

Fire Regime Condition Class (FRCC) Interagency Handbook Reference Conditions

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PNVG Code: JPOP

Potential Natural Vegetation Group: Great Lakes pine forests: Jack pine / Open lands with frequent (high) fire return interval.

Geographic Area: Portions of Minnesota.

Description: Potential natural vegetation group common to very dry, flat outwash plains underlain with coarse-textured sandy soils. Jack pine and barrens predominate.

Description: The jack pine - openland community is endemic to very dry, nutrient impoverished landscape ecosystems. These ecosystems occur in landforms deposited by high-energy glacial melt waters, principally outwash plains and glacial lakebeds, underlain by well sorted coarse-textured sandy soils. They also occur in bedrock controlled landforms with shallow soils of limited moisture storage capacity.

Jack pine is a fast growing, short-lived fire-dependent species that grows farther north than any other American pine and is the most widely distributed pine species in Canada. It is generally regarded as a pioneer species or "fire-disclimax", and is capable of self-replacement. In the absence of fire or other catastrophes, jack pine is succeeded by more tolerant or longer-lived species, but on the poorest, driest sites it may persist as an edaphic climax (Brubaker 1975). Jack pine is one of the most shade-intolerant trees in its native range, requiring full light for growth and survival. It usually grows in even-aged pure stands, although mixed stands also occur.

Jack pine's adaptation to catastrophic fire is largely due to its capacity to produce viable seed within a decade or so of establishment, aerial seed protection and storage in serotinous cones, delayed seed release following fire, and prolific germination of released seed. High seedling densities (2,000 to 5,000 per acre) effectively compete with other re-establishing or invading species and self-thin over time. In the southern part of its range, cones are both serotinous and nonserotinous (Zasada et al. 1992).

Following ignition, jack pine promotes crown fires due to high concentrations of volatile foliar substances, dense foliage, and retention of lower branches that form fuel ladders. Thus surface fires are not common within well stocked jack pine communities. Fires recurring in less than 10 to 15 year intervals prevent jack pine from surviving long enough to produce viable seed, maintaining associated barrens and openlands that comprised 40-50% of the landscape.

Jack pine regenerates successfully after high intensity crown fires, although a relatively low temperature of 120°F is required to open jack pine cones, so even low intensity fires are capable of releasing seed. Jack pine trees are susceptible to mortality during or following a fire, and populations of jack pine tend to survive as seeds (McCune 1988).

Jack pine stands become susceptible to mortality through natural senescence, as well as insects and disease, after 60 to 80 years. However, vigorous trees 185 years old have been found in northwestern Minnesota. Dead stands pose a severe crown fire risk throughout the year, until snags blow down and decompose.

Fire Regime Description: Fire regime groups IV and III with fires occurring every 15 to 25 years. Most fires are replacement. Severe wind events affect mature stands on an approximate 200 year interval. Because stands seldom reach the age where they are susceptible to wind, the overall wind rotation is about 700 years.

Fire behavior in jack pine stands is usually of the highest intensity observed in the boreal forest (de Groot et al. 2004). Jack pine is not only highly adapted to frequent crown fire regimes, it usually requires catastrophic fire to regenerate successfully or to compete with longer-lived or more shade tolerant species.

Within Minnesota, low rainfall coupled with high spring and summer temperature result in fires occurring so frequently that jack pine is often unable to produce viable seed and self-replace. Openlands are created as a consequence, and frequent surface fires maintain openlands and barrens for extended periods.

Vegetation Type and Structure

Class*	Percent of Landscape	Description
A: early-seral all (barrens)	45	Barrens dominated by carex, grasses, and herbaceous plants. Trees comprise less than 10% canopy coverage.
B: mid- seral open (young jack pine)	30	Young jack pine stands less than 15 years of age.
C: mid-seral closed (mature jack pine)	25	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%)
Total	100	

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

All classes burn at an average rate of 8% per year with the caveat that stands would not reburn for 10 years. This is equivalent to a 22 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. With this high frequency of wildfire, red pine stands comprise less than 5% of the total area and are not significant.

