Fire Regime Condition Class (FRCC) Interagency Handbook
Reference Conditions

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PNVG Code: NHFI

Potential Natural Vegetation Group: Northern Hardwood-Fir

Geographic Area: Kuchler's Northern hardwood - fir community occurs throughout the Upper Peninsula of Michigan and at the northern margin of Wisconsin. A variant of this community extends south as the dominant forest type within the northern third of Wisconsin.

Description: The northern hardwood, hardwood - fir, hardwood – hemlock, maple – basswood, and maple - spruce PNVG's are dominantly late successional communities composed of shade-tolerant, long-lived mesophilic species. They occur principally on moraines composed of well to moderately well drained heterogeneous soils with inherently high moisture and nutrient availability.

These wind-driven ecosystems historically changed slowly over centuries due to fine-scale blow-downs, relatively rare broad-scale catastrophic storms, and even rarer fire events (Cleland et al. 2004, Woods 2000, Canham and Loucks 1984, Frelich and Lorimer 1991, Grimm 1984, Runkle 1982). Blowdowns affected conifers than more than hardwoods, and older trees more than younger trees (Foster and Boose1992, Webb 1984). These "asbestos" forests seldom burned (Grimm 1984, Stearns 1949), and exhibited a repeating and shifting steady state of fine-scaled mosaics of species whose overall proportions remained essentially constant (Borman and Likens 1979).

Structurally, these unevenaged forests were characterized by large volumes of coarse woody debris lying beneath multi-storied canopies of different aged cohorts, with supercanopies composed of trees centuries old (Tyrell and Crow 1994). The dominant tree species are among the most moisture and nutrient demanding species in the eastern U.S.A., and their distribution is confined to glacial landforms underlain by fertile soils (Woods 2000, Whitney 1986). Composition of the groundflora and understory varies along a moisture-nutrient gradient, and typically consists of high densities of shade-tolerant tree species, and mesophilic herbaceous species ranging from blue cohosh, yellow violet, sweet cicely, various ferns, and ginseng to a ground-flora depauperate species group.

In the mid-1800's, there were 5.8 million acres of northern hardwood ecosystems in the Upper Peninsula of Michigan (Cleland 2004a, ongoing R-9/SRS/MTU study). Sugar maple, hemlock, yellow birch, balsam fir, cedar in swales, spruce, and beech were the dominant late-successional species recorded along section lines by GLO surveyors (figure 1). Early successional aspen and white birch comprised only 2.0% of the GLO line trees. Large openings likely occurred on less than 1% of the landscape.

In the mid-1800's, there were 8.4 million acres of northern hardwood ecosystems within the 17.8 million acres of forestlands in northern Wisconsin (ongoing R-9/SRS/MTU study). Yellow birch, sugar maple, hemlock, white pine, beech, elm, and basswood were the dominant late-successional species (figure 2). Early successional aspen, white birch, and oak species comprised 4.8% of the GLO corner trees. Large openings likely occurred on less than 1% of the landscape.

