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)

R6NHMB **Northern Hardwood Maple Beech Hemlock**

General Information

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

Modelers

Carlen M. Emanuel cemanuel@tnc.org

Randy Swaty rswaty@tnc.org

Reviewers

Vegetation Type

Forested

Dominant Species*

ACSA
FAGR
TSCA
BEAL2

General Model Sources

- [x] Literature
- [x] Local Data
- [x] Expert Estimate

LANDFIRE Mapping Zones

41 52 49
50 62
51 63

Rapid AssessmentModel Zones

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

Geographic Range

The northern hardwood community was mapped by Kuchler in parts of Maine, Vermont, New Hampshire, Pennsylvania, Maryland, Virginia, North Carolina, Ohio, Michigan, and Wisconsin. R6NHB occurs in TNC ecoregions 45C, 47C, 48C, 60P, 61C, 63C, 64C and Divisions 201C and 202C. This forest type occurs in the northern tier of eastern states extending into southern Canada (southern Ontario). The type spans southern New England westward to the western extent of the range of American beech. This type is most prevalent in the lake states and was estimated to cover ca.10 million acres in the area. Total presettlement acreage was estimated to be 15.4 million acres of the lake states area, forming 89% of the forest type. Presettlement forests of eastern hemlock and yellow birch were frequent on moderate to poorly-drained till plains and outwash plains, especially in the western Upper Peninsula. This assemblage was predominately found around lake and bog margins and in complex mosaics with sugar maple-hemlock forest on the surrounding better-drained soils. Beech-sugar maple-hemlock forests, which dominated nearly 17% of the state surface in the 1800s, were mostly found on large
expanses of rolling moraines in the northern Lower Peninsula and eastern Upper Peninsula. This species mix was also found on the clay lake plain along Saginaw Bay.

Biophysical Site Description

This forest type of moist to dry-mesic sites lies predominantly north of the tension zone,
occurring principally on moraines, fine-textured glacial lake beds, and flat to rolling uplands grading into steep slopes. It occurs commonly on silty/clayey lake plains with thin glacial till over bedrock. It also occurs locally on kettle-kame topography, moderately well-drained to well-drained sandy lake plain, and sand dunes (MNFI, 1990). In the prairie forest border region this type occurs on valley slopes and bottoms, often with northern or eastern aspects, and on poorly-drained sites. Elevations are low to moderate, generally < 2000 ft.

The soils for this type are typically well- to moderately-well-drained loams and silt loams, with rich loam soils over glacial till. These loam soils are well drained, loamy and mesic, commonly termed 'rich soils'.

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

Soil chemistry is circumneutral. The region has a cool snow-forest climate with warm summers. The daily maximum temperature in July ranges from 24 to 29 °C (75 to 85 °F) and the daily minimum temperature in January ranges from -21 to -9 °C (-5 to 15 °F). The mean length of freeze-free days is between 90 to 160 days and the average number of days per year with snow cover of 2.5 cm or more is between 80 and 140 days. The normal annual total precipitation ranges from 610 to 1270 mm (Albert et al. 1986; Barnes, 1991). Quasi-equilibrium landscape areas of 5000 to 8000 ha (minimum dynamic area = 50 x average disturbance size or 2 x maximum disturbance size) are considered to be stable.

Vegetation Description

This northern forest type is a broadly-defined community type with numerous regional, physiographic and edaphic variations. The following tolerant trees can dominate or co-dominate the canopy of this community: Acer saccharum (sugar maple), Tsuga canadensis (eastern hemlock), Fagus grandifolia (American beech) and Betula alleghaniensis (yellow birch). Other important components of the canopy include: Tilia americana (American basswood), Pinus strobus (white pine), Quercus rubra (red oak), Thuja occidentalis (white cedar), Acer rubrum (red maple), Betula papyrifera (paper or white birch) and Fraxinus americana (white ash). Tree species associated with this community but most commonly found in the sub-canopy include: Ostrya virginiana (ironwood or hop-hornbeam), Ulmus americana (american elm) and Abies balsamea (balsam fir). The ground and shrub layer of mesic northern forests is diverse in compositional variation. Communities of beech and sugar maple have relatively few shrubs but do support many spring ephemerals and perennial herbs. Stands composed of mixed hardwoods tend to have a well-developed shrub layer and a fairly diverse groundlayer. A plethora of spring ephemeral herbs in these assemblages can be attributed to the development of moisture-holding and nutrient-rich soils. Sugar maple, yellow birch and basswood enhance the soil. Prevalent herbs of the mesic northern forest include: Actaea pachypoda (white baneberry), Actaea rubra (red baneberry), Allium tricoccum (wild leek), Aralia nudicaulis (wild sarsaparilla), Aralia racemosa (spikenard), Arisaema triphyllum (jack-in-the-pulpit), Carex deweyana, Carex hirtifolia, Carex leptonervia, Carex plantaginea, Carex woodii, Caulophyllum thalictroides (blue cohosh), Circaea alpina (smaller enchanter's nightshade), Circaea lutetiana (tall enchanter's nightshade), Clintonia borealis (blue-bead lily), Cornus canadensis (bunchberry), Galium triflorum (bedstraw), Maianthemum canadense (Canada mayflower), Mitchella repens (partridge berry), Osmorhiza claytonii (sweet cicely), Polygonatum pubescens (Solomon's seal), Smilacina racemosa (false spikenard), Streptopus roseus (twisted stalk), Uvularia grandiflora (bellwort), Trientalis borealis (star flower), Trillium cernuum (nodding trillium) and Trillium grandiflorum (common trillium). Common ferns and clubmosses of this community include: Adiantum pedatum (maidenhair fern), Athyrium filix-femina (lady fern), Athyrium thelypteroides (silvery spleenwort), Botrychium virginianum (rattlesnake fern), Dryopteris spinulosa (spinulose woodfern), Lycopodium annotinum (stiff clubmoss), Lycopodium lucidulum (shining clubmoss) and Lycopodium obscurum (groundpine).

