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## APPENDIX G. LANDSCAPE ECOSYSTEMS & RANGE OF NATURAL VARIABILITY

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## Introduction

Early in the Forest Plan revision process, the Chippewa and Superior National Forests recognized that comparing the past to the present provides a basis for understanding the range of landscape conditions needed to sustain ecosystems and species. Understanding the range of natural variability (RNV) of ecosystem composition, structure, and processes that formerly were common at a variety of landscape scales but are now greatly reduced can help identify what elements of the ecosystem may need special consideration in management (USDA NOI 1997).

The Minnesota Forest Resource Council chartered a panel of experts to define various aspects of the range of natural variability for forested communities in northern Minnesota. The panel was tasked with defining the appropriate timeframe and scale for characterizing RNV as well as identifying and defining the major forest ecosystems in northern Minnesota for which RNV characterizations were needed. The outcomes of this process were documented in two reports authored by Dr. Lee Frelich. The report for the Northern Superior Uplands was completed in 1999, and the one for the Northern Minnesota Drift and Lake Plains in 2000 (Frelich 1999, 2000).

The expert panel determined that the forested landscape conditions that occurred during the time period from 1600AD to 1900AD provide a characterization of those landscapes under RNV. The range of forest conditions during this time period is thought to most closely represent the natural cycles, processes, and disturbances under which the current forest ecosystems and the accompanying biological diversity of northern Minnesota evolved. They also agreed that the appropriate scale for characterizing RNV was at the ecoregion scale within the National Hierarchical Framework of Ecological Units identified as the Section. For the Superior National Forest, the forest conditions within the Northern Superior Uplands from the year 1600 to 1900 provide the appropriate characterization of RNV for the landscape ecosystems in that Section. For the Chippewa National Forest, the forest conditions within the Northern Minnesota Drift and Lake Plains during that same time period provide the appropriate characterization of RNV for the landscape ecosystems in that Section.

It is not the expressed goal of future national forest management to restore the forested landscapes on the Chippewa or Superior National Forests completely to those conditions that occurred when these landscapes operated within the range of natural variability. In fact, today due to past harvesting and fire control, vegetation growth stages may not follow the stages depicted for natural succession. Seed sources are missing, deer populations are much higher and shrub layers are denser on many areas than occurred historically. However, the information derived from a better understanding of these conditions provides a more complete context for analyzing and managing these landscapes in a more ecologically sustainable way. The concept of RNV as a reference condition for analysis can be useful for comparing and evaluating the ability of a national forest to contribute to an acknowledged healthy landscape condition. The analysis of ecological sustainability, when balanced with a similar analysis of the economic and social sustainability offered by the alternatives will guide decision-makers in determining forest management strategies for the future.

Tables GEIS-1 and GEIS-2 list the area of each Landscape Ecosystem (LE) and the ownership within each LE for currently forested lands.

**Table GEIS-1. Landscape Ecosystems within the Northern Minnesota Drift and Lake Plains Section acres and estimated percent within each ownership group**

Landscape Ecosystem	Total Acres	Chippewa NF	Tribal	State	County	Private	Unmanaged (State Park)
Dry Pine	203,573	6%	0%	19%	25%	46%	4%
Dry-mesic Pine-Oak	1,466,688	12%	2%	19%	21%	44%	2%
Dry-mesic Pine	633,192	13%	2%	10%	26%	47%	2%
Boreal Hardwood-Conifer	1,148,251	11%	0%	17%	29%	40%	3%
Mesic Northern Hardwoods	194,880	35%	1%	9%	17%	36%	2%
Lowland Forest	586,490	14%	0%	44%	25%	14%	3%
Total	4,233,074	13%					

Data are estimates of forested lands using Landscape Ecosystems for Section, with more detailed Shadis Landscape Ecosystem Map used for areas within Chippewa NF (updated by NRRI, Dec 2003).

**Table GEIS-2. Landscape Ecosystems within the Northern Superior Uplands Section acres and estimated percent within each ownership group**

Landscape Ecosystem	Total Acres	Superior NF	State	County	Private	Unmanaged (State Park)
Jack Pine-Black Spruce	1,069,905	83%	4%	2%	10%	0%
Dry-mesic Red and White Pine	706,731	36%	15%	13%	33%	1%
Mesic White and Red Pine	756,966	22%	9%	28%	38%	0%
Mesic Birch-Aspen-Spruce-Fir	1,075,332	36%	17%	9%	33%	1%
Northern Hardwood-Conifer	290,670	22%	18%	19%	36%	3%
Lowland Conifer	1,128,056	38%	21%	12%	27%	0%
Rich Swamp	161,232	17%	32%	21%	33%	0%
Total	5,188,892	42%				

Total NF % is based on total NF acreage (including BWCAW) and total acres of forested land in Section. National Forest (NF) percentage is from actual NF acreage divided by actual Section acreage. Other ownerships are NRRI data.

## Northern Minnesota Drift and Lake Plains Section

### Introduction

The narratives for each LE describe the composition, structure, and function of the ecosystems. Vegetation growth stages are described in terms of tree species and age to allow relating this information to national forest inventory data. These narratives are summaries of information found in several draft documents, including:

- “Identification, Description, and Ecology of Forested, Native Plant Communities” by Almendinger and Hanson (1998)
- Matrix and various unpublished documents by Shadis.
- “Natural Range of Variability estimates for forested vegetation growth stages of Minnesota’s Drift and Lake Plains” by Lee Frelich (2000)
- Numerous personal contacts with the authors identified, plus other individuals.

These documents are available in the official record. They are draft documents that have not been published. No published documents were available at the time of writing.

The range of natural variability for each LE is depicted graphically. The graphics show type of disturbance and intervals between disturbances with associated vegetation growth stages. Estimates of the historical (RNV) and current amount of each vegetation growth stage (ten year increments) for all ownerships within the Section are shown in bar graphs for all forested acres in the section compared with National Forest lands. This information is from “Drift and Lake Plains: A comparison of Range of Natural Variation and current conditions” by Brown and White (2001). Numbers were updated by NRRI in December 2003.

Graphics are not available for all LEs.

The vegetation objectives identified for each alternative are shown after the graphics. Objectives were determined for each LE individually.

Figure 2-2 shows the ecosystem types delineated by Shadis (2000) for the Northern Minnesota Drift and Lake Plains LE.

## Dry Pine Landscape Ecosystem

### Composition and Structure

Historically, jack pine and red pine were the dominant species in this LE; aspen, paper birch, white pine, oak, white spruce and balsam fir were also present.

Mixed cohorts of all three native pines were common in the understory. Initially, stands were even-aged, but became multi-aged as stands matured. Jack pine succeeds to red pine when stand replacement fires do not occur, at approximately 75 years of age. A third to half of the landscape was characterized as multi-aged, beyond 75 years old.

The deciduous species very rarely reach the main canopy level unless their roots can reach the water table.

Beaked hazel is the dominant shrub and can achieve high coverage that prevents tree regeneration. Bracken fern is almost always present. A good potential for blueberries exists.

Forests occurred primarily as large patches of jack pine, with red pine, aspen, paper birch, and white pine scattered as small pockets or as individual trees. Patch sizes ranged from 100s-1000s of acres through the multi-aged pine growth stage, and from 10-100s of acres in the oldest multi-aged red-white pine growth stage (CNF Landtypes Paper and matrix, Shadis-see official record).

### Vegetation Growth Stages

*Seedling-Sapling Jack Pine/Aspen Growth Stage (0-15 years)* – Dense stands of regenerating jack pine, with scattered red pine as individuals, groups of trees, or small patches up to 20 acres in size, dominated this LE. The large red pine were an important seed source as the stands aged and experienced minor disturbances.

*Sapling-Pole Jack Pine/Aspen Growth Stage (16-35 years)* – Jack pine continued to dominate during this stage.

*Pole-Mature Pine-Aspen Growth Stage (36-75 years)* – Jack pine is still dominant, but red pine is frequently present in the understory when the remnant, older seed source trees are available.

*Multi-Aged pine/Multi-Aged Red-White Pine Growth Stage (>75 years)* – Both lack of stand replacement fires and occurrence of surface fires allowed red pine to regenerate as an age class under the existing canopy or in canopy gaps. Charred standing snags and downed trees were found throughout these forests. Large diameter red pine dominated the main canopy. Where the main canopy is well stocked the understory will commonly be open.

### Function

This ecosystem experienced frequent stand replacement fires—large patches of forest regenerated every 60-120 years from intense crown fires (Frelich, 2000). Moderate intensity surface fires occurred every 20-40 years. This LE also experienced large-scale wind events every 1000-2000 years.

Surface fires provided opportunities for periodic bursts of jack pine and red pine regeneration. These fires also reduced fuels before they reached a point where high-intensity fires resulted in significant main canopy tree mortality.

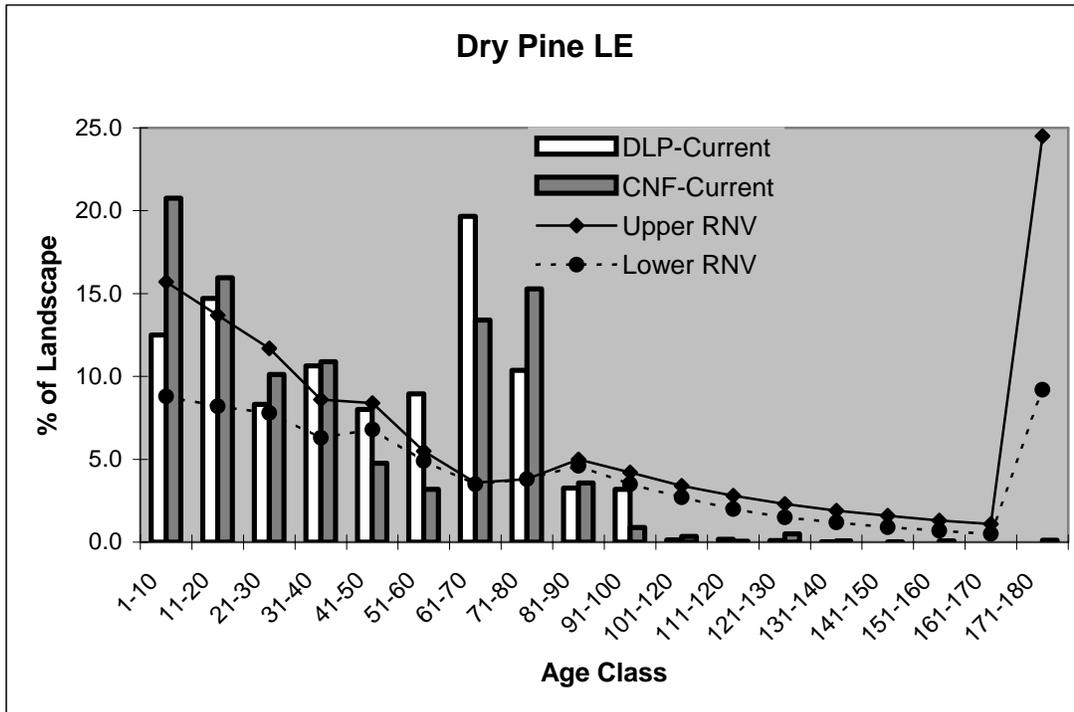
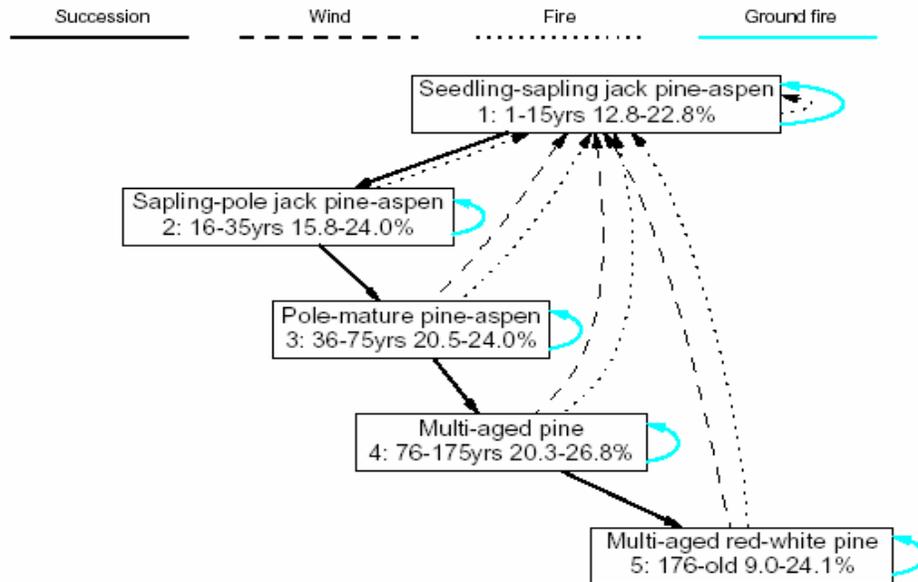
The multi-aged red pine and white pine is considered climax as long as some surface fires occur to provide a seed bed for regeneration. Under natural conditions, fire probably kept this ecosystem from succeeding to spruce-fir.

**Figure GEIS-11. Range of natural variability for the Dry Pine LE.**

Frelich type 13: Dry pine forest

Shadis type 5: Dry pine

Disturbance interval (years) - Wind: 1000-2000 Fire: 60-120 Ground Fire: 40



DLP is all forested lands on all ownerships within the LE in the Drift and Lake Plains Section  
 CNF is all forested lands administered by the Chippewa National Forest within the LE

## Vegetation Objectives

### Stand Diversity Objectives for Dry Pine LE by Alternative (percent of the LE dominated by a forest type)

Forest Types	Existing 2001 (%)	Alternatives						
		A (%)	B (%)	C (%)	D (%)	E (%)	F (%)	G (%)
Jack Pine	29	not	67	48	50	53	69	61
Red Pine	39	By	24	40	44	35	22	30
Aspen	22	LE	2	5	0	3	2	2
Oak	3		2	2	2	2	2	2
Spruce/fir	1		2	3	3	2	2	2
Paper Birch	3		1	1	1	3	1	1
Northern Hardwood	1		1	1	1	1	1	1
White Pine	1		1	1	1	1	1	1
total	100	0	100	101	102	100	100	100

### Age Classes Objectives for Dry Pine LE by Alternative (percent of the LE in an age class)

Age Class	Mid Point of RNV (%)	Existing 2001 (%)	Alternatives						
			A (%)	B (%)	C (%)	D (%)	E (%)	F (%)	G (%)
1-15	17.8	28	not	14	20	10	14	17.8	15
16-35	19.9	26	by	18	26	13	19	19.9	20
36-75	22.3	36	LE	37	34	25	38	22.3	40
76-175	23.6	10		16	14	27	23	23.6	15
175+	16.6	<1		15	7	25	6	16.6	10
total	100	100	0	100	100	100	100	100	100

### Species Diversity Objectives for Dry Pine LE by Alternative

+ = increase from existing condition

m = maintain existing condition

- = decrease from existing condition

Species	Past Condition (GLO) (%)	Existing Condition (FIA 1990) (%)	Alternatives						
			A	B	C	D	E	F	G
Jack Pine	53.6	8.9		+	+	+	+	+	+
Red Pine	17.7	24.7		-	+	+	-	-	-
Tamarack	11.4	0.7		+	+	+	+	+	+
Aspen	5.4	34.0		-	-	-	-	-	-
White Pine	5.0	0.7		+	+	+	+	+	+
White Cedar	2.1	0.0		+	+	+	+	+	+
Paper Birch	2.1	10.3		-	-	-	m	-	-
Balsam Fir	0.8	8.2		-	-	-	-	-	-
Black and White Spruce	0.4	6.9		+	+	+	+	+	+
Red Oak	0.0	1.6		m	m	m	m	m	m
Burr Oak	0.0	0.0		m	m	m	m	m	m
total	98	96							

## Dry-mesic Pine-Oak Landscape Ecosystem

### Composition and Structure

Historically, this LE had a jack pine, red pine, and white pine supercanopy either alone or as mixed pines. Deciduous trees usually occurred as a subcanopy comprised of quaking aspen, paper birch, northern red oak, bur oak, red maple, and bigtooth aspen. These deciduous trees grow to merchantable size and in the absence of pines the deciduous trees would form a cover type.

These forests in a mature condition, typically were a mix of pines and deciduous trees, frequently with 2 pine species and a subordinate canopy of 3 deciduous species. The pine coverage would be 50% to 75%, with the deciduous species making up the balance.

Vertical diversity is definitely a part of these mature and older forests in this system. Oak species and red maple are present at higher levels than aspen and birch in the seedling/sapling size class. This suggests the oak and maple will replace the shorter-lived aspen/birch as the stand ages. Pine species are only a minor part of the understory stocking.

Black cherry is a minor species on the Chippewa National Forest. This ecosystem is where it is present as a minor stand component.

Beaked hazel is the dominant shrub. Large leaved aster is the most commonly found forb.

Patch sizes of similar tree species and age composition varied from less than an acre to hundreds of acres. Multi-aged conditions ranged from less than an acre to thousands of acres.

### Vegetation Growth Stages

*Seedling-Sapling Aspen/Pine/Oak Growth Stage (0-15 years)* – This growth stage included aspen, paper birch, jack pine, red pine, white pine, and oak. It was typically a mixture of two pine species and 3 or more deciduous species.

*Sapling-Pole Aspen/Pine/Oak Growth Stage (16-35 years)* – This growth stage included the same species as those in the 0-19 year stage.

*Pole-Mature Aspen/Pine/Red Maple/Oak (36-75 years)* – This stage included the species previously identified. A supercanopy/subcanopy would develop as the red pine and white pine continued to grow, while the deciduous species slow in growth as they approach their mature canopy height.

*Mature-Large Pine/Red Maple/Oak Growth Stage (76-120 years)* – Red pine and white pine dominated the supercanopy as the aspen and jack pine component reached its normal life span; red maple, northern red oak, and bur oak formed the subcanopy. Surface fires would allow aspen and paper birch to be present at reduced levels compared to the stand replacement fire events.

*Multi-Aged Red Maple/Pine/Oak; Old Red Maple/Red Oak Growth Stage (>120 years)* – Red pine and white pine supercanopy trees with a subcanopy of oak species and red maple characterize these stages.

