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)

R6WPHEif White Pine Hemlock

General Information

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

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Vegetation Type

Forested

Dominant Species*

PIST
TSCA

General Model Sources

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

LANDFIRE Mapping Zones

50
51

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

System occurs in northern Lower Michigan and northern Wisconsin.

Biophysical Site Description

Hemlock and white pine have wide ecological amplitudes, occurring with wetland conifers in poorly-drained landforms and with mesophilic northern hardwoods in marginal upland landforms. White pine and hemlock become dominant within mixed forests in upland ice-contact and glacial lakebed landforms of intermediate soil fertility. These landscape ecosystems typically have low proportions of sugar maple and associated mesophilic deciduous species due to limited soil nutrient availability or moisture holding capacity. Species adapted to frequent disturbance (e.g., jack pine, aspen) occur in low proportions.

Vegetation Description

In the mid-1800s, there were 2.2 million acres of white pine-hemlock ecosystems within the 10.6 million acres of forestlands in northern Lower Michigan (Province 212; Cleland et al. 2004, ongoing R-9/SRS/MTU study). Based on analysis of GLO line tree observations, white pine–hemlock communities were dominated by "pine" recorded to the genus level, followed by hemlock, white pine, red pine, and beech. It is likely much of the undifferentiated pine was white pine given the large diameters of this class (mean of 19.3 inches). Pine and hemlock comprised 62% of GLO line trees, mesophilic sugar maple 3%, and early successional oak, white birch, and aspen 10%.

In the mid-1800s, there were 3.2 million acres of white pine-hemlock-birch ecosystems within the 17.8 million acres of forest lands in northern Wisconsin (Cleland et al. 2004a, ongoing R-9/SRS/MTU study). These landscape ecosystems were dominated by three communities identified by Schulte et al. (2002) as hemlock, hemlock–white pine, and hemlock–yellow birch. Pine and hemlock comprised 33% of GLO line trees, mesophilic sugar maple and yellow birch about 17%, and early successional oak, white birch, and aspen about 20%. The white pine-hemlock forests of Wisconsin were more diverse than those of northern Lower Michigan, with higher proportions of both early and late successional deciduous species. This may be due to the prevalence of wetlands and lakes within Wisconsin, which provided sheltered landscape

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

positions favoring sugar maple, and poorly-drained soils favoring yellow and white birch and quaking aspen. Much of the white pine-hemlock PNVG was in an old growth state, and relatively low densities of tall, large-diameter trees dominated the landscape. Old-growth white pine-hemlock stands were often partially multi-aged (Holla and Knowles 1988) or uneven-aged due to continuous recruitment caused by local disturbances (Quinby 1991). Rogers (1978) reported only 8% of the hemlock stands sampled from Wisconsin to Nova Scotia were even-aged, indicating that very few of the hemlock stands were initiated after a catastrophic event such as a wildfire. In a study of old growth white pine in Canada (Guyette and Dey 1995), canopy dominance and tree size suggested an even-aged structure, whereas actual ages of dominant trees ranged from 267 to 486 years. White pine older than 400 years made up 20% of the dominant trees, 52% were 300 to 400 years old, and 28% were 250 to 300 years old. White pine persisted as the dominant species over a seven-century period in an old-growth white pine forest of Canada, indicating that white pine was self-replacing (Quinby 1991).

Disturbance Description

The hemlock–white pine forests of northern Lower Michigan and Wisconsin were disturbed by large-scale stand-replacing crown fires within rotations of 400–500 years (Cleland et al. 2004a) and by wind events of comparable rotations. During the centuries between catastrophic disturbances, low-intensity small surface fires, windthrown trees and the death of large individual trees through biological or other agents interacted to regulate stand-scale gap dynamics.

The complex structure and age-class distribution of this ecosystem are due to these two distinct disturbance regimes. Broad-scale crown fires occurred very infrequently, selecting for pyrophilic species capable of reproducing in full-light conditions following stand-replacing disturbance. Fine-scale single or group tree mortality and blowdown occurred continuously, and selected for shade-tolerant and mid-shade-tolerant species.

Once white pine has matured and attained larger diameters and crown height, widely spaced dominants are highly resistant to intense surface or maintenance fires (Beverly and Martell 2003). Hemlock is injured or killed by intense surface fires, and both hemlock and white pine suffer high rates of mortality following crown-fires. The successional dynamics of this ecosystem after mixed or severe crown fires may involve establishment of aspen-birch or white pine immediately following the disturbance, with subsequent succession to white and red pine and oak, followed by late successional gap-phase invasion of hemlock and yellow birch beneath white pine during long fire-free periods (Davis et al. 1992).

