

Fire Regime Condition Class (FRCC) Interagency Handbook Reference Conditions

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PNVG Code: JPRP

Potential Natural Vegetation Group: Great Lakes pine forests: Jack pine /Red pine with relatively infrequent (low) fire frequencies.

Geographic Area: Michigan, Wisconsin, and Minnesota

Description: Potential natural vegetation group common to very dry outwash plains or dunal areas with coarse-textured sandy soils. Jack pine, red pine and barrens predominate. Aspen, pin oak, white oak, and white pine may be present. In Wisconsin, Minnesota, and the upper peninsula of Michigan these areas are interspersed within a matrix of relatively fire resistant wetlands, resulting in lower fire frequencies. Other areas historically had lower fire frequencies because they are directly downwind from large water bodies such as Lake Michigan.

Fire Regime Description: Fire regime groups IV and III, with fires occurring every 50 to 100 years and high stand replacement severity. Severe wind events affect mature stands on an approximate 220-year interval. This results in an overall wind rotation of 400 years.

Vegetation Type and Structure

Class*	Percent of Landscape	Description
A: early-seral all (barrens)	10	Barrens dominated by carex, grasses, and herbaceous plants. Trees comprise less than 10% canopy coverage.
B: mid-seral open (young jack pine)	15	Young jack pine stands less than 15 years of age.
C: mid-seral closed (mature jack pine)	40	Jack pine dominated stands 15 to 100 years. In absence of fire most jack pine die by age 100 and this class reverts to barrens (80%) or red pine (20%)
D: late-seral open (young red pine)	15	Open red pine/jack pine stands less than 50 years of age
E: late-seral closed (mature red pine)	20	Open and closed red pine stands greater than 50 years of age
Total	100	

*Formal codes for classes A-E are: AE1A, BM1O, CM1C, DL1O, and EL1C, respectively.

All classes burn at an average rate of 2% per year with the caveat that stands do not reburn for 10 years. This is equivalent to a 60-year fire return interval. In jack pine stands fire severity increases with age with nearly 100% mortality in mature stands. Cones are serotinous and areas quickly regenerate to jack pine. In contrast, red pine stands are more susceptible to replacement fires before age 50. Non-lethal surface fires predominate in mature red pine stands. Both species are short lived with jack pine living to about age 100 and red pine to age 150. The fire frequency and severity varies by succession class as follows:

A: Barrens: All fires are replacement Barrens persist for 25 years before they regenerate to jack pine (75%) or red pine (25%).

B: Jack pine < 15 years of age. Fires are 60% replacement and 40% mixed. Since jack pine do not produce viable seed until age 15, replacement fires result in a barren.

C: Jack pine 15-100 years of age. Fires are 80% replacement and 20% mixed. Fire severity increases with age. Replacement fires result in young jack pine. Stands that escape replacement fire die after age 100 and revert to barrens (75%) and red pine (25%).

D: Open red pine/jack pine stands < 50 years of age. Fires are 75% replacement and 25% mixed. Since red pine doesn't produce viable sufficient seed until age 50, replacement burns result in a barren. Fires are more severe on these sites than on sites with higher fire frequencies due to the buildup of fuels.

E. Open red pine stands > 50 years of age. Larger red pine are more resilient to wildfire. Assumed fire severities are 80% non-lethal surface fires and 20% replacement fires. Red pine stands die after age 150 and revert to young red pine stands. Surface fires maintain stands at a lower stocking level allowing for less moisture competition for individual trees. Repeated surface fires prolong the life of the large trees.

Fire Severity	Fire Frequency (yrs)	Probability	Percent, All Fires	Description
Replacement Fire	100	.01	60	All fires in barrens and 80% of fires in mature jack pine are replacement
Non-Replacement Fire	150	.007	40	Primarily surface fire in older red pine. Mixed fire in young classes.
All Fire Frequency*	60	.017	100	

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

References

Cleland, D.T., T.R. Crow, S.C. Saunders, D.I. Dickmann, A.L. Maclean, J.K. Jordan, R.L. Watson, A.M. Sloan, and K.D. Brosofske. 2004. Characterizing historical and modern fire regimes in Michigan (USA): a landscape ecosystem approach. *Landscape Ecology* 19:311-325.

de Groot, W.J., P.M. Bothwell, S.W. Taylor, B.M. Wotton, B.J. Stocks, and M.E. Alexander. 2004. Jack pine regeneration and crown fires. *Can. J. For. Res.* 34: 1634–1641.