## Function

Fire was the more common natural disturbance factor in this ecosystem, with an estimated stand replacement return interval of 250-500 years. Usually, stand replacement fire events ranged from 10s to 100s of acres. Surface fires are estimated to have occurred at 5 to 40 year intervals. Wind events leveled stands at an estimated interval of 1,000-2,000 years.

Surface fires appear to be the most common process effecting species composition and structure. These fires removed the understory species, setting mature and older vegetation growth stages back one growth stage. A hardwood tree species age class was created, dominated by sprouting, creating a mixed aged stand.

Eventually, a stand replacement event would reinitiate an even-aged stand dominated by aspen, jack pine, red pine, paper birch, northern red oak, bur oak or white pine. These stands were usually a mix of species, comprised of two or more pine species and 3 or more deciduous species.

As the stands approach 60 years of age, the canopy separation between red pine/white pine and the other species becomes apparent. Surface fires may also create canopy separation, by removing the thinned barked hardwoods and jack pine, while retaining the thicker barked red pine/white pine. Pine species would regenerate in patches where surface fires burned hotter.

Aspen and jack pine cover types would succeed to longer-lived species by 75-100 years of age. Paper birch and northern red oak would succeed slightly later. Oak species would experience mortality at earlier ages when exposed to drought conditions. Surface fires allowed these species to remain in the stands as regenerating trees.

In the absence of stand replacement events and surface fires, red maple appears to be the dominant climax species in this ecosystem.

## Vegetation Objectives

### Stand Diversity Objectives for Dry-mesic Pine-Oak LE by Alternative (percent of the LE dominated by a forest type)

Forest Types	Existing 2001 (%)	Alternatives						
		A (%)	B (%)	C (%)	D (%)	E (%)	F (%)	G (%)
Red Pine	30	Not	48	35	56	37	36	38
Jack Pine	6	By	16	7	7	12	24	22
Aspen	40	LE	12	35	7	23	20	18
Paper Birch	9		9	9	6	9	9	9
Northern hdwds	8		5	5	12	8	4	5
White Pine	1		5	3	6	5	3	3
Spruce/fir	4		3	4	4	4	3	3
Oak	2		2	2	2	2	1	2
total	100	0	100	100	100	100	100	100

**Age Classes Objectives for Dry-mesic Pine-Oak LE by Alternative (percent of the LE dominated by an age class)**

Age Class	Existing 2001 (%)	Alternatives						
		A (%)	B (%)	C (%)	D (%)	E (%)	F (%)	G (%)
1-15	16	Not	8	19	4	13	5	10
16-35	22	By	11	25	6	17	7	13
36-75	30	LE	22	32	11	35	34	27
76-120	29		25	10	13	16	26	23
121-175	2		20	5	40	12	18	17
176+	<1		13	*10	26	7	11	10
total	100	0	99	100	100	100	101	100

\* high due to northern hardwoods present

**Species Diversity Objectives for Dry-mesic Pine-Oak LE by Alternative**

+ = increase from existing condition

m = maintain existing condition

- = decrease from existing condition

blank=no objective set

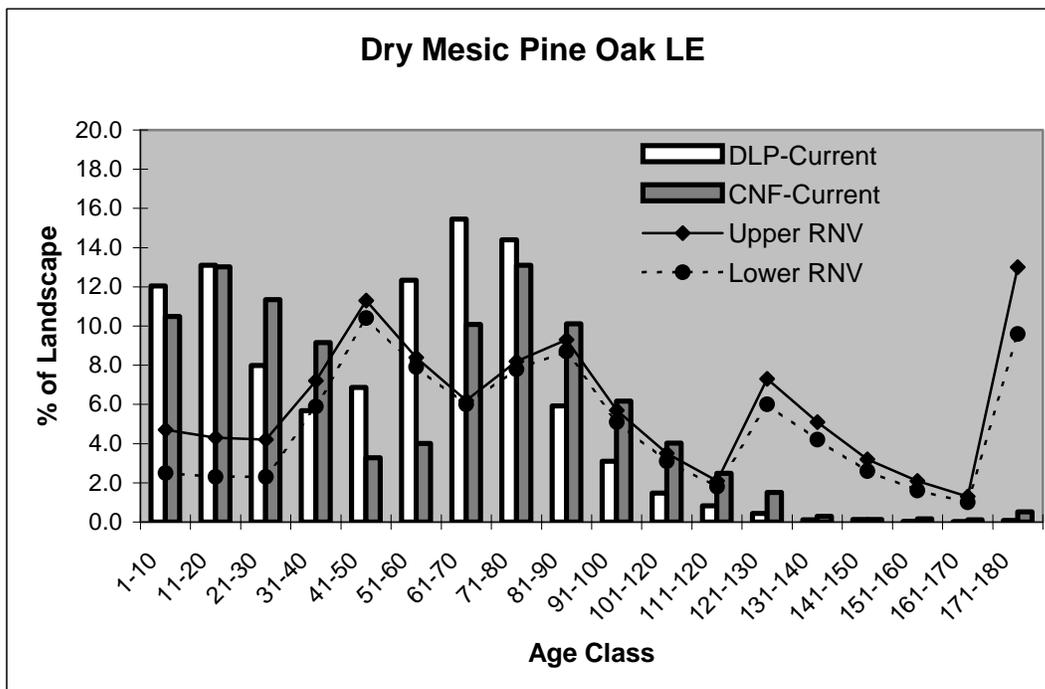
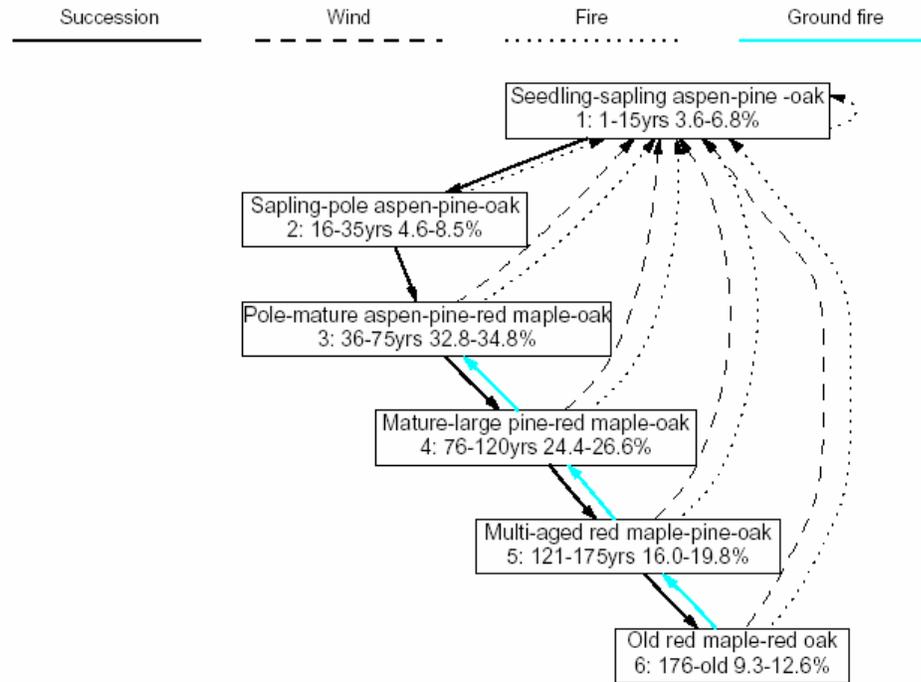
Species	Past Condition (GLO) (%)	Existing Condition (FIA 1990) (%)	Alternatives						
			A	B	C	D	E	F	G
Red pine	19.0	15.0		+	+	+	+	+	+
Jack pine	15.0	5.0		+	+	+	+	+	+
Aspen	15.0	27.0		-	-	-	-	-	-
Tamarack	11.0	3.0		+	+	+	+	+	+
Paper birch	10.0	12.0		m	m	-	m	m	m
White pine	6.5	3.0		+	+	+	+	+	+
White cedar	6.0	4.0		m	m	m	m	m	m
White Spruce	4.5	3.0		+		+		+	+
Balsam Fir	3.0	9.0		+		+		+	+
Red maple	1.4	3.0		+	-	+	m	+	+
Bur oak	1.0	2.0							
Red oak	1.0	2.0							
Sugar maple	1.0	4.5							
Other									
total	94	93							

**Figure GEIS-7. Range of natural variability for the Dry-mesic Pine-Oak LE**

Frelich type 11: Dry-mesic pine-oak forest

Shadis type 2: Dry-mesic pine-oak

Disturbance interval (years) - Wind: 1000-2000 Fire: 250-500 Ground Fire: 40



DLP is all forested lands on all ownerships within the LE in the Drift and Lake Plains Section  
 CNF is all forested lands administered by the Chippewa National Forest within the LE

## Dry-mesic Pine Landscape Ecosystem

### Composition and Structure

Historically, this LE had mature and older stands dominated by a supercanopy of red pine and white pine. The subcanopy is a mixed stand of red maple and paper birch. White spruce, balsam fir, aspen, northern red oak, bur oak and bigtooth aspen are also found in this mixed subcanopy in some of the stands at lower stocking levels.

Jack pine, red pine and white pine can occasionally occur in pure stands.

Beaked hazel is the dominant shrub, which is present on most sites.

Almost one-half of the landscape was characterized as multi-aged, beyond 175 years old.

Patch sizes of similar tree species and age composition varied from ten acres to thousands of acres. Blocks of greater than a thousand acres of young aspen occurred, as did older, multi-aged red and white pine.

### Vegetation Growth Stages

*Seedling-Sapling Aspen/Pine/Oak Growth Stage (0-15 years)* – This growth stage was dominated by aspen stands; it also included jack pine, red pine, white pine, paper birch, and northern red oak. Frequently, red and white pine seedlings were present with aspen, jack pine, paper birch, and northern red oak.

*Sapling-Pole Aspen/Pine/Oak Growth Stage (16-35 years)* – This growth stage included the same species as those in the 0-19 year stage.

*Pole-Mature Aspen/Pine/Oak Growth Stage (36-75 years)* – As the jack pine and aspen component reached their normal life span, red pine, white pine, paper birch, and northern red oak started to dominate.

*Mature-Large Red/White Pine Growth Stage (80-175 years)* – Larger red and white pine dominated this stage with a subcanopy of red maple and paper birch. When surface fires were active, red pine and white pine regeneration may replace the red maple and birch.

*Multi-Aged Red/White Pine Stage (>175 years)* – This stage was similar to the mature stage, but it had more than one age class represented, with at least two canopy levels visible.

### Function

Fire was the more common natural disturbance factor in this ecosystem, with an estimated stand replacement return interval of 175-350 years. Surface fires are estimated to have occurred at 10 to 40 year intervals. Wind events leveled stands at an estimated interval of 500-1,000 years.

Surface fires removed the smaller red and white pine and most of the other species, creating conditions suitable for a new generation of trees to become established. If a longer period occurred without a surface fire, more tree species became established and grew into the main canopy, adding to the age and species diversification. Surface fires slowed this succession, and ultimately a stand replacement event would reinitiate an even-aged stand.

With surface fires occurring regularly, multi-aged red and white pine dominated the landscape.

Aspen and jack pine trees would succeed to longer lived species by 75-100 years of age. Paper birch and northern

red oak would succeed slightly later. Oak species would experience mortality at earlier ages when exposed to drought conditions. Surface fires allowed these species to remain in the stands as regenerating trees.

Without surface fires, a stand understory comprised of balsam fir, white spruce and red maple became dominant. As balsam fir and white spruce grew up to the main canopy, they provided ladders fuels, allowing a stand replacement crown fire. These understory species are thought to be the climax species when fire is absent for long periods.

## Vegetation Objectives

### Stand Diversity Objectives for Dry-mesic Pine LE by Alternative (percent of the LE dominated by a forest type)

Forest Types	Existing 2001	Alternatives						
		A	B	C	D	E	F	G
	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
White Pine	1	not	28	13	42	17	22	21
Red Pine	15	by	26	17	25	15	22	18
Aspen	45	LE	13	35	3	30	19	22
Paper Birch	11		9	11	6	11	14	15
Northern Hardwood	14		14	11	14	14	13	14
Spruce/fir	5		5	5	5	5	5	5
Oak	6		3	6	3	6	3	3
Jack Pine	2		2	2	2	2	2	2
total	99		100	100	100	100	100	100

### Age Classes Objectives for Dry-mesic Pine LE by Alternative (percent of the LE dominated by an age class)

Age Class	Existing 2001	Alternatives						
		A	B	C	D	E	F	G
	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
1-15	15	not	5	17	2	13	8.5	10
16-35	21	by	6	23	3	17	11.5	13
36-75	37	LE	13	29	6	35	16.2	26
76-175	27		27	11	36	20	25.6	19
176+	0		49	*20	53	15	38.4	32
total	100	0	100	100	100	100	100	100

\* high due to northern hardwood present

**Species Diversity Objectives for Dry-mesic Pine LE by Alternative**

+ = increase from existing condition

m = maintain existing condition

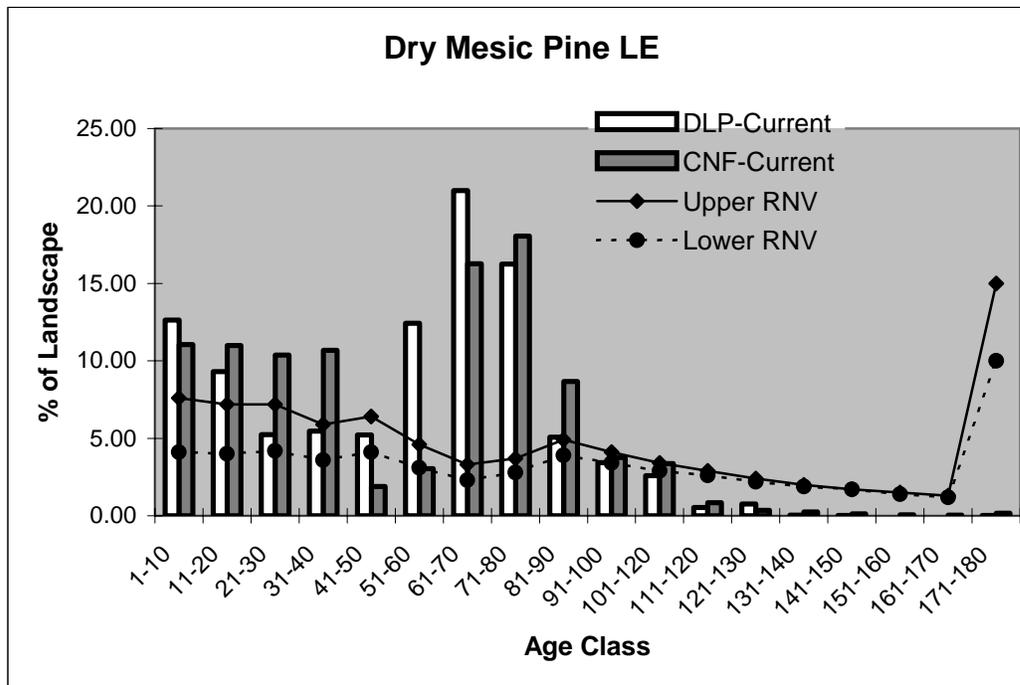
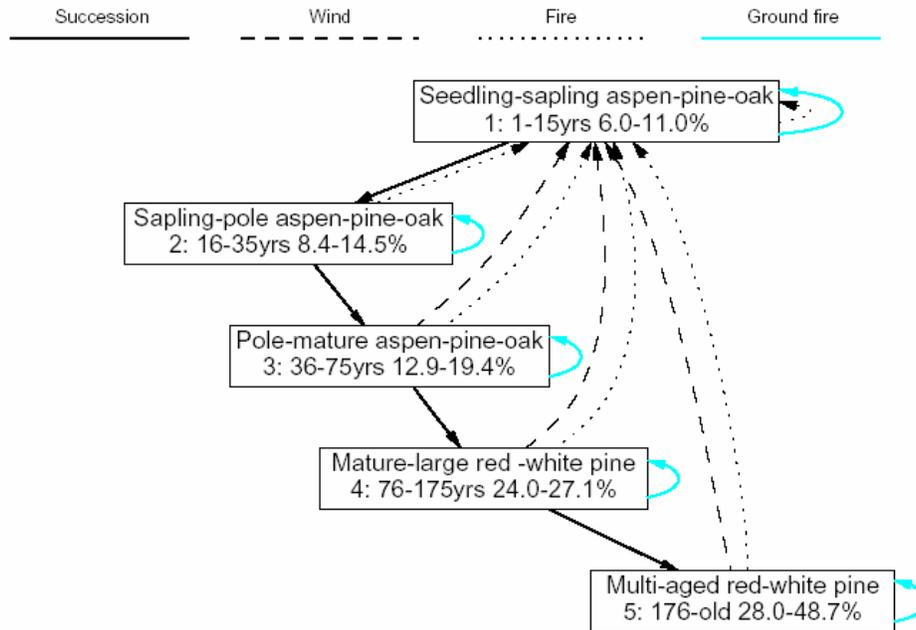
- = decrease from existing condition

blank=no objective set

Species	Past Condition (GLO)	Existing (FIA 1990)	Alternatives						
			A	B	C	D	E	F	G
	(%)	(%)							
Aspen	17	32		-	-	-	-	-	-
Paper birch	13	11							
Red pine	12	9		+	+	+	+	+	+
White pine	12	1		+	+	+	+	+	+
Tamarack	9	1		+	+	+	+	+	+
White cedar	5	3		m	m	m	m	m	m
White spruce	5	3							
Balsam fir	4	5							
Red maple	4	3							
Red oak	3	5		-	-	-	-	-	-
Sugar maple	2	4		-	-	-	-	-	-
Jack pine	1	2		m	m	m	m	m	m
Bur oak	1	3							
Basswood	1	6		-	-	-	-	-	-
total	89	88							

**Figure GEIS-9. Range of natural variability for the Dry-mesic Pine LE**

Frelich type 12: Dry-mesic pine forest  
 Shadis type 4: Dry-mesic pine  
 Disturbance interval (years) - Wind: 500-1000 Fire: 175-350 Ground Fire: 30



DLP is all forested lands on all ownerships within the LE in the Drift and Lake Plains Section  
 CNF is all forested lands administered by the Chippewa National Forest within the LE

## Boreal Hardwood-Conifer Landscape Ecosystem

(Identified as Lowland Hardwood-Conifer Forest in “Draft Identification, Description, and Ecology of Forested, Native Plant Communities” by Almendinger and Hanson 1998)

### Composition and Structure

Historically, this LE was dominated by mixed stands composed of aspen, paper birch, balsam fir, and northern white cedar. White pine, red pine, ash, basswood, bur oak, white spruce, and elm were also present with minor amounts of red maple, sugar maple, red pine and jack pine.