A: Barrens: All fires are replacement. Barrens persist for 25 years before they regenerate to jack pine.

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 barrens.

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

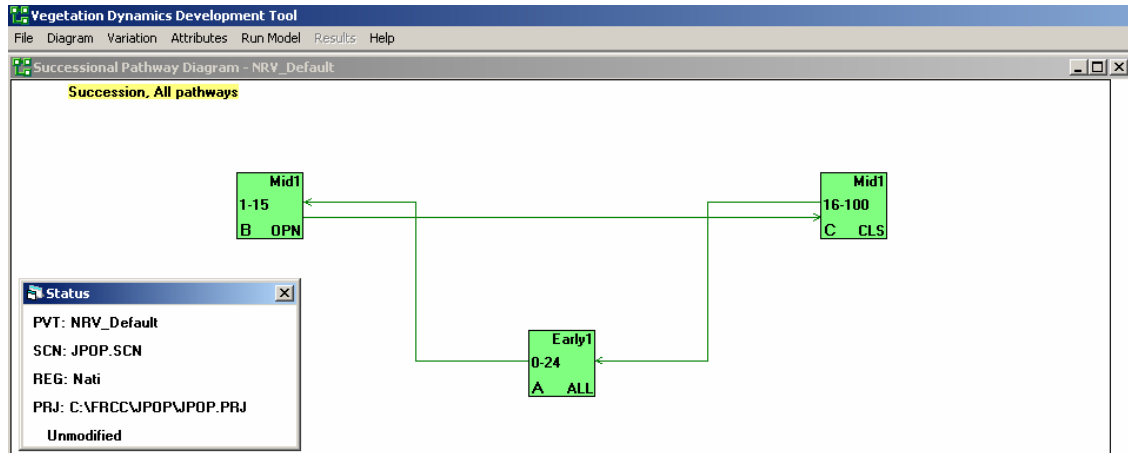
Fire Severity	Fire Frequency (yrs)	Probability	Percent, All Fires	Description
Replacement Fire	26	.038	80	All fires in barrens and 80% of fires in mature jack pine are replacement
Non-Replacement Fire	120	.0082	20	Mixed fire in young jack pine.
All Fire Frequency*	22	.046	100	

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

References

Patterson, William (personal communication)

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



Disturbances by class: Model JP1

Class	To	Agent	Prob	TSD	Freq/ FRI	Rel Age
A	A	Replacement fire	.08	10	22	-25
B	A	Replacement fire	.048	10	31	0
B	B	Mixed fire	.032	10	41	0
C	A	Replacement fire	.064	10	26	0
C	C	Mixed fire	.016	10	72	0
C	B	Wind/weather/stress	.0046	0	220	0

