quercus marilandica	Medium	0	Infinite	Infinite	Infinite	Infinite
825	Quercus michauxii	Medium	0	No Change	No Change	No Change	No Change
827	Quercus nigra	High	0	No Change	Infinite	Infinite	Infinite
828	Quercus nuttallii	Low	0	No Change	No Change	No Change	Infinite
831	Quercus phellos	Medium	0	No Change	No Change	Infinite	Infinite
834	Quercus shumardii	Low	0	Infinite	Infinite	Infinite	Infinite
838	Quercus virginiana	Medium	0	No Change	No Change	No Change	No Change
921	Salix amygdaloides	Low	0	No Change	No Change	No Change	No Change
935	Sorbus americana	Medium	0	No Change	No Change	No Change	No Change
221	Taxodium distichum	Medium	0	No Change	No Change	No Change	No Change
222	Taxodium distichum var.nutans	High	0	No Change	No Change	No Change	No Change
241	Thuja occidentalis	High	0	No Change	No Change	No Change	No Change
971	Ulmus alata	High	0	Infinite	Infinite	Infinite	Infinite
973	Ulmus crassifolia	Low	0	No Change	Infinite	Infinite	Infinite
977	Ulmus thomasii	Low	0	No Change	Infinite	No Change	No Change

Data courtesy of L. Iverson and the Climate Change Tree Atlas (http://www.nrs.fs.fed.us/atlas/tree/tree_atlas.html)

Section 222A - Ozark Highlands



Section 222A--Ozark Highlands

Geomorphology. This Section is part of the Ozark Plateaus geomorphic province. It is a maturely dissected high plateau with dendritic and radial drainage patterns. Most of the Section is equally divided between steep hills with local relief up to 1,000 ft (300 m) and rolling hills with local relief between 200 and 500 ft (60 to 150 m). There are also gently rolling plains with local relief of less than 200 ft; also present is the flat, 6-mile (10-km) wide Mississippi River flood plain, composed of broad bottomlands with associated terraces, ox-bows, and meander scars. Current geomorphic processes are fluvial erosion, transport and deposition, and mass wasting. Widespread karst features include caves, sinkholes, and springs. Elevation ranges from 300 to 1,800 ft (100 to 600 m).

Lithology and Stratigraphy. Quaternary loess deposits (unconsolidated aeolian silt) are widespread on the uplands; areas without loess cover have moderately thick residuum. Lower slopes are covered with Quaternary colluvium; valley bottoms are characterized by alluvial material. The Mississippi's flood plain has up to 150 ft (45 m) of unconsolidated Tertiary and Quaternary alluvium (gravel, sand, silt, and clay) overlying bedrock. Bedrock consists of lower Ordovician dolomite and sandstone, with lesser amounts of Silurian, Devonian, Mississippian, and Pennsylvanian rocks (limestone, chert, sandstone, and shale) around the Section's margins. The oldest bedrock units, near the center of the Section and forming the highest hills, are Proterozoic igneous rocks, volcanics ranging from rhyolite to andesite, some gabbro, and a large granitic pluton.

Soil Taxa. There are Udalfs and Udults, with mesic temperature regime and udic moisture regime. The soils are mostly cherty, developed in loess mantle. Minerology is siliceous or mixed. Soils are generally old, shallow, stony, and acidic, except on broad ridges and bottomlands.

Potential Natural Vegetation. Kuchler vegetation types are mapped as oak-hickory forest, oak-hickory-pine forest, mosaic of bluestem prairie and oak-hickory forest, and cedar glades. Dry upland sites include post oak-blackjack oak-black hickory with lichen-moss ground cover, and shortleaf pine-oak in areas of sandstone bedrock. Mesic slopes sites have white oak-northern red oak-bitternut hickory-flowering dogwood. Riparian sites have river birch-silver maple. Glades have little bluestem-baldgrass; eastern redcedar has invaded these prairie sites as a result of fire suppression. The current trend is to characterize Ozark's landscapes as "woodland" or "savanna" rather than "forest," in recognition of the role of frequent, low-intensity fire.