Greene, D.F., J.C. Zasada, L. Sirois, D. Kneeshaw, H. Morin, I. Charron, and M.J. Simard. 1999. A review of the regeneration dynamics of North American boreal forest tree species. *Can. J. For. Res.* 29: 824–839.

Heinselman, M.L. 1981. Fire and succession in the conifer forests of North America. In *Forest succession: concepts and applications*. Edited by D.C. West, H.H. Shugart, and D.B. Botkin. Springer-Verlag, New York. pp. 374–406.

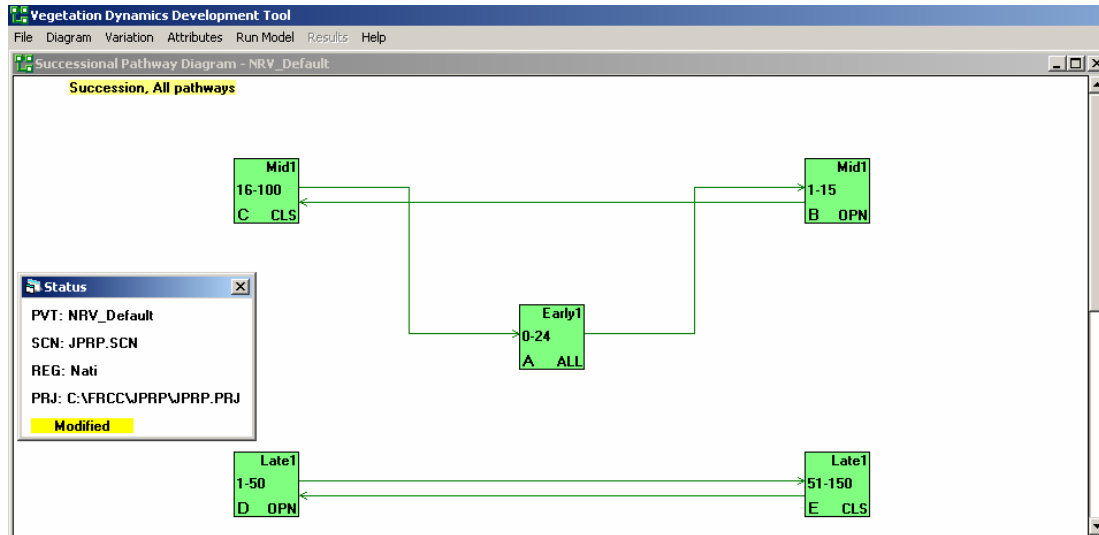
McCune, B. 1988. Ecological Diversity in North American Pines. *Amer. J. Bot.* 75(3): 353-368.

Whitney, G.G. 1986. Relation of Michigan's presettlement pine forests to substrate and disturbance history. *Ecology*. 67(6):1548-1559.

Zasada, J.C., Sharik, T.L., and Nygren, M. 1992. The reproductive process in boreal forest trees. *In A system analysis of the global boreal forest*. Edited by H.H. Shugart, R. Leemans, and G. Bonan. Cambridge University Press, Cambridge, England. pp. 85–125.

Zhang, Q., Pregitzer, K.S. and Reed, D.D. 1999. Catastrophic disturbance in the presettlement forests of the Upper Peninsula of Michigan. *Canadian Journal of Forest Research* 29: 106-114.