Red maple, aspen, black ash and balsam fir are the most prevalent trees regenerating in the understory of mature stands. The aspen and black ash occurs where small pockets of several trees have blown down. Red maple and balsam fir can regenerate without a disturbance.

This system occurs on nutrient rich, moisture transition areas between sugar maple dominated uplands and lowlands with saturated soils. Soils of this system are saturated during the spring and dryer during the summer months.

Almost one-half of this landscape was comprised of older, large conifer. Patch sizes of similar tree species and age composition varied from less than an acre to thousands of acres.

### Vegetation Growth Stages

*Seedling-Sapling Aspen/Birch; Seedling-Sapling Conifer Growth Stage (0-15 years)* – The most common species of this growth stage included aspen, paper birch, tamarack, white pine, white spruce, northern white cedar, and balsam fir.

*Sapling-Pole Aspen/Birch; Sapling-Pole Conifer Growth Stage (16-35 years)* – This growth stage included the same species as those in the 0-19 year stage.

*Pole-Mature Aspen/Birch/Conifer; Pole-Mature Conifer Growth Stage (36-75 years)* – Aspen, paper birch, white pine, white spruce, northern white cedar, and balsam fir were dominant in these growth stages.

*Mature-Large Conifer Growth Stage (76-119 years)* – As the aspen and tamarack component was removed from this growth stage, white pine, white spruce, northern white cedar, and balsam fir began to dominate.

*Mature-Large Conifer; Old-Growth Conifer (>120 years)* – White pine, white spruce, balsam fir, and northern white cedar began to dominate these growth stages.

### Function

Wind was the dominant disturbance in this ecosystem, with an estimated stand replacement return interval of 250-500 years. Stand replacement fires occurred at intervals of 300-600 years. Surface fires occurred, but they did not cause significant tree mortality or affect successional trajectory.

Outbreaks of the eastern spruce budworm caused mortality of balsam fir and white spruce stands, and stand replacement fires frequently followed these epidemics. This created conditions favorable to establishment of even-aged aspen, paper birch, and tamarack stands.

Individual tree mortality and small groups of blown down trees provided release or regeneration opportunities for the mixture of species present.

Without disturbance the stands tended toward a northern hardwood climax without sugar maple. These sites are too wet for sugar maple to competitively reach climax. Thus the climax stand would be a mixture of red maple, basswood, balsam fir, white spruce, white pine, black ash and bur oak. The trees requiring more light regenerate in small openings created by trees that have blown down.

## Vegetation Objectives

**Stand Diversity Objectives for Boreal Harwood-Conifer LE by Alternative** (percent of the LE dominated by a forest type)

Forest Types	Existing 2001	Alternatives						
		A	B	C	D	E	F	G
	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
Aspen	66	Not	14	66	10	50	24	35
Northern Hardwood	11	By	26	10	28	12	23	19
Spruce-Fir	11	LE	39	11	51	22	32	27
Paper Birch	7		7	7	5	7	7	7
Red Pine	4		4	4	4	4	4	4
White Pine	1		10	2	2	5	10	8
total	100	0	100	100	100	100	100	100

**Age Classes Objectives for Boreal Hardwood-Conifer LE by Alternative** (percent of the LE dominated by an age class)

Age Class	Existing 2001	Alternatives						
		A	B	C	D	E	F	G
	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
1-15	23	Not	7.5	22	3	14	8.9	12.0
16-35	28	By	10.0	30	5	19	11.4	15.4
36-75	29	LE	20.0	30	10	38	28.3	31.0
76-175	20		32.0	8	41	20	27.5	22.0
175+	0		31.0	10	41	9	23.9	20.0
total	100	0	101	100	100	100	100	100

**Species Diversity Objectives by Alternative for Boreal Hardwood-Conifer LE by Alternative**

+ = increase from existing condition

m = maintain existing condition

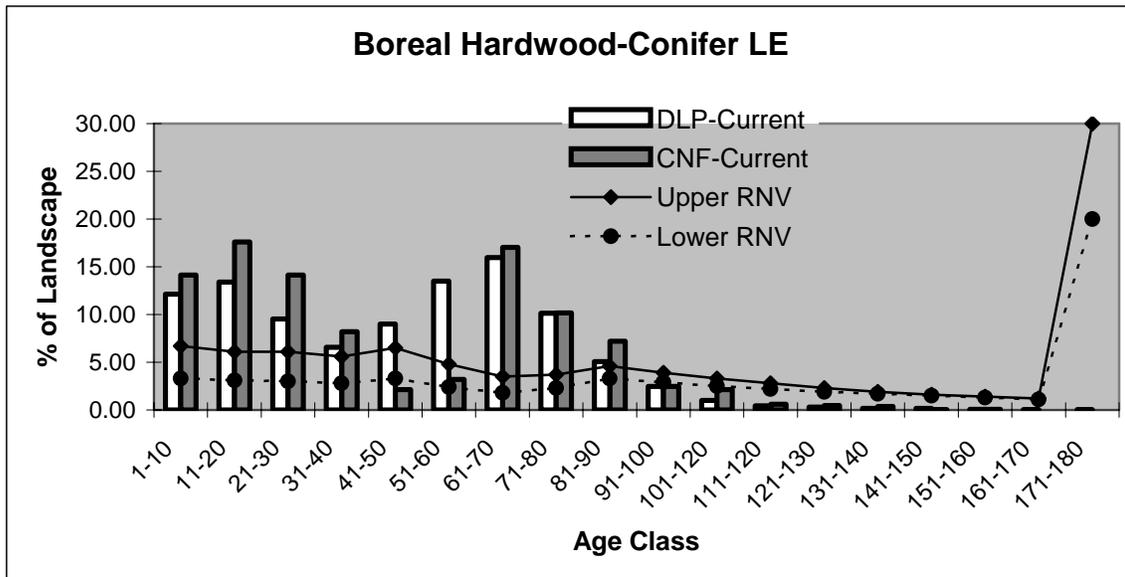
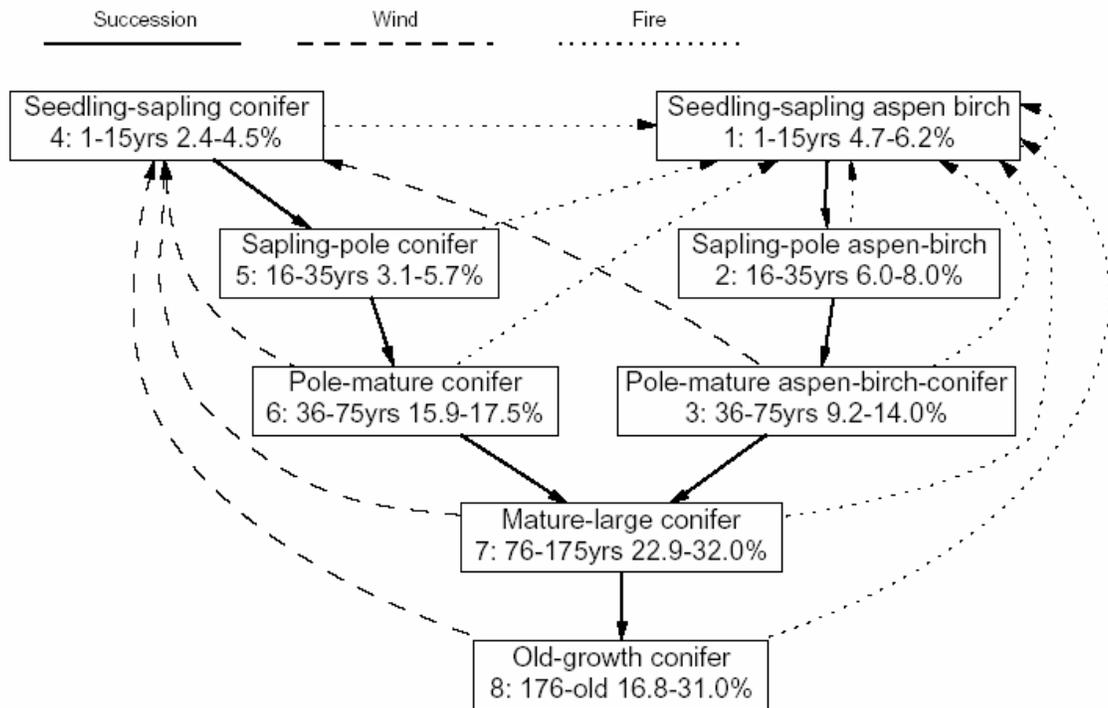
- = decrease from existing condition

blank=no objective set

Species	Past Condition (GLO)	Existing Condition (FIA 1990)	Alternatives						
			A	B	C	D	E	F	G
	(%)	(%)							
Bur oak	0.3	0.8		+		+	+	+	+
Aspen	13.0	30.4		-	m	-	-	-	-
Paper birch	11.7	6.7		m	m	-	m	m	m
Red maple	1.5	2.0		+	m	+	+	+	+
Basswood	1.2	2.8		+	+	+	+	+	+
Green ash	2.3	9.9							
Black ash	in above, green ash #								
White cedar	11.2	5.5		+	+	+	+	+	+
White pine	4.6	0.7		+	+	+	+	+	+
Balsam fir	9.2	12.4		+	m	+	+	+	+
Tamarack	21.5	3.2		+	+	+	+	+	+
White spruce	13.6	10.2		+	+	+	+	+	+
Jack/red pine	3.5	1.8						+	
Balsam poplar	0.8	6.7							
Sugar maple	0.7	2.9							
total	95.1	96.0							

**Figure GEIS-3. Range of natural variability for the Boreal Hardwood-Conifer LE**

Frelich type 7: Mesic boreal hardwood forest  
 Shadis type 1: Boreal Hardwood-Conifer  
 Disturbance interval (years) - Wind: 250-500 Fire: 300-600 Ground Fire: N/A



DLP is all forested lands on all ownerships within the LE in the Drift and Lake Plains Section  
 CNF is all forested lands administered by the Chippewa National Forest within the LE

## Mesic Northern Hardwood Landscape Ecosystem

(Includes the Rich Hardwood system, a minor component on Chippewa NF)

### Composition and Structure

This LE usually occurs on fine-textured, well-drained, gently rolling till plains or stagnation moraines. Historically, the canopy was dominated by sugar maple, basswood, and paper birch. Often listed as associated species present in minor amounts are yellow birch, bur oak and northern red oak. Rare were balsam fir, red pine, white pine and northern white cedar, which are never abundant.

Sugar maple, basswood and ironwood are the major understory trees and would comprise the species present in the main canopy of any stand undisturbed for long periods.

These were all-age stands dependant on individual tree or small group mortality to release trees established in the understory. Patches ranged from ¼ acre to 10s of acres in the younger growth stages, and from 10s-1000s of acres of contiguous forest in the old growth stage. Over three-quarters of the landscape occurred in the older growth stages.

This LE had the largest concentration of small (1/4-2 acres in size) wetlands/vernal pools of all the LEs.

### Vegetation Growth Stages

*Seedling-Sapling Birch/Aspen-Maple Growth Stage (0-15 years)* – Paper birch and aspen dominated areas disturbed by stand replacement fires, but many other species were present, including yellow birch, bur oak, red oak, balsam fir, green ash, red maple, elm, white spruce, and white pine.

Sugar maple (with basswood and ironwood present) dominated areas disturbed by wind.

*Sapling-Pole Birch/Aspen-Maple Growth Stage (16-35 years)* – Paper birch and aspen continued to dominate the stands created by fire, but all the tree species listed in the seedling-sapling growth stage could have been present.

Sugar maple dominance would have continued in areas disturbed by wind.

*Pole-Mature Birch/Pine/Aspen-Mature Maple Growth Stage (3-75 years)* – The aspen and paper birch continued to dominate. The composition of white pine and the other trees species increased in the canopy layer. The understory included a diverse mix of shade-tolerant species such as balsam fir, sugar maple, and basswood.

Sugar maple continues to dominate the areas disturbed by wind.

*Mature-Large Birch/Pine/Maple Growth Stage (76-120 years)* – The aspen and paper birch are replaced by northern hardwood species and conifer species that live longer and can regenerate without a disturbance.

Sugar maple continues to dominate the areas disturbed by wind.

*Old-Growth Pine/Maple Growth Stage (121-195 years)* - The areas previously disturbed are dominated by northern hardwood species with a scattered white pine supercanopy tree. The fire origin stands have a larger component of light requiring species, such as: white pine, bur oak, red oak, yellow birch and green ash mixed with sugar maple and basswood. The wind disturbed areas are dominated by sugar maple and basswood.

*Old-growth Maple* (>195 years) – This stage is dominated by sugar maple.

### Function

This ecosystem experienced large-scale wind and stand replacement fire events every 1000-2000 years. Moderate intensity ground fires were infrequent in this LE. Regeneration occurred primarily by gap-phase replacement so stands usually were all-aged.

Very infrequent stand replacement fires increased tree species diversity by killing the trees and preparing a seedbed suitable for seral species. This allowed invasion by aspen and paper birch, which in turn were replaced by a host of longer-lived species (including white pine and oak species). Eventually, without further disturbance, sugar maple and basswood again dominated the site.

The more common wind disturbance events occurred at small gap-phase opening sizes of ¼ acre to 10s of acres in size. These disturbances released the sugar maple seedlings/saplings that were present in the understory. This same replacement with sugar maple occurred in the larger scale wind disturbance events when stand replacement fires did not follow the wind event.

### Vegetation Objectives

#### Stand Diversity Objectives for Mesic Northern Hardwood and Rich Hardwoods LEs (percent of the LEs dominated by a forest type)

Forest Types	Existing 2001 (%)	Alternatives						
		A (%)	B (%)	C (%)	D (%)	E (%)	F (%)	G (%)
N. Hardwood	31	Not	84	31	88	54	84	75
Aspen	47	by	2	47	1	24	4	4
Spruce/fir	6	LE	6	6	6	6	6	6
Red Pine	3		3	3	3	3	3	3
Paper Birch	10		3	10	1	10	1	10
Oak	1		1	2	0	2	1	1
White Pine	1		1	1	1	1	1	1
total	99		100	100	100	100	100	100

#### Age Classes Objectives for Mesic Northern Hardwood and Rich Hardwoods LEs (percent of the LEs dominated by an age class)

Age Class	Existing 2001 (%)	Alternatives						
		A (%)	B (%)	C (%)	D (%)	E (%)	F (%)	G (%)
1-15	13	Not	1.3	17	0.7	9	2.15	5
16-35	20	By	1.7	22	0.9	12	2.85	6.6
36-75	35	LE	3.4	22	1.8	24	5.35	13.2
76-120	28		3.8	3	2.0	14	5.32	15
121-195	4		6.4	3	3.4	24	8.43	25
195+	*		83	33	91	17	75.9	35
total	100	0	100	100	100	100	100	100