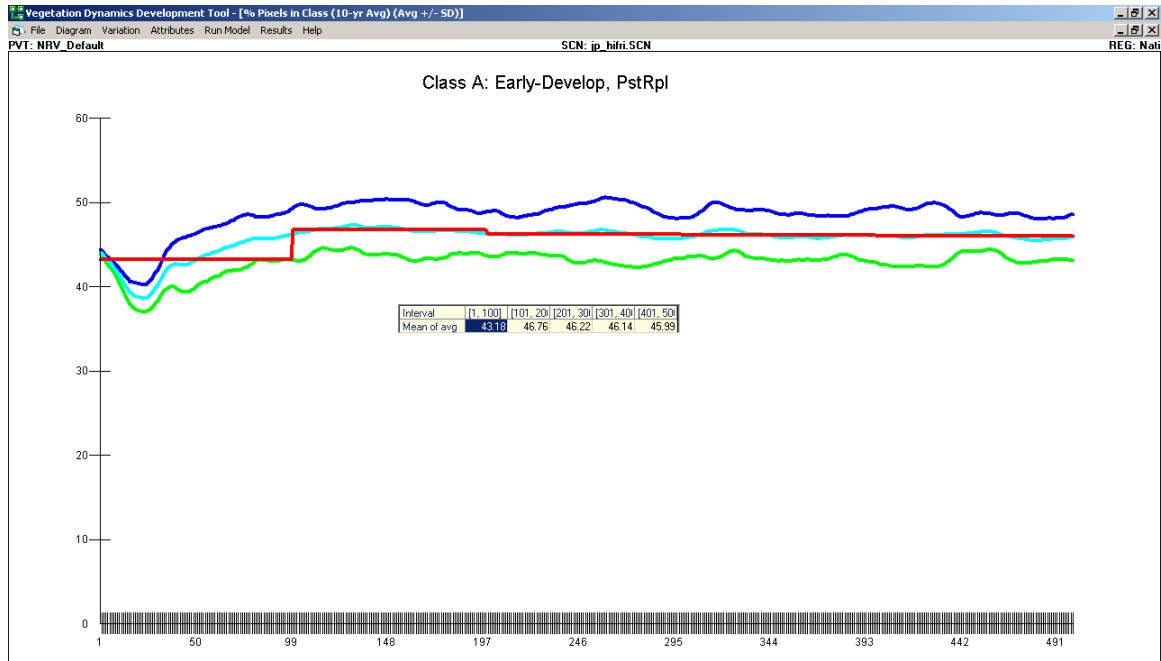
Class A - Barrens: All fires are replacement and occur only after 10 years have elapsed since the previous fire (TSD=10). Class A succeeds to a young jack pine stand (Class B).

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

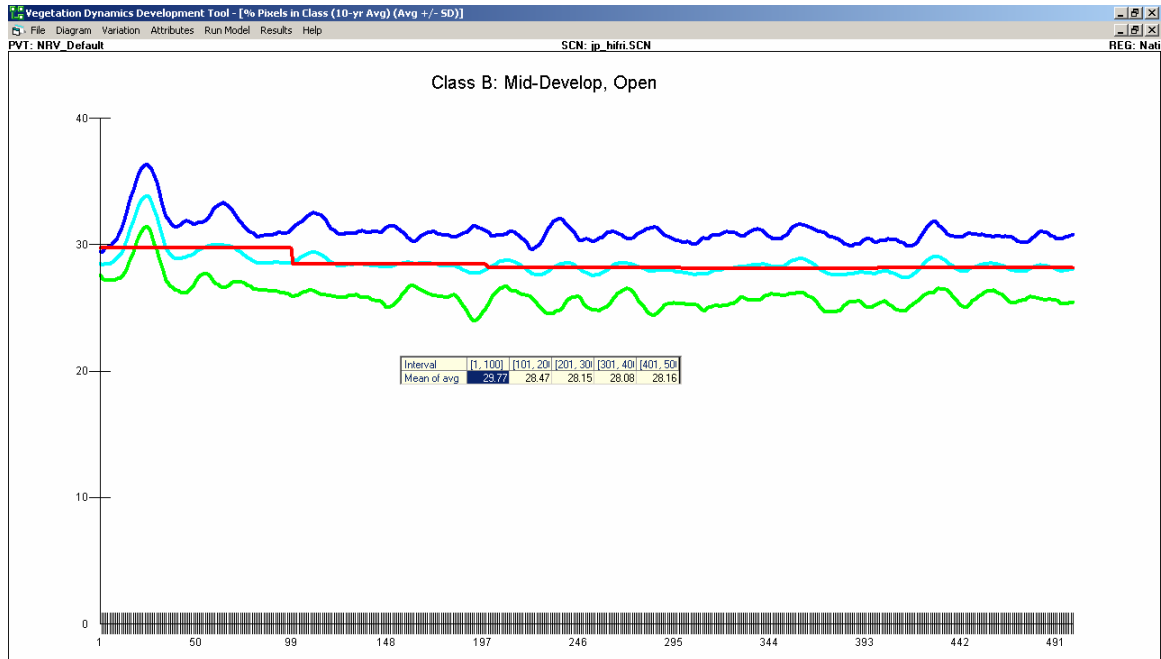
Class C – mature jack pine: Fires are 80% replacement and 20% mixed and occur 10 or more years following previous fire. Stands die if they live to 100 years and go to barrens. Stands blow down at about a 220 year interval.