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



Disturbances by class: Model JPRP

Class	To	Agent	Prob	TSD	Freq/ FRI	Rel Age
A	A	Replacement fire	.02	10	60	-25
A	D	AltSuccession**	.25	0	NA	0
B	A	Replacement fire	.012	10	93	0
B	B	Mixed fire	.008	10	135	0
C	A	Replacement fire	.016	10	72	0
C	C	Mixed fire	.004	10	260	0
C	B	Wind/weather/stress	.0046	0	220	0
C	D	AltSuccession**	.25	0	NA	0
D	A	Replacement fire	.01	10	110	0
D	D	Mixed fire	.01	10	110	0
E	A	Replacement fire	.002	10	510	0
E	D	Surface fire	.018	10	66	-10
E	B	Wind/weather/stress	.0046	0	220	0

** Alternative succession is only applied at the last age of the class. On the VDDT disturbance (Pathways from) table select **Display**, then **Show Ages**, to apply.

Class A: All fires are replacement and occur after 10 years have elapsed since the previous fire (TSD=10). Class A succeeds to a young jack pine stand (Class B). AltSuccession is used to succeed 25% of class to red pine (class D).

Class B - young jack pine < 15 years: Succeeds to C. Fires are 60% replacement and 40% Mixed. Replacement fires go to barrens (class A) due to lack of jack pine seed.

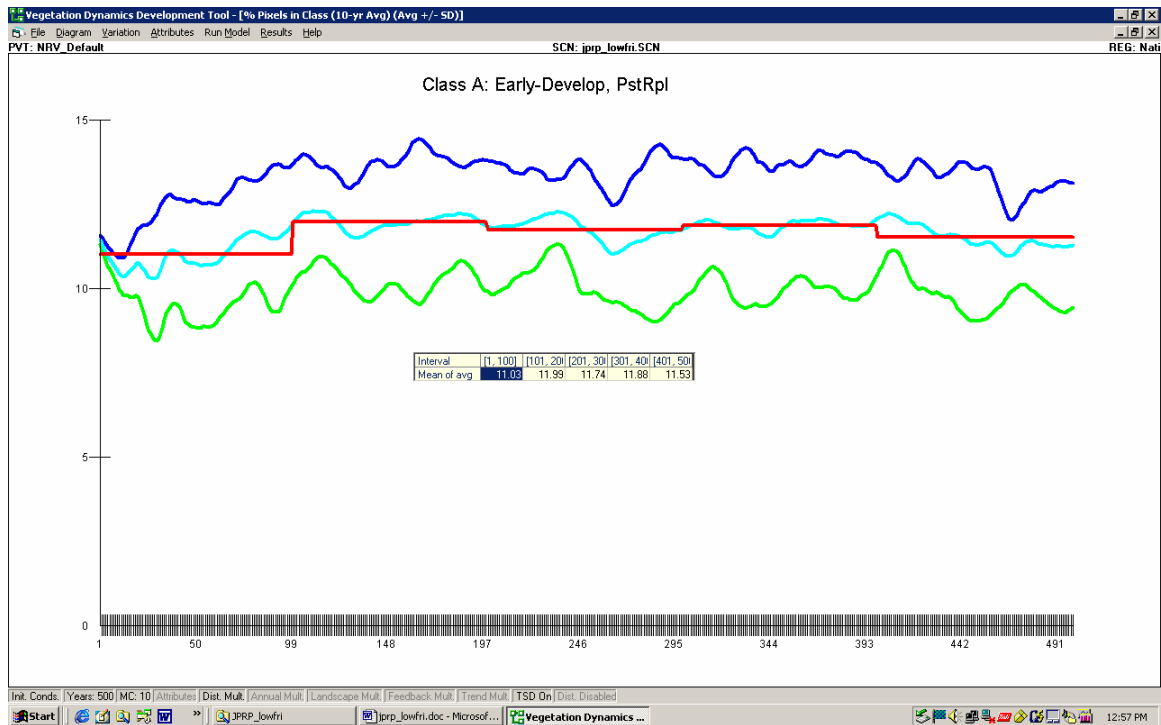
Class C – mature jack pine: Fires are 80% replacement and 20% Mixed. Stands die if they live to 100 years and go to barrens (75%) or red pine (25%). Stands also blow down at about a 220 year interval.

