# Rapid Assessment Reference Condition Model

*The Rapid Assessment is a component of the LANDFIRE project. Reference condition models for the Rapid Assessment were created through a series of expert workshops and a peer-review process in 2004 and 2005. For more information, please visit www.landfire.gov. Please direct questions to helpdesk@landfire.gov.*

## Potential Natural Vegetation Group (PNVG)

**R7PIBA**          **Pine Barrens**

## General Information

**Contributors** *(additional contributors may be listed under "Model Evolution and Comments")*

| **Modelers** | | **Reviewers** | |
|---|---|---|---|
| Michael Ciaranca | Michael.Ciaranca@ma.ngb.army.mil | Michael Batcher | mbatcher@netheaven.com |
| Michael Drake | Mdrake@dep.state.nj.us | Erin Small | esmall@fs.fed.us |
| Erin Small | Esmall@fs.fed.us | Marilyn Jordan | mjordan@tnc.org |

**Vegetation Type**

Woodland

**Dominant Species***

PIRI    QUCO
QUIL
QUVE
QUAL

**General Model Sources**

☑ Literature
☐ Local Data
☑ Expert Estimate

**LANDFIRE Mapping Zones**

60    64
61    65
63    66

**Rapid Assessment Model Zones**

☐ California          ☐ Pacific Northwest
☐ Great Basin         ☐ South Central
☐ Great Lakes         ☐ Southeast
☑ Northeast           ☐ S. Appalachians
☐ Northern Plains     ☐ Southwest
☐ N-Cent.Rockies

### 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.

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 - 10 years for high severity, top-killing fires foster the growth of "pine plains", i.e. , dwarf pine stands of 1 meter in height.

There are two associated pine barrens types within pine barrens systems, wetland pine barrens and frost pockets. Frost pockets occur from Pennsylvania thru 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.

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*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.*

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.

## Vegetation Description

Include woodlands and shrublands with an
open tree canopy of pitch pine (Pinus rigida) and an understory of shrubby oaks (Quercus ilicifolia, Quercus prinoides, Quercus marilandica, Quercus stellata) and heath species (Vaccinium and Gaylussacia spp.; Jordan et. Al 2003). Herbaceous and groundcover species may include golden heather (Hudsonia ericoides), bearberry (Arctostaphylos uva-ursi), mountain laurel (Kalmia latifolia), sweetfern (Comptonia peregrina), wintergreen (Gaultheria procumbens), bracken fern (Pteridium aquilinum), Pennsylvania sedge (Carex pennsylvanica), and cow-wheat (Melampyrum lineare). Pitch pine have the ability to sprout from root crowns but this is dependant upon the age of the tree.

## 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 of the 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 20-40 years 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. And is quick to maturity 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, as well as 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 40-100 year 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 of 2–3? Years) → pitch pine/scrub oak woodland (5–25 years) → pure pitch pine forest with heath/oak scrublands (30–60 years) → pitch pine/tree-sized oak forest (60–100 years) → oak–hickory forest (100–200 years).

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 to 50 years. The scale of disturbance processes differs with the extent of each barrens system.

## Adjacency or Identification Concerns

## 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.

## Issues/Problems

Model assumptions:

Class A represents a number of possibilities at this point – anything from pine plains to shrublands to mixtures of oak and pine or just 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 200 years (3 cumulative fire cycles? –65 years for each cycle 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 not the overstory tree species, pitch pine.

## Model Evolution and Comments

Ciaranca and Drake edited VDDT Model and corrected associated assumptions within the database.  Also, changed Kuchler's (PNV 110) northeastern oak-pine naming convention to Pine Barrens.

Peer reviewed by Marilyn Jordan 04/21/05.

Reviewers should include:  Dr Bill Patterson, UMASS-Amherst, Tim Simmons, MA Division of Fisheries and Wildlife, Joel Carlson, TNC, Horace Somes, NJ Forest Fire Service, Nort Phillips, USFS-Vermont, Marilyn Jordan, TNC-New York, Michael Batcher, Independent, New York, Dave Crary, NPS, Cape Cod.

Peer reviewed by Michael S. Batcher, Ecologist 04/21/05, Erin Small,  Fire Planner USDS Forest Service White Mountain/Green Mountain/Finger Lakes National Forests 04/01/05 and Marilyn Jordan Conservation Scientist TNC 04/21/05.

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**

*Succession classes are the equivalent of "Vegetation Fuel Classes" as defined in the Interagency FRCC Guidebook (www.frcc.gov).*

### Class A     5 %

Early1 All Struct
**Description**
Grass and/or shrubland, can include Carex and Panicum spp., mixed oak or pine/oak seedling mixture, heaths or dwarf pine plains  May include some areas dominated by lichens and mosses.

**Dominant Species* and Canopy Position**

Carex s   Lower
Panicum  Lower
QUIL      Upper
QUPR     Upper

**Upper Layer Lifeform**
☑ Herbaceous
☑ Shrub
☐ Tree

**Fuel Model**  4

**Structure Data (for upper layer lifeform)**

|  | Min | Max |
|---|---|---|
| Cover | 0 % | 100 % |
| Height | no data | no data |
| Tree Size Class | no data | |

☑ Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

Carex spp. And Panicum spp.

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### Class B     25 %

Mid1 Open
**Description**
Pitch pine dominant with scrub oak dominant in the understory (Quercus ilicifolia, Quercus prinoides, Quercus stellata). There can be areas where pitch pine is very sparse and scrub oak and heaths are dominant.

