13550

Northern Atlantic Coastal Plain Pitch Pine Barrens

BpS Model/Description Version: Aug. 2020

Update: 4/25/2018

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Vegetation Type

Forest and Woodland

Map Zones

60, 65

Model Splits or Lumps

This biophysical setting is lumped with 14560, map zone 60.

Geographic Range

Northeastern United States, specifically, southeastern New Jersey, Long Island, Cape Cod and scattered inland locations throughout New York and New England.

Biophysical Site Description

Pine Barrens (northeastern oak-pine forests, Kuchler PNV 110), in general occur on glacial sand plains with substrates that include outwash plains, stabilized sand dunes, and glacial till.

These barrens are found on coarse textured, well-drained, low nutrient soils of the coastal plain and scattered inland locations throughout central-southern New England and adjacent New York.

Vegetation Description

Entire Vegetation description was taken from Jordan et al. (2003):

Pitch pine (*Pinus rigida*) barrens in northeastern North America include woodlands and shrublands with an open tree canopy (10-60% cover) of pitch pine and a dense understory of scrub oak (*Quercus ilicifolia*), black huckleberry (*Gaylussacia baccata*), low blueberry (*Vaccinium pallidum*), and lowbush blueberry (*Vaccinium angustifolium*) (Table 1). Common groundcover plants include golden heather (*Hudsonia ericoides*), bearberry (*Arctostaphylos uva-ursi*) and wintergreen (*Gaultheria procumbens*). Herbaceous species include Pennsylvania sedge (*Carex pensylvanica*), bracken fern (*Pteridium aquilinum*), low-growing panic grasses (*Panicum* spp.), joint weed (*Polygonella articulata*), and cow-wheat (*Melampyrum lineare*). Although overall species richness is low in pine barrens, many rare and endemic species are found in these systems.

BpS Dominant and Indicator Species

|  |  |  |
| --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** |
| PIRI | *Pinus rigida* | Pitch pine |
| QUIL | *Quercus ilicifolia* | Bear oak |
| QUVE | *Quercus velutina* | Black oak |
| QUAL | *Quercus alba* | White oak |
| QUCO2 | *Quercus coccinea* | Scarlet oak |
| GABA | *Gaylussacia baccata* | Black huckleberry |
| VAPA4 | *Vaccinium pallidum* | Blue ridge blueberry |
| QUST | *Quercus stellata* | Post oak |

Species names are from the NRCS PLANTS database. Check species codes at http://plants.usda.gov.

Disturbance Description

Pitch pine is a fire-adapted species. In frequently burned areas (such as the dwarf pine plains on Long Island and in New Jersey) some, but not all, pitch pines have serotinous cones, which only open and release seeds after fire. The incidence of serotiny declines as fire frequency decreases (Givnish 1981; Jordan unpublished).

Serotiny may not be present in Cape Cod pitch pine, and other areas with low fire frequencies. Pitch pine younger than 20-40yrs may produce stump sprouts after top-killing fire (Andresen 1959). If not top killed, pines may recover from fire by sprouting from branches and trunk. Pitch pine has thick, fire-resistant bark. Additionally, pitch pine is quick to mature and to produce seeds. Because of these characteristics, frequent fires of moderate-to-high intensity/severity eventually eliminate all other tree species except for pitch pine and scrub oak. Fire kills tree oak stems more readily than pines, but most tree oaks sprout. Prescribed burning favors pine over the more susceptible oak, as well as the herbaceous component over shrubs.

Different fire frequencies and intensities interrupt succession, accounting for variations in forest composition. Periodic severe wildfires with 40-100yr intervals have produced oak-pine mixtures over extensive areas of uplands while more frequent severe fires have created mixtures of pitch pine and shrub oaks. The most frequent and severe fires have created the pine plains.

Fires, especially large wildfires, have been a major factor in the development of the present differences among forest stands on similar sites in the Pine Barrens. Abandoned uplands sites generally progress from a grass or shrubland (fire return interval 2-3yrs), to pitch pine/scrub oak woodland (5-25yrs), to pure pitch pine forest with heath/oak scrublands (30-60yrs), to pitch pine/tree-sized oak forest (60-100yrs), to oak-hickory forest (100-200yrs).