Class D – young red pine < 50 years: Fires are 50% replacement and 50% mixed. Replacement fires go barrens (class A).

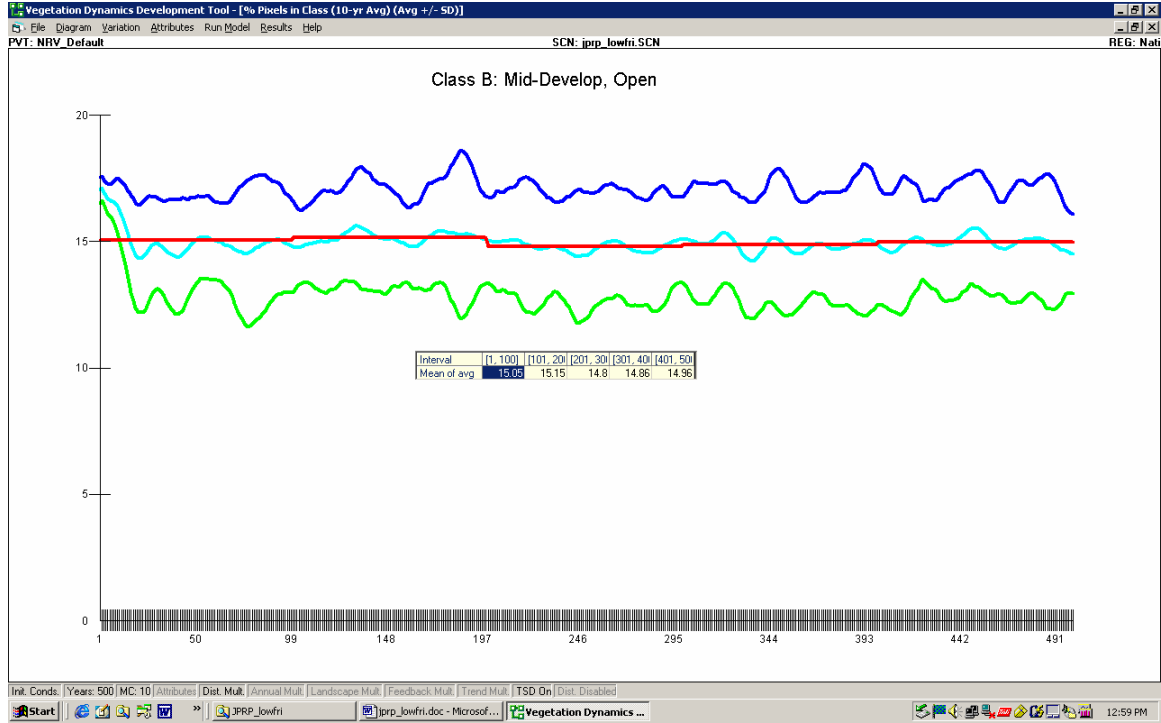
Class E – older red pine >50 years: Fires are 20% replacement and 80% surface. Replacement fires go young red pine (class D). Stands die after age 150 and revert to young red pine. Surface fires reduce stocking and moisture competition of remaining trees increasing the time stands can remain in this class.

Results: Per cent of area by class for 500 years. Ten-year-average + or - 2 SD's.