\* included in 121-195

**Species Diversity Objectives for Mesic Northern Hardwood and Rich Hardwoods LEs**

+ = increase from existing condition through active management

+\* = increase from existing condition through succession

m = maintain existing condition

- = decrease from existing condition through active management

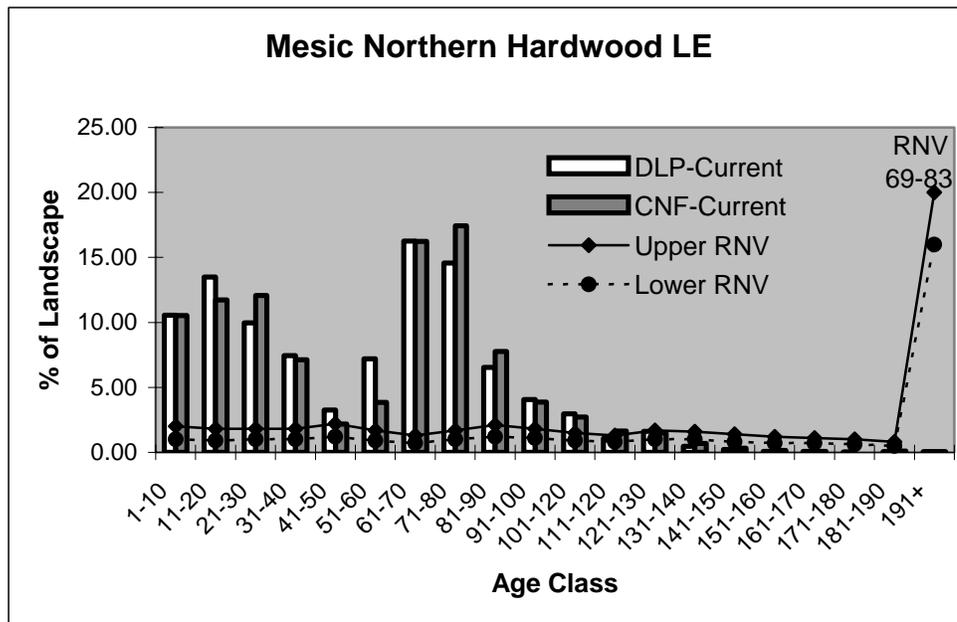
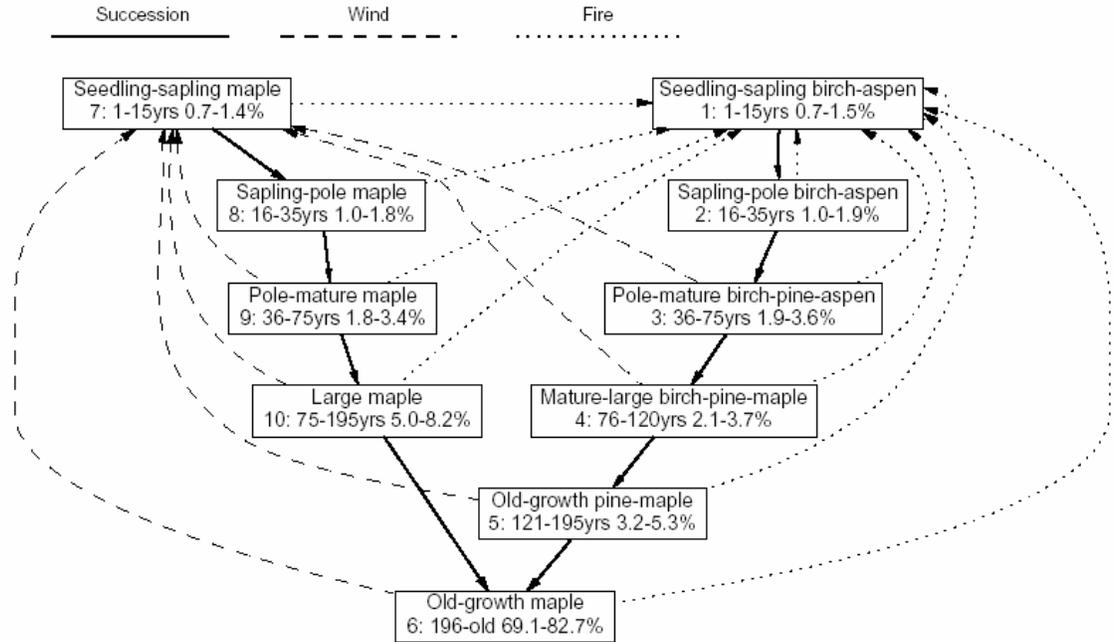
-\* = decrease from existing condition through succession

blank=no objective set

Species	Past Condition (GLO)	Existing Condition (FIA 1990)	Alternatives						
	(%)	(%)	A	B	C	D	E	F	G
Paper birch	16.0	9.0	Not	-	m	-	m	+	m
Aspen	11.0	32.0	By	-	m	-	-	-	-
White pine	9.0	0.5	LE	+	+	+	+	+	+
Balsam fir	9.0	3.0		+	+	+	+	+	+
Tamarack	8.0	1.0		+	+	+	+	+	+
Red maple	7.0	4.0							
Sugar maple	7.0	10.0		+*	m	+*	+*	+*	+*
White cedar	7.0	1.0		+	m	m	m	+	+
Basswood	5.0	9.0							
Elm	2.7	2.6							
Ash	2.3	7.5							
Ironwood	1.7	1.4							
Jack pine	1.0	0.5		m	m	m	m	m	m
Yellow birch	0.8	1.1		+	+	+	+	+	+
Red oak	0.5	2.0		m	+	-*	+	m	m
Bur oak	0.5	2.0							
total	89	87							

**Figure GEIS-5. Range of natural variability for the Mesic Northern Hardwood LE**

Frelich type 9: Mesic northern hardwood forest  
 Shadis type 8: Mesic Northern Hardwood  
 Disturbance interval (years) - Wind: 1000-2000 Fire: 1000-2000 Ground Fire: N/A



DLP is all forested lands on all ownerships within the LE in the Drift and Lake Plains Section  
 CNF is all forested lands administered by the Chippewa National Forest within the LE

## Tamarack Swamp Landscape Ecosystem

12% of LE is Chippewa NF administered lands

### Composition and Structure

Tamarack is the dominant tree species that occurs on this system. The composition of our lowland conifer systems is influenced by the pH of the wetland. This system occurs between the more acidic black spruce wetlands and the more neutral cedar wetlands.

Tamarack is classed as intolerant of shade. Black spruce also occurs in this ecosystem and can be a canopy dominant tree.

### Vegetation Growth Stages

Seedling tamarack (0-20 years) – This growth stage is dominated by tamarack.

Sapling-pole tamarack (21-55 years) – Same as above.

Pole-mature tamarack (56-75 years) – Same as above.

Old growth tamarack (>75 years) – Same as above.

### Function

Stand replacing fire events occur at intervals of 100 to 200 years, while stand replacing wind events occur at intervals of 100 to 350 years.

Either stand replacement disturbance returns the vegetation growth stage to seedling tamarack stage. Fire can occur during any growth stage, while wind is limited to the pole-mature and old growth stages.

Stand maintenance disturbances occur but do not affect successional trajectory.

## Vegetation Objectives

**Stand Diversity Objectives for Tamarack Swamp LE (also includes Forested Poor Fen and Forested Bog) by Alternative (percent of the LE dominated by a forest type)**

Forest Type	Existing 2001 (%)	Alternatives						
		A (%)	B (%)	C (%)	D (%)	E (%)	F (%)	G (%)
<b>Lowland</b>	does not include uplands							
Tamarack	29	Not	29	29	29	29	29	29
Mixed Lowland Conifer	24	By	24	24	24	24	24	24
Lowland Spruce	21	LE	21	21	21	21	21	21
Cedar	16		16	16	16	16	16	16
Lowland hwdws	10		10	10	10	10	10	10
<b>Upland</b>	does not include lowlands							
Aspen	64		22	57	10	45	28	35
Northern Hardwoods	11		15	11	20	11	11	11
Paper birch	8		4	5	2	8	5	5
Red Pine	8		12	16	10	14	12	12
Spruce-fir	8		34	8	43	16	33	27
Jack Pine	0		6	1	6	2	6	4
White Pine	0		5	2	6	3	4	4
Cedar	0		2	0	3	1	1	2
total			100	100	100	100	100	100

**Age Class Objectives for Tamarack Swamp LE (also includes Forested Poor Fen and Forested Bog) by Alternative (percent of the LE in an age class)**

Age Class	Existing 2001	Alternatives						
		A (%)	B (%)	C (%)	D (%)	E (%)	F (%)	G (%)
<b>Uplands</b>								
1-15	17	Not	7.5	17.0	3.0	14.0	8.9	12.0
16-35	23	By	10.0	23.0	5.0	19.0	11.4	15.4
36-75	34	LE	20.0	44.0	10.0	38.0	28.3	31.0
76-175	27		32.0	15.0	41.0	20.0	27.5	22.0
175+	0		31.0	1.0	41.0	9.0	23.9	20.0
total	101		100.5	100.0	100.0	100.0	100.0	100.4
<b>Lowlands</b>								
1-10	1		4.0	8.0	2.0	6.5	7.0	4.5
11-20	2		4.0	8.0	2.0	6.5	7.0	4.5
21-60	13		16.0	32.0	8.0	26.0	22.0	18.0
61-80	14		8.0	16.0	4.0	13.0	10.0	9.0
81-100	26		8.0	16.0	4.0	13.0	8.0	9.0
101+	44		60.0	21.0	80.0	35.0	47.0	55.0
total	100		100	101	100	100	101	100

### Species Diversity Objectives for Tamarack Swamp LE (also includes Forested Poor Fen and Forested Bog) by Alternative

+ = increase existing condition

m = maintain existing condition

- = decrease existing condition

blanc = no objective set

Species	Past Condition (GLO)	Existing Condition (FIA 1990)	Alternative						
			A	B	C	D	E	F	G
	(%)	(%)							
Tamarack	53.0	21.0		+	+	+	+	+	+
Spruce	13.0	16.0		+	+	+	+	+	+
White Cedar	13.0	16.0		+		+	+	+	+
Aspen	5.7	12.6		-	-	-	-	-	-
Paper Birch	3.7	6.5		-	-	-	m	-	-
Red Pine	2.6	1.5		+	+	+	+	+	+
Jack Pine	2.1	0.2		+	+	+	+	+	+
Balsam Fir	1.7	11.5		+	m	+	+	+	+
White Pine	1.4	0.1		+	+	+	+	+	+
Red Maple	0.3	1.5						-	
Sugar Maple	0.2	0.5						-	
Ash	0.8	6.2						-	
Balsam Poplar	0.2	4.2						-	
Elm	0.4	0.9						-	
total	98.10	98.10							

## Forested Poor Fen/Forested Bog Landscape Ecosystem

(Acreage percent and vegetation objectives included in Tamarack Swamp LE)

### Composition and Structure

These are acid peatland systems.

This is a combination of two Native Plant Communities. The Forested Bog is considered unproductive for timber management due to the low productivity of this system. The trees seldom obtain merchantable size and stocking is often low. Only black spruce exists on this highly acid system. It is a minor component on lands managed by the Chippewa National Forest (State owns most of the peatlands).

Forested Poor Fen is the more productive lowland system. The following descriptions are from this system.

Historically, this LE was dominated by tamarack and black spruce. Over one-half of the landscape was characterized by old growth.

### Vegetation Growth Stages

*Seedling-Sapling Tamarack Vegetation Growth Stage (0-35 years)* – This growth stage was dominated by stands of tamarack, but black spruce also occurred.

*Sapling-Pole Tamarack/Black Spruce Growth Stage (36-75 years)* – This growth stage included the same species as above–tamarack and black spruce.

*Pole-Mature Tamarack/Black Spruce Growth Stage (76-100 years)* – This growth stage included the same species as above–tamarack and black spruce.

*Old Growth Tamarack/Black Spruce Growth Stage (>100 years)* – This growth stage included the same species as above–tamarack and black spruce.

### Function

Stand replacing wind and fire events are estimated to have occurred at the same frequency of 200 to 400 years.

Stand replacement fire returned all growth stages to a seedling-sapling stage dominated by tamarack. Black spruce would also regenerate after the fire disturbance. Tamarack is a faster growing tree and is able to overtop the black spruce. By age 150, the shorter-lived tamarack reached it's normal life span and was replaced by black spruce.

See Tamarack Swamp LE for objectives by alternative

## Semi-terrestrial White Cedar and White Cedar Swamp Landscape Ecosystems

(6% of LE is Chippewa NF administered lands)

### Composition and Structure

White Cedar Swamp is more common than Semi-terrestrial White Cedar on the Chippewa lands within the Northern Minnesota Drift and Lake Plains Section. The White Cedar Swamp system is dominated by northern white cedar and balsam fir. The Semi-terrestrial White Cedar system is dominated by northern white cedar and balsam fir with occasionally paper birch. The following descriptions pertain to the White Cedar Swamp system.

### Vegetation Growth Stages

*Seedling-sapling tamarack/cedar-spruce* (0-25 years, percent of the LE) – Fire creates a seedling-sapling tamarack growth stage, while wind events create a seedling-sapling cedar-spruce growth stage. The northern white cedar and black spruce would be present in the seedling-sapling tamarack growth stage also, but only minor amounts of tamarack would be present in the seedling-sapling cedar-spruce growth stage. Tamarack is a light demanding species that does not do well in an understory situation.

*Seedling-sapling tamarack/sapling-pole cedar-spruce*(26-55 years) – Similar to above description, except older.

*Sapling-pole tamarack/pole-mature tamarack-cedar/mature cedar-spruce*(56-110 years) – Same as above.

*Old growth cedar-spruce*(>110 years) – During this stage, tamarack reaches it's normal life span of 150 years, thus this growth stage is dominated by northern white cedar and black spruce.

### Function

Wind is the more common disturbance agent occurring at intervals of 200-400 years. These wind events impact pole size and large stands, returning them to the seedling-sapling growth stages. Tree species dominating the post wind event stands would include northern white cedar and black spruce.

Stand replacement fire is estimated to occur at intervals between 400-800 years. These fires would return any growth stage back to the seedling-sapling tamarack stage. Fire creates an excellent seed bed for tamarack.

Climax stand conditions after a long period without a disturbance is estimated to be a multi-aged, mixed stand of northern white cedar and black spruce.

## Vegetation Objectives

### Stand Diversity Objectives for White Cedar Swamp and Semi-terrestrial White Cedar LEs by Alternative (percent of the LEs dominated by a forest type)

Forest Types	Existing 2001	Alternatives						
		A	B	C	D	E	F	G
	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
Cedar	6.2	Not	30	6	34	17	28	30
Aspen	63	By	18	60	8	42	25	22
Lowland hdwds	18	LE	18	18	18	18	18	18
Spruce-Fir	3		21	6	28	13	16	17
Lowland Spruce*	8		10	8	10	8	10	10
Tamarack*	1		2	1	1	1	2	2
Other	1		1	1	1	1	1	1
total	100	0	100	100	100	100	100	100

\* increases of these forest types would occur on upland sites

### Age Classes Objectives for White Cedar Swamp and Semi-terrestrial White Cedar LEs by Alternative (percent of the LEs dominated by an age class)

Age Class	Existing 2001	Alternatives						
		A	B	C	D	E	F	G
	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
0-10	12	Not	2.2	7.9	1.1	6.0	3.2	3.8
11-30	23	By	4.4	15.8	2.2	12.0	6.4	7.6
31-55	7	LE	5.5	20.0	2.8	15.0	8.0	9.5
56-75	21		4.4	15.8	2.2	12.0	6.4	7.6
76-100	18		5.5	20.0	2.8	15.0	8.0	9.5
101-110	4		2.0	7.9	1.1	6.0	3.2	3.8
>110	14		76.0	12.6	88.0	34.0	65.0	58.2
total	100	0	100	100	100	100	100	100

### Species Diversity Objectives for White Cedar Swamp and Semi-terrestrial White Cedar LEs by Alternative

+ = increase from existing condition through active management

+\* = increase from existing condition through succession

m = maintain existing condition

- = decrease from existing condition through active management

-\* = decrease from existing condition through succession

blank = no objective set

Species	Past Condition (GLO)	Existing Condition (FIA 1990)	Alternatives						
	(%)	(%)	A	B	C	D	E	F	G
White Cedar	28.0	10.0		+	+	+	+	+	+
White Spruce	23.0	8.0		+*	+*	+*	+*	+*	+*
Tamarack	17.0	0.25		+	+	+	+	+	+
Balsam Fir	11.0	15.0		+	+	+	+	+	+
Aspen	4.5	21.0		-	-	-	-	-	-
Paper Birch	4.0	6.0		-		-	-	-	-
White Pine	3.0	0.25		+	+	+	+	+	+
Black Ash	3.0	14.0		m	m	m	m	m	m
Poplar	2.0	17.0		-	-	-	-	-	-
Red Pine	1.0	0.25							
Sugar Maple	0.2	3.0							
Basswood	0.2	2.0							
Black Spruce	Included in White spruce	Included in White spruce		+	+*	+	+	+	+
total	97	97							

## Semi-Terrestrial Black Ash/Black Ash Swamp Landscape Ecosystem

(Note: The disturbance information available is titled: Semi-terrestrial black ash forest and may not apply to the black ash swamp; not included in map or acreage of Section)

### Composition and Structure

Historically, this LE was dominated by black ash stands. Stands contained a mix of black ash with northern white cedar, balsam fir, paper birch, balsam poplar and aspen in the semi-terrestrial system. Frequently, black ash was the only species present in the black ash swamp system.

These black ash stands were both even-aged, with a single canopy level, and multi-aged. Trees in the multi-aged stands varied in diameters and heights. Normally, these stands in the black ash swamp system appeared somewhat open, rather than fully stocked with trees. Over one-half of the landscape was characterized as old growth.

The semi-terrestrial black ash forest commonly occurred on perched water tables within other upland communities.

The black ash swamp occurred in wet areas with flowing water. It was commonly a narrow stringer of trees between the channel and uplands. Sedges dominated the associated plant species.

### Vegetation Growth Stages

*Seedling-Sapling Black Ash/Balsam Poplar Growth Stage (0-20 years)* – This growth stage is dominated by black ash. In the semi-terrestrial system the associated species are also present (balsam poplar, northern white cedar, balsam fir, paper birch, aspen).

*Sapling-Pole Aspen/Black Ash/Balsam Poplar Growth Stage (21-55 years)* – Same species as above.

*Pole-Mature Black Ash/Balsam Poplar/Elm Growth Stage (56-120 years)* – This growth stage included the same types as those in the 20-59 years stage. As the short-lived aspen, balsam poplar, balsam fir and paper birch reached their normal life span, the longer lived black ash and northern white cedar would dominate the stocking.

*Old Growth Black Ash Growth Stage (>120 years)* – This growth stage was dominated by black ash and occasionally northern white cedar.

### Function

Wind was the dominant disturbance in this ecosystem. Time periods between stand-replacing wind events are estimated to have been 200-500 years. Stand-replacing fires are estimated to have occurred at intervals of 1000-2000 years. Low-intensity surface fires did not cause significant tree mortality.

Vegetation Objectives by alternative are not displayed. This community occurs in small stands that are not shown on the LE map due to scale. Managers use forest types to locate stands within this community. Forest types are not identified to change with management activities. Only harvest activity would be multi-aged harvesting in alternatives A, B, C, E, F and G. Harvesting would not occur in Alternative D within this LE.

## Vegetation Objectives for Lowland conifers located within upland LEs on Drift and Lake Plains within Chippewa National Forest

Vegetation objectives for lowland forests do not suggest changes in forest types, only in age classes.

### Age Class Objectives for Lowland Forest Types in Dry Pine LE (percent of the LE dominated by an age class)

Age Class	Existing 2001 (%)	Alternatives						
		A (%)	B (%)	C (%)	D (%)	E (%)	F (%)	G (%)
1-15	1	Not	14	15	10	14	17.8	15
16-35	10	By	18	19	13	19	19.9	20
36-75	17	LE	37	39	25	38	22.3	40
76-175	72		16	22	27	23	23.6	15
175+	0		15	5	25	6	16.6	10
<b>totals</b>	<b>100</b>	<b>0</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>

These objectives are the same as the upland objectives. Recommend using them due to the small number of acres of lowland types within this LE.