Fauna. Major ungulates are white-tailed deer and cattle (elk and bison were extirpated). The major predator is the coyote (the red wolf, timber wolf, and cougar were extirpated). The mink, otter, beaver, black bear, fox, and bobcat had declined but are recovering. The Section supports opossum and some threatened and endangered bats; armadillo recently began invading. Bird species total 143, including bald eagle and other raptors, turkey, various owls, wood duck, roadrunner, kingfisher, various woodpeckers, and various songbirds (many warblers). Habitat diversity (glades, sinkholes, and caves) contributes to rich herpetofauna, including rattlesnakes, copperheads, turtles, and many salamanders. The richness of fish species is great, including 18 endemics and some relics. Introduced trout and carp are thriving. Crustaceans (19 endemic crayfish) and molluscs (seven endemics) include some threatened and endangered species. Insects, spiders, and ticks are very abundant; the gypsy moth had not been established as of August 1995.

Climate. Mean annual precipitation is 40 to 48 in (1,020 to 1,220 mm) from northwest to southeast. Snow averages about 10 in (240 mm). Mean annual temperature is 55 to 60 oF (13 to 16 oC). The growing season lasts 180 to 200 days. Frost pockets are common.

Ecological Section descriptions from:
Ecological Subregions of the United States. 1994. W. H. McNab and P.E. Avers, compilers. Available online: http://www.fs.fed.us/land/pubs/ecoregions/ Last accessed 8 September 2008.

Surface Water Characteristics. Clear, cold spring-fed streams characterize the Ozarks. Karst topography influences surface water, producing losing streams, springs (some large) and spring-fed streams, seeps, and fens. Small sinkhole ponds exist but few natural lakes; however, several large rivers have been dammed to create reservoirs. There is a moderate density of small intermittent drainages, and small to medium-sized perennial streams, most with low to moderate rates of flow.

Disturbance Regimes. Frequent, low intensity, widespread fire occurred prior to European settlement. Fire suppression led to changes in community type and species composition. Closed-canopy forests replaced many woodlands; pastures replaced prairies, glades, and bottomland forests. Climatic influences include occasional summer droughts, winter ice storms, and tornadoes.

Land Use. Forestry, tourism, hunting and fishing, grazing, and lead mining dominate.

Cultural Ecology. Fourteen thousand years ago, small, highly mobile groups of people followed now-extinct Pleistocene game animals such as mammoth and mastodon into the region. The land was covered by late-glacial forests of oak, ash, jack pine, and spruce. Ten thousand years ago the climate became warmer and drier, and prairie, oak savannas, and oak-hickory and pine forests dominated. An abundance of resources supported increasingly larger, denser human populations. One thousand years ago intensive horticultural practices began. Three hundred years ago, the Osage continued seasonal exploitation of the Ozark's resources. Two hundred and fifty years ago French explorers arrived and soon began lead, iron and barite mining activities. Until the mid-1800's the region remained an agricultural frontier, populated principally by yeoman farmers who supplemented their diet with wild resources. Intensive harvesting of pine and oak forests occurred between 1850 and 1915. Poor timber harvesting and farming practices, in combination with frequent fires and floods, left the land bare. In 1933 land management activities emphasizing resource protection and rehabilitation were started by public agencies. At the same time, provisions were made for recreation developments since hundreds of thousands of people were within a day's drive of public lands.

Compiled by Eastern Region, Missouri Department of Conservation, University of Missouri-Columbia, and Natural Resources Conservation Service.
(http://www.fs.fed.us/land/pubs/ecoregions/ch17.html#222A)

Ecological Section descriptions from:
Ecological Subregions of the United States. 1994. W. H. McNab and P.E. Avers, compilers. Available online: http://www.fs.fed.us/land/pubs/ecoregions/ Last accessed 8 September 2008.