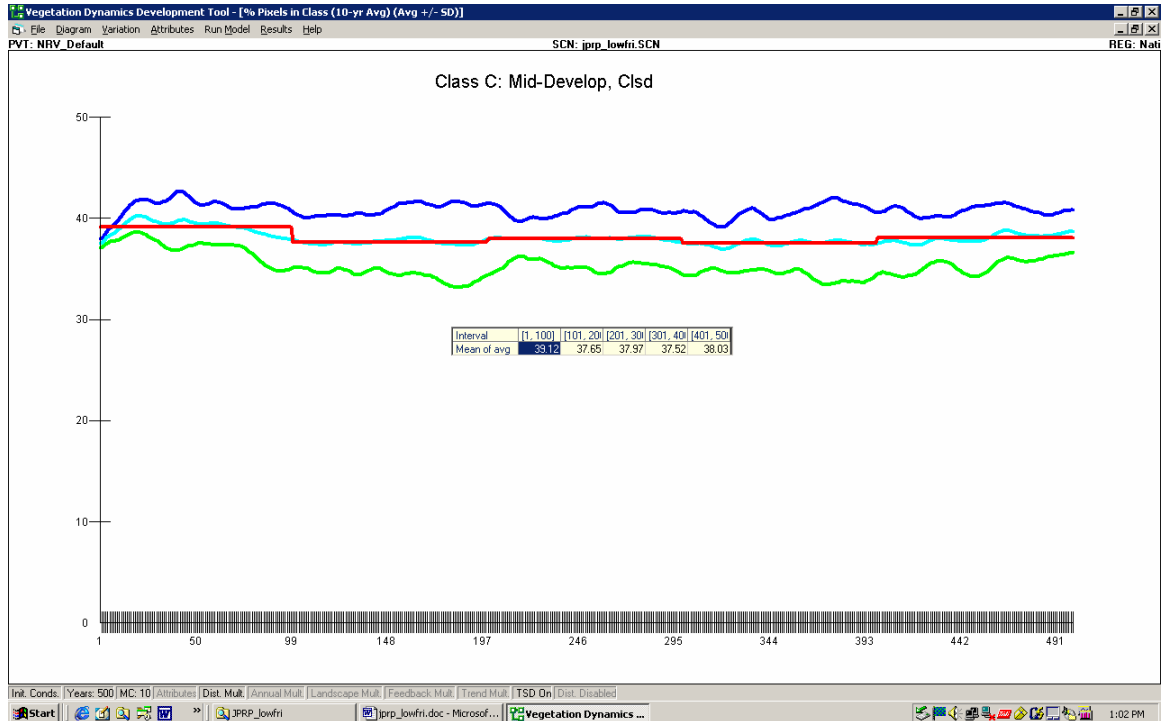
A: Barrens:



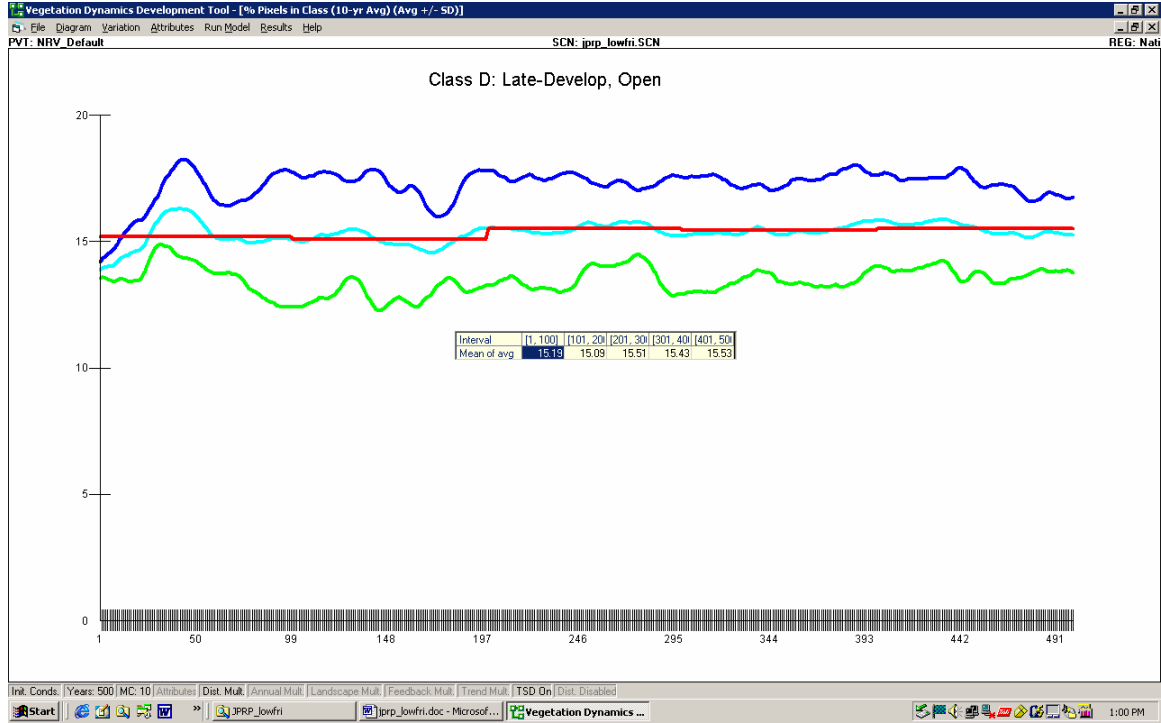
B: Young jack pine stands < 15 years of age