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

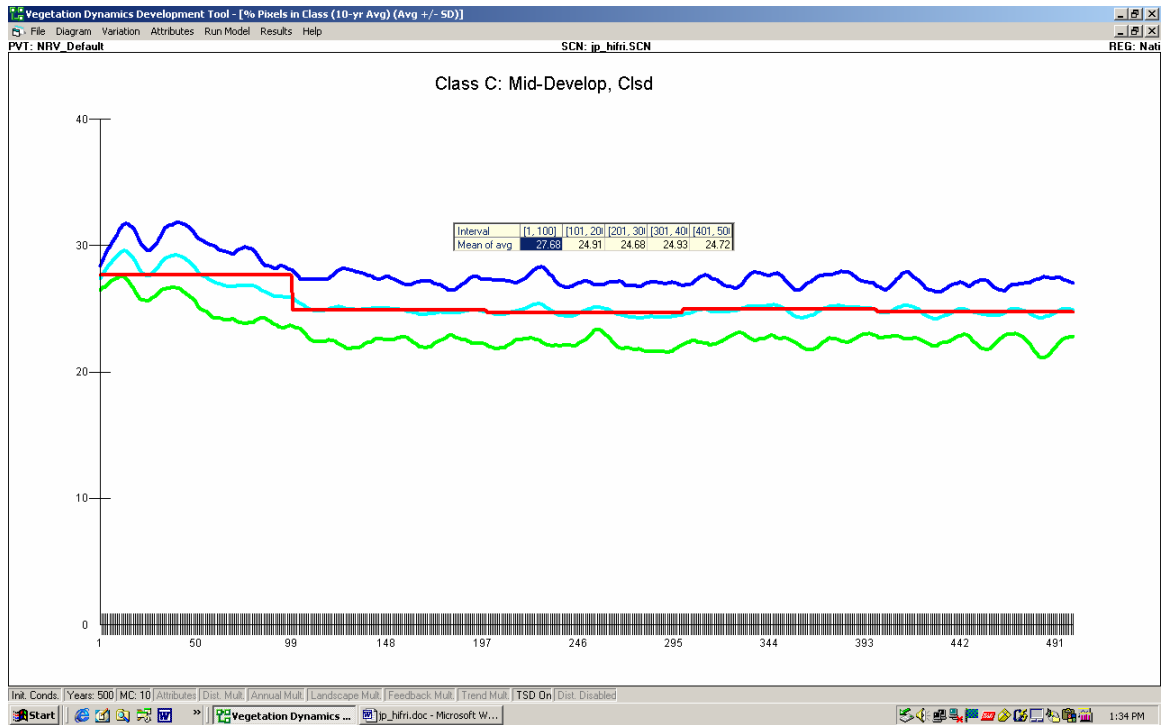
A: Barrens:



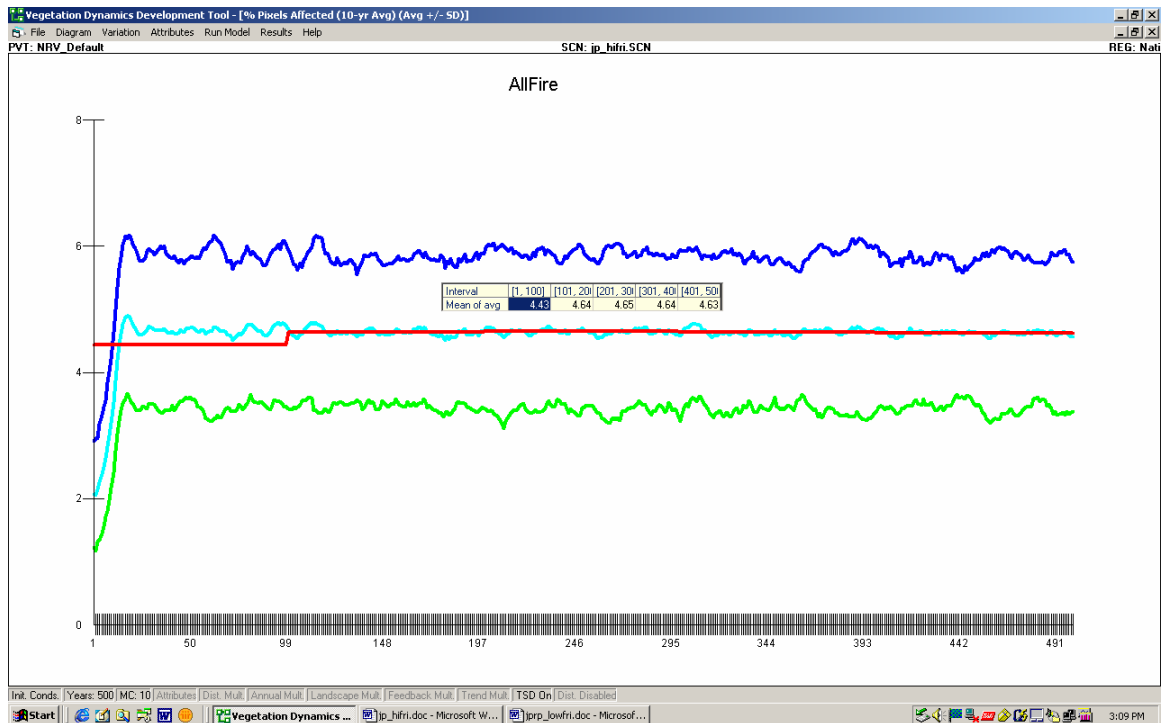
B: Jack pine stands < 15 years of age



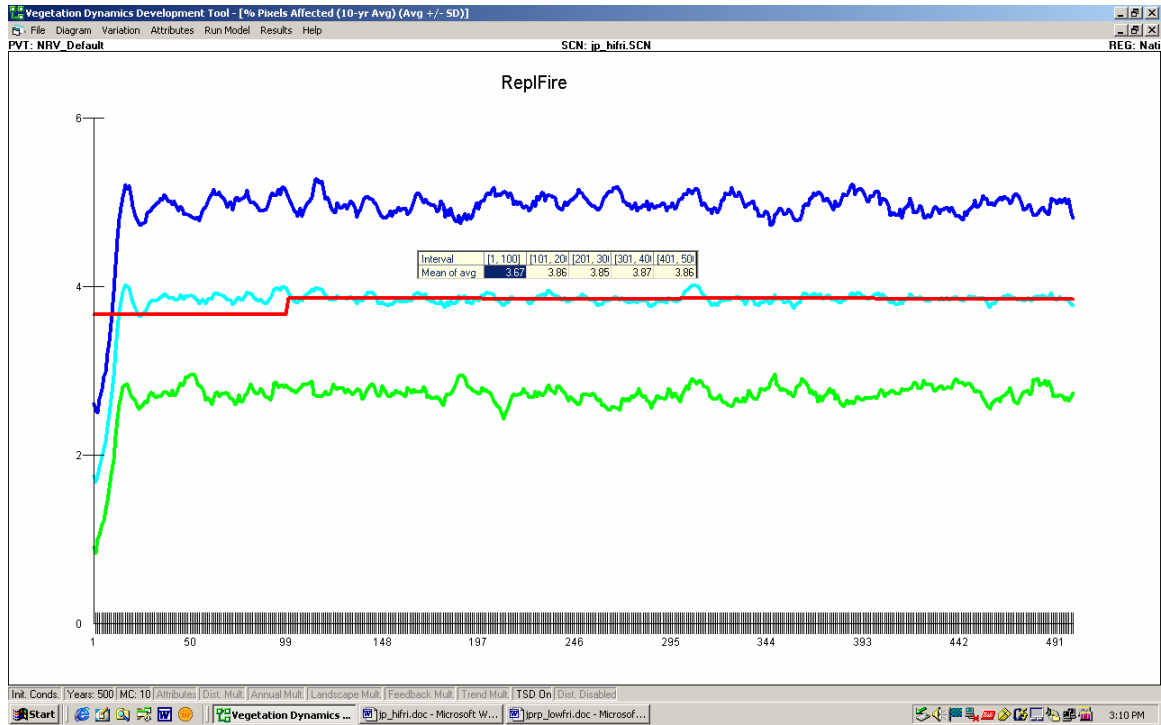
C: Jack pine mature 15-100 years



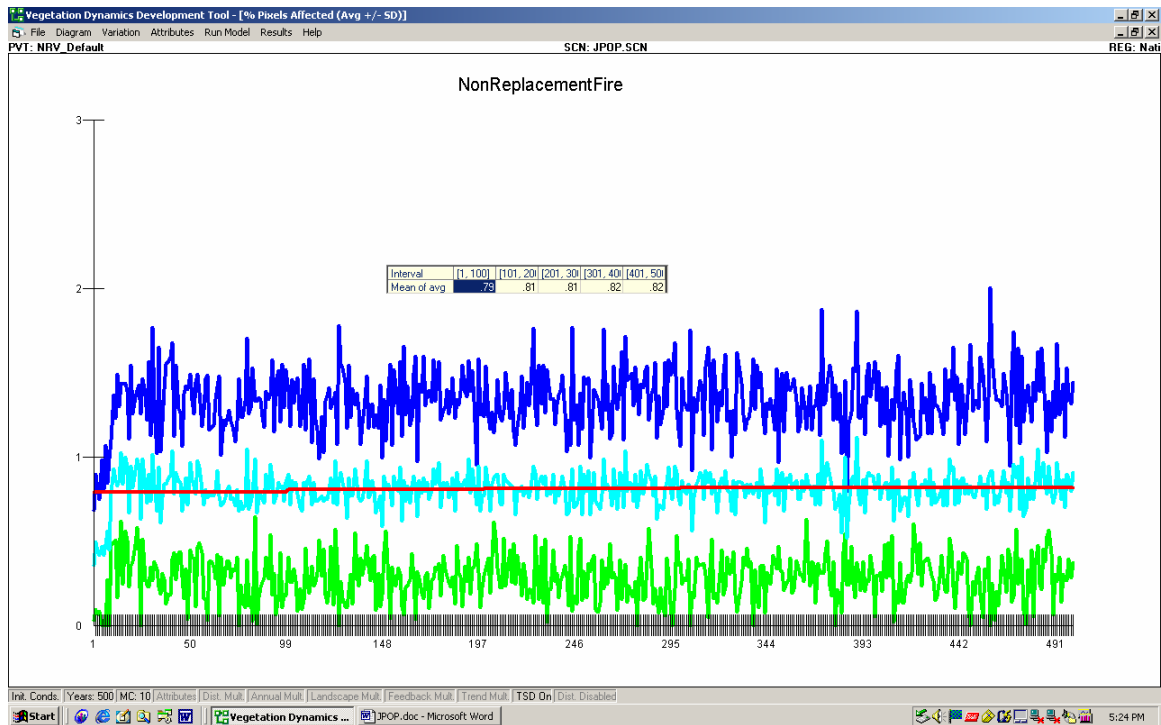
Fire Frequency – all fires: Approximate fire return interval is 22 years (4.65%/yr).



Replacement fire: Approximate replacement fire interval is 26 years.



Non-replacement fire: Approximate fire interval is 120 years.



Catastrophic Windthrow frequency: Approximately 0.14% of the area is affected by catastrophic windthrow per year for a windthrow interval of about 715 years. Because of the frequency of replacement fire, very few stands reach an age that is susceptible to windthrow.