Characteristic shrubs include: Acer pensylvanicum (striped maple), Acer spicatum (mountain maple or moosewood), Cornus alternifolia (alternate-leaved dogwood), Corylus cornuta (beaked hazelnut), Dirca palustris (leatherwood), Lonicera canadensis (fly honeysuckle), Ribes cynosbati (wild gooseberry), Sambucus pubens (red elderberry), Taxus canadensis (Canada yew) and Viburnum acerifolium (maple-leaf viburnum). (Above species lists compiled from MNFI database and from Curtis 1959, Gleason and Cronquist 1964, and Nichols 1935.)

Disturbance Description

Disturbance and successional dynamics in the northern hardwood maple-beech-hemlock type are driven by wind events. Tree falls and crown removal are the primary results from the wind disturbance. Canopy disturbances are frequent but of low intensity, often forming single or small, multiple-tree gaps. The wind

events that can occur are downbursts and microbursts from thunderstorms, tornados, and general circulation winds around severe low-pressure systems. Data for long-term events is estimated from current conditions and sparse historical data. Average rates of disturbance or canopy mortality are estimated at 5.7 to 6.9 % per decade. Light and medium disturbances dominate the disturbance regime. These disturbances are (40%) randomly distributed on landscape. Gap-phase regeneration is dominant, principally fine-scale blow-down. Windstorms that removed 10 to 50 % of the forest canopy occurred at intervals of one to several centuries in a given stand. Heavy disturbances (≥ 40%) were clustered with a patch radius consistent with thunderstorm downbursts. Heavy, catastrophic windstorms and tornados are estimated to have occurred at >1000-year intervals. Rotation periods for wind events range from 69 years for ≥ 10% canopy removal to 1920 years for ≥ 60 % canopy removal. Insect attacks follow wind or ice storm damage, and contribute to the break-up of the stands, generating large amounts of coarse, woody debris.

Adjacency or Identification Concerns

This model is bordered by model R6NHHgl, Northern Hardwoods-Hemlock, model R6 Mesic Maple-Basswood, and the R6 Jack Pine types. The FRCC model BEMA, Beech-Maple, is a finer-scale model of the current condition of Northern Hardwood-Maple-Beech-Hemlock, where hemlock has been extirpated from the system due to silvicultural practices. The southern extension of this type, R6NHMB, is mostly nonexistent due to agricultural conversion.

The four "Northern Hardwood" models in the Rapid Assessment (R6NHMB, R7NHHE, R7NHNE, and R7NHSP) occur across both the Northeast and Great Lakes model zones and have several similarities, including: high moisture/nutrient gradients; historically included more conifer; often dominated by sugar maple; windthrow is the main disturbance agent with fires occurring every ~1,000-2,000 years. There are also several differences, including: beech has limited extent west of eastern Wisconsin and the central Upper Peninsula of Michigan; the amount of hemlock varies. Additional similar PNVGs include: R7BEMA, R7NHMC, R6MABA.

Scale Description

Sources of Scale Data ☑ Literature ☑ Local Data ☑ Expert Estimate

There is limited data for wind event disturbances. Average rates of natural mortality from wind events is estimated at 5.7 to 6.9% per decade, with an estimated rotation of 69 years for wind events resulting in ≥ 10% canopy removal to 1920 years for wind events resulting in ≥ 60% canopy removal. Light to medium wind disturbances dominate the landscape (<40%) and are randomly distributed. Heavy disturbances (≥ 40%) are clustered on the landscape with a patch radius consistent with thunderstorm events. The wind events generated large amounts of coarse woody debris. Rare broad-scale catastrophic storm and fire interactions resulted in fire rotations of more than a thousand years (Cleland et al. 2004, Ziegler 2002, Woods 2000, Canham and Loucks 1984, Frelich and Lorimer 1991, Grimm 1984, Runkle 1982). Most of these fires were severe surface fires that occurred only after prolonged drought and insect/disease events. Ground fuels contained high loads of 100 and 1000 hour fuels. The fire cycle for such forests must have been erratic, with intervals of 200 to 300 years plausible. Fire events were large, burning areas of 1001 to 10,000 acres (Heinselman). Fire Regime V applies to this system.