### Age Class Objectives for Lowland Forest Types in Dry-mesic Pine-Oak LE (percent of the LE dominated by an age class)

Age Class	Existing 2001 (%)	Mid Point of RNV (%)	Alternatives						
			A (%)	B (%)	C (%)	D (%)	E (%)	F (%)	G (%)
1-10	<1	2.1	Not	1.48	7.90	0.48	2.70	2.10	2.10
11-20	2	2.1	by	1.48	7.90	0.48	2.70	2.10	2.10
21-30	<1	2.1	LE	1.48	7.90	0.48	2.70	2.10	2.10
31-40	1	2.1		1.48	7.90	0.48	2.70	2.10	2.10
41-50	2	2.1		1.48	7.90	0.48	2.70	2.10	2.10
51-60	3	2.1		1.48	7.90	0.48	2.70	2.10	2.10
61-70	5	2.1		1.48	7.90	0.48	2.70	2.10	2.10
71-80	10	2.1		1.48	7.90	0.48	2.70	2.10	2.10
81-120	59	15.0		16.00	30.00	17.00	14.00	15.00	15.00
121+	16	68.0		72.00	7.00	79.00	64.00	68.00	68.00
<b>total</b>	<b>100</b>	<b>100</b>		<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>

**Age Class Objectives for Lowland Forest Types in Dry-mesic Pine LE (percent of the LE dominated by an age class)**

Age Class	Mid Point of RNV	Existing 2001	Alternatives						
			A	B	C	D	E	F	G
	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
1-10	3.6	0	Not	2.5	7.9	1.0	4.6	3.6	3.6
11-20	3.6	1	By	2.5	7.9	1.0	4.6	3.6	3.6
21-30	3.6	1	LE	2.5	7.9	1.0	4.6	3.6	3.6
31-40	3.6	2		2.5	7.9	1.0	4.6	3.6	3.6
41-50	3.6	1		2.5	7.9	1.0	4.6	3.6	3.6
51-60	3.6	1		2.5	7.9	1.0	4.6	3.6	3.6
61-70	3.6	4		2.5	7.9	1.0	4.6	3.6	3.6
71-80	3.6	14		2.5	7.9	1.0	4.6	3.6	3.6
81-120	13	60		14	30	17	11	13	13
121+	58	16		66	7	75	52	58	58
total	100	100		100	100	100	100	100	100

**Age Class Objectives for Lowland Forest Types in Boreal Hardwood-Conifer LE (percent of the LE dominated by an age class)**

Age Class	Mid Point of RNV	Existing 2001	Alternatives						
			A	B	C	D	E	F	G
	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
1-10	4.6	1	Not	3.9	7.9	3.15	5.5	4.6	4.6
11-20	4.6	3	By	3.9	7.9	3.15	5.5	4.6	4.6
21-30	4.6	1	LE	3.9	7.9	3.15	5.5	4.6	4.6
31-40	4.6	1		3.9	7.9	3.15	5.5	4.6	4.6
41-50	4.6	1		3.9	7.9	3.15	5.5	4.6	4.6
51-60	4.6	2		3.9	7.9	3.15	5.5	4.6	4.6
61-70	4.6	6		3.9	7.9	3.15	5.5	4.6	4.6
71-80	4.6	10		3.9	7.9	3.15	5.5	4.6	4.6
81-120	11	57		12.0	31.0	14.00	10.0	11.0	11.0
121+	52	19		57.0	6.0	61.00	46.0	52.0	52.0
total	100	101	0	100	100	100	100	100	100

**Age Class Objectives for Lowland Forest Types in Mesic Northern Hardwood LEs**  
(percent of the LEs dominated by an age class)

Age Class	Mid Point of RNV (%)	Existing 2001 (%)	Alternatives						
			A	B	C	D	E	F	G
				(%)	(%)	(%)	(%)	(%)	(%)
1-10	1.2	0	Not	0.9	7.9	0.73	2.0	1.2	1.2
11-20	1.2	0	By	0.9	7.9	0.73	2.0	1.2	1.2
21-30	1.2	1	LE	0.9	7.9	0.73	2.0	1.2	1.2
31-40	1.2	2		0.9	7.9	0.73	2.0	1.2	1.2
41-50	1.2	1		0.9	7.9	0.73	2.0	1.2	1.2
51-60	1.2	3		0.9	7.9	0.73	2.0	1.2	1.2
61-70	1.2	7		0.9	7.9	0.73	2.0	1.2	1.2
71-80	1.2	13		0.9	7.9	0.73	2.0	1.2	1.2
81-120	16	55		17.0	29.4	17.0	15.0	16.0	16.0
121+	74.5	18		76.0	7.6	77.0	69.0	74.5	74.5
total	100	100	0	100	100	100	100	100	100

## Northern Superior Uplands Section

### Introduction

The narratives for each LE describe the composition, structure, and function of the ecosystems. Vegetation growth stages are described in terms of tree species and age to allow relating this information to national forest inventory data. These narratives are summaries of information found in several documents, including:

- The Boundary Waters wilderness Ecosystem by Miron Heinselman (1996)
- “Range of Natural Variability in Forest Structure for the Northern Superior Uplands” by Lee Frelich (1999)
- Draft “Native Plant Communities of the Northern Superior Uplands: Forest Supersystem” by K. Rusterholz (2002) Numerous personal contacts with the authors identified and other individuals.

These documents are available in the official record. They are documents that have not been published with the exception of the text by Heinselman.

The range of natural variability for each LE is depicted graphically. The graphics show disturbance intervals for each vegetation growth stage and estimates of the historical and current amount of each vegetation growth stage (ten year increments) for all ownerships within the Section and for the Superior National Forest. This information is from “Northern Superior Uplands: A comparison of Range of Natural Variation and current conditions” by Brown and White (2001).

The vegetation objectives identified for each alternative are shown after the graphics. Objectives were determined for each LE individually.

Figure 2-3 shows the ecosystem types delineated by NRRI (2000) for the Northern Superior Uplands Section.

## Jack Pine-Black Spruce Landscape Ecosystem

### Composition and Structure

Two jack pine systems are described by Frelich (1999). The jack pine-aspen-oak system is found only in the northwestern corner of the Section, mostly within the Voyageurs National Park. Less than 300 acres are identified within the Superior National Forest. The following description is for the dominant Jack Pine-Black Spruce System.

The Jack Pine-Black Spruce System occurs on dry sites with coarse textured soils or thin soils over bedrock.

Jack pine and black spruce dominate the canopy, either individually or as a mixed type. Aspen and paper birch are occasionally present in lesser amounts, although aspen can become the cover type under certain conditions. Balsam fir is usually absent in the canopy.

### Vegetation Growth Stages

*Seedling jack pine/fir-spruce-cedar* (1-10 years of age) Jack pine is the dominant species following fire. Aspen, paper birch, black spruce and balsam fir may also be present. Typically, most species will be present within a few years following the fire that will compose the later age classes.

Black spruce is the dominant species following a wind disturbance, although balsam fir is also present.

*Sapling jack pine/seedling fir-spruce-cedar* (11-20 years of age) Jack pine dominates sites after a fire and black spruce dominates after a wind disturbance.

*Pole jack pine/seedling fir-spruce-cedar* (21-30 years of age) As above.

*Pole jack pine/sapling fir-spruce-cedar* (31-50 years of age) As above.

*Mature jack pine/pole-mature fir-spruce-cedar* (51-70 years of age) As above.

*Large jack pine/pole-mature fir-spruce-cedar* (71-80 years of age) As above.

*Multi-aged fir-spruce-cedar* (>80 years of age) Only applies to wind origin stands dominated by black spruce.

*Large jack pine* (81-110 years of age) Only applies to jack pine stands originating after fire.

*Jack pine-fir-spruce* (111-180 years of age) Only applies to jack pine stands originating after fire.

*Multi-aged fir-spruce-cedar* (>180) Applies to jack pine stands originating after fire and same vegetation growth stage as the '>80 years of age' that originated from a wind disturbance.

### Function

Fire is the most common stand replacement disturbance, estimated to occur at 50-100 year intervals. Stand replacement wind events are estimated to occur at intervals of 1000-2000 years.

Dense jack pine stands are common following a stand replacement fire. Jack pine and black spruce have

serotinous or semi-serotinous cones that shed lots of seed following a fire. These two species have sufficient seed stored in cones at age 15 to 30 for regenerating a burned site.

Typically, most species will be present within a few years following the fire that will compose the later age classes. The stand replacement fire may kill the balsam fir seed source, slowing the regeneration invasion of this species.

The more shade tolerant black spruce and balsam fir are able to germinate and survive in the understory and the stocking slowly increases without a disturbance.

Quaking aspen can readily seed in after a stand replacement fire. Usually the jack pine seedlings will outgrow aspen seedlings as this is not a good growing site for aspen.

After age 80, mortality in the jack pine starts to allow more light into the understory. By 110 years of age the stand has become a mixed stand of jack pine and black spruce. Succession into a multi-aged black spruce type has been accomplished by 180 years after the fire disturbance. Black spruce and balsam fir are considered the climax trees on this system without a disturbance.

Wind events occur at longer intervals. The composition and succession is simply to a younger black spruce type that will initially appear even-aged, but achieve multi-aged condition by 80 years after the wind event. Balsam fir may also be present.

#### Stand Diversity Objectives for Jack Pine-Black Spruce LE – Outside the BWCAW by Alternative (percent of the LE dominated by a forest type)

Forest Types (without lowlands)	Existing all of SNF 2001 (%)	Existing outside BWCAW 2001 (%)	Alternatives						
			A	B	C	D	E	F	G
			(%)	(%)	(%)	(%)	(%)	(%)	(%)
Jack Pine	35.0	27.0	Not	40.0	38.0	9.4	45.0	35.0	60.0
Spruce-Fir	11.0	13.0	By	35.0	2.0	74.0	6.0	23.0	6.0
Aspen, Aspen/ Spruce-Fir	46.0	43.0	LE	9.0	43.0	1.9	33.0	19.0	18.0
Paper Birch	2.0	4.8		5.0	5.0	3.7	5.0	12.0	5.0
Red Pine outside/inside	4.0	9.0		9.0	9.0	9.0	9.0	9.0	9.0
White Pine	1.0	2.3		2.3	2.3	2.3	2.3	2.3	2.3
total	99	99		100	99	100	100	100	100

#### Age Classes Objectives for Jack Pine-Black Spruce LE – Outside BWCAW by Alternative (percent of the LE dominated by an age class)

Age Class	Existing 2001 (%)	Alternatives						
		A	B	C	D	E	F	G
		(%)	(%)	(%)	(%)	(%)	(%)	(%)
1-10	10	Not	6.6	15	1.5	11	13.4	8.6
11-50	20	By	26.5	61	6.0	44	35.3	34.5
51-80	13	LE	19.8	15	4.5	33	15.3	25.8
81-110	30		11.2	4	4.5	8	10.5	25.8
111-180	22		14.9	2	84.0	4	12.0	5.0
181-300	6		21.3	1	*	*	13.9	*

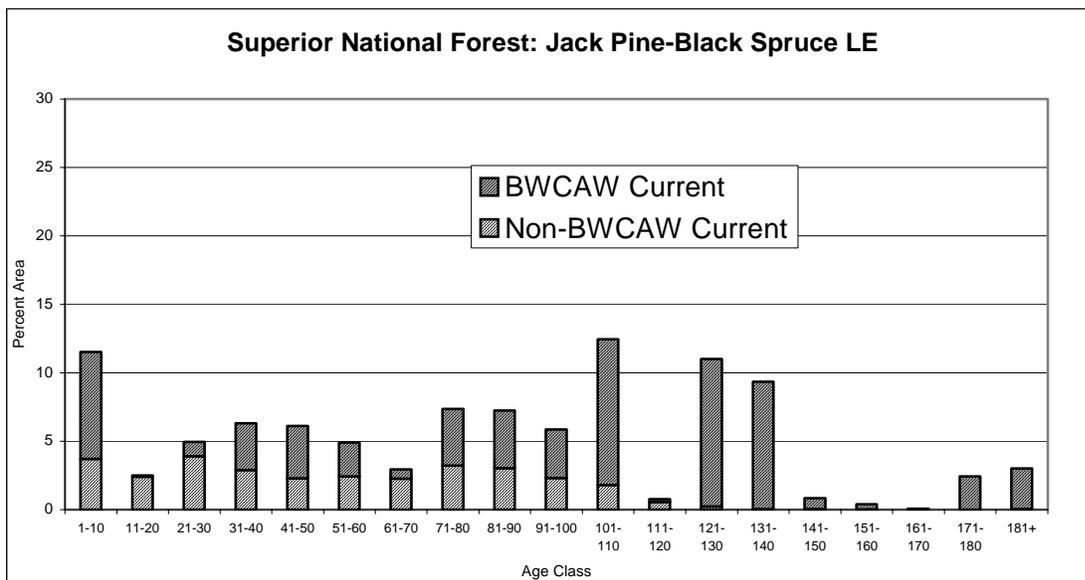
Age Class	Existing 2001	Alternatives						
		A	B	C	D	E	F	G
	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
total	101	0	100	100	101	100	100	100

\*The number above this symbol includes all older age classes, Alt D 111+ = 84%

**Species Diversity Objectives for Jack Pine-Black Spruce LE Outside BWCAW Only by Alternative**

- + = increase from existing condition through active management
- +\* = increase from existing condition through succession
- m = maintain existing condition
- = decrease from existing condition through active management
- \* = decrease from existing condition through succession
- blank = no objective set

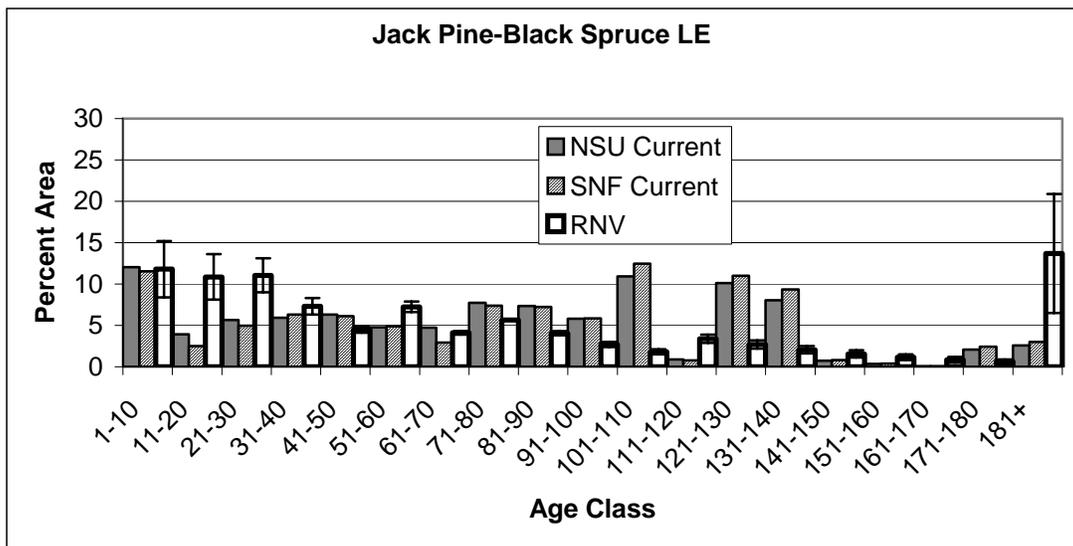
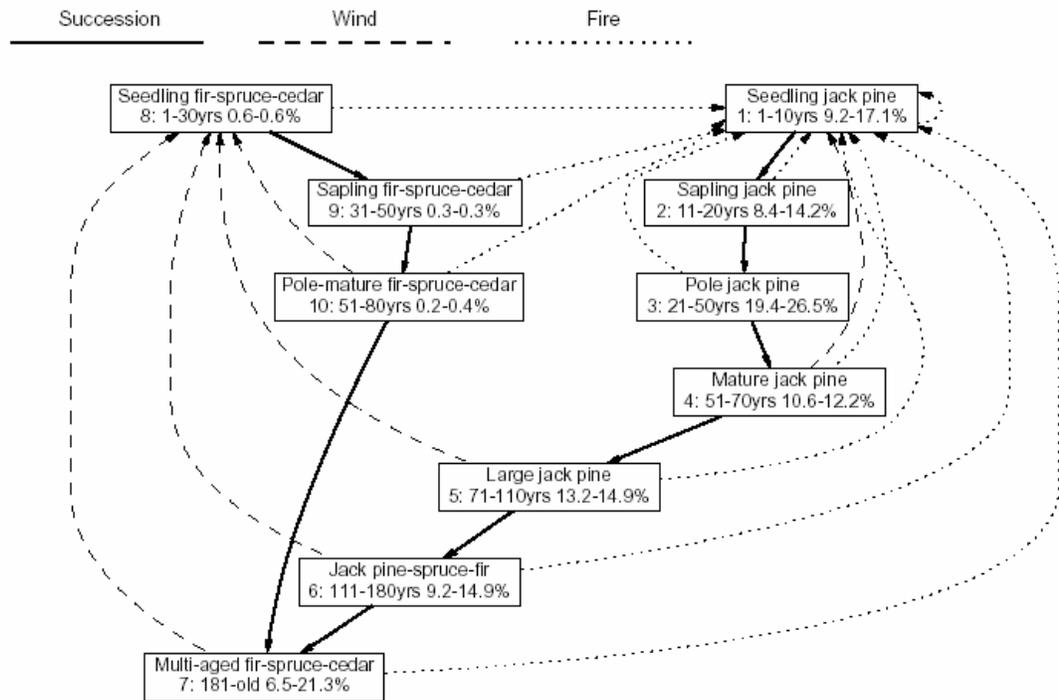
Species	Past Condition (GLO)	Existing Condition (FIA 1990)	Alternatives						
	(%)	(%)	A	B	C	D	E	F	G
Jack pine	27.6	11.1		+	+	-	+	+	+
Paper birch	14.7	14.5				-	+		+
Aspen	13.3	23.3		- *		-	-	-	-
Black spruce	13.1	17.1		+	-	+		-	+
Tamarack	8.2	1.3		+		-	+	+	+
Balsam fir	7.5	17.9		+*	-	+	-	-	+
Red pine	4.8	4.4							
White spruce	4.5	2.2		+*		-		+	+
White pine	4.2	0.9		+	+			+	+
White cedar	1.7	1.1						-	
Red maple	0.3	6.1				+			
Lowland hardwood	0.2	2.0							
Other	0.0	0.1							
total	94	93							



**Figure GEIS-23. Range of natural variability for the Jack Pine-Black Spruce LE**

Frelich type 7: Jack pine-black spruce

Disturbance interval (years) - Wind: 1000-2000 Fire: 50-100 Ground Fire: N/A



NSU is all forested lands on all ownerships within Northern Superior Uplands Section  
 SNF is all forested lands administered by Superior National Forest  
 RNV bar height is the mid-point of the RNV value, with range depicted by vertical line

## Dry-mesic Red and White Pine Landscape Ecosystem

### Composition/Structure

These were typically mixed stands that included some of the following species: aspen, paper birch, red pine, white pine, jack pine, balsam fir, black spruce, white spruce, bigtooth aspen and red maple. The jack pine, red pine and black spruce may dominate the stocking on the drier sites, with the other species more common on mesic sites.