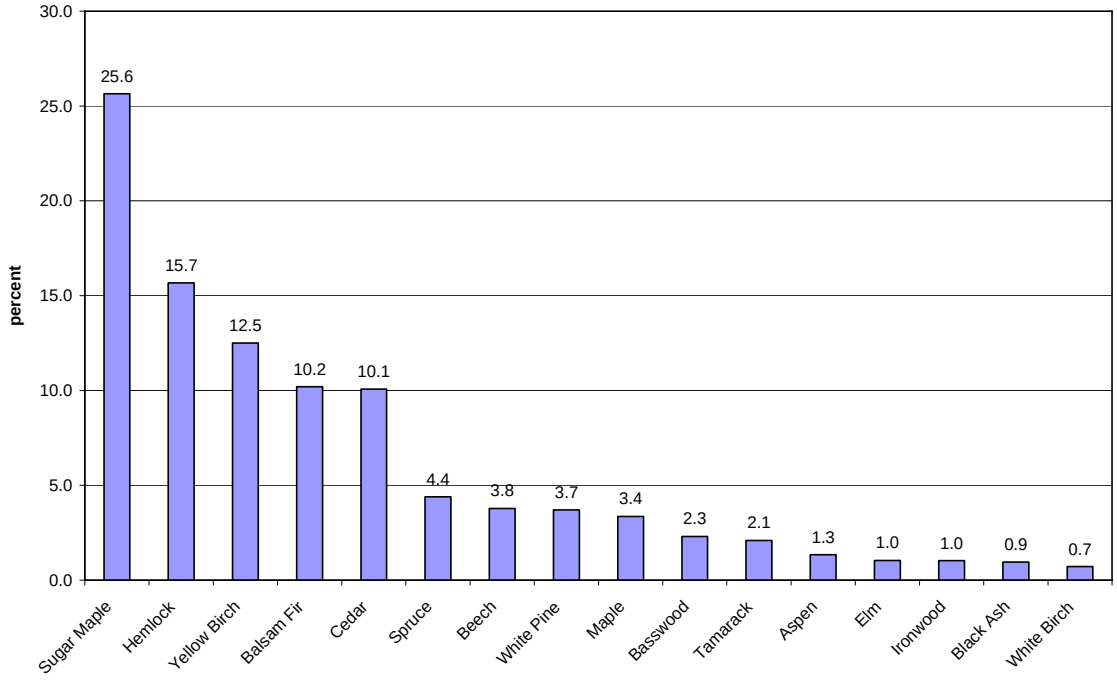

Figure 1. Composition of the Northern hardwood - Fir PNVG of Michigan's Upper Peninsula based on GLO line note counts.

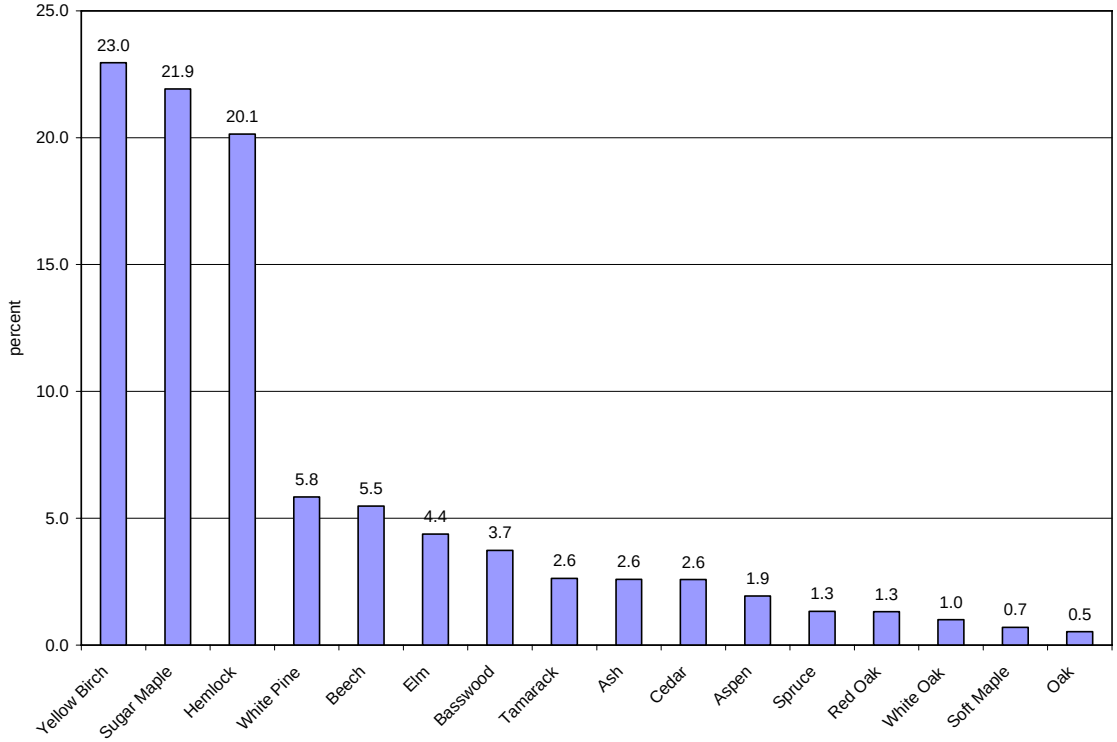

Figure 2. Composition of the N. hardwood – hemlock PNVG of N. Wisconsin based on GLO corner.

Fire Regime Description:

Composed of fire-sensitive species, fires only occurred within this forest type following catastrophic wind events or during periods of extreme drought. This fire-resistance is due to high rates of organic matter decomposition and low rates of fuel accumulation, closed and multi-storied canopy effects on microclimate, succulent ground-flora and herbaceous layers, high soil moisture storage capacity, and the dispersed canopies of volatile coniferous foliage within a fire-resistant deciduous hardwood matrix.