Successional trajectories were historically regulated by disturbance regime, as well as by landscape-level patterns in communities and environment and localized edaphic conditions. Landscape-level patterns of lakes, wetlands, deciduous species, openlands, and other fuel discontinuities determined fire-exposed versus fire-protected landscape positions (Dovciak et al. 2003). Within landforms, localized conditions of soil texture and drainage, and resulting gradients of available nutrients and moisture impeded invasion by nutrient-demanding shade-tolerant hardwoods (Rogers 1978).

Preferential recruitment of hemlock beneath white pine and development of mor-like soil organic horizons within hemlock stands that inhibited hardwood invasion (Davis et al. 1994) are examples of biologically mediated successional dynamics. All these natural processes and factors have had a strong selective effect on the age, structure, and composition of these forests.

Adjacency or Identification Concerns

This type can be comingled with the northern hardwood-hemlock PNV; however, white pine and hemlock will dominate in this type under natural disturbance regimes, given a seed source. The type often fringes on the red pine-white pine PNV and may be confused, particularly in Class C. Yellow birch may also be codominant in Wisconsin.

Scale Description

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

Landscape must be adequate in size to contain natural variation in vegetation and disturbance regime. Replacement fires at 400-500 years may be in the thousands of acres. Surface and mixed fires could be less than 10 acres.

Issues/Problems

Model Evolution and Comments

Need review of scale and adjacency concerns. Edits from FRCC description document and model are insignificant. Corrected some minor errors in model with Jim Merzenich. This model has three early-successional classes and Class A can succeed to either Class B or C. Additional modelers: Kim Brosofske, Sari Saunders, Greg Nowacki, Bill Patterson, Andi Koonce.

*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

Stands primarily consist of early-seral aspen, birch, and other hardwood species. Surface fires in aspen-birch are replacement and set this class back to age 0. These stands vigorously resprout to aspen.

Dominant Species* and Canopy Position

BEPA Upper
POTR5 Upper

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☑ Tree

Fuel Model 9

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	100 %
Height	Shrub Short 0.5-0.9m	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:

Class B 15 %

Early2 Closed

Description

Stands consist primarily of mixed white oak, red oak, and red maple. White pine will develop in the understory of these stands and eventually overtop them. Fires in this class are 50% replacement and 50% mixed. Replacement fires result in an early-seral aspen-birch stand (Class A: 50%), or the oak may resprout and result in a young oak stand (Class B: 50%). Stands that escape replacement fire develop a white pine understory. These stands succeed to mature white pine after 200 years.

Dominant Species* and Canopy Position

QURU Upper
ACRU Upper
QUAL Upper

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☑ Tree

Fuel Model 9

Structure Data (for upper layer lifeform)

	Min	Max
Cover	50 %	100 %
Height	Shrub Short 0.5-0.9m	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:

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Class C 25 %

Early3 Closed

Description

Stands consist of red pine and young white pine, generally < 100 years of age which succeed to older white pine stands. These stands may or may not contain red pine. In the absence of fire, red pine stands develop a white pine understory and succeed to mature white pine stands. An even mix of replacement and mixed fires is assumed. Replacement fires either revert the stand to early-seral (Class A) or back to a young pine stand. The result of a replacement fire is largely dependent upon the age of the stand burned and the ability of red and white pine to reseed the burned area. Mixed-severity fires may also occur, setting the stand back 25 years.

Dominant Species* and Canopy Position

PIST	Upper
PIRE	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	50 %	100 %
Height	Shrub Short 0.5-0.9m	Tree Tall 25-49m
Tree Size Class	Medium 9-21"DBH	

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 9

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

Class D 55 %

Late1 Closed

Description

Stands consist of mature and old growth white pine. Over time, and in fire's absence, associated large hemlock may develop.

Dominant Species* and Canopy Position

PIST	Upper
TSCA	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	50 %	100 %
Height	Tree Medium 10-24m	Tree Tall 25-49m
Tree Size Class	Very Large >33"DBH	

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 9

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

Class E 0 %

Late1 All Structu

Description

Dominant Species* and Canopy Position

Structure Data (for upper layer lifeform)

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

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☐ Tree

Fuel Model no data

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

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Disturbances

Disturbances Modeled

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

Historical Fire Size (acres)

Avg:
Min: 1
Max: 2000

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	370			0.00270	54
Mixed	1666			0.00060	12
Surface	588			0.00170	34
All Fires	200			0.00500	

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