Issues/Problems

Lon- term data related to wind disturbance patch size and frequency, fire frequency, size, ignition, and seasonality are lacking or scarce for this type. This model, R6NHMB, reflects the supposition that fire ignitions occurred only in classes C and D.

Model Evolution and Comments

RA 6 model name changed to Maple-Beech-Hemlock. Josh Cohen, Dave Cleland, Jim Merzenich are suggested as reviewers. FRCC model NHWD3, Northern Hardwoods #2, represents the northern hardwood type within the Lake States at a finer scale than RA6NHMB.

Succession Classes**

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

Class A 1 %

Early1 All Struct

Description

These early-seral stands are characterized by aspen, yellow birch, and sugar maple seedlings and saplings 0 to 9 years of age. This is also a secondary successional class following a replacement fire.

Dominant Species* and Canopy Position

ACSA3 Upper
FAGUS Upper
BEAL2 Upper

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☑ Tree

Fuel Model 10

Structure Data (for upper layer lifeform)

	Min	Max
Cover	30 %	60 %
Height	Tree Regen <5m	Tree Short 5-9m
Tree Size Class	Sapling >4.5ft; <5"DBH	

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

Class B 5 %

Mid1 Closed

Description

This is a young to intermediate stand, 10 to 60 years of age, dominated by sugar maple, beech, aspen, and miscellaneous mid-tolerant tree and shrub species. Class A succeeds to this class. The intermediate stand is dominated by beech and sugar maple, 20 - 60 yrs old. Yellow birch is beginning to senesce and die, forming coarse woody debris. Hemlock seedlings and saplings become established in the understory.

Dominant Species* and Canopy Position

ACSA3 Upper
FAGUS Upper
BEAL2 Upper
TSUGA Lower

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☑ Tree

Fuel Model 10

Structure Data (for upper layer lifeform)

	Min	Max
Cover	60 %	100 %
Height	Tree Regen <5m	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:

Class C 15 %

Late1 Open

Description

These are late-intermediate to mid-age (60 to 80 years of age) mixed hardwood stands composed of sugar maple, beech, aspen, and miscellaneous hardwoods. Hemlock is becoming established in the midstory. These stands experience the light to moderate wind events that result in windthrow. Replacement fire from Box D that enters these open stands becomes a mixed severity fire because of the openness of the

Dominant Species* and Canopy Position

ACSA3 Upper
FAGUS Upper
TSUGA Low-Mid
BEAL2 Mid-Upper

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☑ Tree

Fuel Model 10

Structure Data (for upper layer lifeform)

	Min	Max
Cover	50 %	60 %
Height	Tree Short 5-9m	Tree Tall 25-49m
Tree Size Class	Large 21-33"DBH	

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

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

stand structure. Yellow birch has mostly died out in this seral stage.

Class D 79 %

Late1 Closed

Description

This is a mature to old-growth sugar maple, beech, and hemlock stand greater than 60 years of age. The stand structure is closed but moving to old-growth characteristics with hemlock as the climax species. The rare combination of wind events followed by insect and disease attacks and coupled with severe drought produce conditions favorable for severe, large-scale, landscape replacement fires. Long-term (several generations) accumulations of coarse woody debris along with mortality from the wind-insect/disease-drought event change the fuel load, type, and arrangement from FM 10 to FM 12.

Dominant Species* and Canopy Position

ASCA3 Upper
FAGUS Upper
TSUGA Mid-Upper

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 12

Structure Data (for upper layer lifeform)

	Min	Max
Cover	60 %	100 %
Height	Tree Medium 10-24m	Tree Tall 25-49m
Tree Size Class	Large 21-33"DBH	

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

Class E 0 %

Late1 All Structu

Description

N/A. 4 box model.

Dominant Species* and Canopy Position

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☐ Tree

Fuel Model no data

Structure Data (for upper layer lifeform)

	Min	Max
Cover	%	%
Height	no data	no data
Tree Size Class	no data	

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

Disturbances

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

Disturbances Modeled

- [x] Fire
- [ ] Insects/Disease
- [x] Wind/Weather/Stress
- [ ] Native Grazing
- [ ] Competition
- [ ] Other:
- [ ] Other

Historical Fire Size (acres)

Avg:
Min: 1000
Max: 10000

Sources of Fire Regime Data

- [x] Literature
- [x] Local Data
- [x] Expert Estimate

Fire Regime Group: **5**

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	2000			0.0005	59
Mixed	3000			0.00033	40
Surface					
All Fires	1199			0.00084	

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