Potential Changes in Area-Weighted Importance Values for Tree Species
Section 222A - Ozark Highlands

--- Sorted by Scientific Name ---

FIA Code	Scientific Name	Model Reliability	Current Area-weighted Importance Value	Percent Change Area-weighted Importance Value: PCM Model Low emissions	Average of 3 GCM Models Low emissions	Average of 3 GCM Models High emissions	HAD Model High emissions
12	Abies balsamea	High	0	No Change	No Change	No Change	No Change
311	Acer barbatum	Medium	0	No Change	No Change	No Change	No Change
313	Acer negundo	Medium	133	43	105	905	456
314	Acer nigrum	Low	0	No Change	No Change	No Change	No Change
315	Acer pensylvanicum	High	0	No Change	No Change	No Change	No Change
316	Acer rubrum	High	369	-8	-11	17	27
317	Acer saccharinum	Medium	148	75	59	265	149
318	Acer saccharum	High	499	-71	-88	-98	-99
319	Acer spicatum	High	0	No Change	No Change	No Change	No Change
331	Aesculus glabra	Low	3	-100	-100	-100	-100
332	Aesculus octandra	Medium	0	No Change	No Change	No Change	No Change
356	Amelanchier sp.	Medium	12	-33	-67	-17	-67
367	Asimina triloba	Low	25	-24	-56	-76	-76
371	Betula alleghaniensis	High	0	No Change	No Change	No Change	No Change
372	Betula lenta	High	0	No Change	No Change	No Change	No Change
373	Betula nigra	Low	3	533	700	4933	2767
375	Betula papyrifera	High	0	No Change	No Change	No Change	No Change
379	Betula populifolia	Medium	0	No Change	No Change	No Change	No Change
381	Bumelia lanuginosa	Low	7	286	329	457	457
391	Carpinus caroliniana	Medium	35	34	131	460	634
401	Carya aquatica	Medium	0	No Change	No Change	No Change	No Change
402	Carya cordiformis	Low	338	32	51	36	52
403	Carya glabra	High	760	-46	-53	-51	-51
404	Carya illinoensis	Low	13	692	469	500	508
405	Carya laciniosa	Low	6	-100	-83	-83	0
407	Carya ovata	Medium	525	-26	-34	-34	-41
408	Carya texana	High	1236	12	16	16	10
409	Carya tomentosa	High	854	15	15	16	13
421	Castanea dentata	Medium	0	No Change	No Change	No Change	No Change
452	Catalpa speciosa	Low	0	No Change	No Change	No Change	No Change
461	Celtis laevigata	Medium	30	1753	1933	2017	1963
462	Celtis occidentalis	Medium	451	-4	-24	-18	-20
471	Cercis canadensis	Medium	278	-18	-8	1	-4
43	Chamaecyparis thyoides	Low	0	No Change	No Change	No Change	No Change
491	Cornus florida	High	1211	-41	-44	-41	-38
521	Diospyros virginiana	Medium	393	8	26	45	41
531	Fagus grandifolia	High	49	-100	-98	-98	-90
541	Fraxinus americana	High	622	-26	-20	-10	-13
543	Fraxinus nigra	High	0	No Change	No Change	Infinite	Infinite
544	Fraxinus pennsylvanica	Medium	238	47	66	71	68
546	Fraxinus quadrangulata	Low	0	Infinite	Infinite	Infinite	Infinite
551	Gleditsia aquatica	Low	0	No Change	Infinite	No Change	No Change
552	Gleditsia triacanthos	Low	211	27	76	151	136
555	Gordonia lasianthus	Medium	0	No Change	No Change	No Change	No Change
571	Gymnocladus dioicus	Low	0	No Change	No Change	No Change	No Change
580	Halesia sp.	Medium	0	No Change	No Change	No Change	No Change
591	Ilex opaca	High	0	No Change	No Change	No Change	No Change
601	Juglans cinerea	Low	0	No Change	No Change	No Change	No Change
602	Juglans nigra	Medium	574	-39	-66	-86	-89
68	Juniperus virginiana	Medium	1574	-13	-13	-20	-34
71	Larix laricina	High	0	No Change	No Change	No Change	No Change
611	Liquidambar styraciflua	High	115	111	225	403	721
621	Liriodendron tulipifera	High	95	-62	-66	-3	123
641	Maclura pomifera	Medium	145	154	147	241	189
651	Magnolia acuminata	High	0	No Change	No Change	No Change	No Change
652	Magnolia grandiflora	Medium	0	No Change	No Change	No Change	No Change
654	Magnolia macrophylla	Low	0	No Change	No Change	No Change	No Change
653	Magnolia virginiana	High	0	No Change	No Change	No Change	No Change
682	Morus rubra	Low	269	35	55	135	91
691	Nyssa aquatica	Medium	0	No Change	No Change	No Change	No Change
694	Nyssa biflora	High	2	0	1050	1650	1350
692	Nyssa ogeche	Medium	0	No Change	No Change	No Change	No Change
693	Nyssa sylvatica	High	390	-1	8	32	49
701	Ostrya virginiana	Medium	246	26	69	185	178