The principal cause of fuel formation leading to fire in northern hardwood ecosystems is broad-scale, storm-driven windthrow of catastrophic proportions (Canham and Loucks 1984, Dunn et al. 1983, Runkle 1982. Canham and Loucks (1984) estimated the return interval for catastrophic storms to be about 1,200 years in northern Wisconsin. Their comparisons of the presettlement disturbance regime with contemporary climatological records suggest that catastrophic thunderstorms were the principal mechanism for large-scale windthrow, followed by tornadoes that accounted for one-third of blowdown recorded by surveyors. Not only were these storms nearly stand-replacing events in themselves, but after the slash resulting from them cured, the probability of fire increased exponentially. However fires within undisturbed, intact systems that did start or that moved into these stands from adjacent areas tended to smolder in the duff layer and move very slowly, eventually going out and causing little damage to the overstory (Frelich and Lorimer 1991, Stearns 1949).

Within the 5.8 million acres of northern hardwood ecosystems in the upper Peninsula of Michigan, there were 146,028 acres of blown down forests and 54,903 acres of burned areas based on analyses of General Land Office survey notes recorded between 1840 and 1855 (Cleland et al. 2004a, Maclean and Cleland 2003). Assuming a 15 year recognition window, the historical fire rotation was 1,568 years. If surveyors recognized a blow-down 20 years after the event, catastrophic wind rotations would have been 786 years, with a 30 year recognition window estimate of 1,179 years. Because of the fire-resistance of undisturbed mesic deciduous forests, these estimates suggest that approximately 40% of the blown-down areas within this forest type in the Upper Peninsula subsequently burned.

Within the 8.4 million acres of northern hardwood ecosystems in northern Wisconsin, there were 396,485 acres of blown down forests and 61,800 acres of burned areas based on analyses of General Land Office survey notes recorded between 1840 and 1855 (Cleland et al. 2004a). Assuming a 15 year recognition window, the historical fire rotation was 2,039 years. If surveyors recognized a blow-down 20 years after the event, catastrophic wind rotations would have been 425 years, with a 30 year recognition window estimate of 637 years. Because of the fire-resistance of undisturbed mesic deciduous forests, these estimates suggest that approximately 16% of the blown-down areas in this forest type in Wisconsin subsequently burned. Wisconsin's northern hardwood communities experienced more wind and less fire disturbance than those in Michigan's Upper Peninsula. Although wind rotations differed across two-state area, fire rotations for northern hardwoods were uniformly very long, ranging from 1,400 to more than 2,000 years.

Fire Regime Group V. Severe wind events were assumed to reset mature stands on an approximate 1100 year rotation in Michigan's Upper Peninsula in the following VDDT models. Most replacement fire occurs in slash created by these wind events. Forty percent of the blowdown areas burn and revert to an openland or an early seral aspen/birch stage that lasts 60 years. Replacement fires without associated wind events are very rare.

Vegetation Type and Structure

Class*	Percent of Landscape	Description
A: early seral all	5	Early seral stands characterized by aspen and paper birch; 0 to 60 years of age; class following a replacement fire
B: mid-seral open	10	Young stand 0 to 75 years of age dominated by mid-tolerant species. Class A succeeds to this class; Windthrow of mature stands generally result in this class.
C: mid- seral closed	5	Mid age mixed hardwood-conifer stands 76 to 150 years of age; Susceptible to windthrow.
D: late- seral closed	80	Old stands greater than 150 years
Total	100	

*Formal codes for classes A-E are: AE1A, BM1O, CM1C, and DL1C respectively.

Fire Frequency and Severity

Fire Severity	Frequency (yrs)	Probability	Percent, All Fires	Description
Replacement Fire	1400	.000714	100	
Non-Replacement Fire	none	0	0	
All Fire Frequency*	1400	.000714	100	
**Stand replacing windthrow	1100	.0009		

*All Fire Probability = sum of replacement fire and non-replacement fire probabilities. All Fire Frequency = inverse of all fire probability (previous calculation).