### Vegetation Growth Stages

*Sapling birch/sapling-pole pine/sapling-pole spruce-fir* (0-10 years of age) These three stages overlap the stated age class, but originate from different disturbance situations. The sapling birch occurs in response to a stand replacement fire and would likely include: aspen, paper birch, jack pine, red pine and white pine.

The sapling-pole pine stage occurs following a wind event in a mature stand that includes understory white pine (numerous other species would also be present).

The sapling-pole spruce-fir stage occurs after a wind event in a multi-aged stand of red and white pine when the understory pine is missing.

*Pole-mature birch/sapling-pole pine/sapling-pole spruce-fir* (11-50 years of age) These three stages are similar to above.

*Mature birch-pine* (51-100 years of age) This stage includes the mixed stand that may have aspen, paper birch, jack pine, red pine and white pine. It is a stage that occurs after a stand replacement fire.

*Mature pine* (100-120 years of age) This stage is dominated by mature red and white pine following a stand replacement fire.

*Mature pine/multi-aged white pine* (120-140 years of age) The mature pine is dominated by mature red and white pine following a stand replacement fire. The multi-aged white pine would be the result of surface fire in the *multi-aged pine-spruce-fir* stage.

*Multi-aged pine-spruce-fir/multi-aged white pine* (141-200 years of age) These two stages are multi-aged. Spruce-fir regeneration would occur under the pine overstory and grow into the main canopy by this age. The white pine dominated condition arises after a surface fire and is characterized by white pine overstory and understory.

*Multi-aged spruce-fir* (>200 years of age) This is a balsam fir, white spruce and/or black spruce dominated stand.

### Function

The stand replacement events are fire at 150-300 year rotations and wind at 1000-2000 year rotations. Surface fires occur at an average of 40 years.

The severe fires will initiate stands dominated by aspen and paper birch with several other species present, including red and white pine. The aspen and birch seedlings can arise from sprouts or seed blown into the site from adjacent unburned areas. The red pine and white pine seed is from trees that survived the stand replacement

fire. Balsam fir and white spruce frequently become established immediately after the stand replacement fire from seed supplied by trees surviving in wetter, incompletely burned sites. Typically, most species will be present within a few years following the fire that will compose the later age classes.

Normally, surface fires would occur at 40 year average intervals. Small seedlings and saplings of all species would be killed. Red pine and white pine are adapted to survive low to moderate intensity surface fires by 30 to 50 years of age. These fires may provide conditions suitable for red pine and white pine regeneration.

Without fire, succession would reduce the aspen and paper birch stocking by 100 years of age, resulting in a pine cover type.

Without fire, white spruce or black spruce and balsam fir would regenerate under the canopy of pine creating a multi-aged pine-spruce-fir stand by age 140 years. If no disturbance events occurred the stand would ultimately succeed to a multi-aged spruce-fir type by age 200.

Wind events may create sapling to pole size stands by removing the taller trees and retaining the understory trees. Depending on the situation this would result in a sapling to pole size white pine stand or a sapling to pole size spruce-fir stand.

Eastern spruce budworm would play a role in stands dominated by balsam fir and white spruce. The overstory and understory white spruce and balsam fir would be killed. If the stand burned, succession would begin with the aspen and birch dominated growth stage. If fire did not occur, the small balsam fir missed in the understory would usually provide a seedling/sapling size stand that could continue to mature and ultimately become multi-aged.

Red pine and white pine survive most fires. Only the more severe crown fires would likely kill all of the red pine and white pine in an area. In this system the surface fires act to reduce ladder fuels and accumulations of fuels that would lead to the more severe crown fires.

## Vegetation Objectives

### Stand Diversity Objectives for Dry-mesic Red and White Pine LE by Alternative (percent of the LE dominated by a forest type)

Forest Types	Existing 2001	Alternatives						
		A	B	C	D	E	F	G
	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
Spruce-Fir	11	Not	48	10	55	25	38	33
Aspen	59	By	3	50	2	28	15	21
Jack Pine	10	LE	14	12	11	11	13	12
Red Pine	4		14	12	13	14	13	13
White Pine	8		14	8	14	14	13	13
Paper Birch	7		7	7	4	7	7	7
Northern hdwds	1		1	1	1	1	1	1
total	100	0	101	100	100	100	100	100

**Age Classes Objectives for Dry-mesic Red and White Pine LE by Alternative**  
(percent of the LE dominated by an age class)

Age Class	Existing 2001 (%)	Alternatives						
		A (%)	B (%)	C (%)	D (%)	E (%)	F (%)	G (%)
0-10	15	Not	3	15	1.2	6.5	5	5.5
11-50	23	By	12	58	4.8	26.0	17	22.0
51-100	52	LE	15	24	6.0	32.5	15	27.5
101-140	10		12	2	15	7.0	11	9.0
141-200	1		11	2	15	10.5	11	13.5
200+	0		47	2	58	17.5	41	22.5
total	101	0	100	103	100	100	100	100

**Species Diversity Objectives for Dry-mesic Red and White Pine LE by Alternative**

+ = increase from existing condition through active management

+\* = increase from existing condition through succession

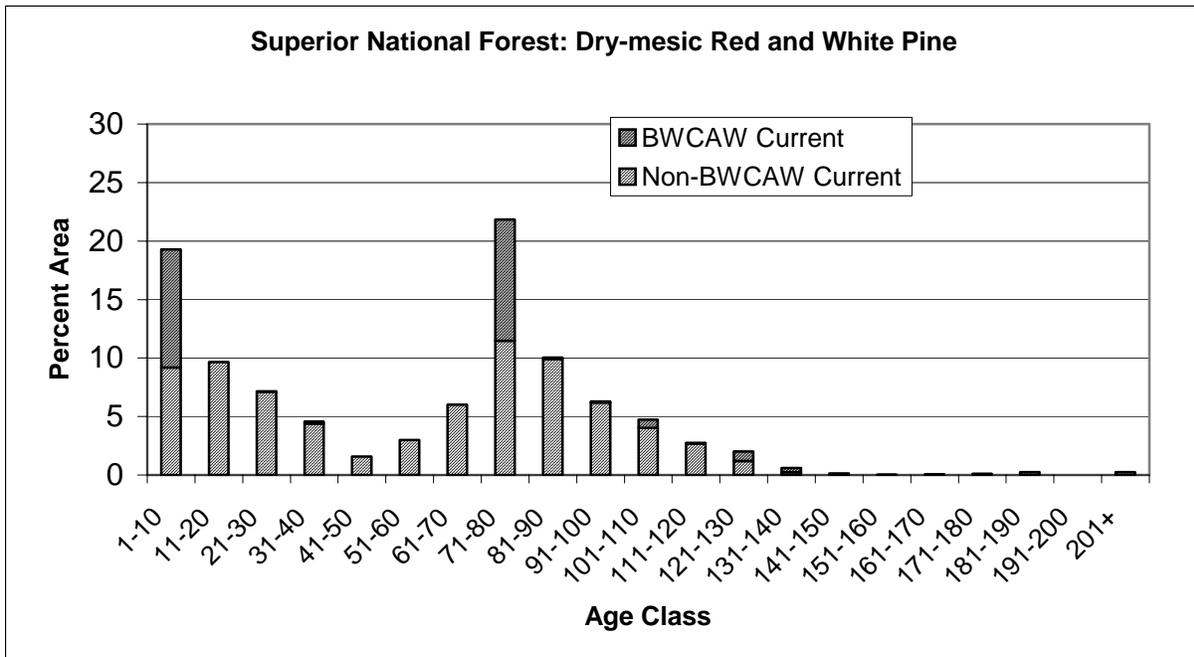
m = maintain existing condition

- = decrease from existing condition through active management

-\* = decrease from existing condition through succession

blank = no objective set

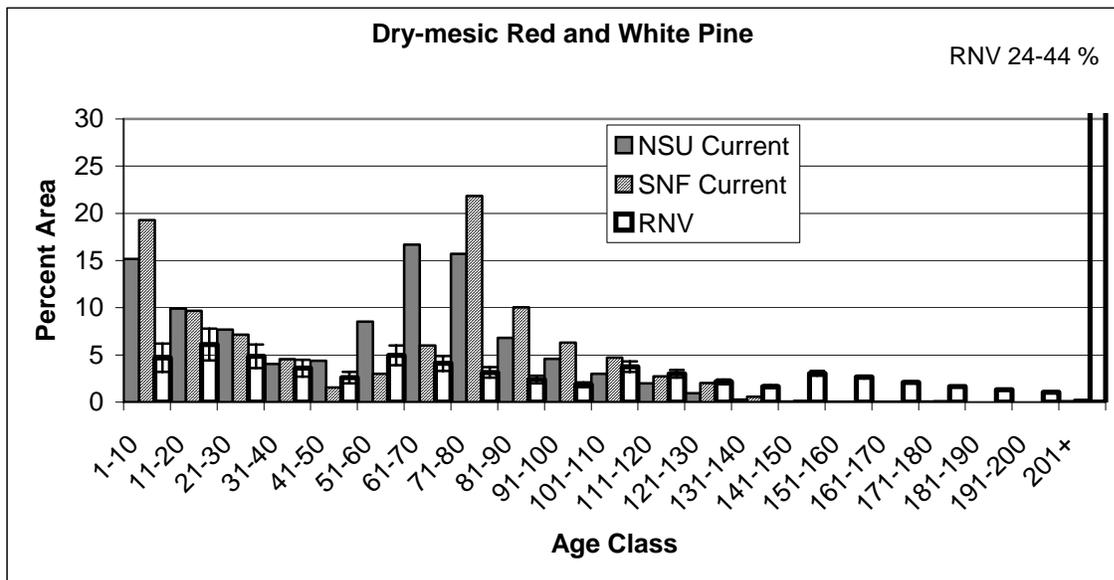
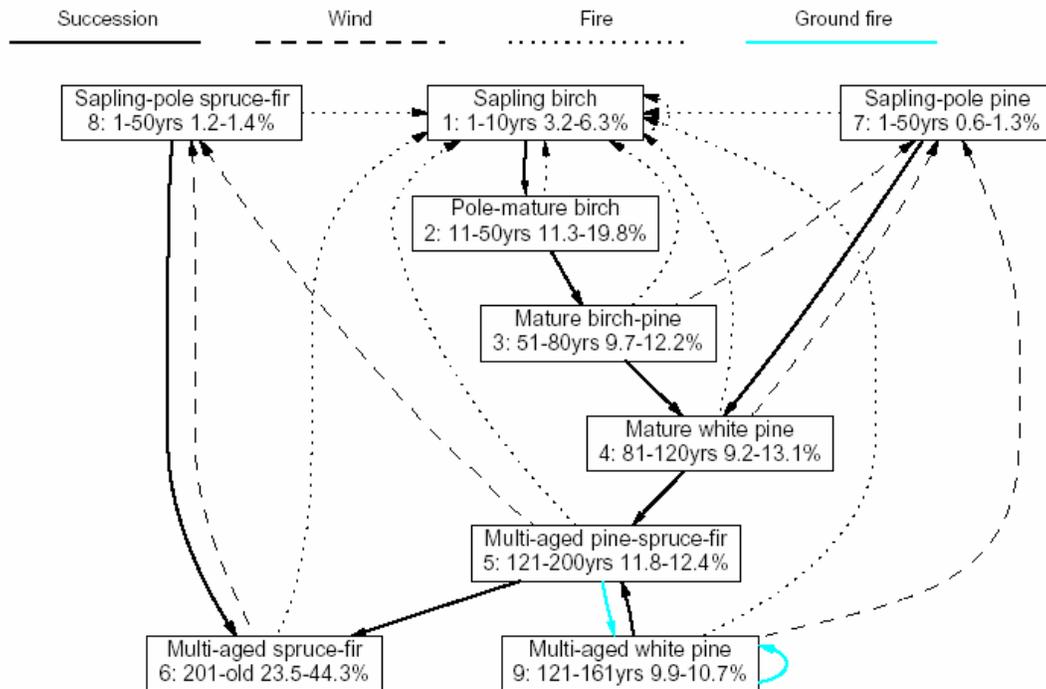
Species	Past Condition (GLO) (%)	Existing Condition (FIA 1990) (%)	Alternatives						
			A	B	C	D	E	F	G
Aspen	14.4	28.7		-*	-	-*	-	m	-
White spruce	5.3	2.7		+	+	+	+	m	
White cedar	4.0	2.7		+				m	+
Paper birch	17.6	19.5				-*		m	
Balsam fir	10.4	18.2		-	-	+*	-	m	
Sugar maple	0.8	8.4						m	
Black spruce	7.7	6.8				+*		m	
Jack pine	12.7	4.0		+	+			m	+
Red pine	9.7	3.4		+	+	+	+	m	+
Lowland hardwood species	1.2	3.0						m	
White pine	10.6	1.9		+	+	+	+	m	+
Tamarack	5.4	0.3		+	+		+	m	+
Other	0.1	0.3						m	
total	100	99.9							



**Figure GEIS-14. Range of natural variability for the Dry-mesic Red and White Pine LE**

Frelich type **2: Dry red pine-white pine**

Disturbance interval (years) - Wind: 1000-2000 Fire: 150-300 Ground Fire: 40



NSU is all forested lands on all ownerships within Northern Superior Uplands Section  
 SNF is all forested lands administered by Superior National Forest  
 RNV bar height is the mid-point of the RNV value, with range depicted by vertical line

## Mesic White and Red Pine Landscape Ecosystem

### Composition/Structure

This system is dominated by mixed stands that include red pine, white pine, aspen, paper birch, northern white cedar, white spruce and balsam fir.

The moist conditions associated with this system favor white pine more than red pine, although both species are depicted here.

### Vegetation Growth Stages

*Sapling birch/sapling-pole pine/sapling-pole spruce-fir* (1-10 years of age) These three stages overlap the stated age class, but originate from different disturbance situations. The sapling birch occurs in response to a stand replacement fire and would likely include: aspen, paper birch, northern white cedar, white spruce, balsam fir, red pine and white pine.

The *sapling-pole pine* stage occurs following a wind event in a mature stand that includes understory white pine and/or red pine (numerous other species would also be present).

The *sapling-pole spruce-fir* stage occurs after a wind event in a multi-aged stand when the understory is white spruce, black spruce and/or balsam fir.

*Pole-mature birch/sapling-pole pine/sapling-pole spruce-fir* (11-50 years of age) These three stages are similar to above.

*Mature birch-pine* (50-80 years of age) This stage originates after a stand replacement fire 50 years ago. Species present include a mixture of some of the following: aspen, paper birch, northern white cedar, white spruce, balsam fir, red pine and white pine.

*Mature white pine* (81-120 years of age) During this stage the white pine and/or red pine becomes the dominant canopy species.

*Multi-aged pine-spruce-fir/multi-aged white pine* (121-200) In the absence of surface fires, white spruce and balsam fir will regenerate in the understory, creating a multi-aged stand.

When surface fires occur they eliminate most of the spruce and balsam fir, while creating conditions that allow white pine and red pine to regenerate. Multi-aged stands comprised of white pine and red pine overstory and a white pine/red pine understory may occur.

*Multi-aged spruce-fir* (>200) Stands that escape disturbance will be dominated by white spruce and balsam fir in a multi-aged condition.

### Function

The stand replacement events are fire at 150-300 year rotations and wind at 1000-2000 year rotations. Surface fires occur at an average of 40 years.

The severe fires will initiate stands dominated by aspen and paper birch with several other species present,

including red and white pine. The aspen and birch seedlings can arise from sprouts or seed blown into the site from adjacent unburned areas. The red pine and white pine seed is from trees that survived the stand replacement fire. Balsam fir and white spruce frequently become established immediately after the stand replacement fire from seed supplied by trees surviving in wetter, incompletely burned sites.

Succession would reduce the aspen and paper birch stocking by 80-100 years of age, resulting in a pine cover type.

White spruce and balsam fir would regenerate under the canopy of pine creating a multi-aged pine-spruce-fir stand by age 120 years. If no disturbance events occurred the stand would ultimately succeed to a multi-aged spruce-fir type by age 200.

Normally, surface fires would occur at 40 year average intervals. These fires would reduce the spruce-fir stocking and provide conditions suitable for white pine regeneration. Multi-aged white pine stands result.

Wind events may create sapling to pole size stands by removing the taller trees and retaining the understory trees. Depending on the situation (species present in understory) this would result in a sapling to pole size white pine/red pine stand or a sapling to pole size spruce-fir stand.

Eastern spruce budworm would play a role in stands dominated by balsam fir and white spruce. The overstory and understory would be killed. If the stand burned, succession would begin with the aspen and birch dominated growth stage. If fire did not occur, the small balsam fir missed in the understory would usually provide a seedling/sapling size stand that could continue to mature and ultimately become multi-aged.

Red pine and white pine survive most fires. Only the more severe crown fires would likely kill all of the red pine and white pine in an area. In this system the surface fires act to reduce ladder fuels and accumulations of fuels that would lead to the more severe crown fires.