711	Oxydendrum arboreum	High	0	No Change	No Change	No Change	Infinite
721	Persea borbonia	High	0	No Change	No Change	No Change	No Change
94	Picea glauca	Medium	0	No Change	No Change	No Change	No Change
95	Picea mariana	High	0	No Change	No Change	No Change	No Change
97	Picea rubens	High	0	No Change	No Change	No Change	No Change
105	Pinus banksiana	High	0	No Change	No Change	Infinite	No Change
107	Pinus clausa	Medium	0	No Change	No Change	No Change	No Change
110	Pinus echinata	High	745	100	149	201	203
111	Pinus elliottii	High	0	No Change	Infinite	Infinite	Infinite
115	Pinus glabra	Medium	0	No Change	No Change	No Change	No Change
121	Pinus palustris	High	0	Infinite	No Change	Infinite	Infinite
123	Pinus pungens	Medium	0	No Change	No Change	No Change	No Change
125	Pinus resinosa	Medium	0	No Change	No Change	No Change	No Change
126	Pinus rigida	High	0	No Change	No Change	No Change	No Change
128	Pinus serotina	High	0	No Change	No Change	No Change	No Change
129	Pinus strobus	High	1	-100	-100	-100	-100
131	Pinus taeda	High	45	800	1584	3471	5320
132	Pinus virginiana	High	24	-13	46	267	617
722	Planera aquatica	Low	0	No Change	No Change	No Change	No Change
731	Platanus occidentalis	Medium	290	13	14	17	11
741	Populus balsamifera	High	0	No Change	No Change	No Change	No Change
742	Populus deltoides	Low	46	17	87	474	346
743	Populus grandidentata	High	0	No Change	No Change	No Change	No Change
746	Populus tremuloides	High	0	No Change	No Change	Infinite	Infinite
766	Prunus americana	Low	0	Infinite	Infinite	Infinite	Infinite
761	Prunus pensylvanica	Medium	0	No Change	No Change	No Change	No Change
762	Prunus serotina	High	378	33	31	34	49
763	Prunus virginiana	Low	0	No Change	No Change	No Change	No Change
802	Quercus alba	High	3428	-37	-47	-54	-57
804	Quercus bicolor	Low	12	-58	-100	-100	-100
806	Quercus coccinea	High	593	-65	-73	-73	-73
808	Quercus durandii	Low	0	No Change	No Change	No Change	No Change
809	Quercus ellipsoidalis	Medium	0	No Change	No Change	Infinite	Infinite
812	Quercus falcata var. falcata	High	210	120	203	285	320
813	Quercus falcata var. pagodaefolia	Medium	5	80	300	360	480
816	Quercus ilicifolia	Low	0	No Change	No Change	No Change	No Change
817	Quercus imbricaria	Medium	129	29	44	41	42
842	Quercus incana	Medium	0	No Change	No Change	No Change	No Change
819	Quercus laevis	High	0	No Change	No Change	No Change	No Change
820	Quercus laurifolia	High	0	No Change	No Change	Infinite	Infinite
822	Quercus lyrata	Medium	1	0	0	800	800
823	Quercus macrocarpa	Medium	30	120	297	2297	1293
824	Quercus marilandica	Medium	1087	73	76	71	54
825	Quercus michauxii	Medium	0	Infinite	No Change	No Change	Infinite
826	Quercus muehlenbergii	Medium	417	-23	-35	-42	-53
827	Quercus nigra	High	1	14700	39400	68700	88800
828	Quercus nuttallii	Low	1	-100	0	0	100
830	Quercus palustris	Medium	59	29	-56	-64	-56
831	Quercus phellos	Medium	8	175	425	838	1413
832	Quercus prinus	High	48	-100	-92	-52	-23
833	Quercus rubra	High	760	16	7	-36	-50
834	Quercus shumardii	Low	4	3825	6375	6875	6850
835	Quercus stellata	High	3629	34	40	44	36
837	Quercus velutina	High	3808	-5	-18	-31	-36
838	Quercus virginiana	Medium	0	No Change	No Change	No Change	Infinite
901	Robinia psuedoacacia	Low	74	50	-32	-35	-39
921	Salix amygdaloides	Low	0	No Change	No Change	No Change	No Change
922	Salix nigra	Low	72	-17	-22	272	65
931	Sassafras albidum	High	666	-22	-28	-38	-41
935	Sorbus americana	Medium	0	No Change	No Change	No Change	No Change
221	Taxodium distichum	Medium	2	-50	-50	0	50
222	Taxodium distichum var.nutans	High	0	No Change	No Change	No Change	Infinite
241	Thuja occidentalis	High	0	No Change	No Change	No Change	No Change
951	Tilia americana	Medium	7	-86	-71	3443	414
261	Tsuga canadensis	High	0	No Change	No Change	No Change	No Change
971	Ulmus alata	High	417	240	356	387	377
972	Ulmus americana	Medium	850	-9	-23	-18	-18
973	Ulmus crassifolia	Low	1	16700	27800	27500	23900
975	Ulmus rubra	Medium	422	-36	-41	-39	-35
977	Ulmus thomasii	Low	5	-100	-100	-60	400