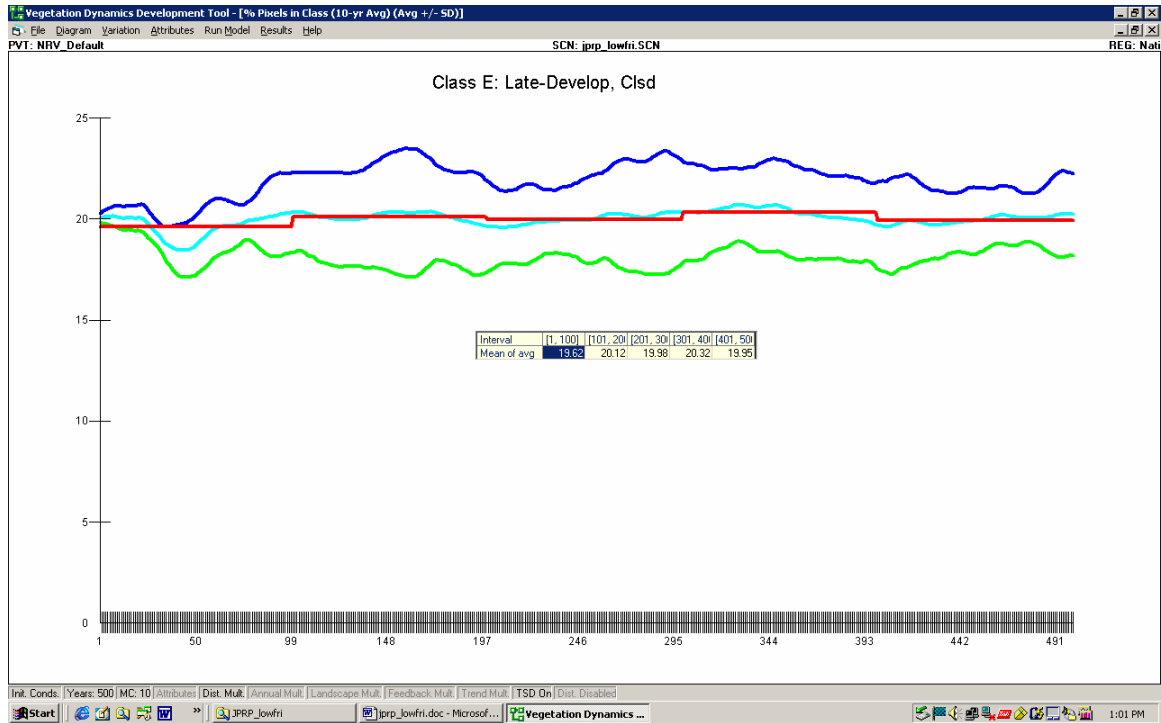
C: Jack pine mature 15-100 years



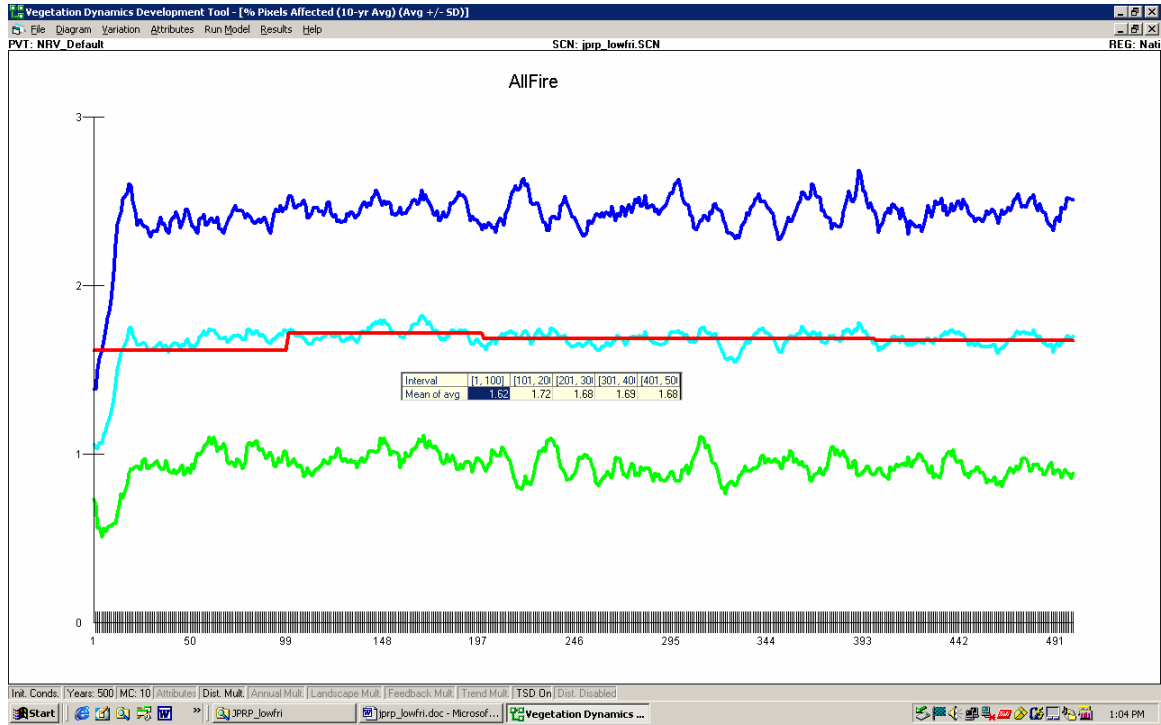