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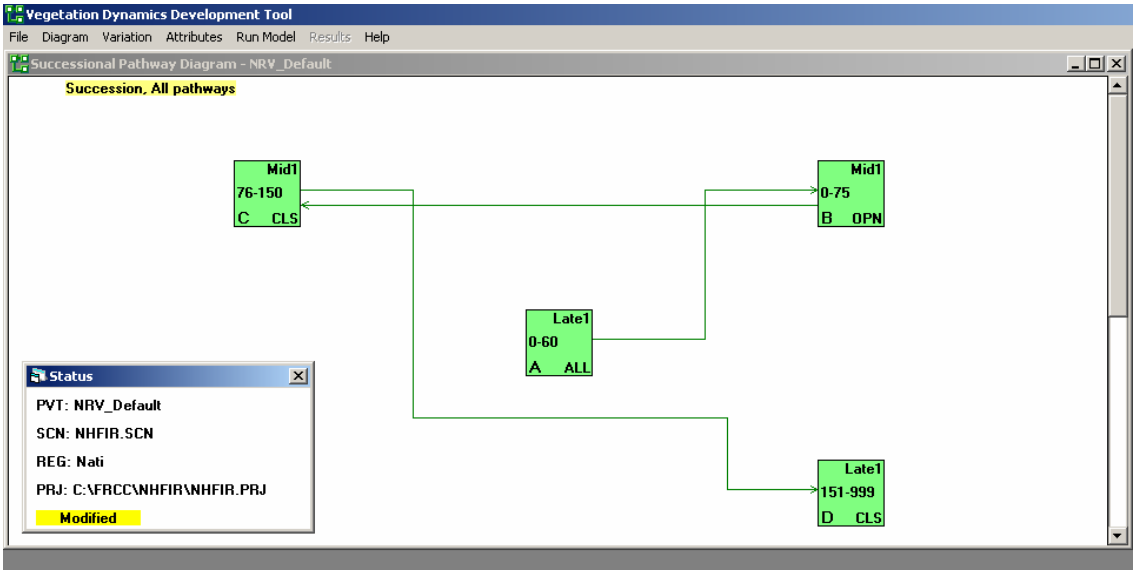
PERSONAL COMMUNICATION (if applicable):

VDDT File Documentation: Model is located in C:\FRCC\NHF1. Text files must be located in C:\FRCC for project file to work. Diagram shows succession only

Model structure



Disturbance probabilities by class: VDDT model NHF1

Class	To	Agent	Prob	TSD	Freq/ FRI	Rel Age
A	A	Replacement fire	.0025	0	400	-60
B	A	Replacement fire	.004	0	250	0
C	A	Replacement fire	.0002	0	5000	0
C	B	Wind/weather/stress	.001	0	1000	0
D	A	Replacement fire	.0002	0	5000	0
D	B	Wind/weather/stress	.001	0	1000	0

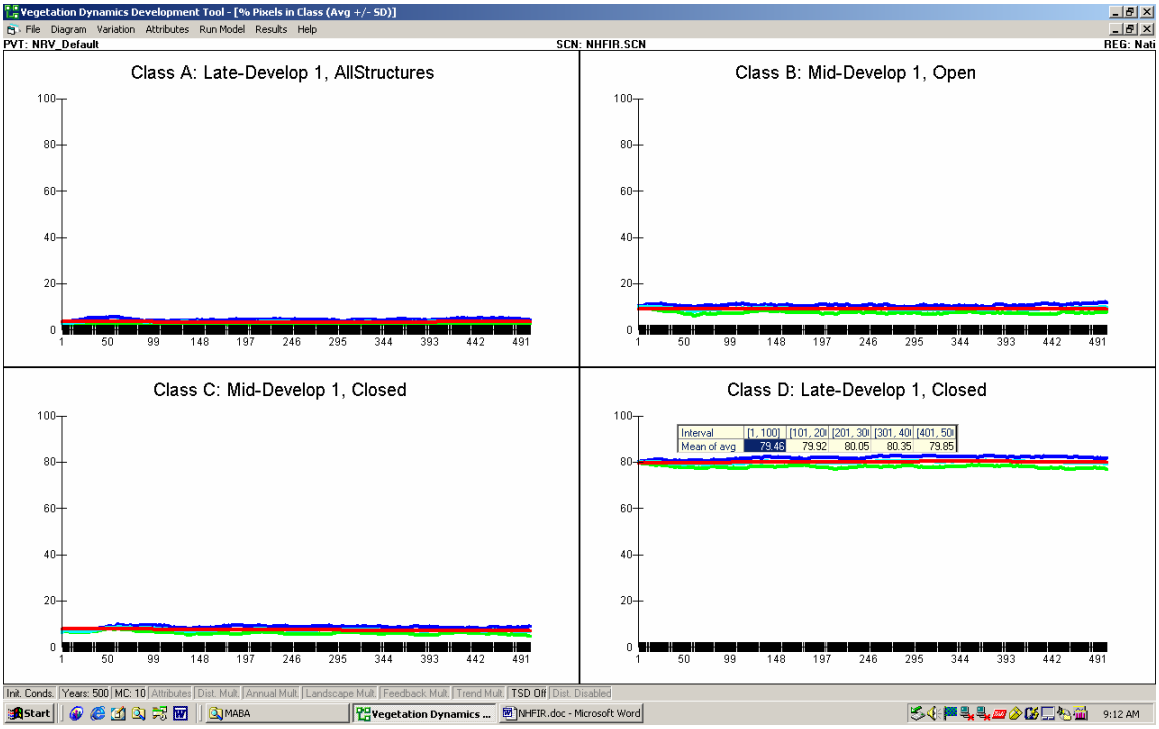
Class A – early seral aspen, birch < 60 yrs: A succeeds to young mid seral stands (class B).