**Dominant Species* and Canopy Position**

PIRI    Upper
QUIL    Low-Mid
QUPR   Low-Mid

**Upper Layer Lifeform**
☐ Herbaceous
☑ Shrub
☑ Tree

**Structure Data (for upper layer lifeform)**

|  | Min | Max |
|---|---|---|
| Cover | 60 % | 100 % |
| Height | Shrub Medium 1.0-2.9m | Shrub Tall >3.0 m |
| Tree Size Class | Pole 5-9" DBH | |

☑ Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

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

The canopy here is considered open based on Pitch Pine  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

**Fuel Model**  4

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### Class C     40 %

Mid2 Closed
**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

**Dominant Species* and Canopy Position**

PIRI    Upper
QUIL    Low-Mid
GABA   Low-Mid
VAPA4  Low-Mid

**Upper Layer Lifeform**
☐ Herbaceous
☑ Shrub
☑ Tree

**Fuel Model**  6

**Structure Data (for upper layer lifeform)**

|  | Min | Max |
|---|---|---|
| Cover | 20 % | 60 % |
| Height | Tree Regen <5m | Tree Medium 10-24m |
| Tree Size Class | Pole 5-9" DBH | |

☐ Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

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## Class D    25 %

Late1 Closed
**Description**

Pitch pine – oak codominant; canopy oak species include Quercus velutina, Quercus coccinea, Quercus alba, Quercus stellata (60-100% min and max crown closure respectively).

**Dominant Species\* and Canopy Position**

| | |
|---|---|
| PIRI | Upper |
| QUIL. | Mid-Upper |
| GABA | Low-Mid |
| VAPA4 | Low-Mid |

**Upper Layer Lifeform**

☐ Herbaceous
☑ Shrub
☑ Tree

**Fuel Model** 9

**Structure Data (for upper layer lifeform)**

| | Min | Max |
|---|---|---|
| Cover | 20 % | 60 % |
| Height | Tree Short 5-9m | Tree Medium 10-24m |
| Tree Size Class | Medium 9-21"DBH | |

☐ Upper layer lifeform differs from dominant lifeform.
Height and cover of dominant lifeform are:

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## Class E    5 %

Late3 Closed
**Description**

Oak heath or Oak–hickory forest – Carya spp., Quercus velutina, Quercus rubra, Quercus alba; some heath and scrub oak present. Hickory can be a co-dominant, but oak dominated forests are more common ((60-100% min and max crown closure respectively)..

**Dominant Species\* and Canopy Position**

| | |
|---|---|
| Carya s | Upper |
| QUIL | Mid-Upper |
| GABA | Low-Mid |
| VAPA4 | Low-Mid |

**Upper Layer Lifeform**

☐ Herbaceous
☐ Shrub
☑ Tree

**Fuel Model** 9

**Structure Data (for upper layer lifeform)**

| | Min | Max |
|---|---|---|
| Cover | 60 % | 100 % |
| Height | Tree Short 5-9m | Tree Medium 10-24m |
| Tree Size Class | Medium 9-21"DBH | |

☐ Upper layer lifeform differs from dominant lifeform.
Height and cover of dominant lifeform are:

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## Disturbances

**Disturbances Modeled**

☑ Fire
☐ Insects/Disease
☑ Wind/Weather/Stress
☐ Native Grazing
☐ Competition
☐ Other:
☐ Other

**Historical Fire Size (acres)**

Avg: no data
Min: 10
Max: 100000

**Sources of Fire Regime Data**

☑ Literature
☐ Local Data
☑ Expert Estimate

**Fire Regime Group:    1**

I: 0-35 year frequency, low and mixed severity
II: 0-35 year frequency, replacement severity
III: 35-200 year frequency, low and mixed severity
IV: 35-200 year frequency, replacement severity
V: 200+ year frequency, replacement severity

**Fire Intervals (FI)**

Fire interval is expressed in years for each fire severity class and for all types of fire combined (All Fires). Average FI is central tendency modeled. Minimum and maximum show the relative range of fire intervals, if known. Probability is the inverse of fire interval in years and is used in reference condition modeling. Percent of all fires is the percent of all fires in that severity class. All values are estimates and not precise.

| | Avg FI | Min FI | Max FI | Probability | Percent of All Fires |
|---|---|---|---|---|---|
| Replacement | 78 | | | 0.01282 | 10 |
| Mixed | 32 | | | 0.03125 | 25 |
| Surface | 12 | | | 0.08333 | 65 |
| All Fires | 8 | | | 0.12740 | |

## References

Brown, James K.; Smith, Jane Kapler, eds. 2000. Wildland fire in ecosystems: effects of fire on flora. Gen. Tech. Rep. RMRS-GTR-42-vol. 2. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 257 p.

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Burns, Russell M., and Barbara H. Honkala, tech. coords. 1990. Silvics of North America: 1. Conifers; 2. Hardwoods. Agriculture Handbook 654. U.S. Department of Agriculture, Forest Service, Washington, DC. Vol.2, 877 p.

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.

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, A.G. Windisch. Conceptual ecological models for the Long Island pitch pine barrens: implications for managing rare plant communities. Forest Eco. Mgmt. pp. 158-168.

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. Pp.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. Pp.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.

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

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, Menakis, James P., Hardy, Colin C., Hann, Wendel J., Bunnell, David L. 2002. Development of coarse-scale spatial data for wildland fire and fuel management. Gen. Tech. Rep. RMRS-GTR-87. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 41 p. + CD.

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.

U.S. Department of Agriculture, 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. R.T.T. Forman, ed. Rutgers Univ. Press. Pp.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.)

Unpublished data: 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, New York.

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