D: Young red pine stands < 50 years of age



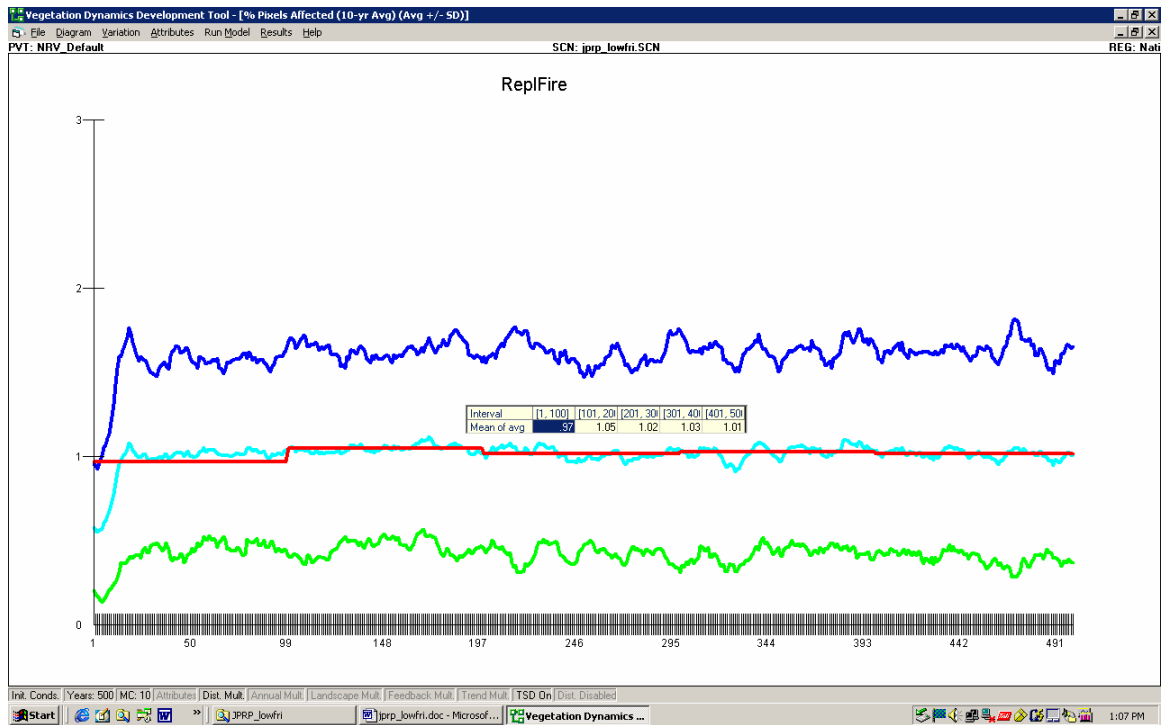
E: Older red pine stands > 50 years of age