The types of fire in the oak forests are very different from those in pitch pine woodlands. Oak forests can be shifted to pitch pine woodlands, but only with severe fires or high intensity fires that would kill canopy oaks.

Ice buildup and heavy snow may be a factor in some northeastern pine barrens. Ice storms can also be a factor in coastal barrens and oak forests. They would operate in all states, but have most impact as tree canopy increases. Return intervals would vary from 5-50yrs. The scale of disturbance processes differs with the extent of each barrens system.

Pine barrens are heavily influenced by fire, the composition and structure of the pine barrens components vary with fire frequency, intensity and severity. In general, tree oaks are more prevalent in those stands having a long fire return interval for high severity fires, while at the other extreme, return intervals of 8-10yrs for high severity, top-killing fires foster the growth of "pine plains," i.e., dwarf pine stands 1m in height.

Fire Frequency

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Severity** | **Avg FI** | **Percent of All Fires** | **Min FI** | **Max FI** |
| Replacement | 77 | 10 |  |  |
| Moderate (Mixed) | 31 | 25 |  |  |
| Low (Surface) | 12 | 65 |  |  |
| All Fires | 8 | 100 |  |  |

Fire interval is expressed in years for each fire severity class and for all types of fire combined (All Fires). Average FI is the central tendency modeled. Percent of all fires is the percent of all fires modeled in that severity class. Minimum and Maximum FIs show the relative range of fire intervals as estimated by model contributors, if known.

Scale Description

Pre-Columbian disturbance (replacement fire), wide scale in nature and ranged from several hundred acres to hundreds of thousands of acres.

Native Americans fired the landscape for reasons including, but not limited to, access, game drives, and food production. This information alludes to the frequency of fire on the landscape.

Adjacency or Identification Concerns

There are two associated pine barrens types within these systems: wetland pine barrens and frost pockets. Frost pockets occur from Pennsylvania through Long Island, Cape Cod, to Maine, with wetland pine barrens occurring mostly in New Jersey.

Wetland pine barrens are wet areas within the pine barrens forest areas that demonstrate wetland and upland pine barrens vegetation. Where fire frequency is high, these areas may be dominated by large, wet grasslands.

Frost pockets are characterized by localized topography providing for cold air intrusion, traditional cooling, and heating. Temperature extremes can be dramatic with below-freezing temperatures being recorded during all months of the year. Vegetation structure is zonal as temperature extremes moderate toward the upper edges of these sites. Within frost pockets, vegetation ranges from microbial crusts where temperature extremes are greatest to shrubs and finally tree components as temperature extremes moderate.

Additionally, Coastal Plain ponds and Atlantic White Cedar swamps may be embedded in these pine barrens (NatureServe 2007).

From Jordan et al (2003): In the absence of frequent fire, frost damage, insect herbivory, cutting, or other disturbance, trees invade and barrens convert to closed-canopy forest (Forman, 1979; Little, 1979; Schweitzer and Rawinski, 1988; Thompson, 1995; Kurczewski and Boyle, 2000; Motzkin et al., 2002).

Issues or Problems

**Model assumptions**

Class A represents many possibilities at this point, e.g., anything from pine plains, to shrublands, to mixtures of oak and pine, or just to mixed oak.

Class B represents mid-seral closed. Although there is an open canopy of pitch pine, there will be a closed understory of dominant scrub oak.

In the absence of a pitch pine seed source, class A will automatically progress to class E.

Class D represents the climatic climax community with fire. Should no fire occur in class D for 200yrs (three cumulative fire cycles at 65yrs each if adding all fire probabilities), it will climax at E, an oak-hickory forest.

Within the model class B, the canopy is considered closed based on scrub oak and not the overstory tree species, pitch pine.

Native Uncharacteristic Conditions

Comments

A concern of Marilyn Jordan is that no non-fire related disturbances have been captured. Hurricanes, insect disturbance and land clearing are all considered to be important.