## Vegetation Objectives

### Stand Diversity Objectives for Mesic White and Red Pine LE by Alternative

(percent of the LE dominated by a forest type)

Forest Types	Existing 2001 (%)	Alternatives						
		A (%)	B (%)	C (%)	D (%)	E (%)	F (%)	G (%)
Spruce-Fir	17	Not	38	20	50	28	30	28
White Pine	2	By	25	5	23	10	27	20
Aspen	52	LE	10	46	3	30	15	20
Paper Birch	12		12	12	7	12	12	12
Jack Pine	5		8	5	5	8	8	8
Red Pine	10		5	10	10	10	5	10
Northern Hardwoods	2		2	2	2	2	2	2
total	100	0	100	100	100	100	99	100

**Age Classes Objectives for Mesic White and Red Pine LE by Alternative**  
(percent of the LE dominated by an age class)

Age Class	Existing 2001 (%)	Alternatives						
		A (%)	B (%)	C (%)	D (%)	E (%)	F (%)	G (%)
0-10	11	Not	2.9	15.0	1.3	7.0	5.2	4.5
11-50	22	By	11.6	59.0	5.3	28.0	17.3	18.0
51-80	35	LE	8.7	13.0	4.0	21.0	11.0	13.5
81-100	15		5.8	7.0	2.7	6.0	5.5	9.0
101-120	5		5.8	1.0	2.7	6.0	5.5	9.0
121+	11		65.0	5.0	84	32.0	56.6	46.0
total	99	0	100	100	100	100	101	100

**Species Diversity Objectives for Mesic White and Red Pine LE by Alternative**

+ = increase from existing condition through active management

+\* = increase from existing condition through succession

m = maintain existing condition

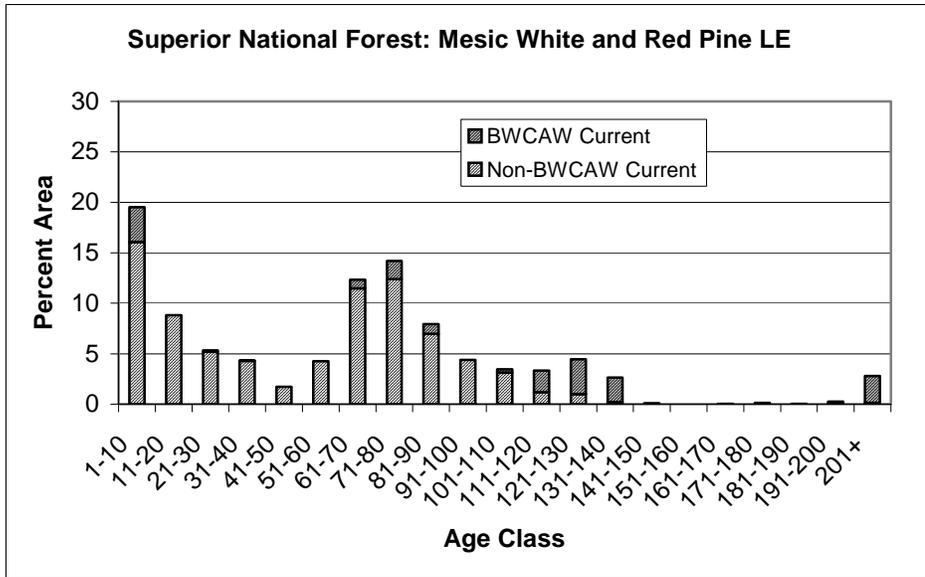
- = decrease from existing condition through active management

-\* = decrease from existing condition through succession

-/\* = decrease through active management or succession

blank = no objectives set

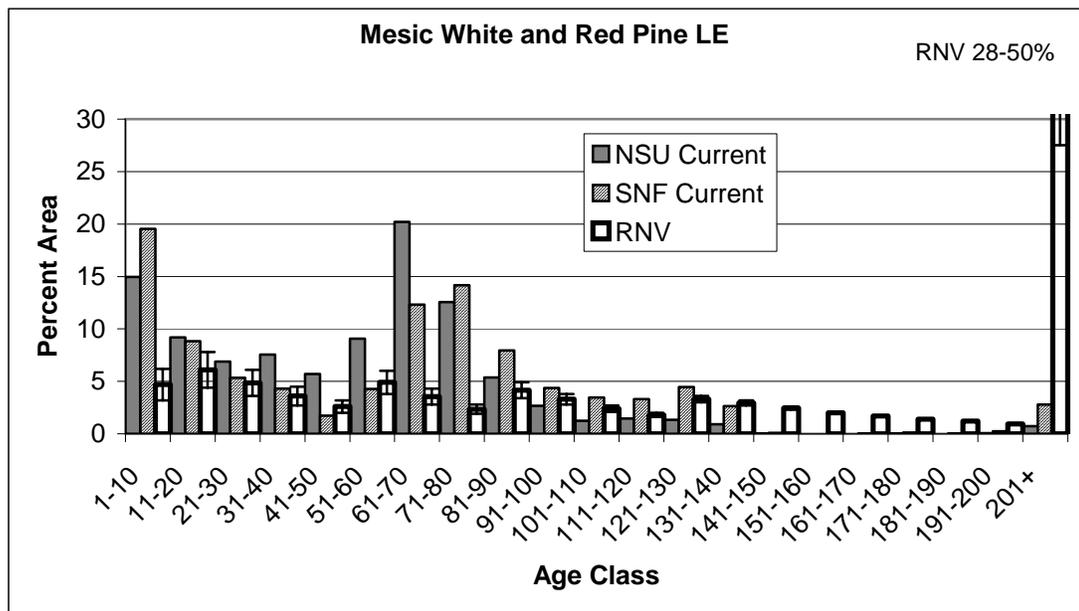
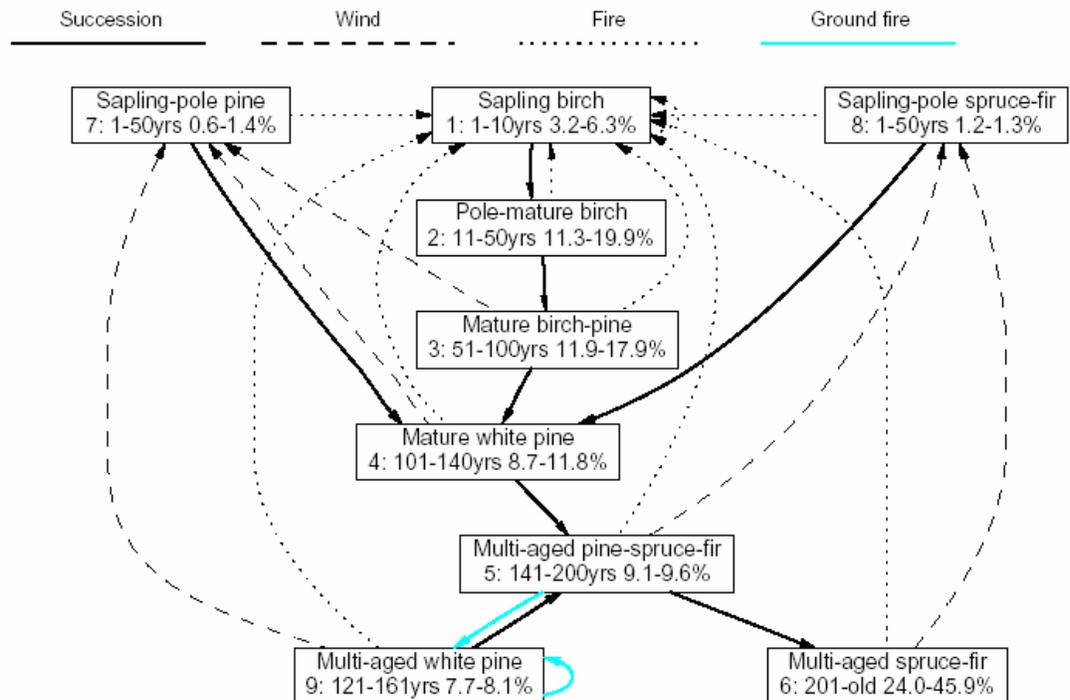
Species	Past Condition (GLO)	Existing Condition (FIA 1990)	Alternatives						
	(%)	(%)	A	B	C	D	E	F	G
Birch	22.5	21.5						m	
White pine	19.0	1.1		+	+	+	+	+	+
Balsam fir	9.4	22		+*	+*	+*	+*	-/*	+*
Tamarack	9.3	0.5		+	+	+	+	-	+
Aspen	8.6	27.3		-/*	-/*	-/*	-/*	-/*	-/*
Black spruce	6.2	4.5		+*	+*	+*	+*	+*	+*
White spruce	6.1	2.2		+	+	+*	+	+	+
White cedar	6.0	3.7		+			+	+	+
Northern Hardwood species	4.5	10.5		-/*	-/*		-/*	-/*	-/*
Red pine	3.7	1.2		+			+	+	+
Jack pine	3.5	1.3		+	+		+	+	+
Lowland Hardwood species	1.1	4.4							
total	100	100							



**Figure GEIS-16. Range of natural variability for the Mesic White and Red Pine LE**

Frelich type **3: Mesic red pine-white pine**

Disturbance interval (years) - Wind: 1000-2000 Fire: 150-300 Ground Fire: 40



NSU is all forested lands on all ownerships within Northern Superior Uplands Section  
 SNF is all forested lands administered by Superior National Forest  
 RNV bar height is the mid-point of the RNV value, with range depicted by vertical line

## Mesic Birch-Aspen-Spruce-Fir Landscape Ecosystem

### Composition/Structure

These are mixed stands of aspen, paper birch, balsam fir and white spruce. Occasionally, northern white cedar, bigtooth aspen or red maple is present.

### Vegetation Growth Stages

*Sapling birch/sapling-pole conifer* (1-10 years of age) Stands dominated by aspen and paper birch regenerate after a stand replacement fire.

The sapling-pole conifer stage occurs after a wind event and is composed of balsam fir and white spruce with lesser amounts of northern white cedar or red maple.

*Pole-mature birch/sapling-pole conifers* (11-50 years of age) These are similar to the previous growth stage, just older.

*Mature birch-conifer/pole-mature conifer* (51-80 years of age) Again the stand origins are different. The fire origin aspen-birch dominated stands have developed an understory of white spruce and balsam fir.

The pole-mature conifer stands are more a single canopy stage composed of balsam fir, white spruce and possibly northern white cedar or red maple.

*Multi-aged conifer* (>80 years of age) These are multi-aged stands dominated by balsam fir with white spruce, northern white cedar and red maple present on some sites.

### Function

The fire rotation period is 100-200 years and the wind rotation 1000-2000 years. Surface fires are not present in this system.

Following a stand replacement fire, the stand is rapidly colonized by aspen and paper birch.

Balsam fir and white spruce may regenerate at the same time or later as the stand ages. These two conifers will grow slower initially, thus remain in the understory until near age 50, when they become a definite component of the stand.

By age 80, mortality has begun in the aspen and paper birch. A multi-age stand is developing with a strong conifer component. This results in a multi-aged balsam fir/white spruce condition. Paper birch and northern white cedar are frequently components of the climax tree stage.

Wind events would set the multi-age spruce/fir stand back to a sapling-pole stand that is still dominated by balsam fir and white spruce. It would grow into the pole-mature stage and ultimately become multi-aged.

Eastern spruce budworm would play a role in stands dominated by balsam fir and white spruce. The overstory and understory would be killed. If the stand burned, succession would begin with the aspen and birch dominated growth stage. If fire did not occur, the small balsam fir missed in the understory would usually provide a

seedling/sapling size stand that could continue to mature and ultimately become multi-aged.

### Vegetation Objectives

#### Stand Diversity Objectives for Mesic Birch-Aspen-Spruce-Fir LE by Alternative (percent of the LE dominated by a forest type)

Forest Types	Existing	Alternatives						
	2001	A	B	C	D	E	F	G
	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
Spruce-Fir	27	Not	57	27	71	31	54	40
Paper Birch	13	By	13	13	10	14	13	13
Aspen	45	LE	12	45	3	40	12	26
Jack Pine	6		6	6	5	7	9	9
Red Pine	5		5	5	4	6	5	5
White Pine	1		4	1	4	4	4	4
Northern Hardwood	3		3	3	3	3	3	3
total	100	0	100	100	100	105	100	100

#### Age Classes Objectives for Mesic Birch-Aspen-Spruce-Fir LE by Alternative (percent of the LE dominated by an age class)

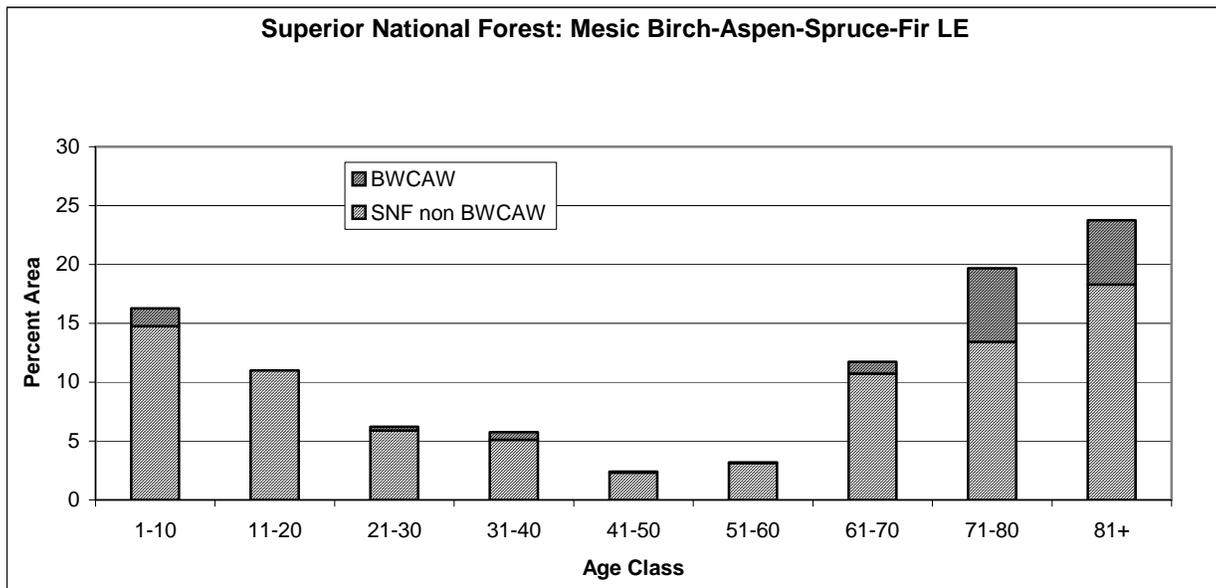
Age Class	Existing	Alternatives						
	2001	A	B	C	D	E	F	G
	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
0-10	10	Not	5	15	2	9	7.4	7.5
11-50	27	By	17	61	8	36	22.5	30.0
51-80	39	LE	11	12	6	27	13.1	22.5
81-100	15		67	13	83	18	57.3	15.0
101+	10		*	*	*	10	*	25.0
total	101	0	100	85	99	100	100	100

\* indicates the older age classes are in the above number, Alt B 81+ is 67%

**Species Diversity Objectives for Mesic Birch-Aspen-Spruce-Fir LE by Alternative**

- + = increase from existing condition through active management
- +\* = increase from existing condition through succession
- m = maintain existing condition
- = decrease from existing condition through active management
- \* = decrease from existing condition through succession
- blank = no objective set

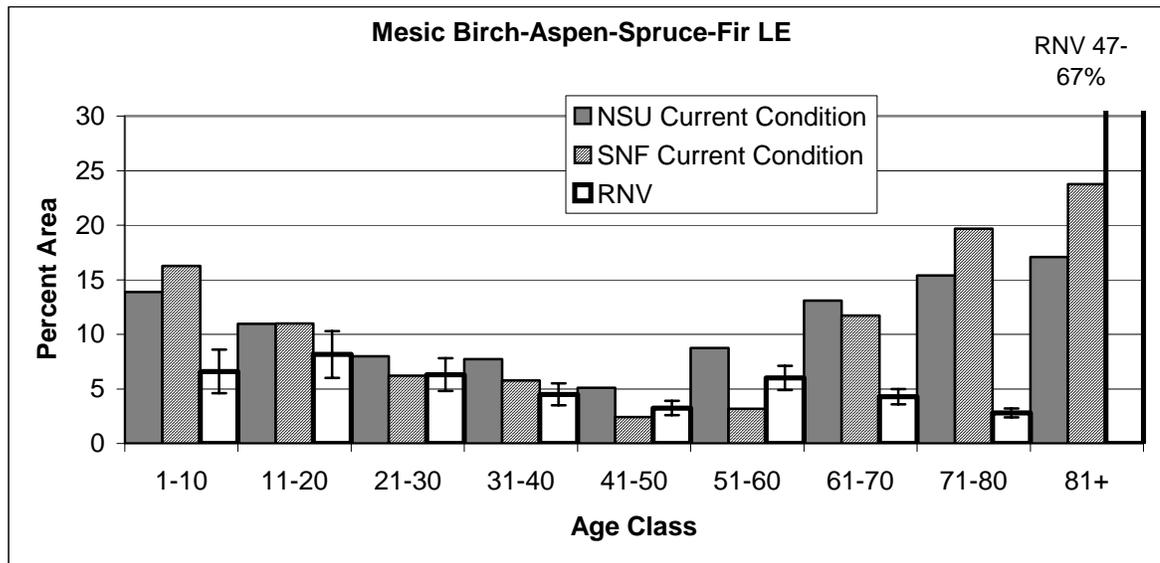
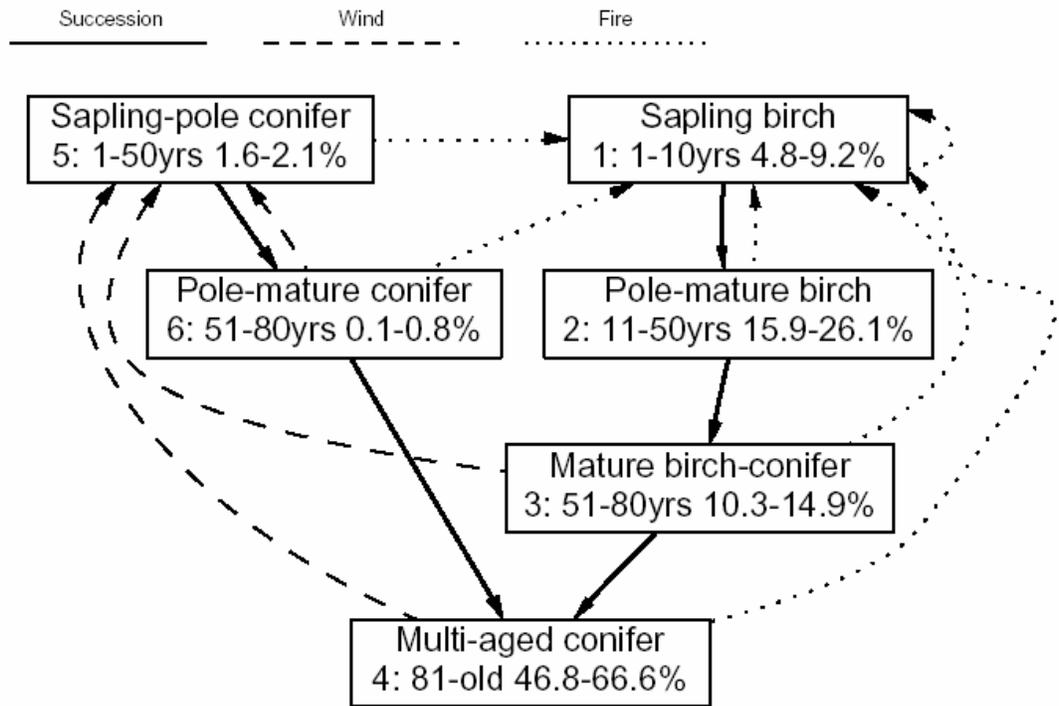
Species	Past Condition (GLO)	Existing Condition (FIA 1990)	Alternatives						
			A	B	C	D	E	F	G
	(%)	(%)							
Paper birch	22.8	20.3				-	+		
Balsam fir	17.5	23.2				+*			
Black spruce	9.5	8.6				+*			
White cedar	9.2	4.2		+		+	+	+	+
White spruce	9.1	3.1		+	+	+	+	+	+
White pine	8.6	0.5		+	+	+	+	+	+
Aspen	7.6	26.5		-		-	-	-	-
Tamarack	7.2	0.4		+	+	+	+	+	+
Northern Hardwood species	3.3	7.1							
Jack pine	2.1	0.8							
Red pine	1.5	0.7							
Lowland Hardwood species	1.5	4.0							
total	100	99							