Data courtesy of L. Iverson and the Climate Change Tree Atlas (http://www.nrs.fs.fed.us/atlas/tree/tree_atlas.html)

Potential Changes in Area-Weighted Importance Values for Tree Species
Section 222A - Ozark Highlands

--- Sorted by Current Area-weighted Importance Value ---

FIA Code	Scientific Name	Model Reliability	Current Area-weighted Importance Value	Percent Change Area-weighted Importance Value			
				PCM Model Low emissions	Average of 3 GCM Models Low emissions	Average of 3 GCM Models High emissions	HAD Model High emissions
837	Quercus velutina	High	3808	-5	-18	-31	-36
835	Quercus stellata	High	3629	34	40	44	36
802	Quercus alba	High	3428	-37	-47	-54	-57
68	Juniperus virginiana	Medium	1574	-13	-13	-20	-34
408	Carya texana	High	1236	12	16	16	10
491	Cornus florida	High	1211	-41	-44	-41	-38
824	Quercus marilandica	Medium	1087	73	76	71	54
409	Carya tomentosa	High	854	15	15	16	13
972	Ulmus americana	Medium	850	-9	-23	-18	-18
403	Carya glabra	High	760	-46	-53	-51	-51
833	Quercus rubra	High	760	16	7	-36	-50
110	Pinus echinata	High	745	100	149	201	203
931	Sassafras albidum	High	666	-22	-28	-38	-41
541	Fraxinus americana	High	622	-26	-20	-10	-13
806	Quercus coccinea	High	593	-65	-73	-73	-73
602	Juglans nigra	Medium	574	-39	-66	-86	-89
407	Carya ovata	Medium	525	-26	-34	-34	-41
318	Acer saccharum	High	499	-71	-88	-98	-99
462	Celtis occidentalis	Medium	451	-4	-24	-18	-20
975	Ulmus rubra	Medium	422	-36	-41	-39	-35
826	Quercus muehlenbergii	Medium	417	-23	-35	-42	-53
971	Ulmus alata	High	417	240	356	387	377
521	Diospyros virginiana	Medium	393	8	26	45	41
693	Nyssa sylvatica	High	390	-1	8	32	49
762	Prunus serotina	High	378	33	31	34	49
316	Acer rubrum	High	369	-8	-11	17	27
402	Carya cordiformis	Low	338	32	51	36	52
731	Platanus occidentalis	Medium	290	13	14	17	11
471	Cercis canadensis	Medium	278	-18	-8	1	-4
682	Morus rubra	Low	269	35	55	135	91
701	Ostrya virginiana	Medium	246	26	69	185	178
544	Fraxinus pennsylvanica	Medium	238	47	66	71	68
552	Gleditsia triacanthos	Low	211	27	76	151	136
812	Quercus falcata var. falcata	High	210	120	203	285	320
317	Acer saccharinum	Medium	148	75	59	265	149
641	Maclura pomifera	Medium	145	154	147	241	189
313	Acer negundo	Medium	133	43	105	905	456
817	Quercus imbricaria	Medium	129	29	44	41	42
611	Liquidambar styraciflua	High	115	111	225	403	721
621	Liriodendron tulipifera	High	95	-62	-66	-3	123
901	Robinia psuedoacacia	Low	74	50	-32	-35	-39
922	Salix nigra	Low	72	-17	-22	272	65
830	Quercus palustris	Medium	59	29	-56	-64	-56
531	Fagus grandifolia	High	49	-100	-98	-98	-90
832	Quercus prinus	High	48	-100	-92	-52	-23
742	Populus deltoides	Low	46	17	87	474	346
131	Pinus taeda	High	45	800	1584	3471	5320
391	Carpinus caroliniana	Medium	35	34	131	460	634
461	Celtis laevigata	Medium	30	1753	1933	2017	1963
823	Quercus macrocarpa	Medium	30	120	297	2297	1293
367	Asimina triloba	Low	25	-24	-56	-76	-76
132	Pinus virginiana	High	24	-13	46	267	617
404	Carya illinoensis	Low	13	692	469	500	508
356	Amelanchier sp.	Medium	12	-33	-67	-17	-67
804	Quercus bicolor	Low	12	-58	-100	-100	-100
831	Quercus phellos	Medium	8	175	425	838	1413
381	Bumelia lanuginosa	Low	7	286	329	457	457
951	Tilia americana	Medium	7	-86	-71	3443	414
405	Carya laciniosa	Low	6	-100	-83	-83	0
813	Quercus falcata var. pagodaefolia	Medium	5	80	300	360	480
977	Ulmus thomasii	Low	5	-100	-100	-60	400
834	Quercus shumardii	Low	4	3825	6375	6875	6850
331	Aesculus glabra	Low	3	-100	-100	-100	-100
373	Betula nigra	Low	3	533	700	4933	2767