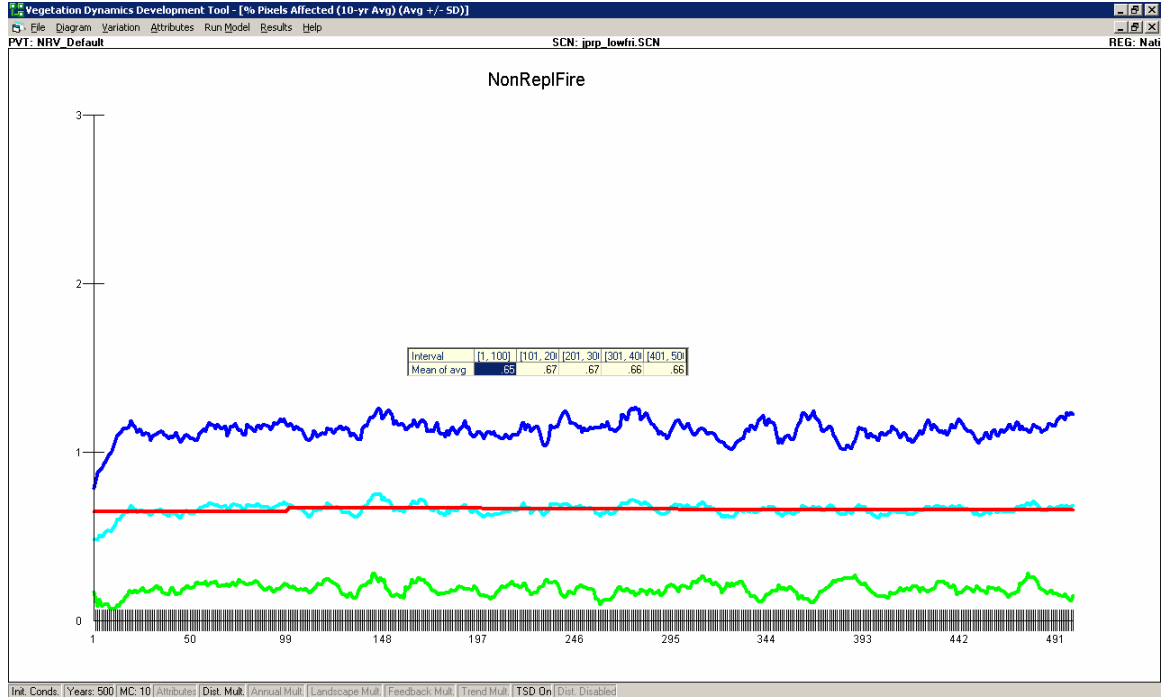
All fire frequency: 1.7% of the area burns/year for a FRI of 60 years.



Replacement fire frequency: 1.0% of the area burns/year for a FRI of 100 years.



Non-replacement fire frequency: 0.66% of the area burns/year for a FRI of 150 years.



Catastrophic Windthrow frequency: Approximately 0.26% of the area is affected by catastrophic windthrow per year for a windthrow interval of about 385 years.