**Figure GEIS-21. Range of natural variability for the Mesic Birch-Aspen-Spruce-Fir LE (percent of LE on all ownerships).**

Frelich type 6: Mesic birch-aspen-spruce-fir

Disturbance interval (years) - Wind: 1000-2000 Fire: 100-200 Ground Fire: N/A



NSU is all forested lands on all ownerships within Northern Superior Uplands Section  
 SNF is all forested lands administered by Superior National Forest  
 RNV bar height is the mid-point of the RNV value, with range depicted by vertical line

## Northern Hardwood-Conifer Landscape Ecosystem

(This system was updated by NRRI staff to include an additional fire disturbance at a 200-400 year interval and the presence of balsam fir and white spruce, referred to as Northern Hardwood-Conifer LE)

### Composition/Structure

This system within the Superior National Forest is usually within a band not more than 15 miles from Lake Superior. The system is dominated by sugar maple with yellow birch present. Rarely, northern white cedar is present.

These northern hardwood stands are characteristically short trees, with numerous frost cracks. Only the climatic influence of Lake Superior allows the band of sugar maple dominated stands to be present within 15 miles of the shoreline.

Inland from Lake Superior this system also includes basswood, northern red oak and red maple.

### Vegetation Growth Stages

*Sapling birch/sapling maple* (1-10 years of age) These two growth stages have different origins. The birch type originates after a stand replacement fire, which is rare in this system.

The sapling maple type originates after a stand replacement wind event, also rare.

*Pole-mature birch/pole-mature maple* (11-50 years of age) These are simply older versions of the previous younger stage.

*Mature birch-maple/pole-mature maple* (51-100 years of age) Same as above.

*Mature maple* (101-150 years of age) Sugar maple dominates the stands by this age.

*Multi-aged maple* (151+ years of age) Sugar maple dominates and regenerates after individual tree mortality creating an all age stand.

### Function

Stand replacement fire rotations are 2000-4000 years and wind rotations are 1000-2000 years. Thus the primary disturbance is individual tree mortality or small groups of trees.

After a stand replacement fire, aspen and paper birch would regenerate dominating the main canopy. However, sugar maple would sprout and be present as slower growing trees, as would lesser amounts of yellow birch. In the drier inland areas red maple, basswood and northern red oak would also be present.

As the stand matures the shorter lived species would succeed to the understory species, creating a mature stand dominated by sugar maple. Eventually, the stand becomes an all-aged sugar maple stand.

Stand replacement wind events can return the mature stands back to a sapling, sugar maple dominated stand. This stand would continue to mature and become all-aged.

The longer duration multi-aged sugar maple stand has an understory of sugar maple dominated species that remain in the understory until the death of a canopy tree allows the growing space for the understory trees to compete for main canopy presence.

Very few acres of this LE occur within the BWCAW, thus no age class table is shown to display the percentage of each age class with the Wilderness.

**Stand Diversity Objectives for Northern Hardwood-Conifer LE by Alternative**  
(percent of the LE dominated by a forest type)

Forest Types	Existing 2001	Alternatives						
		A	B	C	D	E	F	G
	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
Northern hwdws	34	not	40	30	47	40	38.0	39.0
Paper Birch	19	by	20	17	8	18	19.0	19.0
Aspen	29	LE	13	32	4	20	13.5	14.0
Spruce-Fir	14		22	14	37	16	24.0	22.5
White Pine	0		5	3	4	4	5.0	5.0
Red Pine	4		0	4	0	2	0.5	0.5
total	100	0	100	100	100	100	100	100

**Age Classes Objectives for Northern Hardwood-Conifer LE by Alternative**  
(percent of the LE dominated by an age class)

Age Class	Existing 2001	Alternatives						
		A	B	C	D	E	F	G
	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
0-10	5.0	Not	4	11	1.2	5	3.9	3.9
11-50	24.0	By	16	43	4.8	20	15.6	15.6
51-100	51.0	LE	20	16	6.0	25	16.3	16.3
101-150	19.0		20	2	18.0	25	13.8	13.8
151+	1.0		41	31	70.0	25	50.4	50.4
total	100	0	100	100	100	100	100	100

**Species Diversity Objectives for Northern Hardwood-Conifer LE by Alternative**

+ = increase from existing condition through active management

+\* = increase from existing condition through succession

m = maintain existing condition

- = decrease from existing condition through active management

-\* = decrease from existing condition through succession

-/\* = decrease through either active management or succession

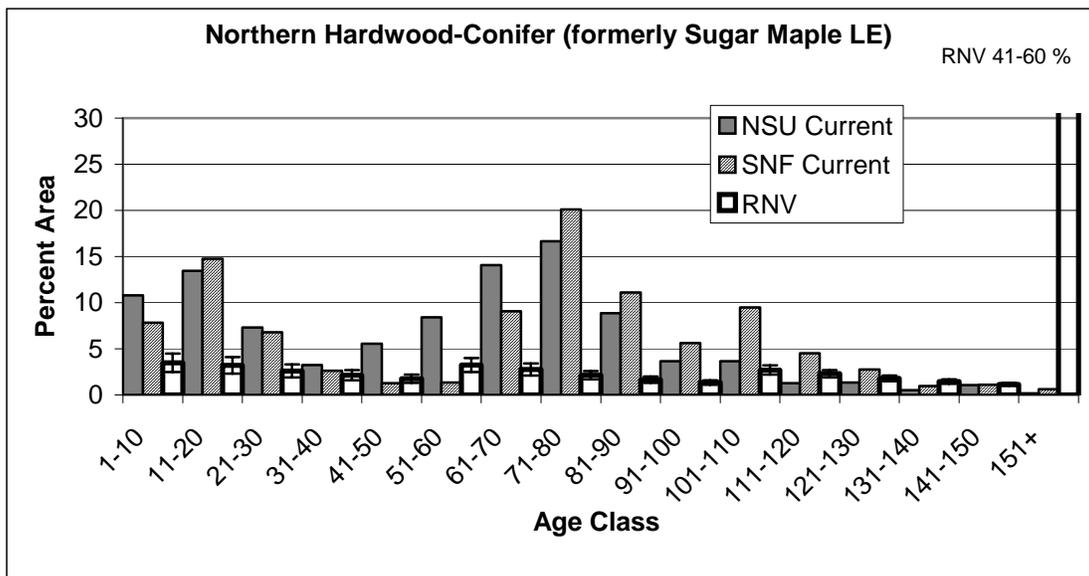
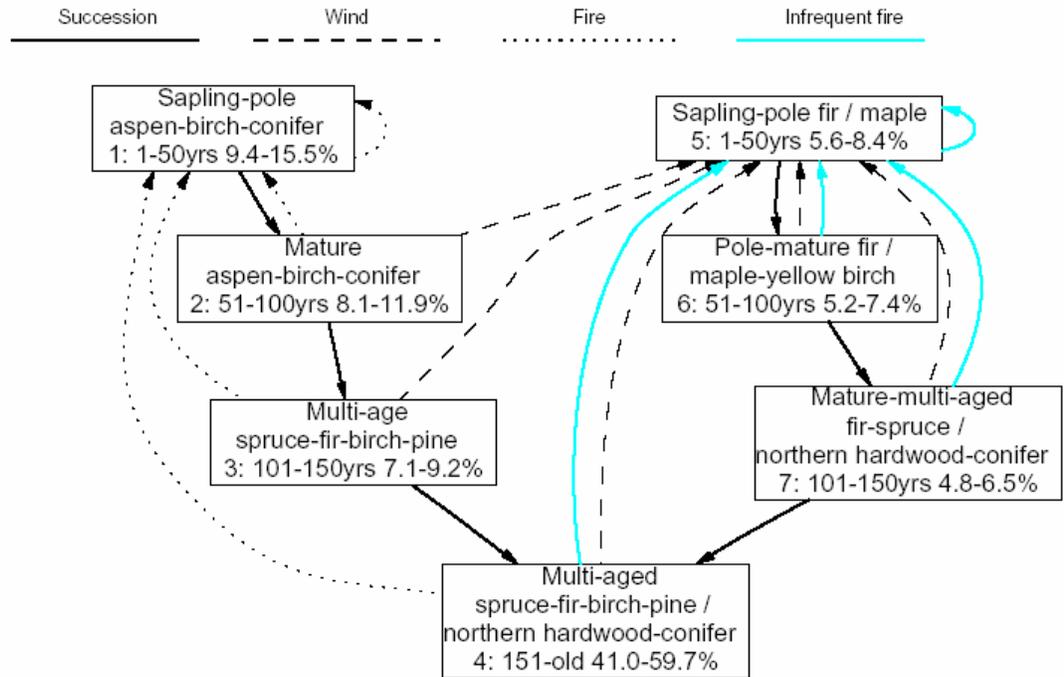
blank = no objective set

Species	Past Condition (GLO)	Existing Condition (FIA 1990)	Alternatives						
	(%)	(%)	A	B	C	D	E	F	G
Paper birch	21.9	23.0		-/*	-/*	-/*	+	-/*	-/*
Balsam fir	16.4	12.2		+*	+*	+*	+*	+*	+*
White cedar	10.8	3.3		+	+	+	+	+	+
White pine	8.9	0.2		+	+	+	+	+	+
Sugar maple	8.1	25.6		+*	+*	+*	+*	+*	+*
White spruce	8.0	1.7		+	+	+	+	+	+
Yellow birch	7.2	0.8		+	+	+	+	+	+
Aspen	6.4	16.3		-/*	-/*	-/*	-/*	-/*	-/*
Black spruce	4.7	0.4							
Tamarack	3.8	1.5							
Black ash	1.6	3.8		+*	+*	+*	+*	+*	+*
Basswood	1.3	2.1							
Red pine	0.5	1.1							
Red maple	0	6.7		+*	+*	+*	+*	+*	+*
total	100	99							

**Figure GEIS-25. Range of natural variability for the Northern Hardwood-Conifer LE (formerly Sugar Maple LE)**

Frelich type 9: Sugar Maple-Northern Hardwood

Disturbance interval (years) - Wind: 1000-2000 Fire: 200-400 Infrequent Fire: 600-1000



## Lowland Conifer Landscape Ecosystem

### Composition/Structure

This ecosystem includes all of the lowland conifer areas in the Northern Superior Uplands. Black spruce, tamarack and northern white cedar dominate these stands.

Each species listed can be the lone dominant species or these areas can be a mix of two or all three species. Normally, black spruce occurs on the more acid, organic soils and northern white cedar on the more neutral sites, with tamarack as a pH transition between the two types. Tamarack also occurs as a seral species on sites that will succeed to black spruce.

### Vegetation Growth Stages

*Seedling black spruce* (1-40 years of age) As defined above, this can be a mixed stand of northern white cedar, black spruce and tamarack or the stand can be comprised of one or two of these species.

*Sapling black spruce* (41-80 years of age) Same species as above.

*Pole-mature black spruce* (81-160 years of age) Same species as above.

*Multi-age black spruce* (>160 years of age) This stage is usually dominated by black spruce or northern white cedar. Trees of all age and size classes are present.

### Function

Fire is the more frequent stand replacement disturbance. Fire rotations are 150-300 years. Stand replacement wind events have a rotation of 1000-2000 years.

The semi-closed cones of black spruce provide abundant seed after a stand replacement fire.

The presence of black spruce and northern white cedar seedlings in the understory of these lowland conifer types also provides trees to grow into the main canopy after a wind event.

The regenerating stands described in the earlier two paragraphs will grow into a single canopy stand with few understory trees. By 160 years of age, the main canopy has broken-up creating a multi-aged stand. Usually, tamarack is not part of this multi-aged stand. Tamarack usually regenerates after a disturbance and is not tolerant of shade.

## Rich Swamp Landscape Ecosystem

(17% of LE is Superior NF administered lands; this LE is incorporated into the Lowland Conifer LE for Vegetation Objectives)

### Composition/Structure

This system is dominated by black ash and/or balsam poplar. It includes the Semi-terrestrial Hardwood Forest Subsystem and the Wet Broad-leaved Swamp Forest Subsystem as defined by Rusterholz (2002). The sites range from those that are only wet in the spring to sites that are wet year round. Other tree species that may occur on these sites include: elm, green ash, paper birch, aspen, yellow birch, balsam fir, northern white cedar, and white spruce.

Black ash seedlings are always present in the understory. Conifers always constitute a minor component of the total stocking.

### Vegetation Growth Stages

*Seedling-sapling* (1-20 years of age) Black ash or balsam poplar would dominate the stocking with numerous other species potentially present at lower densities.

*Sapling-pole* (21-50 years of age) Same species as above.

*Pole-mature* (51-100 years of age) Same species as above.

*Multi-aged ash or cedar* (>100 years of age) These stands are dominated by black ash and regenerating black ash. Other species may be present at lower densities.

### Function

Natural disturbances that set stands back to a young age class are rare. Stand replacement fires occur at rotations of 500-1000 years and stand replacement wind events at rotations of 1000-2000 years.

After either type of stand replacement events, the stand is dominated by black ash or balsam poplar seedlings.

These trees continue to grow until the older trees reach their normal life span. As individual trees die, they are replaced by understory black ash seedlings, creating a multi-aged stand.

This multi-aged condition occurs on more than 80% of the landscape.

Elm used to be more common in this ecosystem, but the introduction of Dutch Elm Disease has kept the elm stocking to very low or non-existent levels.

### Vegetation Objectives for lowland forests

#### Age Classes Objectives for Lowland Conifer within Jack Pine-Black Spruce and Dry-mesic Red & White Pine LEs by Alternative – Applies to following LTAs: La07, La08, La09, La13, La15, La16, La21, La22, La23, La24, La34, Lc05, Le01, Le02, Le04, Le11, Ma14, Ma19, Ma21

(percent of the LE dominated by an age class-used Lowland Conifer RNV)

Age Class	Existing 2001 (%)	Alternatives						
		A (%)	B (%)	C (%)	D (%)	E (%)	F (%)	G (%)
0-39	9	Not	13.5	31.5	6.75	18.0	16.5	10
40-79	27	By	13.5	31.5	6.75	18.0	16.5	10
80-159	62	LE	27.0	9.0	13.5	33.0	33.0	20
160+	2		46.0	28.0	73.0	31.0	34.0	60
total	100	0	100	100	100	100	100	100

#### Age Classes Objectives for Lowland Conifer within Mesic White & Red Pine LE and Mesic Birch-Aspen-Spruce-Fir LEs by Alternative – Applies to following LTAs: La11, La14, La17, La35, La36, La37, Lb02, Lb03, Lb04, Lb05, Lb08, Lc06, Lc07, Lc10, Lc20, Ld01, Le03, Le08, Le09, Le10, Ma01, Nd04, Nd05

(percent of the LE dominated by an age class-estimated RNV information as between Lowland Conifer and Rich Swamp)

Age Class	Existing 2001 (%)	Alternatives						
		A (%)	B (%)	C (%)	D (%)	E (%)	F (%)	G (%)
0-39	5	Not	8.8	32	4.4	14	10	7
40-79	31	By	8.8	32	4.4	14	10	7
80-159	60	LE	17.6	27	8.8	28	20	14
160+	4		64.8	9	82.4	44	60	72
total	100	0	100	100	100	100	100	100

#### Age Classes Objectives for Lowland Conifer within Mesic Northern Hardwood-Conifer LE by Alternative – Applies to following LTAs: Lb10, Lb11

(percent of the LE dominated by an age class- used Rich Swamp RNV)

VGS	Age	Existing 2001	Min	Mid	Max	B	C	D	E	F	G
1	1-20	2	2.9	4.3	5.7	2	16	1	5	2.8	2
2	21-50	2	0.5	0.6	0.9	3	23	1.5	7.5	4.2	3
3	51-100	32	6.8	9.5	1.2	5	31	2.5	12.5	7	5
4	101-160	42	81.3	25.8	89.9	27	21	28.5	15	26	27
*5	161+*	22		60.0		63	9	66	60	60	63
Total		100		100.2		100	100	100	100	100	100

\* Estimated age class for RNV by truncating VGS 4 from rich swamp at 300.

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