Class B - Mid-succession young forest (0-75 yrs): Succeeds to class C. Windthrow in older classes returns vegetation to this class. Replacement fires (mostly in slash) result in early seral (assume that 40 % of windthrown areas burn).

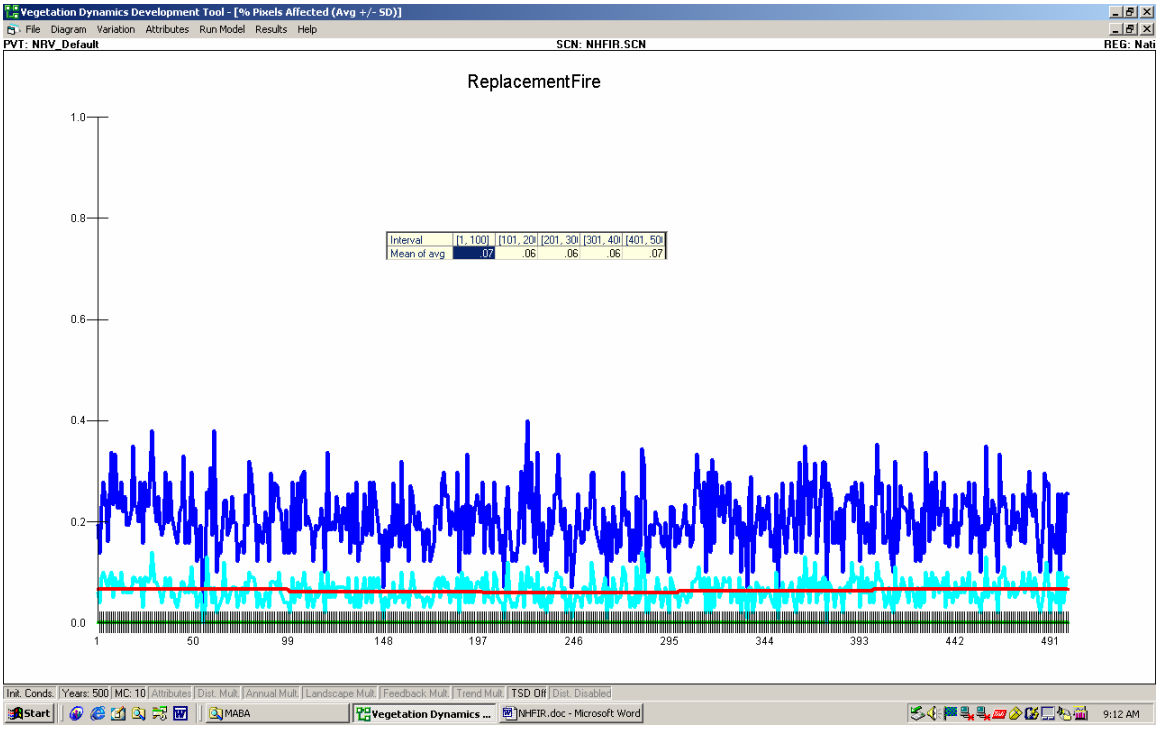
Class C – Mixed hardwoods (76-150 yrs): Succeeds to class D. Susceptible to catastrophic windthrow on 1000 year rotation but replacement fire is very rare.

Class D – Old late seral forests (> 150 yrs): End point of succession. Same disturbances as class C.

Percent acres by class



Percent of area affected by replacement fires per year (all fires are replacement). This corresponds to an average replacement rotation of 1400 years (0.07%/yr). Most fires occur in windthrown stands.



Per cent of area affected by stand replacing windthrow per year.