Succession Classes

**Mapping Rules**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Upper Layer Lifeform** | **Height (m)** | **Canopy Cover (%)** | | | | | | | | | |
| **0-10** | **11-20** | **21-30** | **31-40** | **41 - 50** | **51-60** | **61-70** | **71-80** | **81-90** | **91-100** |
| Herb | 0-0.5 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |
| Herb | 0.5-1.0 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |
| Herb | >1.0 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |
| Shrub | 0-0.5 | A | A | A | A | A | A | A | A | A | A |
| Shrub | 0.5-1.0 | A | A | A | A | A | A | A | A | A | A |
| Shrub | 1.0-3.0 | A | A | A | A | A | A | A | A | A | A |
| Shrub | >3.0 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |
| Tree | 0-5 | UN | UN | B | B | B | B | UN | UN | UN | UN |
| Tree | 5-10 | UN | UN | C | C | C | C | E | E | E | E |
| Tree | 10-25 | UN | UN | D | D | D | D | E | E | E | E |
| Tree | 25-50 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |
| Tree | >50 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |

Succession class letters A-E are described in the Succession Class Description section. Some classes use a leafform distinction where a qualifier is added to the class letter: Brdl (broadleaf), Con (conifer), or Mix (mixed conifer and broadleaf). UN refers to uncharacteristic native or a combination of height and cover that would not be expected under the reference condition. NP refers to not possible or a combination of height and cover which is not physiologically possible for the species in the BpS.

**Description**

Class A 6 Early Development 1 - All Structures

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| QUPR | Quercus prinoides | Quercus prinoides | Lower |
| QUIL | Quercus ilicifolia | Bear oak | Lower |
| CAPE6 | Carex pensylvanica | Pennsylvania sedge | Upper |
| PTAQ | Pteridium aquilinum | Western brackenfern | Upper |

Description

Grass and/or shrubs. This class can include *Carex* spp., *Panicum* spp., *Pteridium aquilinum*, *Vaccinium* spp., and *Gaylussacia baccata*.

*Maximum Tree Size Class*  
None

Class B 24 Mid Development 1 - Open

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PIRI | Pinus rigida | Pitch pine | Upper |
| QUIL | Quercus ilicifolia | Bear oak | Low-Mid |
| QUPR | Quercus prinoides | Quercus prinoides | Low-Mid |

Description

Scrub oak (*Quercus ilicifolia*) is the dominant life form at this stage.

The canopy here is considered open, based on pitch pine and not the understory tree species, scrub oak. This is a woodland type seral stage with PIRI having 10-60% min and max canopy closure respectively. QUIL and QUPR have a 30-80% min and max canopy closure respectively.

*Maximum Tree Size Class*  
Pole 5-9" DBH

Class C 39 Mid Development 2 - Closed

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PIRI | Pinus rigida | Pitch pine | Upper |
| QUIL | Quercus ilicifolia | Bear oak | Low-Mid |
| GABA | Gaylussacia baccata | Black huckleberry | Low-Mid |
| VAPA4 | Vaccinium pallidum | Blue ridge blueberry | Low-Mid |

Description

Pure pitch pine forest. Heaths may or may not be present, depending on fire history. PIRI has 60-100% min and max crown closure respectively

*Maximum Tree Size Class*  
Pole 5-9" DBH

Class D 26 Late Development 1 - Closed

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PIRI | Pinus rigida | Pitch pine | Upper |
| QUIL | Quercus ilicifolia | Bear oak | Mid-Upper |
| GABA | Gaylussacia baccata | Black huckleberry | Low-Mid |
| VAPA4 | Vaccinium pallidum | Blue ridge blueberry | Low-Mid |

Description

Pitch pine-oak codominant. Canopy oak species include *Quercus velutina, Quercus coccinea, Quercus alba*, and *Quercus stellata.*

*Maximum Tree Size Class*  
Medium 9-21"DBH

Class E 5 Late Development 2 - Closed

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| VAPA4 | Vaccinium pallidum | Blue ridge blueberry | Upper |
| QUIL | Quercus ilicifolia | Bear oak | Mid-Upper |
| GABA | Gaylussacia baccata | Black huckleberry | Low-Mid |

Description

Oak heath or oak-hickory forest: *Carya* spp., *Quercus velutina, Quercus rubra,* and *Quercus alba. S*ome heath and scrub oak are present. Hickory can be a co-dominant, but oak-dominated forests are more common.