694	Nyssa biflora	High	2	0	1050	1650	1350
221	Taxodium distichum	Medium	2	-50	-50	0	50
129	Pinus strobus	High	1	-100	-100	-100	-100
822	Quercus lyrata	Medium	1	0	0	800	800
827	Quercus nigra	High	1	14700	39400	68700	88800
828	Quercus nuttallii	Low	1	-100	0	0	100
973	Ulmus crassifolia	Low	1	16700	27800	27500	23900
12	Abies balsamea	High	0	No Change	No Change	No Change	No Change
311	Acer barbatum	Medium	0	No Change	No Change	No Change	No Change
314	Acer nigrum	Low	0	No Change	No Change	No Change	No Change
315	Acer pensylvanicum	High	0	No Change	No Change	No Change	No Change
319	Acer spicatum	High	0	No Change	No Change	No Change	No Change
332	Aesculus octandra	Medium	0	No Change	No Change	No Change	No Change
371	Betula alleghaniensis	High	0	No Change	No Change	No Change	No Change
372	Betula lenta	High	0	No Change	No Change	No Change	No Change
375	Betula papyrifera	High	0	No Change	No Change	No Change	No Change
379	Betula populifolia	Medium	0	No Change	No Change	No Change	No Change
401	Carya aquatica	Medium	0	No Change	No Change	No Change	No Change
421	Castanea dentata	Medium	0	No Change	No Change	No Change	No Change
452	Catalpa speciosa	Low	0	No Change	No Change	No Change	No Change
43	Chamaecyparis thyoides	Low	0	No Change	No Change	No Change	No Change
543	Fraxinus nigra	High	0	No Change	No Change	Infinite	Infinite
546	Fraxinus quadrangulata	Low	0	Infinite	Infinite	Infinite	Infinite
551	Gleditsia aquatica	Low	0	No Change	Infinite	No Change	No Change
555	Gordonia lasianthus	Medium	0	No Change	No Change	No Change	No Change
571	Gymnocladus dioicus	Low	0	No Change	No Change	No Change	No Change
580	Halesia sp.	Medium	0	No Change	No Change	No Change	No Change
591	Ilex opaca	High	0	No Change	No Change	No Change	No Change
601	Juglans cinerea	Low	0	No Change	No Change	No Change	No Change
71	Larix laricina	High	0	No Change	No Change	No Change	No Change
651	Magnolia acuminata	High	0	No Change	No Change	No Change	No Change
652	Magnolia grandiflora	Medium	0	No Change	No Change	No Change	No Change
654	Magnolia macrophylla	Low	0	No Change	No Change	No Change	No Change
653	Magnolia virginiana	High	0	No Change	No Change	No Change	No Change
691	Nyssa aquatica	Medium	0	No Change	No Change	No Change	No Change
692	Nyssa ogeche	Medium	0	No Change	No Change	No Change	No Change
711	Oxydendrum arboreum	High	0	No Change	No Change	No Change	Infinite
