Natural Range of Variability estimates

for forest vegetation growth stages of

Minnesota's Drift and Lake Plains

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Final Version, April 16, 2000

Tamarack Swamp

Successional rules:

Rotation period for wind: 100-350 years

Rotation period for fire: 100-200 years

Fire returns any VGS to the seedling stage

Wind can return the pole-mature or old-growth stages to the seedling stage

Stand maintenance disturbances occur but do not affect successional trajectory

VGS	Age	Range of variability (%) of landscape
Seedling tamarack	1-20	12.8-24.4
Sapling-pole tamarack	21-55	18.8-31.2
Pole-mature tamarack	56-75	9.4-12.9
Old growth tamarack	>75	31.5-59.0

Forested Bog

Successional rules:

Rotation period for wind: 200-400 years

Rotation period for fire: 100-200 years

Fire returns any VGS to the seedling stage

Wind can return the pole-mature or old-growth stages to the seedling stage

Stand maintenance disturbances occur but do not affect successional trajectory

VGS	Age	Range of variability (%) of landscape
Seedling-sapling black spruce	1-35	19.4-31.4
Sapling-pole black spruce	36-75	18.7-26.0
Pole-mature black spruce	76-160	23.8-23.9
Old growth black spruce	>160	18.8-38.0

Forested Poor Fen

Successional Rules:

Rotation period for wind, 200-400 years

Rotation period for fire, 200-400 years

Fire will return any VGS to the seedling-sapling stage

Wind will return pole-mature or old growth to the seedling-sapling stage

Stand maintenance fires occur but do not affect successional trajectory

	Age	Range of

VGS		variability (%) of landscape
Seedling-sapling tamarack	1-35	13.7-23.0
Sapling-pole tamarack-black spruce	36-75	14.4-22.2
Pole-mature tamarack-black spruce	76-100	8.0-11.1
Old growth tamarack-black spruce	>100	43.8-63.9

White cedar swamp

Successional Rules:

Rotation period for wind, 200-400 years

Rotation period for fire, 400-800 years

Fire will return any VGS to the seedling-sapling tamarack stage

Wind will advance pole-mature tamarack-cedar, and return mature or old growth cedar-spruce to seedling-sapling cedar-spruce

Stand maintenance fires occur but do not affect successional trajectory

Spruce refers to a mixture of black and white spruce

VGS	Age	Range of variability (%) of landscape
Seedling-sapling tamarack	1-55	6.5-12.2
Sapling-pole tamarack	56-75	2.3-4.2
Pole-mature tamarack-cedar	76-100	2.6-4.4
Seedling-sapling cedar-spruce	1-30	5.9-9.5

Sapling-pole cedar-spruce	31-55	4.7-7.4
Mature cedar-spruce	56-110	13.5-18.4*
Old-growth cedar-spruce	>110	43.9-64.5

*Can be separated into 56-75 and 75-110 age classes as follows:

56-75: 5.0-6.8

76-110: 8.5-11.6

Semiterrestrial cedar forest

Successional Rules:

Rotation period for wind, 200-500 years

Rotation period for fire, 1000-2000 years

Fire will return any VGS to the seedling-sapling aspen-birch-spuce-tamarack stage

Wind will advance pole-mature aspen-birch-cedar, and return mature or old growth cedar-fir-birch to seedling-sapling cedar-fir-birch

Stand maintenance fires occur but do not affect successional trajectory

Spruce refers to a mixture of black and white spruce

VGS	Age	Range of variability (%) of landscape
Seedling-sapling aspen-birch-spruce-tamarack	1-25	1.2-2.4
Sapling-pole aspen-birch-spruce-tamarack	26-55	1.5-2.9
Pole-mature aspen-birch-spruce-	56-75	0.9-1.7

cedar-tamarack		
Seedling-sapling cedar-fir-birch	1-25	4.3-9.1
Sapling-pole cedar-fir-birch	26-55	5.2-10.8
Mature cedar-fir-birch	56-110	11.2-19.1*
Old-growth cedar-fir-birch	>110	53.9-75.7

*Can be separated into 56-75 and 75-110 age classes as follows:

56-75: 4.2-7.0

76-110: 7.0-12.1

Semiterrestrial black ash forest

Successional Rules:

Rotation period for wind, 200-500 years

Rotation period for fire, 1000-2000 years

Fire will return any VGS to the seedling-sapling stage

Wind will return pole-mature or old growth to the seedling-sapling stage

Stand maintenance fires occur but do not affect successional trajectory

VGS	Age	Range of variability (%) of landscape
Seedling-sapling black ash-balsam poplar	1-20	4.5-9.3
Sapling-pole black ash-balsam	21-55	7.6-15.6

poplar-elm		
Pole-mature black ash-elm	56-120	12.6-21.6
Old-growth black ash	>120	53.5-75.3

Lowland hardwood-conifer forest

Successional Rules:

Rotation period for wind, 250-500 years

Rotation period for fire, 300-600 years

Fire will return any VGS to the seedling-sapling aspen-birch stage

Wind will advance pole-mature birch-conifer or return pole-mature and old-growth conifer to the conifer seedling-sapling stage

Stand maintenance fires occur but do not affect successional trajectory

Conifer refers to a mixture of white pine, white spruce, cedar and fir

VGS	Age	Range of variability (%) of landscape
Seedling-sapling aspen birch	1-15	4.7-6.2
Sapling-pole aspen-birch	16-35	6.0-8.0
Pole-mature aspen-birch-conifer	36-75	9.2-14.0
Seedling-sapling conifer	1-15	2.4-4.5
Sapling-pole conifer	16-35	3.1-5.7
Pole-mature conifer	36-75	15.9-17.5
Mature-large conifer	76-175	22.9-32.0

Old-growth conifer	>175	16.8-31.0

Rich hardwood forest

Successional Rules:

Rotation period for wind, 300-600 years

Rotation period for fire, 1000-2000 years

Fire will return any VGS to the seedling-sapling birch-aspen stage

Wind will advance pole-mature birch-aspen-pine, mature-large birch-pine-maple, old-growth pine-mapleor or return pole-mature maple and large maple old growth to the seedling-sapling maple stage

Stand maintenance fires slightly lengthen the time spent in the mature-large birch-pine -maple and pine-maple stages.

Conifer refers to white pine and fir

VGS	Age	Range of variability (%) of landscape
Seedling-sapling birch-aspen	1-15	0.7-1.5
Sapling-pole birch-aspen-conifer	16-35	1.0-1.9
Pole-mature birch-aspen-conifer	36-75	1.8-3.3
Mature-large birch-maple-conifer	76-120	1.9-3.1
Old-growth pine-maple	120-195	2.7-3.9
Old-growth maple	>195	48.1-67.4
Seedling-sapling maple	1-15	2.3-4.2

Sapling-pole maple	16-35	3.1-5.6
Pole-mature maple	36-75	5.6-9.5
Large maple	76-195	13.5-18.8

Mesic northern hardwood forest

Successional Rules:

Rotation period for wind, 1000-2000 years

Rotation period for fire, 1000-2000 years

Fire will return any VGS to the seedling-sapling birch-aspen stage

Wind will advance pole-mature birch-pine-aspen, mature-large birch-pine-maple, or return old-growth maple, pole-mature maple or large maple to the seedling-sapling maple stage

Stand maintenance fires slightly lengthen time spent in the mature-large birch-pine-maple, old-growth pine-maple stages.

VGS	Age	Range of variability (%) of landscape
Seedling-sapling birch-aspen	1-15	0.7-1.5
Sapling-pole birch-aspen	16-35	1.0-1.9
Pole-mature birch-pine-aspen	36-75	1.9-3.6
Mature-large birch-pine-maple	76-120	2.1-3.7
Old-growth pine-maple	121-195	3.2-5.3
Old-growth maple	>195	69.1-82.7

Seedling-sapling maple	1-15	0.7-1.4
Sapling-pole maple	16-35	1.0-1.8
Pole-mature maple	36-75	1.8-3.4
Large maple	75-195	5.0-8.2

Mesic oak brushland-savanna-forest

Successional Rules:

Rotation period for wind, 1000-2000 years

Rotation period for fire, 500-1000 years

Surface fire, 5-10 years, with 0.1 or 0.2 annual chance, sets savanna stage or seedling oak-aspen forest stage back to the grass-brush stage

Fire will return any VGS to the grass-brush stage

Wind will return pole-mature, mature-large aspen-oak pine, old multi-aged pine-oak and old pine-maple-oak seedling-sapling aspen-oak stage

VGS	Age	Range of variability (%) of landscape
Grass-brush	1-15*	19.4-57.1
Savanna	16-35*	9.5-14.2
Seedling-sapling aspen-oak	1-35*	2.7-3.7
Sapling-pole aspen-oak pine	36-75	2.7-4.0

Pole-mature aspen-oak-pine	76-115	2.5-3.8
Mature-large aspen-oak-pine	116-140	1.4-2.3
Old multi-aged pine-oak	141-195	16.8-49.4
Old maple-pine-oak	>195	2.6-7.9

*Model has two different successional pathways. The grass-brush-savanna pathway has frequent fires that prevent succession with random annual chance of 0.1 (10-year fire return) or 0.2 (5-year fire return). Those stands that escape from the grass-brush-savanna route (no fire for 30 years) get into the forest pathway and have a separate stand age, starting from the time of the last fire (either a surface fire that maintained the gras-brush or savanna or forest fire that set forest back to grass-brush). Another way of stating all this is that there are two alternate 1-35 year old states that coexist--one grass-brush-savanna and one the seedling-spaling aspen-oak.

Dry-mesic pine-oak forest

Successional Rules:

Rotation period for wind, 1000-2000 years

Rotation period for fire, 250-500 years

Surface fire, 40 years, can set mature-large aspen-pine red maple-oak, multi-aged red maple-pine-oak or old red maple-oak back one stage.

Fire will return any VGS to the seedling-sapling aspen-jack pine-oak stage

Wind will return pole-mature aspen-pine-red maple-oak, mature-large pine-oak-red maple, multi-aged red maple-pine-oak or old red maple-red oak to the seedling-sapling stage

Pine refers to mixed jack, red and white pines

VGS	Age	Range of variability (%) of landscape
Seedling-sapling aspen-pine -oak	1-15	3.6-6.8

Sapling-pole aspen-pine-oak	16-35	4.6-8.5
Pole-mature aspen-pine-red maple-oak	36-75	32.8-34.8
Mature-large pine-red maple-oak	76-120	24.4-26.6
Multi-aged red maple-pine-oak	121-175	16.0-19.8
Old red maple-red oak	>175	9.3-12.6

Dry-mesic pine forest

Successional Rules:

Rotation period for wind, 500-1000 years

Rotation period for fire, 175-350 years

Surface fires, 30 years, slow rate of successional advancement

Fire will return any VGS to the seedling-sapling stage

Wind will return pole-mature aspen-pine-oak, mature-large red-white pine and multi-aged red-white pine to the seedling-sapling stage

Pine refers to jack pine and red/white pine mixture

VGS	Age	Range of variability (%) of landscape
Seedling-sapling aspen-pine-oak	1-15	6.0-11.0
Sapling-pole aspen-pine-oak	16-35	8.4-14.5
Pole-mature aspen-pine-oak	36-75	12.9-19.4
Mature-large red -white pine	76-175	24.0-27.1

Multi-aged red-white pine	>175	28.0-48.7

Dry pine forest

Successional Rules:

Rotation period for wind, 1000-2000 years

Rotation period for fire, 60-120 years

Surface fire, 40 years, slows rate of successional advancement

Fire will return any VGS to the seedling-sapling jack pine-aspen stage

Wind will return pole-mature jack pine-aspen, multi-aged pine or multi-aged red and white pine to the seedling-sapling stage

Pine refers to mixed jack, red and white pines

VGS	Age	Range of variability (%) of landscape
Seedling-sapling jack pine-aspen	1-15	12.8-22.8
Sapling-pole jack pine-aspen	16-35	15.8-24.0
Pole-mature pine-aspen	36-75	20.5-24.0
Multi-aged pine	76-175	20.3-26.8
Multi-aged red-white pine	>175	9.0-24.1