*Maximum Tree Size Class*  
Medium 9-21"DBH

Model Parameters

Deterministic Transitions

|  |  |  |  |
| --- | --- | --- | --- |
| **From Class** | **Begins at (yr)** | **Succeeds to** | **After (years)** |
| Early1:ALL | 0 | Mid1:OPN | 4 |
| Mid1:OPN | 5 | Mid2:CLS | 19 |
| Mid2:CLS | 20 | Late1:CLS | 64 |
| Late1:CLS | 65 | Late1:CLS | 964 |
| Late2:CLS | 200 | Late2:CLS | 999 |

Probabilistic Transitions

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Disturbance Type** | **Disturbance occurs In** | **Moves vegetation to** | **Disturbance Probability** | **Return Interval (yrs)** | **Reset Age to New Class Start Age After Disturbance?** | **Years Since Last Disturbance** |
| Replacement Fire | Early1:ALL | Early1:ALL | 0.05 | 20 | Yes | 0 |
| Replacement Fire | Mid1:OPN | Early1:ALL | 0.025 | 40 | Yes | 0 |
| Mixed Fire | Mid1:OPN | Mid1:OPN | 0.1 | 10 | No | 0 |
| Wind or Weather or Stress | Mid2:CLS | Mid1:OPN | 0.002 | 500 | Yes | 0 |
| Replacement Fire | Mid2:CLS | Early1:ALL | 0.0067 | 149 | Yes | 0 |
| Mixed Fire | Mid2:CLS | Mid1:OPN | 0.013 | 77 | Yes | 0 |
| Surface Fire | Mid2:CLS | Mid2:CLS | 0.2 | 5 | No | 0 |
| Alternative Succession | Late1:CLS | Late2:CLS | 1 | 1 | Yes | 200 |
| Wind or Weather or Stress | Late1:CLS | Mid1:OPN | 0.002 | 500 | Yes | 0 |
| Replacement Fire | Late1:CLS | Early1:ALL | 0.007 | 143 | Yes | 0 |
| Mixed Fire | Late1:CLS | Mid1:OPN | 0.01 | 100 | Yes | 0 |
| Surface Fire | Late1:CLS | Late1:CLS | 0.025 | 40 | No | 0 |
| Replacement Fire | Late2:CLS | Early1:ALL | 0.002 | 500 | Yes | 0 |
| Surface Fire | Late2:CLS | Late2:CLS | 0.01 | 100 | No | 0 |

References

Burns, R.M. and B.H. Honkala, tech. coords. 1990. Silvics of North America: 1. Conifers; 2. Hardwoods. Agriculture Handbook 654. USDA Forest Service, Washington, DC. vol.2. 877 pp.

Eberhardt, R. W. and R. E. Latham. 2000. Relationships among vegetation, surficial geology and soil water content at the Pocono mesic till barrens. Journal of the Torrey Botanical Society 127:115-124.

Forman, R.T. 1979. Pine Barrens: Ecosystem and Landscape. Academic Press, New York. 601 pp.

Givnish, T.J., 1981. Serotiny, geography and fire in the pine barrens of New Jersey. Evolution 35:101–123.

Jordan, M., W.A. Patterson III and A.G. Windisch. 2003. Conceptual ecological models for the Long Island pitch pine barrens: implications for managing rare plant communities. Forest Eco. Mgmt. 185:158-168.

Kurczewski, F.E. and J.F. Boyle. 2000. Historical changes in the pine barrens of central Suffolk County, New York Northeast. Nature 7:95–112.

Latham, R.E., J.E. Thompson, S.A. Riley and A. W. Wibiralske. 1996. The Pocono till barrens: shrub savanna persisting on soils favoring forest. Bulletin of the Torrey Botanical Club 123: 330-349.