721	Persea borbonia	High	0	No Change	No Change	No Change	No Change
94	Picea glauca	Medium	0	No Change	No Change	No Change	No Change
95	Picea mariana	High	0	No Change	No Change	No Change	No Change
97	Picea rubens	High	0	No Change	No Change	No Change	No Change
105	Pinus banksiana	High	0	No Change	No Change	Infinite	No Change
107	Pinus clausa	Medium	0	No Change	No Change	No Change	No Change
111	Pinus elliottii	High	0	No Change	Infinite	Infinite	Infinite
115	Pinus glabra	Medium	0	No Change	No Change	No Change	No Change
121	Pinus palustris	High	0	Infinite	No Change	Infinite	Infinite
123	Pinus pungens	Medium	0	No Change	No Change	No Change	No Change
125	Pinus resinosa	Medium	0	No Change	No Change	No Change	No Change
126	Pinus rigida	High	0	No Change	No Change	No Change	No Change
128	Pinus serotina	High	0	No Change	No Change	No Change	No Change
722	Planera aquatica	Low	0	No Change	No Change	No Change	No Change
741	Populus balsamifera	High	0	No Change	No Change	No Change	No Change
743	Populus grandidentata	High	0	No Change	No Change	No Change	No Change
746	Populus tremuloides	High	0	No Change	No Change	Infinite	Infinite
766	Prunus americana	Low	0	Infinite	Infinite	Infinite	Infinite
761	Prunus pensylvanica	Medium	0	No Change	No Change	No Change	No Change
763	Prunus virginiana	Low	0	No Change	No Change	No Change	No Change
808	Quercus durandii	Low	0	No Change	No Change	No Change	No Change
809	Quercus ellipsoidalis	Medium	0	No Change	No Change	Infinite	Infinite
816	Quercus ilicifolia	Low	0	No Change	No Change	No Change	No Change
842	Quercus incana	Medium	0	No Change	No Change	No Change	No Change
819	Quercus laevis	High	0	No Change	No Change	No Change	No Change
820	Quercus laurifolia	High	0	No Change	No Change	Infinite	Infinite
825	Quercus michauxii	Medium	0	Infinite	No Change	No Change	Infinite
838	Quercus virginiana	Medium	0	No Change	No Change	No Change	Infinite
921	Salix amygdaloides	Low	0	No Change	No Change	No Change	No Change
935	Sorbus americana	Medium	0	No Change	No Change	No Change	No Change
222	Taxodium distichum var.nutans	High	0	No Change	No Change	No Change	Infinite
241	Thuja occidentalis	High	0	No Change	No Change	No Change	No Change
261	Tsuga canadensis	High	0	No Change	No Change	No Change	No Change

Data courtesy of L. Iverson and the Climate Change Tree Atlas (http://www.nrs.fs.fed.us/atlas/tree/tree_atlas.html)