Latham, R.E., J.E. Thompson, A. Sugden-Newbery and P. Stoll. Spatial analysis of vegetation change in a mesic shrubland: effects of geomorphology, fire history and forest proximity. (In preparation for Landscape Ecology)

Little, Silas.1979. Fire and plant succession in the New Jersey Pine Barrens. In. Pine Barrens Ecosystem and Landscape. R.T.T. Forman, ed. Rutgers Univ. Press. 297-314.

Maurice, K. R., J. M. Welch, C. P. Brown and R. E. Latham. 2004. Mesic till barrens in retreat: topography, fire, and forest contagion effects. Landscape Ecology (in press).

McCormick, J. 1979. The Vegetation of the New Jersey Pine Barrens. In. Pine Barrens

Ecosystem and Landscape. R.T.T. Forman, ed. Rutgers Univ. Press. 229-244.

Meilleur, A., J. Brisson, and A. Bouchard. 1997. Ecological analysis of the northernmost population of pitch pine (Pinus rigida) Can. J. For. Res. 27:1342-1350.

Motzkin, G., S. Ciccarello and D.R. Foster. 2002. Frost pockets on a level sand plain: does variation in microclimate help maintain persistent vegetation patterns? J. Torrey Bot. Soc. 129:154–163.

NatureServe. 2005. International Ecological Classification Standard: Terrestrial Ecological Classifications. Terrestrial Ecological Systems of the Northeast Region, US Draft Legend for Landfire Project: Northeast Rapid Assessment Model Zone. Arlington, VA. 61 pp.

NatureServe. 2007. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA. Data current as of 10 February 2007.

Petraitis, P.S. and R.E. Latham. 1999. The importance of scale in testing the origins of alternative community states in ecosystems. Ecology 80:429-442.

Schmidt, Kirsten M., J.P. Menakis, C.C. Hardy, W.J. Hann and D.L. Bunnell. 2002. Development of coarse-scale spatial data for wildland fire and fuel management. Gen. Tch. Rep. RMRS-GTR-87. Fort Collins, CO: USDA Forest Service, Rocky Mountain Research Station. 41 p. + CD.

Schweitzer, D.F. and T.J. Rawinski., 1988. Element Stewardship Abstract for Northeastern Pitch Pines–Scrub Oak Barrens. The Nature Conservancy, Arlington, VA. 22 pp.

Seischab, F. K. and J. M. Bernard. 1996. Pitch Pine (Pinus rigida Mill.) Communities in the Hudson Valley Region of New York. Am. Midl. Nat. 136:42-56.

Thompson, J.E., 1995. Interrelationships Among Vegetation Dynamics, Fire, Surficial Geology, and Topography of the Southern Pocono Plateau, Monroe County, Pennsylvania. M.S. Thesis, University of Pennsylvania. 159 pp.

USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (2002, December). Fire Effects Information System, [Online]. Available:

http://www.fs.fed.us/database/feis/.

Wacker, P.O. 1979. Human Exploitation of the New Jersey Pine Barrens before 1900. In. Pine Barrens Ecosystem and Landscape. Forman, R.T.T., ed. Rutgers Univ. Press. 3-24.

Wibiralske, A.W., R.E. Latham and A. Johnson. 2004. A biogeochemical analysis of the Pocono till barrens and adjacent hardwood forest underlain by Wisconsinan and Illinoian till in northeastern Pennsylvania. Canadian Journal of Forest Research (in press).

Windisch, A.G., 1999. Fire Ecology of the New Jersey Pine Plains and Vicinity. Ph.D. dissertation, Rutgers-The State University, New Brunswick, NJ. 327 pp.

Windisch, A. 1994. A preliminary wildfire history for the Long Island Central Pine Barrens. Report submitted to the Long Island Chapter of The Nature Conservancy, Cold Spring Harbor, NY. Unpublished data.

Windisch, A. 1990. Draft Element Stewardship Abstract for Dwarf Pine Barrens. The Nature Conservancy, Arlington, VA.